

**REPAIR, BY-PASS AND REPLACEMENT
IN THE
URINARY TRACT**

THESIS

submitted as part of the requirements for the degree of

DOCTOR of MEDICINE

UNIVERSITY of CAPE TOWN

by

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February, 1966

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INTRODUCTION

"In a few hours the reader in London or New York could be in Africa, where a multitude of miserable ostracised women wait from one end of the Continent to the other for some one to come and repair their fistulae.

"Where standards of obstetric care are high in the more favoured countries fistulae of the urinary tract are more commonly due to gynaecological trauma. Where the standard of surgery is equally high, urinary fistulae become a rarity . . ."

J. Stallworthy (1965): Brit. M.J., i, 1303.

(Review of H.C. Valk: Urologic injuries in Gynaecology.)

It is against the background of obstetric urinary fistulae in the African patient that my personal interest and experience in this problem originated and developed. Starting in the Northern region of Nigeria, in a small Mission hospital, in 1944, it continued during years of surgical apprenticeship at Groote Schuur Hospital, Cape Town, at Omdurman, Khartoum and Kassala in the Sudan in 1954 and, finally, in the medical service of the Province of Natal at Edendale Hospital in Pietermaritzburg during 1955 to 1963.

During this period of 21 years the situation, in Africa, has not changed appreciably. Indeed, with the progress of surgery and, especially, major surgery in the pelvis, the number of urinary fistulae are increasing. A further small number of cases are the outcome of more intensive radiation therapy for malignant disease in the pelvis.

So often, in the history of surgery, it has come about that a surgical technique, developed for the management of a specific diseased condition, has subsequently found further application - sometimes even more fruitful application - in the treatment of a different disease. Even though the obstetric urinary fistula may eventually disappear, the techniques developed for its management will continue to find useful application in the treatment

of other diseases where basically similar conditions are present. Thus, for instance, the management of the ureter divided during elective hysterectomy is no different from that required for a ureter damaged during the repair of a uterus rupturing during unsupervised labour. Replacement of the urethra damaged during prolonged labour presents a problem similar to replacement following urethrectomy for carcinoma of the vulva or urethra. Enlargement of the bladder with a capacity diminished after extensive fistula formation and repeated attempts at repair is basically the same problem as that presented by a bladder contracted as a result of chronic tuberculous cystitis or following radical partial cystectomy.

The subject matter of this thesis might appear to consist of eleven separate essays. These have been grouped under the headings repair, by-pass and replacement. However, it is believed that the same theme might be apparent throughout, based chiefly on the following considerations:

- a. Retrospective survey of case notes forms no part of this thesis. It is a record of personal observation of every patient mentioned. The evolution of ideas and techniques is the result of close observation of the progress of these patients, sometimes modified after a careful evaluation of the observations of other workers as reported in the medical literature.
- b. At no time was a consideration of the patient, as an integrated whole, and the evaluation of the entire urinary tract, sacrificed in the approach to a study of the more localized pathology. It is firmly believed that such an omission will be to the detriment of the patient. Whatever part of the urinary tract is involved, therefore, the approach to the problem remains fundamentally the same.
- c. In the management of these cases there has always been the closest co-operation between the urological surgeon and his colleague in gynaecology. This has always ensured an objective and critical check in all decisions

regarding management of cases. Such a close combination of two disciplines has promoted further uniformity of approach to problems varying in detail.

Therefore, although the subject matter has been subdivided into eleven sections, the problem in them all remains basically the same and there is considerable overlap between the sections. Subdivision was necessary only to facilitate systematic discussion.

It will be noticed that the kidney itself has not been included in the subject matter of this thesis. The problems presented by repair and replacement of the kidney, the excretory part of the urinary system, are very different from those of the duct system. The organ is essential to life; although renal reserve is considerable there is no spare tissue that can be used as an autograft; because of its very special structure and function, no other body tissue can be used to replace functioning renal tissue; injury is often associated with bleeding, posing problems not seen in other parts of the urinary tract. It seemed appropriate to omit the kidney from this discussion.

Instead of the usual arrangement, where all the references are listed at the end of the thesis, a bibliography is provided at the end of each section. It involves the repetition of a small number of references but it has the advantage of making the references on a particular aspect or subject more easily available for other workers who might require suggestions for further reading.

Grateful acknowledgement for assistance in the preparation of this thesis is made to:

a. Successive Medical Superintendents at Edendale Hospital, Pietermaritzburg - Dr. J. Parker (at present Director of Medical Services in the Province of Natal), Dr. T.N. Adnams and Dr. D. Ranking - for allowing me

to use the records of the Hospital.

b. D.M. Lithgow, B.Sc., F.R.C.S., Senior Obstetrician and Gynaecologist at Edendale Hospital (at present Principal Obstetrician and Gynaecologist at the General Hospital, Johannesburg, and First Assistant to the Professor of Obstetrics and Gynaecology, University of the Witwatersrand) for referring many of the patients mentioned in this thesis and for his valuable and stimulating cooperation during the period 1955 to 1963.

c. Dr. J. Colenbrander, Senior Radiologist at Edendale Hospital, Pietermaritzburg, for allowing me to use the records of his Department and for permitting me the facilities of his Department for the arteriographic studies discussed in Section B.3.

d. The British Association of Urological Surgeons and the Publishers of the British Journal of Urology for permission to include Section B of this thesis. In a slightly modified form this Section was awarded the Prize in the 1965 Essay Competition on Urinary Diversion, and published as a monograph by the British Journal of Urology.

e. The South African Medical Journal for permission to include Section A.4, some of which has previously been published in this Journal.

f. The South African Journal of Surgery for permission to include Section A.5.

g. The Journal of Urology for permission to include Section C.2.

h. The Journal of Obstetrics and Gynaecology of the British Commonwealth for permission to include Section A.3.

i. The Medical Superintendent, The Ernest Oppenheimer Hospital, Welkom, for permission to include details of Case 51.

j. Mr. E.O. Hesketh of Pietermaritzburg, Natal, for his generous financial support of this investigation over the last 3 years. Without this help this work would not have been possible.

SECTION A.1

URETERIC INJURY IN OBSTETRICS AND SURGERY

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URETERIC INJURY IN OBSTETRICS AND SURGERY

Injury to the ureter is a major complication of surgery. It may result in loss of life, the loss of a kidney, considerable morbidity, and often necessitates an additional major operation. To the patient, especially if injury leads to an external urinary fistula, it is a most distressing event.

In the majority of cases the accident is avoidable .

The management of ureteric injury is not always satisfactory and certain aspects of will be reviewed.

Over a period of $9\frac{1}{2}$ years, 19 patients with injury to a ureter have been treated. These will form the basis of the subsequent discussion.

It is impossible to determine the true incidence of trauma to the ureter. Conger and associates⁹ found 13 cases in 2,400 major operations in the pelvis, an incidence of 0.56 per cent. Green and his colleagues²¹ reported 78 cases during the management of 623 patients with carcinoma of the cervix, while Lui and Meigs²⁵ found 45 cases of uretero-vaginal fistula following radical pelvic surgery in 473 patients. Talbert and co-workers⁶³ encountered urological complications in 17 of 112 radical hysterectomies. Injury to the ureter is not always clinically apparent. In some patients an obstructed ureter may produce slight fever and loin pain during the early postoperative phase and all symptoms may then disappear. The whole process of renal death after ureteric occlusion may be symptomless¹². Newell⁴² found an obstructed ureter at autopsy in 6 cases, none of which was suspected before. St. Martin and co-workers⁶² who examined 332 patients following non-radical pelvic surgery, found ureteric injury in 8 cases. In 20 patients who had a Wertheim operation performed, the ureter was injured in six. It would appear that

postoperative examination in all patients following operative procedures in the pelvis will reveal a considerable number of unsuspected injured ureters, and that the incidence of the complication is significantly higher than is indicated by available statistics.

Most injuries to the ureter occur during operative procedures in the pelvis. In this series hysterectomy was the most common procedure - abdominal in 6 and vaginal in one. It occurred 4 times during caesarean section and in 3 cases during exploration of a ruptured uterus. In 3 instances it followed prolonged labour and the application of forceps. In one patient the ureter was damaged while draining a tubo-ovarian abscess and in one patient one of reduplicated ureters was divided during aortic aneurysmectomy.

This experience coincides with that of published reports^{10,33,60}. The importance of radiotherapy is stressed by Green and his colleagues²¹ and Staubitz and co-workers⁶⁰. This acts either as a primary cause or by devitalizing the tissues so that healing after surgery is impaired. The ureter has been injured during operations on the colon and rectum and during excision of a diverticulum of the bladder⁵². The ureter has been mistaken for the sympathetic chain, and a portion of it excised during lumbar sympathectomy²³.

No surgeon or institution is exempt. Ureters are injured during the emergency management of a ruptured uterus in a small district hospital but also during elective hysterectomy in the most sophisticated circumstances.

The actual nature of the damage to the ureter cannot always be determined accurately, except where the injury is recognized at operation. In this series a subsequent exploratory operation revealed an encircling ligature in 3 cases. The lower ureter was involved in dense scar tissue in the

majority of cases without clear evidence as to the nature of the original trauma. Abbott and Higgins¹ in their review of 61 patients consider complete ligation, partial or complete transection, excision of a portion of the ureter, necrosis after crushing with a clamp and ischaemia from excessive stripping the most common types of injury. Badenoch², in a series of 39 cases, found that more than half were due to suture or ligature. This is also the conclusion of Jacobson³³. Duffy¹⁷ confirms these findings and considers that acute angulation of the ureter by proximal ligatures may well lead to partial or complete obstruction. The injury is bilateral in a significant number of cases. In the series of Abbott and Higgins¹ both ureters were injured in 9 patients (14.9 per cent.)

The injury occurred with almost equal frequency on the right (9 cases) and the left sides (10 cases.) The level of the injury, as determined by ureteric catheterization, was recorded in 8 cases. It varied from 1 cm. to 10 cm. above the ureterovesical opening, with 7 cases within 4 cm. from that point.

In only 4 cases was the injury to the ureter recognized at the time of the operation. This figure is lower than in some of the recorded series. Prentiss and Mullenix⁵², in a series of 24 patients, found that the injury was recognized in 9 instances while the figure quoted by Staubitz and colleagues⁶⁰ is 7 out of 22 patients. It is generally agreed that immediate recognition provides the ideal opportunity for repair⁵³.

Injury to the ureter is frequently followed by the development of an externally draining fistula. In this series such a fistula was present in 12 cases - uretero-vaginal in 6, uretero-cervical in 4 and uretero-cutaneous in 2 patients. In a further 3 cases, in which the intramural part of the ureter was involved, an abnormal ureterovesical opening was established. These observations are confirmed by other reports. In 130 injuries reported

by Petkovic⁴⁹ a fistula was present in 105 cases. Green and co-workers²¹ found stricture of the ureter resulting from injury in 24 per cent of their cases. Staubitz and his colleagues⁶⁰ describe 2 (of 16) cases presenting with ureteroperineal fistula. Everett¹⁹ reports a patient who developed a ureteroperitoneal fistula with urinary ascites following a total abdominal hysterectomy.

The establishment of an external fistula is an important event. It draws attention to the ureteric injury which might otherwise have escaped discovery. It provides drainage for the obstructed kidney and will allow preservation of at least some renal function, even for a very considerable period. Renal function will improve after removal of the obstruction. It must be recognized though that fistulous drainage is never free. This is confirmed by the almost constant finding of hydronephrosis and dilatation of the ureter on the affected side (9 cases in this series), sometimes of a non-functioning kidney (5 cases.)

Diagnosis of injury to the ureter is seldom difficult. In 20 to 40 per cent of the cases the diagnosis will be made during the operative procedure. In certain instances damage will be suspected but not confirmed, due to poor visualization or the need for rapid termination of the operation if a patient is in poor general condition. In such cases, further examination (intravenous pyelography and ureteric catheterization) should be performed as soon as the patient's general condition permits. In a small group of patients ureteric injury will be suspected in the early postoperative phase. The evidence will vary from anuria in bilateral injury to pain and tenderness in the loin and early fistula formation. In these cases a combination of urography and cystoscopy with ureteric catheterization will again settle the doubt or confirm the diagnosis and localise the lesion to guide subsequent management. In later cases the diagnosis of injury will be suggested by the development of an external

urinary fistula or by the discovery of hydronephrosis or a non-functioning kidney on intravenous pyelography. To localise the fistula methylene blue may be instilled into the bladder: if the bladder is intact no leakage will be observed. Intravenous indigocarmine will demonstrate a uretero-vaginal or uretero-cervical fistula²¹. However, cystoscopy and retrograde pyelography are the most valuable methods of examination and are essential preliminaries to a complete anatomical diagnosis and planning of treatment.

Realising the implications of damage to the ureter, it is very important to consider how the accident can be avoided in practice. In obstetrics, injury to the bladder and ureter will only finally be eliminated when proper antenatal supervision for every pregnant woman and adequate medical supervision at every confinement. While labour is permitted to continue for 4 to 5 days with only untrained assistance and a late caesarean section or repair of a ruptured uterus performed where facilities and assistance are inadequate, the ureters will continue to be damaged.

In elective surgical procedures in the lower abdomen and pelvis much can be done to avoid ureteric injury. It is important to do a full pre-operative survey of the urinary tract^{4,60}. This will reveal the anatomy and any abnormalities present and will serve not only as a guide at operation but also assist in management should injury occur. The placement of fairly large catheters in the ureters before operation is regarded by many workers as a most valuable aid to avoid damage to the ureter^{4,33, 53,60,62}. Spence and Boone⁵⁹, however, do not find it helpful as the ureter remains difficult to palpate. The identification of the ureter before proceeding with operation in the pelvis is considered an important part of technique^{5,11,59}. This is easy as the ureter has a constant

anatomical position in the pelvis and peristaltic contractions can usually be observed. Alternatively the surgeon may elect to identify all structures before clamping, incision or ligation⁴ and thus avoid injury to the ureter. It was noted earlier that the ureteric injury occurs close to the bladder (within 4 cm.) in the majority of instances. This juxtavesical part of the ureter is not easy to expose. Fortunately it is usually easier to isolate the anatomical structures that really requires identification, eg. the uterine artery. All reports stress the importance of avoiding mass clamping and ligation for bleeding^{4,33}. Unnecessary mobilization and stripping of the ureter should be avoided^{4,21,62}. Other workers stress the avoidance of undue traction, gentle handling⁴, accurate haemostasis and extraperitoneal wound drainage²¹ and careful peritonealization^{33,62}.

With established ureteric damage, the management varies according to whether the injury is recognized at the time of operation or only subsequently.

If injury is recognized at operation its nature and site determine the treatment. A ureter that has been crushed or ligated should be released and intubated. Drainage is maintained for 10 days and an intravenous pyelogram subsequently performed periodically to check on late stricture formation. Partial or complete division of the ureter is treated by meticulous end-to-end anastomosis over a splinting catheter if the site of injury is more than 5 cm. above the ureterovesical opening^{5,17,52,59,67}. More elaborate methods of anastomosis³⁶ or proximal ureterotomy²² has not been used. Aftertreatment is the same as for crushing or ligation. With more distal injuries it is probably wiser to tie off the distal stump and re-anastomose the proximal end to the bladder.

Ligation of the cut ureter is generally condemned^{45,52}. Uretero-

cutaneous anastomosis is still considered by some surgeons if part of the ureter is devitalized⁴⁰ but has no place in the management of these cases by other workers⁵². Ureterocolostomy should not be performed in early or late cases.

In those cases where damage to the ureter is only discovered later, cystoscopy and calibration of the ureter is performed as a first step. Where injury has resulted in a stricture this may be dilated and the patient observed for subsequent improvement in renal function and degree of hydronephrosis. In the presence of a fistula, if a catheter can pass the point of injury, it has been suggested that it should be left in and that the fistula may close^{21,23}. Where this was attempted, in the present series, a stricture has always developed requiring subsequent operation.

The vast majority of patients require operative exploration. Operation can usually be performed safely and successfully when the patient presents. In this series, patients were first seen 18 days to 19 months following the original operation or confinement, the average interval being 20 weeks, and all were operated on as soon as the preoperative study had been completed. Active urinary infection with fever or a very poor general condition (eg. following pelvic sepsis or severe blood loss) may sometimes require postponement of the operation. Occasionally, in severe sepsis or debilitation, especially in cases with bilateral injury, temporary nephrostomy drainage may be the best initial method of treatment⁵⁹.

The most satisfactory approach is the transperitoneal route. The ureter is identified where it crosses the common iliac bifurcation and traced downwards. Although the site of injury is most often low down, the lower end of the ureter is frequently involved in dense scar and a considerable length has to be sacrificed to obtain a pliable end with good blood supply suitable for anastomosis. For this reason end-to-end anastomosis is never

possible in late reconstruction. It was attempted, unsuccessfully, in one patient in this series (Case 2.)

Following mobilization and trimming, the best method for disposal of the ureter has to be determined. The most commonly used procedure is that of ureteroneocystostomy^{1,5,17,21,33,40,53,59,60,62,67}. For this technique to be successful the end of the ureter should reach the bladder without tension. In no case was an attempt made to create a valvular ureterovesical anastomosis, either by intramural tunnelling^{15,47,61,66} or by the use of a mechanical valve^{34,35}. A simple pull-through technique after fish-mouthing the end of the ureter is adequate. Two anchoring sutures are used inside the bladder and a further two to anchor the adventitia of the ureter to the outside of the bladder. No ureteric splint is used and suprapubic drainage⁴³ is not considered necessary. In this series re-implantation of the ureter was performed in 12 cases, all of whom were cured.

When more than 5 cm. of the ureter has been lost, the end of the ureter can reach the bladder only under tension. In these cases some tissue has to be interposed to bridge the gap and the use of the tubed bladder flap (the Boari operation) gives very good results.

This operation was first conceived and demonstrated on a cadaver by Weller van Hook in 1893⁴⁶. In 1894 it was performed by Boari⁵, in a dog. It was first performed in a human patient by Ockerblad⁴⁴ in 1936. Barnes and Farley³ used it in the experimental animal to replace the lower third of the ureter. The flap is usually 3 cm. wide. The greatest length can be obtained by basing the flap just above the ureteric opening on the appropriate side and taking it obliquely over the dome of the bladder to just above the internal meatus on the opposite side. It works best for replacement of 5 to 10 cm. of the lower ureter but has been used to replace

20 cm.⁴⁶ Its successful use in human patients has been reported frequently^{1,7,8,17,18,20,29,53,59,67}. In this series it was used in 2 patients and both were cured (Cases 2 and 4.)

An operative procedure not unlike the Boari bladder tube was described by Demel in 1924¹⁴. The bladder was bisected, in the coronal plane, about 1 cm. above the ureteric orifice. The resulting opening was closed in the sagittal plane forming an elongated tube consisting of almost the entire bladder dome. By this method 10 to 15 cm. Of the lower ureter can be replaced. A modification of this method has been suggested by Hamm and his colleagues²³. The bladder flap is so planned that any portion of the terminal ureter that may be normal, including the normal ureterovesical opening, is retained. The end of this distal portion of the ureter can be anastomosed to the end of the proximal ureter, gaining length and preserving the normal ureterovesical junction. The authors regard the preservation of a good blood supply an important part of the operative technique. This is achieved by giving the bladder flap a broad base and by including a major branch of the superior vesical artery in the base of the flap.

Where a still greater length of ureter has been lost its replacement becomes more difficult. A variety of materials has been used to replace the ureter in the experimental animal and in the human patient. These vary from split thickness skin³¹ and autogenous pedicled fallopian tube⁵⁷ to polythene tubes^{26,65}, vitallium tubes³⁷ or a free fascial transplant over a vitallium tube³⁸, homologous ureter²⁶, heterogenous ureter - direct¹⁶ or after storage in plasma⁶⁴ - and bloodvessels: autogenous artery²⁶ or vein⁵⁴, autogenous artery imbedded in submucosal intestinal tunnels^{55,56} and freeze-dried homologous artery⁵⁸.

A different approach, which has found clinical application, is to mobilize the kidney and lower it on its pedicle to secure a greater length

of ureter^{25,50,51}. In this way, it is claimed, 7 cm. length can be gained. Alternatively, complete autotransplantation of the kidney to a lower position may be performed^{27,28}. Mobilization of the whole bladder, and using it as a 'flap', has been used in the experimental animal and in human patients to replace up to 6 cm. of the lower ureter²³.

None of the above techniques has found general application.

In the occasional case an opportunity will arise to salvage a case by caverno-colostomy²⁴ or to by-pass a failed repair of a ureteropelvic stricture by uretero-calyostomy³² or pyelocalycoureterostomy⁴¹, while a rare case lends itself to a direct anastomosis between renal pelvis and bladder (pyelocystostomy)^{30,68}.

Transmidline uretero-ureterostomy is a procedure that should be considered in selected cases. In a sole remaining kidney a damaged ureter can be transplanted to the opposite stump¹³, or the ureter can be anastomosed end-to-side to the intact opposite ureter⁴⁵. This aspect is discussed in greater detail in Section A.2.

Probably the most successful and most generally applicable technique, however, is the use of an isolated segment of ileum to bridge the gap in the ureter. The loop can easily be placed in a retroperitoneal position on either side of the abdomen. There is no need to narrow it. The application of this technique is discussed in detail in Section C.1. In this series it was used in only one patient (Case 5.)

The need for nephrectomy should not arise. It is still sometimes regarded as unavoidable^{40,50,52} and indicated when the organ is irreparably damaged⁴⁸. Staubitz and co-workers⁶⁰ removed the kidney in 4 of their 22 patients because of a poor result after re-implantation or cutaneous ureterostomy. Talbert and colleagues⁶³ report the loss of 7 kidneys (by surgical removal or autonephrectomy) in 17 cases with urological complications after

radical pelvic surgery. In 130 ureteric injuries reported by Petkovic⁴⁹, immediate nephrectomy was performed in 9 patients and the kidney could be saved in only 76 cases. In this series nephrectomy was performed in one patient. She was admitted 10 months after the left ureter had been damaged during hysterectomy. The kidney was adherent and shrunken and showed longstanding pyelonephritis on histological examination (Case 13.)

In late cases, as in those recognized at operation, ligation of the damaged ureter, cutaneous ureterostomy and ureterocolostomy should not be considered. These procedures have no place in the management of the damaged ureter. They have not been used in the present series.

In summary, the management of the cases in the present series was as follows:

Ureteroneocystostomy - 12 cases, all cured.

Boari flap - 2 cases, cured.

End-to-end uretero-ureterostomy - 2 cases, 1 failed, Boari flap done.

Ileal loop replacement - 1 case, cured.

Nephrectomy - 1 case.

Spontaneous re-establishment of opening into the bladder at the site of the tear - 1 case, cured.

No treatment - 1 case.

CONCLUSIONS

- a. The most reliable method of avoiding damage to the ureter is to identify any structure, during an operative procedure, before clamping, tying or cutting it. This is made easier by sufficient prior operative experience gained under supervision, by an unhurried technique with proper visibility at all times and by gentle handling of tissues.
- b. The best opportunity for repairing a damaged ureter is when the injury is recognized at operation.
- c. The best time for repairing a damaged ureter is as soon as the diagnosis has been established.
- d. The most appropriate technique can be decided only when the anatomy of the injury has been studied completely. It will vary from uretero-ureterostomy in some cases recognized at operation, to ureteroneocystostomy in the majority of cases, a bladder tube in a few cases and intestinal replacement in an occasional case. Other techniques will only very rarely be indicated.
- e. Sacrifice of functioning renal tissue, cutaneous ureterostomy or transplant into the intact large bowel should never be necessary.

A.1 CASE RECORDS

CASE 1:

An African male aged 22 years presented with pain in the left loin. On examination there was a pulsating mass above and to the left of the umbilicus. The presence of an aortic aneurysm was confirmed on aortography (Fig. A.1.1.) The renal pelvis on the left side was noted to be bifid.



Fig. A.1.1 Case 1:

Preoperative aortogram showing an aortic aneurysm. Reduplicated renal pelvis on left side.



Fig. A.1.2 Case 1:

Postoperative aortogram. Left upper tract slightly dilated. Good function.

Resection of a saccular aneurysm was performed and lateral closure of the defect in the aorta performed. The ureter on the left side was isolated during the dissection but a second ureter on the same side was transected. Immediate end-to-end anastomosis over a splinting catheter was performed. The catheter was removed after 10 days and follow-up examination 4 months later showed normal function and anatomy of the part of the kidney drained by the repaired ureter (Fig. A.1.2.)

CASE 2:

An African female aged 25 years had been leaking urine through the abdominal wound since the drainage of a tubo-ovarian abscess 4 weeks previously. The intravenous pyelogram showed hydronephrosis on the right side. Cystoscopic findings were normal. A catheter was obstructed at 10 cm. in the right ureter.

Laparotomy revealed the ureter obstructed by an encircling catgut suture. The ureter was mobilized, trimmed and an end-to-end anastomosis performed. However, obstruction recurred.

Six weeks later the abdomen was re-explored and the lower 11 cm. of the right ureter replaced with a Boari flap. Normal recovery followed.

CASE 3:

An African female aged 18 years had been leaking urine from the vagina



Fig. A.1.3 Case 3:
Preoperative pyelogram. No
function on right side.

following caesarean section for
obstructed labour 4 weeks ear-
lier.

Vaginal examination showed
urine issuing from the canal of
the cervix. On the intravenous
pyelogram no function was obser-
ved in the left kidney.



Fig. A.1.4 Case 3:
Retrograde pyelogram. Ob-
struction in right ureter.

Cystoscopy showed normal features. A catheter was obstructed at 4 cm.

from the left ureteric orifice
(Fig. A.1.4.)



Fig. A.1.5 Case 3:

Postoperative pyelogram. Persistent hydronephrosis right side with return of function.

At operation a uretero-cervical fistula was demonstrated 4 cm. above the left ureteric opening. The ureter was transected and re-implanted into the bladder. Normal recovery followed.

Four weeks after the operation the left upper tract was still dilated but function had returned (Fig. A. 1.5.)

CASE 4:

An African female aged 21 years presented with a urinary leak from the vagina following a caesarean section 2 months previously. On examination the urine was seen to leak through a vaginal fistula just anterior to the cervix. On the intravenous pyelogram no function was observed on the left side. The bladder was normal on cystoscopy and a ureteric catheter was obstructed at 3 cm. on the left side.

At operation the lower end of the left ureter was found imbedded in a mass of dense scar tissue. After mobilization and trimming a gap of 7 cm. had to be bridged. A flap of suitable length was raised from the bladder and anastomosed to the lower end of the ureter.

The postoperative course was normal and she left hospital 3 weeks after the operation. The left kidney had resumed function.

CASE 5:

An African female aged 42 years had the right ureter accidentally divided during total hysterectomy for multiple fibroids. The injury was recognized and the proximal ureter was re-implanted into the bladder. A uretero-vaginal fistula developed. Seven weeks after the original

operation the pelvis was explored, the ureter mobilized and reconnected to the bladder via a Boari flap. The uretero-vaginal fistula recurred. At this stage there was marked hydronephrosis on the right side. When she was first seen 7 months following the first operation a uretero-vaginal fistula was present. There was no secretion on the right side on the intravenous pyelogram. The right ureter was re-explored and its lower 15 cm. replaced with an isolated loop of ileum. An intravenous pyelogram in the early postoperative phase showed a nephrogram effect on the right side. Satisfactory function had returned when she was seen 3 months later.

CASE 6:

An Indian female aged 50 years had been leaking urine from the vagina since hysterectomy for menorrhagia 3 weeks previously. A uretero-vaginal fistula was present on the right side. The intravenous pyelogram showed hydronephrosis on the involved side. The right ureter was re-implanted into the bladder and the fistula cured.

CASE 7:

A 34-year old African female had been leaking urine from the vagina since prolonged labour with stillbirth of her third baby 2 months previously. She was found to have 2 vesico-vaginal fistulae with the left ureter opening into the fistula. The function of the kidney on the left side was grossly diminished. Two attempts at vaginal repair failed. On abdominal exploration the left ureteric orifice and the juxtavesical part of the left ureter was found involved in scar tissue. The left ureter was re-implanted into the bladder. Subsequently the vesico-vaginal fistula was repaired by the vaginal route.

CASE 8:

An African female aged 36 years had a second caesarean section performed 3 weeks before admission, followed by a leak of urine from the vagina. A uretero-cervical fistula was present. At cystoscopy the bladder was normal and a ureteric catheter was obstructed at 2 cm. on the right side.

The right kidney was severely infected and the intravenous pyelogram showed dilatation of the right upper tract. She had a deformity of the pelvis associated with fibrous dysplasia of both femora. The right ureter was re-implanted into the bladder and the fistula cured.

CASE 9:

An African female aged 48 years had the right ureter divided during hysterectomy for uterine fibroids. The injury was recognized and the ends sutured over a polythene catheter. A ureterocutaneous fistula developed. The intravenous pyelogram showed definite hydronephrosis on the right side. The right ureter was re-implanted into the bladder and the condition cured.

CASE 10:

A 24-year old African female had a 3-day labour terminated by caesarean section 4 months previously, since which time there has been a leak of urine from the vagina. Intravenous pyelogram showed a left-sided hydronephrosis. A ureterocervical fistula was present. The bladder was normal at cystoscopy while a catheter was obstructed at 4 cm. on the left side. The condition was cured by re-implantation of the left ureter into the bladder.

CASE 11:

African female, aged 44 years, had a hysterectomy performed 3 weeks before admission. This was followed by incontinence of urine. She presented with a ureterovaginal fistula on the left side. The left kidney showed no function on the intravenous pyelogram while early hydronephrosis was present on the right side. The bladder was found normal on cystoscopy. Re-implantation of the left ureter cured the condition.

CASE 12:

A 46-year old African female presented with a vesicovaginal fistula, the result of a prolonged labour. There was marked eversion of the bladder and the right ureter opened in the fistula. The intravenous pyelogram showed a

non-functioning kidney on the right side with a normal kidney on the left side, confirmed on retrograde pyelography. Two attempts at vaginal repair failed. The right ureter was re-implanted into the bladder, and the fistula subsequently repaired by the vaginal route. The postoperative pyelogram showed that the right kidney had resumed function.

CASE 13:

A 36-year old African female had hysterectomy performed 9 months before admission. Her postoperative recovery was complicated by fever and a tender mass in the left loin. The intravenous pyelogram showed a non-functioning left kidney. The bladder was normal while the left ureter was obstructed at 3 cm. from the orifice. Left nephrectomy was performed. There was considerable perinephric fibrosis while the kidney was shrunken and firm with a dilated tortuous ureter. Histological examination showed longstanding pyelonephritis.

CASE 14:

An African female aged 22 years had a prolonged labour terminated by symphysiotomy and forceps delivery. A large vesico-vaginal fistula resulted. This was repaired. However she continued to leak per vaginam although she also voided normally.

She presented with the left ureter opening into the vagina while the vesico-vaginal fistula had been successfully closed. Osteitis pubis was present. The intravenous pyelogram showed diminished function on the left side. The left ureter was re-implanted into the bladder and the condition cured.

CASE 15:

An African female aged 37 years had an hysterectomy performed for uterine fibroids. She had postoperative oliguria. On cystoscopic examination, on the third postoperative day, the right ureter was found obstructed in its juxtavesical part. The intravenous pyelogram showed slight hydronephrosis on the left side, while no function was evident on the right side. The abdomen was explored and the right ureter re-implanted into the bladder. The postoperative pyelogram demonstrated returning renal function.

CASE 16:

A 42-year old African female had been leaking urine from the vagina since hysterectomy was performed 3 months previously. She was found to have obstruction of the left ureter 2 cm. from its orifice with a uretero-vaginal fistula. The intravenous pyelogram showed dilatation of the calyces and ureter on the left side. On exploration, the uretero-vaginal was demonstrated at a point where a non-absorbable ligature surrounded the ureter. Re-implantation was performed and the condition cured.

CASE 17:

Details of this patient are given in Section A.4, Case 20: re-implantation of the right ureter followed by closure of a vesico-vaginal-cutaneous fistula.

CASE 18:

An African female aged 36 years had a prolonged labour terminated by forceps delivery. Rupture of the uterus occurred and total hysterectomy was performed. On the 14th postoperative day an abscess discharged through the vaginal vault and this was followed by a urinary leak. She presented with a left uretero-vaginal fistula. The intravenous pyelogram showed early hydronephrosis on the left side. No treatment was permitted.

CASE 19:

An African female aged 38 years had an obstructed labour, a transverse lie, with her 4th confinement, with rupture of the uterus. Hysterectomy was performed and a tear of the bladder sutured. She presented 5 weeks later with a vesico-vaginal fistula. A poorly functioning and dilated upper tract was demonstrated, on the left side, on both intravenous and retrograde pyelograms. Cystoscopy showed 2 small fistulae in the bladder, along the previous suture line. The left ureter had been involved in the tear and a new orifice had been established above and lateral to the normal situation. The vesico-vaginal fistula was closed by the vaginal route.

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SECTION A.2

TRANS-URETERO-URETEROSTOMY IN URETERIC REPAIR

CONTENTS

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TRANSURETEROURETEROSTOMY IN URETERIC REPAIR

Uretero-ureterostomy, transuretero-ureterostomy, transmidline uretero-ureterostomy or contra-lateral uretero-ureterostomy implies the anastomosis of one ureter to the ureter on the opposite side so that the kidney on one side is drained into the lower ureter on the opposite side. The classical opportunity for using this technique exists when one kidney has previously been removed (or one kidney is irreparably diseased) and an indication exists for diverting the urine from the lower ureter on the opposite side. The technique is, however, also applicable where the kidney of the recipient ureter is healthy and functioning in which case the one ureter will drain the urine from both kidneys.

The feasibility of anastomosing one ureter to the opposite ureter was examined by Sharpe in 1906,¹⁵ working on dogs and cadavers. Independently, Gilbride⁶, suggested the same operation for ureteric anastomosis in 1911. A slightly different approach was followed by Ceccarelli² who, using dogs as the experimental animal, performed a partial anastomosis between the two kidneys. Part of the cortices was also sutured together. He found only slight and temporary impairment of function and demonstrated how new vascular connections were established so that the entire pedicle of one kidney could eventually be ligated without disturbing renal function.

The first human case was reported by Higgins in 1935⁷. In his patient the right ureter had become implicated in a diverticulum with stones. There was severe reflux, pain on urination and progressive hydronephrosis. The ureter was mobilised, transferred to the opposite side retroperitoneally and anastomosed end-to-side to the opposite ureter. A good result was achieved. Neuswanger¹² carefully studied the

technique of uretero-ureteral anastomosis in 32 dogs over a period of 4 years and then used it in a patient in whom the lower end of the left ureter had become extensively involved in recurrent multiple papillomas. Smith and Smith¹⁷ reported 2 cases in 1940. They used the technique of Higgins except that they preferred to ligate the ureter and do a side-to-side anastomosis. A classical case was recorded by Slutsky¹⁶. His patient had a right nephrectomy performed 9 years earlier. The left ureter was extensively damaged during an operation for chronic adnexal disease. After demonstrating a healthy ureteric stump on the right side by retrograde study, the injured ureter was transferred (retroperitoneally in front of the great vessels) and anastomosed end-to-side to the right ureter over a splinting catheter. A good result was obtained. The author advises a preliminary nephrostomy very strongly.

Moore^{10,11} studied the blood supply of the ureter and concluded that the viability of the ureter was not endangered during extensive mobilization if the arterial supply from the renal artery and the longitudinal peri-ureteric arterial plexus were not interrupted. Following preliminary experimental work on dogs and a cadaver, he performed trans-uretero-pyelostomy for the first time in a human patient. The kidneys were in an ectopic position. He also reported a case in whom transuretero-ureterostomy was done for damage to the ureter during hysterectomy. Surgical trauma to the ureter, vesico-ureteric reflux, involvement of the ureter in inflammatory or malignant disease, benign or low-grade malignant primary tumour of the ureter and intractable cicatricial obstruction are regarded by him as the main indications for this procedure. The treatment of low-grade papilloma of the ureter by local or segmental excision has also been recorded by other workers^{3,13,14,18}. In some of these cases an ileal segment has been used to replace the excised ureter but

transuretero-ureterostomy is an alternative method that should be considered in these rare cases.

In the patient reported by Davis and Lee⁴, hysterectomy, 8 months earlier, was complicated by a uretero-vaginal fistula. Right nephrectomy was performed and only subsequently was it discovered that the fistula communicated with the left ureter. This damaged ureter was then transected and anastomosed end-to-side with the stump on the right side, using a splinting catheter. The result was excellent with considerable improvement in the pre-operative hydronephrosis. The authors suggest that this procedure is a reasonable alternative to ureterovesical re-implantation or ureterosigmoid transplantation for injury or stricture of the lower ureter.

The largest reported series is that of Hodges and his co-workers⁸. They applied the operation in cases with lesions of the lower ureter where the opposite ureter and the bladder were normal as well as in cases with irreparable disease of the kidney (or its absence, e.g. after previous nephrectomy) and of the opposite ureter. The operation was regarded as successful if a patent anastomosis was secured with relief of urinary infection, ureteric obstruction and preoperative hydronephrosis.

In the patient reported by Moore⁹, the right kidney was non-functioning while the left side was grossly dilated. After right nephrectomy, an oblique end-to-end anastomosis was performed between the two ureters. The right ureter was brought across the midline intraperitoneally. Nephrostomy drainage was provided for 25 days. The patient made a good recovery.

An unusual application for this technique is described by Buchtel¹. In a series of 10 cases he used it in the treatment of patients with reduplication of the ureters where one ureter opened extravasically or was

diseased. He advised against the operation where there was great disparity between the size of the ureters. Alternative methods for treating these patients would have been re-implantation of the affected ureter into the bladder or anastomosis between the two renal pelves.

The technique of uretero-ureterostomy finds a useful application in securing a single abdominal stoma in patients requiring bilateral cutaneous ureterostomy. If the ureters are sufficiently long both ends can be brought to the skin surface and their adjacent borders sutured together⁵. In other cases the one ureter is brought across the midline and anastomosed end-to-side to the opposite ureter in a retroperitoneal position, the end of only the recipient ureter being brought to the surface¹⁹. This procedure is most often required in children with congenital neurogenic bladder with gross sacculation of bladder and dilatation of the ureter but it had also been used in persistent pseudomonas infections, urinary tract tuberculosis and inoperable bladder cancer.

The technical variations of the operation are shown in Fig. A. 2.1.

a - f.

The ureter is brought across the midline in the retroperitoneal position in front of the big vessels. Uretero-ureterostomy may be end-to-side, end-to-end or side-to-side. The most popular technique is an end-to-side anastomosis whether this is to a ureteric stump or to a ureter draining a normal kidney. Nephrostomy or a proximal ureteric 'vent' during the immediate postoperative period has been recommended but is probably not necessary for a successful outcome.

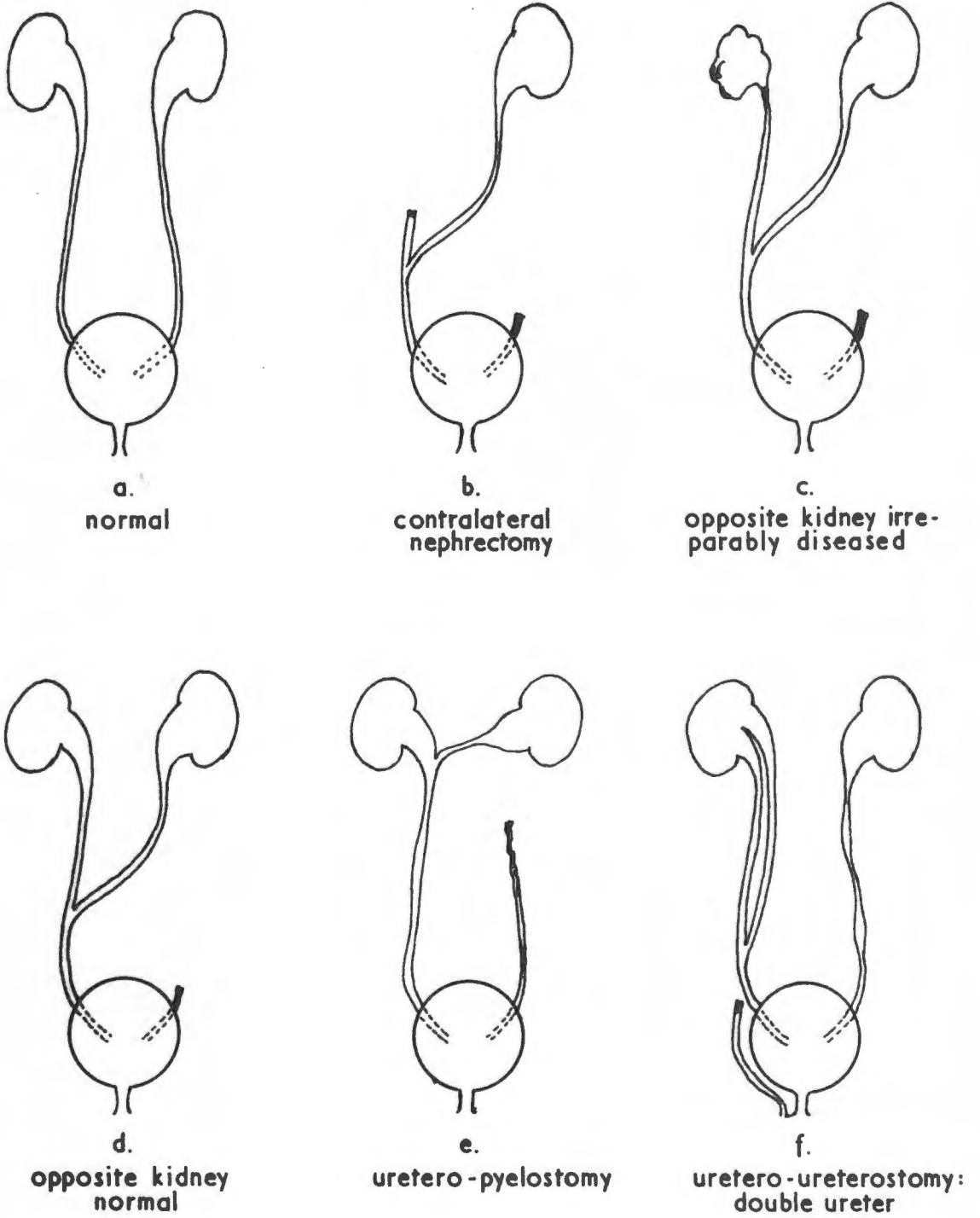


FIG. A.2.1.
URETERO-URETEROSTOMY:
various applications.

It would appear that this operation may find useful application in the following conditions:

1. Injury (with stricture or fistula) of the lower ureter. This would include cases of repeated calculus formation in the lower ureter, involvement of the lower ureter in diverticulum of the bladder and damage resulting from repeated operative procedures.
2. Primary neoplasm of the ureter, either benign or of a low-grade malignancy, or involvement of the ureter in malignant disease affecting a neighbouring organ, eg. the bladder, where the disease is otherwise operable.
3. Drainage of a ureter opening in an ectopic position.
4. Establishing a single ureterostomy stoma where bilateral cutaneous ureterostomy is required.
5. Vesico-ureteric reflux with troublesome pain on urination and progressive hydronephrosis, on one side.

Indications for uretero-ureterostomy are seldom if ever absolute. The alternatives are most usually re-implantation of the ureter into the bladder, replacement of the ureter with an isolated loop of ileum or an ileal conduit. The advantages of the operation are:

1. The retention of a normal ureterovesical junction instead of a re-implantation junction or an enterovesical anastomosis where reflux is not uncommonly present subsequently;
2. An operation of a smaller magnitude than the construction of an isolated loop of ileum and avoiding the possible complications of small bowel anastomosis;
3. The avoidance of any possibility of reabsorption of urinary constituents as would be present with ileal replacement or ileal conduit.

In the rare cases where obstruction is present in the lower ureter in a sole remaining kidney with a healthy patent ureteric stump on the opposite side and a normal bladder, uretero-ureterostomy would appear to be the ideal solution to the problem. In other cases the best of several alternatives can only be decided after detailed study of the pathological anatomy, the residual renal function and an assessment of the survival period in the individual case. In some of these uretero-ureterostomy may well be selected as the procedure of choice.

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SECTION A.3

OBSTETRIC FISTULAE OF THE URINARY TRACT

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OBSTETRIC FISTULAE OF THE URINARY TRACT

In many hospitals in the Republic of South Africa, fistulae of the urinary tract still constitute a common type of surgical case. In contrast to many reports from Europe and the United States of America^{2,10,18,20}, where these fistulae usually follow radical pelvic surgery or therapeutic irradiation, obstetrical misadventure is by far the commonest cause of these fistulae locally. They occur most often amongst African women. In the more remote parts of the country confinements are usually conducted with only untrained assistance. More often than not, such assistance in the rural areas, primitive in type, is the only obstetrical help available. The lack of skilled obstetric care can often be blamed on inadequacy of the transport system or the means for making use of available transport. In many cases the fault lies with the lack of a sound communication system in rural areas, whereby the provincial ambulance centre cannot be readily contacted. Efficient medical care, district nursing assistance and institutional accommodation are not yet easily available in all areas. Similar conditions undoubtedly still exist in other parts of the world^{11, 22,25}. Coupled with this is the impression that the pelvis in the African female is more often generally contracted than in the white races, so that mild to serious degrees of cephalo-pelvic disproportion occur more frequently. The mean height of the Zulu female in Natal is $61\frac{1}{2}$ inches and her pelvic brim area 100 cm^2 . The average size of the babies is only fractionally smaller than that of white babies.

This account deals with the experience at the Edendale Hospital in Pietermaritzburg, Natal, over a period of $9\frac{1}{2}$ years (1954 to 1963). During this period a total number of 309 fistulae of the urinary tract were treated. Of these, 248 fistulae resulted from labour and its compli-

cations. Nine fistulae (3 vesico-vaginal and 6 uretero-vaginal or uretero-cutaneous) complicated pelvic operations, assault or chronic infection, while 52 cases had malignant vesico-vaginal fistulae associated with advanced carcinoma of the cervix. The management of these 61 fistulae is discussed under Sections A.1 and B.3.

Obstetric fistula accounted for 2.2 per cent of all cases admitted to the gynaecology wards. The majority of the patients was referred to the hospital from the central, northern and southern districts of Natal. (Fig. A.3.1. a and b.). The patients were most often young primiparae. Although the ages varied from 16 to 75 years, about 80 per cent of the patients were in the age group 17 to 30 years and in more than 75 per cent of cases the fistula complicated a first or second confinement. It was hoped that the establishment of a large African hospital in this area might assist in reducing the incidence of obstetric fistulae by providing facilities for antenatal supervision, by admission of difficult cases, by its district nursing services and, especially, by disseminating the idea that medical supervision during pregnancy and confinement is beneficial and necessary. However, a survey of the number of new admissions each year shows no such decline as yet. (Fig. A.3.2.).

The events leading to the formation of the urinary fistulae may be summarised as follows:

Prolonged labour only	122 cases.
Prolonged labour with application of forceps	47
Prolonged labour with craniotomy	20
Prolonged labour with caesarean section	23
Ruptured uterus, hysterectomy	7
Ruptured uterus, repair of uterus	6
Elective caesarean section	4
No reliable history given	19 " .

In only 6 patients in the entire group was a live baby reported.

In only one case was stillbirth the result of a foetal abnormality - an

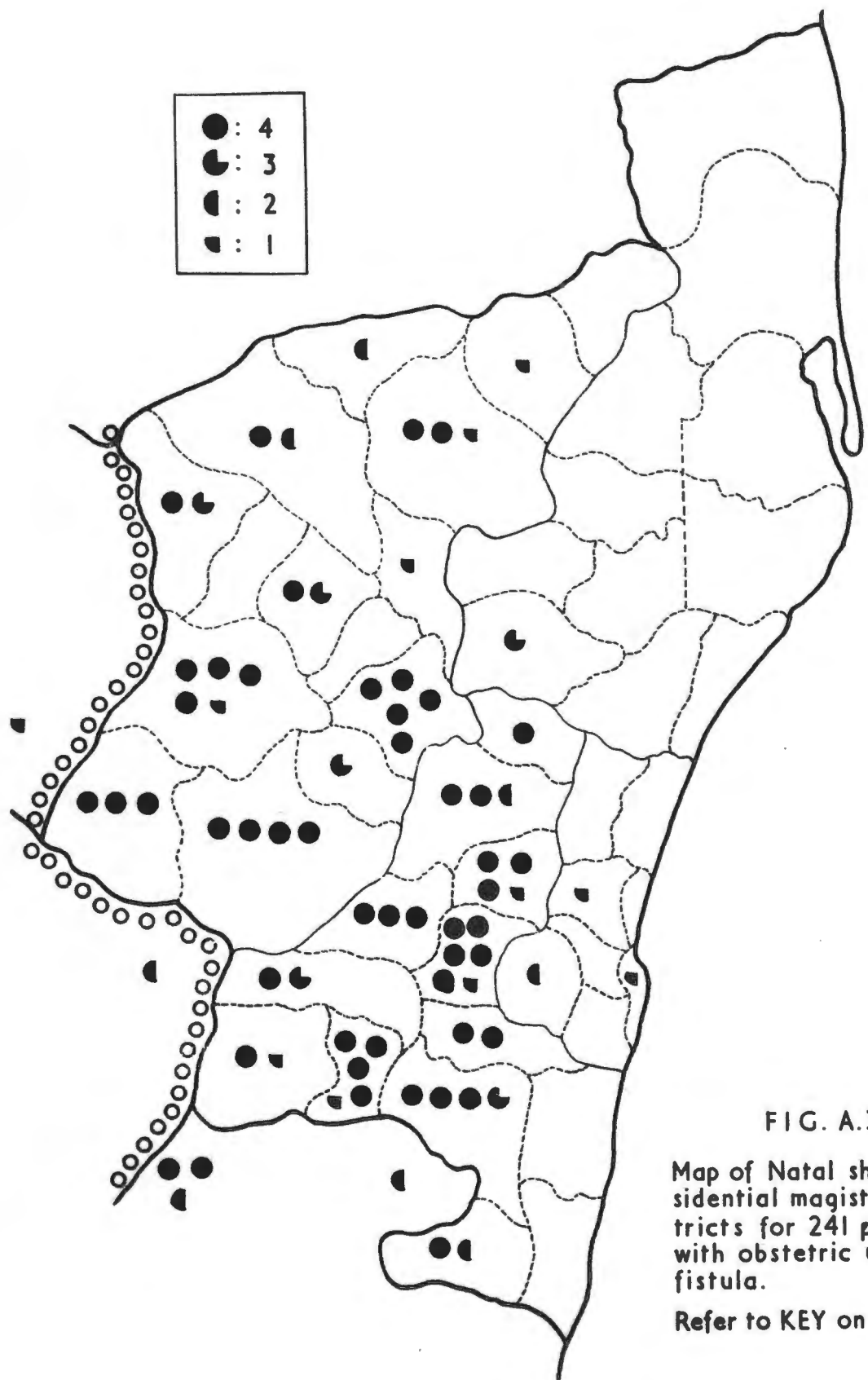


FIG. A.3.1.a

Map of Natal showing residential magisterial districts for 241 patients with obstetric urinary fistula.

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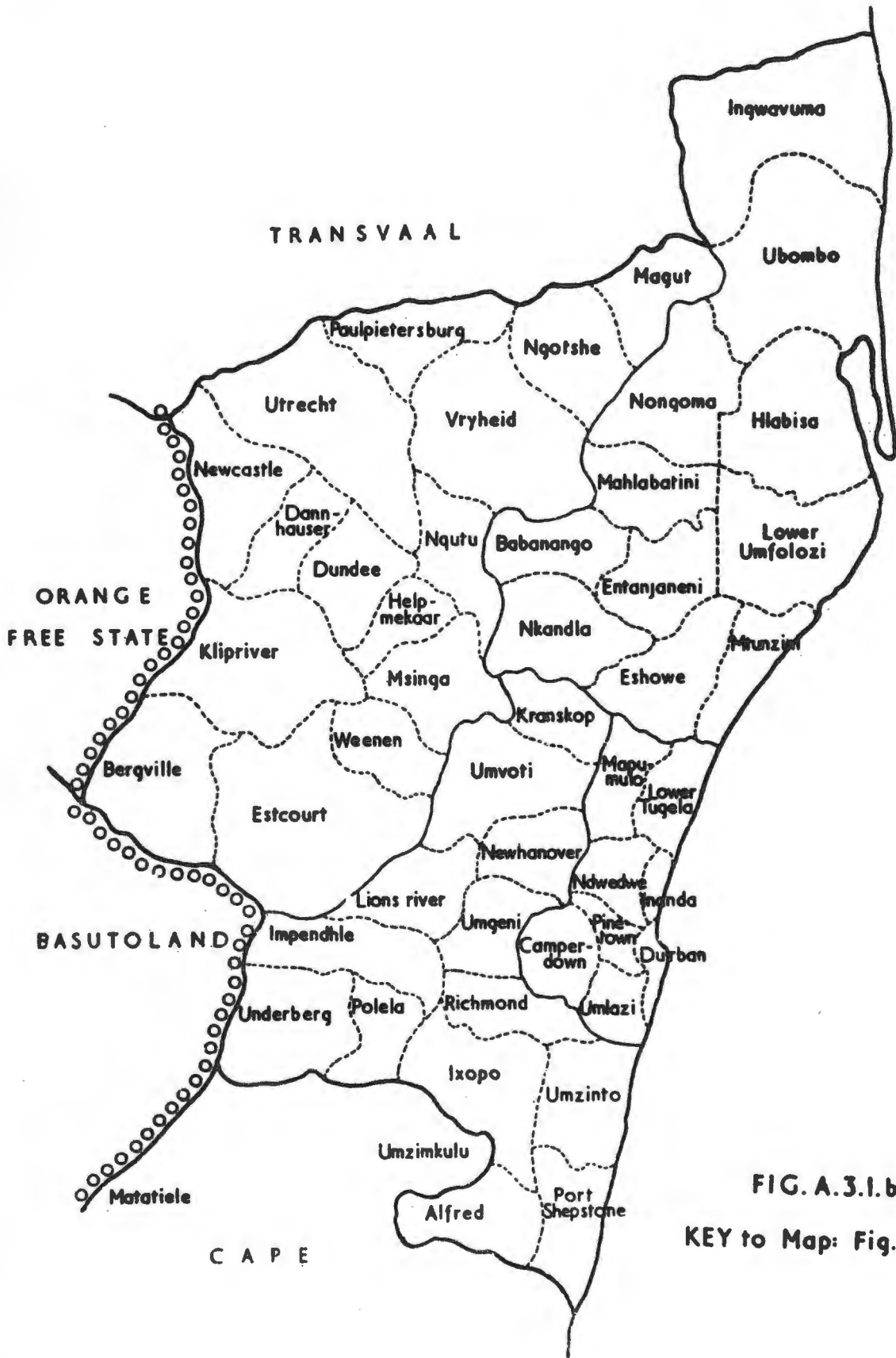


FIG. A.3.1.b
KEY to Map: Fig. A.3.1.a

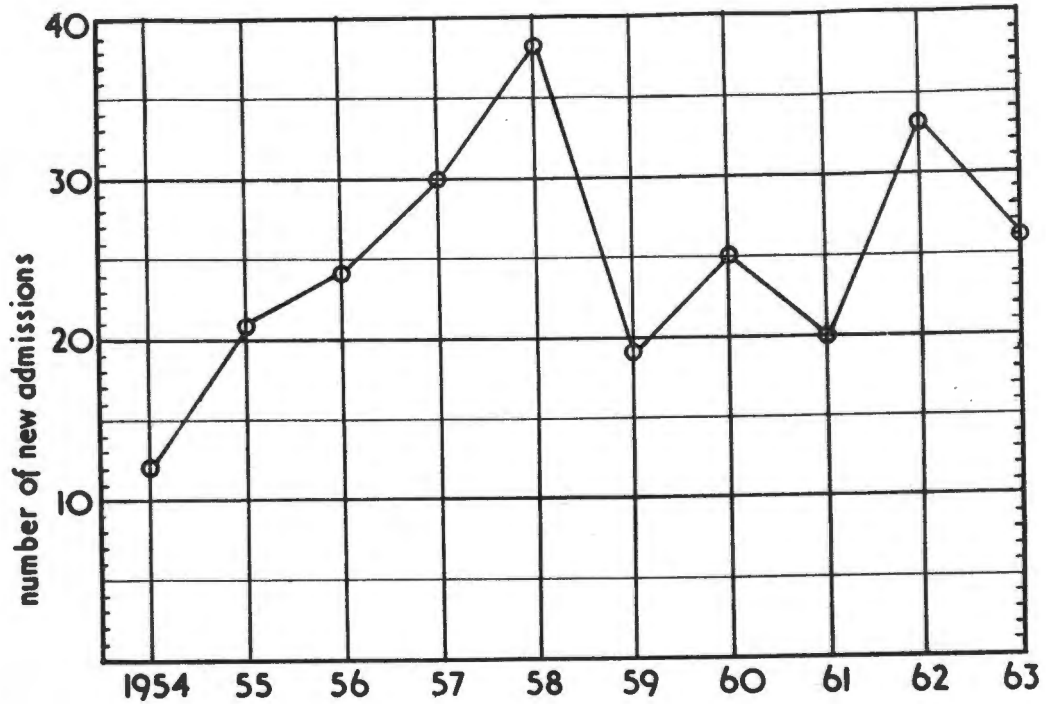


Fig. A.3.2.

Number of new admissions, of obstetric urinary fistula, per year.

infant with hydrocephalus.

The fistulae were of various anatomical types as follows:

Vesico-vaginal	185 cases
Vesico-urethro-vaginal	34
Urethro-vaginal	9
Urethro-cutaneous + vesico-vaginal	1
Vesico-cervical	8
Vesico-cervical-cutaneous	1
Vesico-cervico-vaginal	1
Cervico-vesico-urethrovaginal	1
Uretero-vaginal	3
Uretero-cervical	3
Uretero-cervico-vaginal	1
Uretero-vesico-vaginal	1

Three patients had multiple fistulae (3 in one and 2 in 2 patients) while 3 patients were re-admitted for recurrent fistulae previously

successfully treated.

It is of interest to review additional pathological conditions discovered on clinical examination of these patients:

Eversion of the bladder at the fistula (sufficient to be noteworthy)	17 cases
Vaginal stenosis (excluding mild cases)	26
Rectovaginal fistula	20
Third or second degree perineal tear	20
Foot drop (bilateral 11, right 7, left 3)	21
Bladder calculus	8
Fibroid uterus	5
Bilharziasis	3
Tuberculosis of the spine, pulmonary tuberculosis, nodular goitre, ovarian cyst, acute appendicitis, fibrous dysplasia (femora), each	1 case.

One patient was later complicated by the development of carcinoma of the cervix.

Most of these conditions necessitated additional surgical procedures eg. vaginoplasty, closure of recto-vaginal fistulae or perineal tears, removal of bladder stones and hysterectomy. Bilharziasis was treated if the lesion was active. It was not thought that the presence of bilharziasis was ever the cause of failure to close a vesico-vaginal fistula. Eversion of the bladder needed no special attention. Complete inversion was present in only one case. It was observed on 2 occasions in a group of 175 cases by Moir²⁹.

It is of interest to note the association of maternal obstetric palsy with urinary tract fistula in 21 cases. This association has been denied in the past²⁴ on the assumption that nerve damage results from compression of the nerve trunks against the pelvic brim whereas vaginal fistulae result from prolonged pressure of the foetal skull in the lower part of the pelvis.

Again, it has been taught that the ureters, as a result of their displacement above the pelvic brim in protracted labour, will escape the com-

pression that leads to fistula formation. This has been disproved by evidence obtained from the dissection of the bodies of women who died undelivered after prolonged labour¹⁵. In the present series there are several cases where a ureter, alone or in addition to other structures, suffered damage due to prolonged labour only.

It has been pointed out that the patient with an obstetric urinary fistula is usually a young primipara who has lost her baby. Unattended, the possibility of subsequent live children is poor, sexual intercourse is often impossible and the continuous urinary leak makes social existence very difficult. It is clear that medical assistance would be eagerly sought. Yet, the patients were first seen at periods varying from 2 weeks to 30 years after fistula formation. In some cases this period was occupied by one or more attempts at closure of the fistula elsewhere while, in other cases, the patient apparently resigned herself to the condition or did not realise that cure was possible. The average interval between fistula formation and first consultation was 8 months. A small group of 7 patients had had the ureters transplanted into the colon as a primary method of treatment. These were first seen one to 14 years afterwards, the average interval being 10 years.

Operations for curing the fistula had been performed on 26 patients before their admission to Edendale Hospital. Of these operative procedures, 24 were by the vaginal route (the number of operations varying from one to 6 in individual cases), one patient had an abdominal and a vaginal operation, while another had a combined abdominoperineal procedure performed. This is probably not a reliable indication of the actual number of previous operations. Patients are in the habit of moving from hospital to hospital, allowing only one or two attempts at each institution, and they may consider it good policy not to mention previous opera-

tions. All surgeons admit that successful operative closure of a fistula is more difficult after previous attempts and that this difficulty increases proportionately with the number of previous operations. This has also been the experience at Edendale Hospital.

The clinical picture of obstetric urinary fistula is well known. Where the ureters are involved, special investigations may be required to determine the anatomy of the lesion. Many patients had severe vulval excoriation, often with warty thickening of the vulval and perineal skin. Many had vaginal stenosis, varying in degree from mild to the most severe where only a small densely fibrotic pit existed with urine leaking from its apex. Fistulae varied from pin-hole openings to large apertures where the cervix had sloughed, the whole of the bladder base and urethra had disappeared and the ureters opened into the fistulous area or on to its proximal everted margin.

An intravenous pyelogram was performed as a routine. This often provided important information and established valuable base-line evidence for later comparison. A blood urea investigation was also routinely done. Gross impairment of renal function was seldom found. Evidence of septic absorption from the bladder with toxic myocarditis¹⁷, was never found. A chest X-ray and peripheral blood study completed the general check-up of the patient. Local examination determined the situation and size of the fistula, the position of the ureteric orifices, the integrity of the urethral canal (if present) and the position and patency of the canal of the cervix. An effort was made to determine the bladder capacity, by digital palpation if possible or by exploring the bladder cavity with a sound or cystoscope. The findings were carefully recorded in a diagram. Cystoscopic examination was often required and ureteric calibration and retrograde pyelography were done where involvement of

the ureter was suspected.

All patients were operated on as soon as general and local conditions permitted. The patient was placed on a nutritious high-calorie diet with additional vitamin supplements. The haemoglobin value of the blood was brought up to over 12 Gm. per cent, by transfusion of whole blood if necessary. In long standing fistulae the vulval excoriation was permitted to settle down and local sepsis treated with antiseptic douches. In the vast majority of cases sufficient time was allowed for slough to separate spontaneously. In some instances this was hastened by cutting away the dead tissue at the weekly fistula clinic. No operation was performed so early that slough had to be cleared at operation⁷ neither was a definite minimum time interval after confinement regarded as necessary¹⁵. Following the earlier work of Baker and his colleagues^{3, 4}, and the more recent report of Collins and Jones¹³, preoperative cortisone was used for a short period. As there was no perceptible improvement in the local conditions or in the postoperative results, this modification was discontinued. Where a rectovaginal fistula or perineal tear was present this was usually left alone until cure of the fistula had been obtained. The additional lesion often served to improve the exposure during vaginal operation. In patients with a high rectovaginal fistula a temporary colostomy was often performed as a preliminary procedure.

Classification:

In discussing the treatment of obstetric urinary fistulae and in assessing the results of operation it is useful to have cases classified so that comparison is possible with the work at other institutions and so that the difficult type of case can be identified and possibly referred to workers with special experience and interest in this type of surgery. A simple classification⁷ seemed more acceptable and generally

useful than a more elaborate one¹⁶. The type of classification used is as follows:

1. Uncomplicated cases, where vaginal repair was possible. These cases could be subclassified according to the anatomical position of the fistula into:

- a. Those involving the bladder neck and urethra or urethra only;
- b. Midvaginal, and
- c. High vaginal or juxta-cervical.

The presence of vaginal stenosis was not considered a complicating feature.

2. Cases presenting with damage to the ureter or the presence of the ureteric orifice near or in the fistula.

3. Complicated cases, also referred to as 'difficult' cases, where closure of the fistula was impossible or possible only with supplementary operative procedures. This was due to the size of the fistula, to dense attachments of its margins to the pubis and pubic rami, and to massive fibrosis, often in a fistula of long standing after several previous attempts at closure. Reduction in bladder capacity and the presence of other pathological conditions were sometimes additional factors.

TREATMENT

Group 1 - 196 cases:

In general the paring technique of Sims was used for the smaller fistulae and the flap-splitting method (Mackenrodt-Mahfouz) for the larger fistulae. Episiotomy or Schuchardt's incisions were used, where necessary, to improve the exposure. The ureters were identified, by cystoscopy if necessary, intubated, the ureteric catheters taken through the urethra and left in during the operation. Without this precaution it is possible

to include one or both ureters in the suture line.

Following operation, a Foley catheter size 18 to 24 F was left indwelling. During the last 2 years of this survey a female Gibbon catheter size 14 to 16 F was preferred, retained by suturing its flanges to the labia. Suction drainage, by the Wangenstein technique, was maintained and closely supervised for an average of 12 days after operation. The nursing care in this stage should be of the highest order. An antibiotic was administered routinely for 5 days following operation and a sulfa-drug for a further week. The patient was allowed to adopt the position in bed, dorsal or lateral, which she found most comfortable. Alarming haemorrhage sometimes occurred within 24 hours after the operation. This may come from the suture line itself or from a deep Schuchardt's incision. Clot retention was a problem in two cases in this series. Both were managed by evacuating the clot through the urethral catheter, using varidase solution in one case to liquefy the clot.

The criteria for cure of a fistula must be clearly stated. If these are not accurately defined comparison of results with those reported in the literature will be confusing. For a 100 per cent cure the following conditions must be fully satisfied:

1. Complete continence both by day and by night. It has been found that the bladder should be able to hold a minimum quantity of 6 ounces of fluid to achieve this.
2. No stress incontinence should be present.
3. The vagina should have a sufficient capacity for normal coitus and dyspareunia or apareunia should not be a leading complaint in the follow-up period.
4. Traumatic amenorrhoea should not be present post-operatively.
5. The patient should be left a normal capacity for childbearing.

With these criteria in mind, a summary of the results obtained in this group is given in Fig. A.3.3. From the shorter summary in Fig. A.3.4 it will be noticed that the vesico-urethro-vaginal type of fistula (Group 1.a) is the most difficult variety to close successfully and also most likely to be complicated by severe stress incontinence.

Using the criteria listed above, the cure rate obtained was 52.6 per cent (varying from 86.2 per cent in high fistulae to 33 per cent in the urethro-vaginal type). If those cases with mild stress are included the cure rate was 64.3 per cent (varying from 86.2 to 51.6 per cent). If simple closure of a fistula is accepted as a cure the results will improve further, while if the criteria for cure are taken as a 'dry bed' (with the patient getting up frequently) and a reasonably contented patient (this would include many of those patients with a residual pin-hole fistula) the results will be better still.

The residual pin-hole fistula often proved decidedly difficult to cure. On re-operating on these cases the impression that they really are 'funnel diverticula' of the bladder, lined with mucosa, was repeatedly confirmed. Not one of these was observed to close spontaneously. Diathermy fulguration of these fistulae was not found a worthwhile procedure. The patients were often reasonably content and several of them had subsequent pregnancies.

The greatest single factor preventing adequate cure was postoperative stress incontinence. This was thought to be the result of fibrosis with rigidity of the bladder neck and shortening and retraction of the urethra¹³ while a diminished bladder capacity was considered to be a significant additional factor in a number of cases. Severe reduction of bladder capacity was found in a large number of his patients by Lavery¹². All the various types of operation described for the cure of this condi-

		number of vaginal operations								totals	%	
		1	2	3	4	5	6	6+	0			
cured: full control	a	15	2	3	1	-	-	-	-	21	103	52.6
	b	38	10	6	2	1	1	-	1	59		
	c	16	4	-	1	1	-	-	1	23		
cured: mild stress	a	5	4	1	-	-	-	1	1	12	23	11.7
	b	7	2	1	1	-	-	-	-	11		
	c	-	-	-	-	-	-	-	-	-		
cured: marked stress	a	2	1	2	-	-	-	-	-	5	9	4.6
	b	4	-	-	-	-	-	-	-	4		
	c	-	-	-	-	-	-	-	-	-		
residual pin-hole	a	7	3	3	1	3	1	1	-	19	41	21.0
	b	11	4	1	-	1	2	-	-	19		
	c	-	2	-	-	1	-	-	-	3		
no change	a	1	1	1	2	-	-	1	1	7	14	7.1
	b	2	1	1	-	-	-	-	2	6		
	c	1	-	-	-	-	-	-	-	1		
died	c	2	-	-	-	-	-	-	-	2	2	1.0
no information											4	2.0
										196	100.0	

FIG. A.3.3
 OBSTETRIC URINARY FISTULA - GROUP I:
 results of operative treatment

	a		b		c	
		%		%		%
cured: full control	21	51.6	59	70.7	25	86.2
cured: mild stress	12		11		—	
cured: marked stress	5	7.8	4	4.0	—	—
residual pin-hole	19	29.4	19	19.2	3	10.3
no change	7	11.2	6	6.1	1	3.5
	64		99		29	

FIG. A.3.4
 OBSTETRIC URINARY FISTULA - GROUP I:
 summary of results of operative treatment

tion were tried but none proved consistently helpful. The best results were achieved by using a type of operation called 'labial flap urethroplasty' (a modification of a procedure described by Charlewood⁷) which had as its objective the elongation of the urethra¹⁴. The possibility of devising a plastic valve for insertion into the bladder neck, so designed as to open at a certain intravesical pressure, was considered but not finalised. Such a device has been described by Bruce⁶. It is made from a core of steel covered with silicone rubber. The ball-valve mechanism is operated by bringing a small magnet, of similar polarity, to about 1 cm, from the valve seat. The valve is inserted under local anaesthesia through a 32 F tube. It has been tolerated well over a short trial period. Other methods for securing continence in these difficult cases will be discussed later.

Many patients, cured of their fistula, complained of dyspareunia or apareunia due to post-operative stenotic bands, contracture of the vulval introitus or shortening of the vagina. A significant degree of vaginal stenosis was recorded in 26 of our cases. A McIndoe vaginoplasty was performed in several cases with, usually, only partial success. The patients rarely co-operated in retaining the mould or persisting with vaginal dilatations for a sufficiently long period. The Shirodkar technique, whereby an inlay graft was inserted into the ischio-rectal fossa, was used in 2 cases without success.

Traumatic amenorrhoea was a not uncommon finding. A sound could usually be passed into the uterus and synechiae could seldom be demonstrated. The cause and significance of this problem await further investigation.

Calculus formation in the bladder was observed in 8 cases. These calculi were probably all of the secondary type, the result of bladder in-

fection. Not infrequently they formed in a 'pseudo-diverticulum' of the bladder following closure of a fistula.

Very many of these cases, after cure of the fistula, returned for antenatal supervision. They were all subjected to caesarean section. In two women spontaneous vaginal delivery took place. Both had recurrent fistulae which were subsequently repaired.

Two patients died during treatment in hospital. In neither of these was death due directly to the fistula or to operative treatment.

Group 2 - 27 cases.

This group consisted of two types of case:

- a. A group of 17 patients with vesico-cervical or juxtacervical fistulae, with the ureteric orifices in close relation to the fistula. These fistulae were closed after transabdominal transvesical exposure. The selection of cases and the operative technique are described in Section A.4. All these patients were cured in one operation. Postoperative stress incontinence did not occur.
- b. A group of 10 cases where the ureter, either alone or in addition to other structures, was damaged. In all these cases the ureter was transected above the fistula or stricture and re-implanted into the bladder. In one case a Boari flap was used to bridge a 10 cm. defect. In 7 of these cases a co-existing vesicovaginal fistula was closed, once by the abdominal approach and by vaginal operation in the remainder. All these cases were cured. There were no postoperative complications. This group is discussed in Section A. 1.

Group 3 -25 Cases:

The patients in this group had fistulae which could not be closed by any method of vaginal repair. In all of them the urethra was involved or completely destroyed and in most of them there was severe vaginal stenosis present. A rectovaginal fistula was present, in addition, in some of the cases. In most cases several attempts at repair had proved unsuccessful, in some the condition was recognized as unsuitable for local repair on first examination.

- a. In 4 cases the urethra was replaced by using a short isolated loop of ileum. The technique of this operation (ileo-urethroplasty) is described in Section C.2. In one case, because of a reduced bladder capacity, a longer loop was used to increase the bladder capacity at the same time. All the patients were considerably improved.
- b. In 5 cases the bladder was completely mobilized, the remains of the uterus excised and the bladder remnant anastomosed to the front of the rectum immediately above the anal canal. The details of this operative procedure (vesicorectoplasty) is described in Section B.1.

Three of these patients had rectovaginal fistulae as well and this was found a convenient site for implantation of the bladder. A reliable anal sphincter must be present. In one of these patients, because of extreme vaginal stenosis, firm fibrosis and densely adherent fistula margins, coupled with a very small pelvis, symphysiotomy was performed to improve the exposure at operation. This proved most helpful. These patients were most satisfied with the result. Urinary control was complete and biochemical abnormalities were not

observed over periods of up to 2 years after operation.

- c. Five patients were seen in whom the ureters had been transplanted previously as primary treatment for vesico-vaginal fistula, 8 to 14 years previously. Two patients had severe hyperchloraemic acidosis and one of them died in uraemia shortly after admission. In 3 patients the vesicovaginal fistulae were closed at the first attempt and it was suggested that a short length of colon with the implanted ureters be transferred to the bladder. Permission for this procedure was not obtained. Experience with this group of cases suggested that there should not be any place for transplantation of the ureters into the intact colon in the treatment of urinary fistulae.
- d. One patient with a large vesicovaginal fistula with complete eversion of the bladder and a rectovaginal fistula was treated by partial colpocleisis. She had full urinary control. Blaikley⁵ is of the opinion that colpocleisis is a valuable method in the management of difficult vesico-vaginal fistulae and that it should be used more often.
- e. One patient had a substitute bladder constructed from an isolated rectosigmoid pouch with a perineal colostomy - the Gersuny operation (see Section B.2). Apart from slight stenosis of the perineal stoma, which yielded to dilatation, she remained very well.
- f. An unusual type of fistula resulted from penetration of the urethra from the anterior aspect while doing a symphysiotomy for obstructed labour. The patient presented with an anterior urethro-vestibular fistula. She also had a vesicovaginal

fistula which was closed at the first attempt. The urethral tissues had been so attenuated that a strip of external oblique fascia was used to buttress it and close the fistula. The fistula healed and full continence was restored. A similar case has been reported by Moir²¹.

- g. In 4 patients the main problem was a severe reduction in the bladder capacity, associated with a large vesicourethrovaginal fistula. Closure of the fistula was achieved in one case. The bladder was subsequently enlarged, using a short loop of pelvic colon, and considerable improvement in the marked stress incontinence resulted. One patient, seen 10 years following ureterocolostomy, had her vesicovaginal fistula closed after 2 operations. Because the bladder could hold only $2\frac{1}{2}$ to 3 ounces of fluid an ileo-cystoplasty was performed when the ureters were transferred from the colon to the bladder. She was fully continent. A similar case has been recorded by Pyrah²³. In 2 patients closure of the fistula proved impossible. Both had temporary supravaginal urinary diversion performed - one to the colon and one to an ileal conduit. Afterwards the closure of the fistula, in the dry bladder, was successful. Subsequently the ureters were transferred to the bladder, increasing the bladder capacity at the same time. No stress incontinence was present. This program has previously been reported^{1, 26}. Cibert⁸ also observed that incontinence disappeared when high intravesical pressure is relieved by ileocystoplasty. The impression was gained that a grossly reduced bladder capacity is sometimes responsible for failure to close a fistula, or

for marked stress incontinence after fistula closure. It is suggested that this aspect always be investigated and that temporary supravescical urinary diversion and planned enlargement of the bladder by ileo- or colocystoplasty should be considered in the management of a small number of urinary fistulae.

- h. In 4 cases the ureters were re-implanted into the bladder higher up to allow of safe vaginal operation. In one case this was done by the vaginal route, but the abdominal approach is preferable. In one patient a calculus was removed from a pseudo-diverticulum at the same time. One patient developed carcinoma of the cervix following successful closure of the vesicovaginal fistula.

In almost all these 25 cases considerable improvement was achieved. In most of them the anatomy and function of the urinary tract could not be restored to normal. Each case would appear to have presented a problem needing individual consideration. In deciding on a program of management, measures that are known to reduce normal life expectancy should, if at all possible, be avoided. In all cases the rehabilitation of the patient, within her particular social setting, should receive due consideration.

CONCLUSIONS

- a. The advantage of admitting patients with urinary fistulae to a few centres, where they are attended by workers experienced and interested in this type of surgery, is suggested. This is stressed especially for the difficult and complicated cases. These can be recognised. Results are directly proportional to the experience of the surgeon, the attention to important detail in the operative management and the vigilance of the postoperative care.
- b. Special operative methods are required in those cases where the fistula involves the ureter or where the fistula is closely related to the ureteric orifice.
- c. In some of the difficult cases, where there is gross reduction of bladder capacity with failure to close the fistula or marked postoperative stress, temporary suprapubic diversion of the urine and bladder enlargement may have a place in management.

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SECTION A.4

VESICO-VAGINAL FISTULA:
the place of abdominal operation in repair.

CONTENTS

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VESICOVAGINAL FISTULA:
the place of abdominal operation in repair.

In the surgical treatment of uncomplicated vesicovaginal fistula, the vaginal approach is employed in the vast majority of patients. This is the correct attitude for three reasons: firstly, because by this approach the majority of fistulae can be cured; secondly because it is a lesser surgical procedure with fewer complications than an abdominal operation and thirdly, because vaginal operation involves a territory with which the gynaecologist, in whose department these cases are generally treated, is thoroughly acquainted.

The above is especially true for those fistulae resulting from prolonged labour. Most of these fistulae are situated low on the trigone, at the bladder neck or in the urethra. Abdominal operation has no place in the initial management of these cases. However, after repeated attempts at closure per vaginam, the fistulous opening may gradually work upwards away from the bladder floor¹⁵ and may then be accessible to suprapubic repair. Where a vaginal operative procedure is indicated in the management of obstructed labour (eg. application of forceps or craniotomy), the vesicovaginal fistula that may result is frequently in the region of the interureteric ridge or even higher. More recently, with extensive surgical procedures in the pelvis being done more frequently, with the use of irradiation for pelvic cancer and with proper obstetrical care available for most population groups, a much larger proportion of vesicovaginal fistulae are located above the trigone of the bladder.

It is the opinion of most gynaecological surgeons that the vaginal route is quite adequate for the repair of all vesicovaginal fistulae. TeLinde²⁰ has never encountered a fistula in which he felt that a supra-

pubic approach could have had any advantage. Moir^{10,11,12} feels that the abdominal approach should be reserved for very exceptional cases, less than 3 to 4% of the total. The vaginal route is considered safer and surer than the transvesical or transperitoneal⁴. Carter et al² reports using the abdominal approach in 2 of 73 cases, Counciller and Haigler³ in 5 of 253, Foda⁵ in 4 of 220, O'Connor and Sokol¹⁵ in 11 of 54 cases while Naidu¹⁴ used it in only one of 208 patients.

Some gynaecological surgeons and most urologists feel that there is a certain proportion of fistulae, varying in number according to the cause of the injury, where the ideal method of treatment can best be decided after full uro-gynaecological study including the status of the upper urinary tract, the relation of the fistula to the ureteric orifices, the presence of epithelialization of the fistulous tract, the pliability of the tissues surrounding the fistula and the outcome of previous operative procedures. Schneiderman and Streen¹⁷ base their approach for repair of the fistula on its location in relation to the trigone. They favour the suprapubic route if the fistulous tract leads from the upper vagina to the retro-trigonal area. This view is also held by Immergut and Cottler⁶ and Taylor¹⁹, while Miller⁹ uses the abdominal approach for fistulae just inside the trigone, in the midline, in or near the ureteric orifice or above the trigone. Counseller and Haigler³ use the abdominal approach if the fistula is high and cannot be exposed or if it is complicated by a rectovaginal fistula. Several authors^{6,19} stress the advisability of abdominal approach when the fistula is situated above the trigone and opens through a scarred, fixed vaginal vault, usually following total hysterectomy, when there is no cervix to use as a tractor¹³. Moir^{10,12} however points out that most traumatic fistulae shows no loss of tissue and that the surrounding tissues are usually soft and vascular allowing the damaged parts to be drawn down

to within easy reach of repair by the vaginal route. Other indications for abdominal approach are inadequate vaginal exposure or repeated failure of vaginal repair¹⁹.

Several important advantages are claimed for the abdominal approach. Adequate exposure of the fistula under direct vision is possible. This permits adequate mobilization of the tissues at the margin of the fistula into separate layers, complete clearance of scar tissue and meticulous closure with inversion of the mucosal edge into the bladder. Because the ureteric orifices can be seen - and the ureters intubated if necessary - dissection and closure can proceed with greater freedom and confidence. In this way closure of the bladder without tension is easier to achieve. It is possible to close the defect in the vesicovaginal septum⁶ and in this way provide adequate support for the mucosal suture layer. By the abdominal approach repair or reimplantation of the ureter is possible if this is necessary because of injury to the ureter or involvement in the fistula. If suprapubic drainage is required postoperatively, it requires no additional surgical procedure when using the abdominal approach. As an additional advantage of the abdominal approach Joubert⁷ mentions the frequent finding of bowel adherent to the deep aspect of the fistula. He found this particularly in fistulae following total hysterectomy. Injury to the bowel would have been likely with vaginal repair. Preoperative diagnosis would not be possible.

Of the suprapubic techniques the transperitoneal transvesical approach is that most favoured. The extra-peritoneal technique is not recommended¹². A few authors^{8,16} use a combined vaginal and transvesical technique with success.

Over a period of $9\frac{1}{2}$ years from 1954 to 1963, 309 patients suffering from urinary tract fistulae were seen at Edendale Hospital, Pietermaritz-

burg. Of this total 248 fistulae were associated with childbirth and its complications. The events preceding fistula formation could not be ascertained in 19 patients. Prolonged labour alone caused 122 cases, it followed vaginal operative procedures (forceps, craniotomy, etc.) in 67 patients, while caesarean section, repair of a ruptured uterus or hysterectomy preceded fistula formation in 40 cases. However, as these procedures were performed almost always after prolonged labour, their precise role in the causation of the fistula was difficult to assess.

A program of treatment was determined for each patient after gynaecological and urological study and consultation, and modified during the course of treatment when necessary. Vaginal operative procedures were used in 196 patients, in 34 patients special techniques were necessary while a suprapubic operation was performed in 18 patients. Of these 18 patients the fistula followed an abdominal operative procedure during childbirth in 13 cases. It is clear, on comparing this figure with that for the whole group, that the high fistula (for which a suprapubic approach may be used) much more frequently follows operative trauma, while the low vesicovaginal and urethrovaginal fistula is almost always the outcome of a prolonged labour with a low-lying foetal head.

In deciding to approach the fistula from above, two considerations were considered especially important. Firstly, the anatomical localization of the fistula in the bladder. If the bladder opening of the fistula was located partly or wholly above the interureteric ridge, suprapubic operation was seriously considered. If the vaginal opening was located high up in a scarred and fixed vaginal vault, abdominal approach was further favoured. Secondly, the relation of the lower ureter to the fistula. If the ureteric opening was dangerously close to the margin of the fistula, or if the intramural ureter was involved in the

fistula and the possibility of reimplantation was considered, a suprabubic approach was considered necessary.

The operative technique was identical in all cases and the patients were all cured after a single operation.

With the patient in a moderate Trendelenburg position the peritoneal cavity is opened through a left paramedian incision from the pubis to just above the umbilicus. The surgeon, if right-handed, works from the left side of the patient. After a selfretaining abdominal retractor has been placed and the bowel packed away the bladder is opened in the midsagittal plane from its dome downwards into the fistula. The ureteric orifices are located, 6F ureteric catheters passed up the ureters and left in position during the operation. The whole thickness of the bladder wall is dissected from the cervix and the vaginal vault, beginning at the peritoneal reflexion and working down to and around the fistula, excising the epithelialized fistulous tract if this is present. The dissection must proceed until pliable bladder wall and vagina is reached and the bladder edges can be approximated with no suggestion of tension. A certain amount of venous ooze is always present during this stage.

The first layer of bladder sutures is now inserted. This consists of closely-spaced interrupted sutures of 3-0 atraumatic chromic catgut placed in the inner layer of bladder muscle emerging immediately deep to the mucosal edge. If correctly done the line of mucosal apposition is virtually invisible and no suture is exposed on the mucosal aspect. The ureteric catheters are withdrawn and any blood removed from the bladder by suction just before completing this layer. The second layer consists of interrupted sutures of the same material to close the outer layer of bladder muscle in the extraperitoneal part and a continuous sero-muscular suture for the remainder of the bladder closure. Just before

starting the seromuscular suture, a corrugated rubber drain is passed down into the vagina with its upper end lying in the vesicovaginal space extraperitoneally. The vaginal fistulous opening is closed loosely around the drain.

The abdomen is closed in the usual way. The perineum is exposed. The lower end of the rubber drain is delivered and anchored with a stitch. An 18F catheter is placed in the bladder, gently irrigated to confirm the absence of bloodclot and anchored to the vulva with a cross-stitch. The bulb of the catheter is not inflated.

Postoperatively the patient is nursed in the dorsal position with three pillows, with continuous dependent drainage of the urethral catheter. Sulfadimidine 1.0 Gm. is given three times a day and an adequate fluid intake maintained. The drain is removed three days and the urethral catheter twelve days after operation.

Certain points in surgical technique are considered especially important to secure a successful operative result. The bladder is opened sufficiently widely to allow adequate visualization of the whole operation area. Mobilization of full-thickness bladder wall to secure apposition without tension is most important. There is no need to split the bladder mucosal and muscular layers. Meticulous submucosal sutures as a first-layer closure of the bladder is second in importance only to adequate mobilization. Closure of the vaginal wall is not considered an important technical point. Extraperitoneal drainage prevents a haematoma in the vesicovaginal septum.

Postoperative drainage of the bladder is a much debated aspect of technique. Cystotomy and temporary diversion of the urine by indwelling ureteric catheters for 8 days is advised by Immergut and Cottler⁶ and Moir¹⁰. Suprapubic and urethral catheter drainage is used by O'Conor

and Sokol¹⁵ and Morgan¹³ while suprapubic drainage followed by urethral catheter drainage is advised by Streen¹⁸ and Roen¹⁶. Suprapubic drainage only is used by Taylor¹⁹ and Miller⁹. The period of drainage varies from 8 to 21 days. Nursing in the prone position to assist drainage is used by Taylor¹⁹ and Roen¹⁶. Low suction suprapubic drainage is considered ideal by Marshall and Twombly⁸. Simple dependent urethral catheter drainage is considered completely satisfactory.

In properly selected cases the results of suprapubic closure of a vesicovaginal fistula are very good. In the recorded series the success rates vary from total in several reports^{3,10,14,18,19,20} to 13 out of 15⁸, 10 out of 12¹, 15 out of 16¹³ and 9 out of 11¹⁵.

The surgeon who undertakes the closure of a vesicovaginal fistula by the abdominal route must be virtually certain of achieving a successful closure in one operation. This can be achieved only by combining careful selection of cases with a meticulous operative technique.

It is considered that in a small number of vesicovaginal fistulae (7 per cent in this series) repair by the abdominal approach offers a reliable, convenient and safe method of obtaining successful closure.

A.4 CASE RECORDS

CASE 20:

An African female aged 30 years had a ruptured uterus due to obstructed labour. At laparotomy a low anterolateral tear was found and sutured. On the second postoperative day urine started to leak from the vagina and on the eighth day a urinary leak from the abdominal wound was noticed. Wound dehiscence occurred on the twelfth day and this was resutured. On admission she was found to have a large vesicovaginal fistula through which a sound could be passed to the abdominal wall. The intravenous pyelogram showed some stasis on the right side. Cystoscopy showed a large fistula situated just medial to the right ureteric orifice. A ureteric catheter passed into the fistula emerged from the abdominal wall. (Fig. A.4.1.) A catheter passed up the right ureter without obstruction and the retrograde pyelogram confirmed slight dilatation of the ureter and pelvis (Fig.A.4.2.). Laparotomy was performed 2 months after confinement. The fistulous tract was traced from the abdominal wall

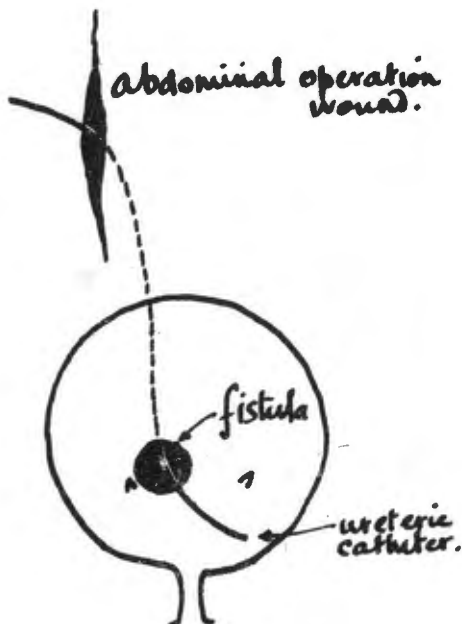


Fig. A.4.1. Case 20:
Sketch of findings at cystoscopy.



Fig. A.4.2. Case 20:
Retrograde pyelogram. Dilatation of right upper tract.

through the lower part of the uterus and bladder into the vagina. The lower end of the right ureter was identified, mobilized, and the ureter re-implanted higher up into the bladder. The remnant of the uterus was removed. The bladder was opened, dissected from the vagina and the fistula closed.

Primary healing of abdominal wound and fistula followed.

CASE 21:

An African female aged 30 years aborted at 5 months. While performing removal of the retained placenta, rupture of the uterus occurred. At operation the tear was found to extend into the bladder on the left side. Both organs were repaired. A urinary leak from the vagina started on the eighth postoperative day. On admission she was found to have a vesicovaginal fistula with its vaginal opening in the torn cervix. Intravenous pyelography demonstrated definite dilatation of the left pelvis and ureter. Cystoscopy showed an irregular fistulous opening in the position of the left ureteric orifice - the orifice itself could not be definitely identified. At operation the bladder was opened and the left ureter found to open into the fistulous tract. The ureter was divided close to the bladder and retransplanted higher up. The bladder was dissected free and the fistula closed. Primary healing occurred. A postoperative pyelogram showed considerable improvement in the dilatation of the left upper urinary tract.

CASE 22:

An African female, aged 35 years, had a rupture of the uterus following prolonged labour. Subtotal hysterectomy was performed. This was followed by a vesicovaginal fistula. At cystoscopy, the internal opening of the fistula was situated just above the interureteric ridge. There was considerable dilatation of the upper tract on the right side on the intravenous pyelogram (Fig. A.4.3.). The fistula was closed by the abdominal route.

CASE 23:

African female, aged 34 years had a difficult twin birth 5 months before admission. The second baby was extracted with forceps. This was followed by a vesicovaginal fistula in the juxtacervical position. Cystoscopy confirmed an internal opening above the level of the interureteric ridge. Abdominal closure was successful.



Fig.A.4.3 Case 22:

Intravenous pyelogram: marked hydro-nephrosis right side.

CASE 24:

African female aged 24 had a second lower segment caesarean section performed a month before admission. This was followed by a vaginal fistula, the urine appearing from the external os. At cystoscopy the fistula was located in the midline above the level of the ureteric orifices. She was cured after abdominal operation.

CASE 25:

African female, aged 39 years, had a forceps delivery following prolonged labour $2\frac{1}{2}$ years before admission. This was followed by urinary leak from the vagina. An attempt at vaginal repair failed. Abdominal repair was tried, without success. Cystoscopy showed a fistula in the midline well above the interureteric ridge. The intravenous pyelogram was normal. She was cured by abdominal repair.

CASE 26:

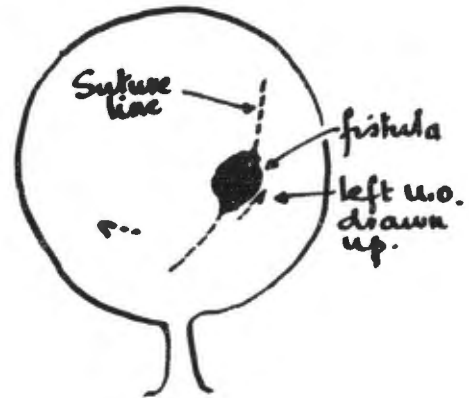
African female, aged 27 years, complaining of a urinary leak from the vagina for 8 months, following caesarean section. On examination urine was seen to come from the external os. Cystoscopy showed a fistula above the left ureteric orifice. Abdominal repair was successful.

CASE 27:

An African female, aged 22 years, had a ruptured uterus following prolonged labour due to a neglected face presentation. The uterus was repaired. A urinary leak followed. On examination she had a vesicocervical fistula with the internal opening well above the left ureteric orifice. (Fig. A. 4.4.) The fistula was closed by abdominal operation.

CASE 28:

An African female, aged 32 years had a prolonged confinement with her sixth baby, resulting in stillbirth and a vesicocervical fistula. The intravenous pyelogram was normal. Cystoscopy showed a midline fistula above the interureteric ridge. This was repaired by the abdominal approach.



CASE 29:

African female aged 22 years had a ruptured uterus following prolonged labour. A subtotal hysterectomy was performed. She presented 4 months later with a urinary vaginal leak. Intravenous pyelogram was normal. She had a juxtacervical fistula of considerable size with

Fig. A.4.4. Case 27:
Sketch of findings at cystoscopy.

the internal opening above the trigone. Abdominal repair was successful. A cyst of the right ovary was removed at the same time.

CASE 30:

A 35 year old African female attended 4 months after a caesarean section for an obstructed labour. She had been leaking urine since. A juxtacervical fistula was repaired by the abdominal approach.

CASE 31:

African female, aged 22 years had an obstructed labour with her second confinement, due to a brow presentation. Craniotomy was performed. This was followed by a urinary discharge from the vagina. She had a vesicocervical fistula with the internal opening well above the interureteric ridge. The intravenous pyelogram was normal. An attempt at vaginal closure failed. Abdominal repair was successful.

CASE 32:

An African female, aged 20 years, had a prolonged first labour. Caesarean section was performed. A urinary leak from the vagina followed. Cystoscopy showed that the lower ureter on the right side had been involved in the fistula but had established a new opening higher up. A vesicovaginal fistula opened immediately below it. The fistula was repaired by the abdominal approach.

CASE 33:

A 30 year old African female had had 3 caesarean sections. A prolonged fourth labour was terminated by caesarean section. She attended 8 months later with a large fistula in the juxtacervical position. The intravenous pyelogram was normal. Cystoscopy showed the internal opening above the interureteric ridge. The anterior surface of the cervix presented at the upper edge of the fistula. (Fig. A.4.5.) Abdominal closure was successful.

CASE 34:

African female, aged 30 years had an obstructed labour due to a hydrocephalic infant. The uterus ruptured and a subtotal hysterectomy was performed. She presented with a juxtacervical fistula a month later. A large irregular fistula was situated just above the interureteric ridge. Initially she had a mild bilateral hydronephrosis with poor renal function but this improved. A month after admission the fistula was repaired by abdominal approach.

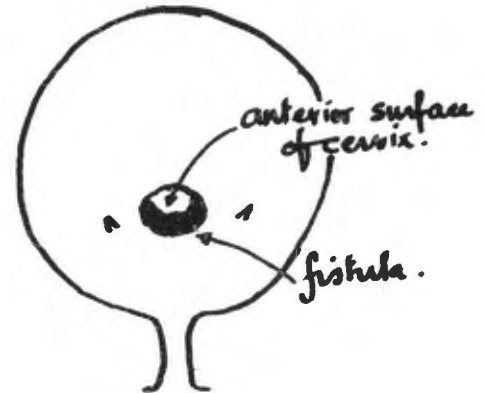


Fig. A.4.5. Case 33:
Sketch of findings at cystoscopy.

CASE 35:

An African female, aged 30 years, had a caesarean section at her 9th confinement. A tear in the bladder resulted, which was repaired. She presented with a vesicocervical fistula with the internal opening well above the interureteric ridge. There was mild bilateral hydronephrosis on the intravenous pyelogram. At operation a pathological appendix was removed and the fistula repaired.

CASE 36:

African female, aged 23 years, had been leaking urine since a lower segment caesarean section a month previously. Cystoscopy showed the internal opening of a high vesicovaginal fistula well above and slightly lateral to the left ureteric orifice. Abdominal repair was successful.

CASE 37:

An African female, aged 35 years, with a large nodular goitre, had a jux-

ta cervical fistula following a prolonged labour. On examination she was found to have multiple uterine fibroids. The internal opening of the fistula was situated in the position of the right ureteric orifice. Hysterectomy was performed and the fistula closed from the abdominal side.

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SECTION A.5

RADICAL PARTIAL CYSTECTOMY:
variations in technique

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RADICAL PARTIAL CYSTECTOMY:
Variations in technique

There is no general agreement about the place of segmental resection in the treatment of carcinoma of the bladder. By segmental resection (partial cystectomy) is implied the removal of the full thickness of that part of the bladder wall bearing the tumour with a margin of at least 1.5 cm. of macroscopically normal bladder wall around the tumour¹⁴. The ideal bladder growth suitable for segmental resection is a well demarcated, single, protuberant lesion, preferably situated in the mobile portion of the dome of the bladder²⁰. In this situation resection with an ample margin is possible without undue handling¹³. Partial cystectomy is still a satisfactory procedure when the growth extends down as far as the bladder neck anteriorly in the male: resection may include part of the prostate⁹. Partial cystectomy may be possible in a low-lying tumour of the bladder base. This will involve re-implantation of one or both ureters and closure of the defect by wide mobilization of the dome and its anastomosis to the posterior margin of the bladder neck or prostate¹⁵. Most workers however feel that involvement of the trigone is an indication for total cystectomy^{9,13}, that nephrectomy should be considered if the tumour involves the ureterovesical orifice³⁰ and that partial cystectomy is not applicable where the vesical neck is involved in the female bladder^{14,15,31}.

Total cystectomy, as a method of treatment in carcinoma of the bladder, has basically two aims: it preserves renal function which is endangered by ureteric obstruction and it eradicates the neoplasm²¹. These aims should be satisfied by segmental resection if it is to retain a place in the management of carcinoma of the bladder.

It is believed that segmental resection can be successfully used in the treatment of some bladder tumours and that its application can be extended

by certain variations in technique:

- a. The whole of the bladder including the upper third of the prostate and the prostatic urethra in the male may be resected and a continent urinary reservoir constructed by anastomosing an intestinal segment to the prostatic urethra^{8,11,25,26,27}. Alternatively, following subtotal resection of the bladder the urinary bladder may be expected to regenerate around an acrylic mould^{4,28} or following simple suprapubic or urethral catheter drainage^{1,2,3}.
- b. The trigone, terminal ureters and posterior part of the bladder neck and proximal urethra may be excised, if involved in a primary bladder tumour or if approached or invaded by carcinoma of the cervix^{22,32}, with transplantation of the ureters into the fundus of the bladder. Complete pelvic lymphadenectomy is permitted by this technique. In these cases the superior vesical arteries may be dissected out and conserved to ensure an adequate blood supply to the remaining part of the bladder¹⁹.
- c. The distal part of the bladder, including the bladder neck and the urethra in the female, may be excised, usually where these parts are invaded by carcinoma of the urethra or vagina, and urinary continence preserved by anastomosing the bladder opening to the rectum (vesicorectoplasty) or by an ileal urethroplasty. In both techniques the normal ureterovesical junctions are preserved.

A.5 CASE RECORDS

CASE 38: Proximal radical partial cystectomy:

E.P., African male patient aged 40 years from Malawi was seen in November, 1961 complaining of pain in the right loin and intermittent haematuria for 2 years. He had been losing weight for 2 months and had been feeling progressively weaker for a month.

On examination there was evidence of weight loss. Blood pressure 110/70 mm. Hg. Tender firm mass right loin. Chest x-ray clear. Haemoglobin 7.5 Gm. per cent, blood urea 42 mg. per cent. The intravenous pyelogram showed a non-functioning kidney on the right side while hydronephrosis was present on the left side. (Fig. A.5.1.). Cystoscopy showed a diffuse healed bilharzial lesion and an extensive papillary neoplasm more prominent in the right half of the bladder. The bladder neck area was not invaded. On bimanual examination a soft tumour was palpable, not bigger than would be expected on cystoscopy. Biopsy of the growth revealed a transitional cell carcinoma grade II.



Fig. A.5.1. Case 38:

Intravenous pyelogram. No function on right, hydronephrosis on left.

Through a long right paramedian incision the caecum and ascending colon were mobilized. An enlarged kidney and a dilated tortuous ureter were mobilized and turned downwards (Fig. A.5.2a.). Total cystectomy was performed including the upper third of the prostate, the urethra and ejaculatory ducts being divided at the same level (Fig. A.5.2b.). Inspection of the specimen confirmed that growth did not encroach on the bladder neck. A 12-inch segment of lower ileum was isolated, both ends closed, the middle point of its anti-mesenteric border anastomosed to the urethral stump in two layers and the left ureter anastomosed to the proxi-

mal end by the mucosa-to-mucosa technique (Fig. A.5.2c.).

The operation specimen showed numerous sessile papillomatous masses in the bladder. Papillomatous masses were also present throughout the whole length of the right ureter whilst numerous small sessile papillomata were present in the hydronephrotic right renal pelvis (Fig. A.5.3.a and b.). The tumour was a transitional cell carcinoma grade II, showing early infiltration of the submucosa. Numerous bilharzia ova were present in the sections (Fig. A.5.4.)

The patient recovered without event and was discharged 19 days after operation in good health, passing urine satisfactorily at three- to four- hourly intervals, with full control. Serum electrolytes remained normal. Cystography demonstrated the ileal bladder (Fig. A.5.5.). The last news received from the patient was a year after operation when he was still in good health and doing his normal work.

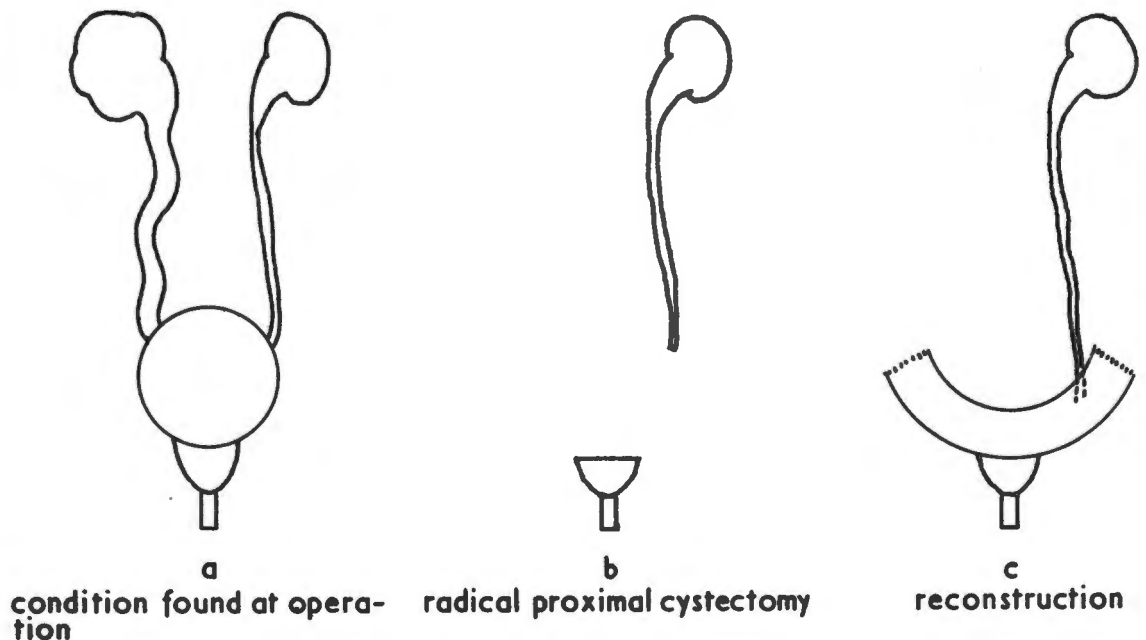
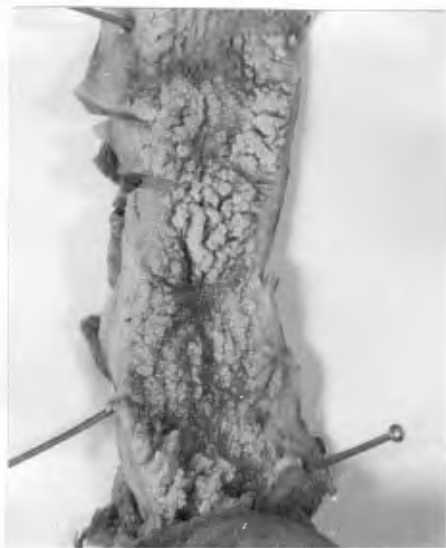


Fig. A.5.2 Case 38:
Radical proximal partial cystectomy.



a.



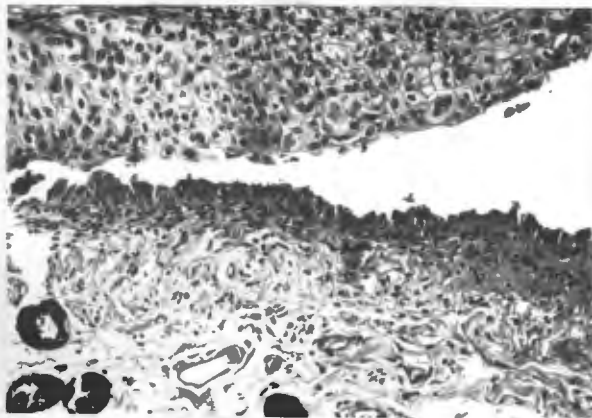
b.

Fig. A.5.3. Case 38:

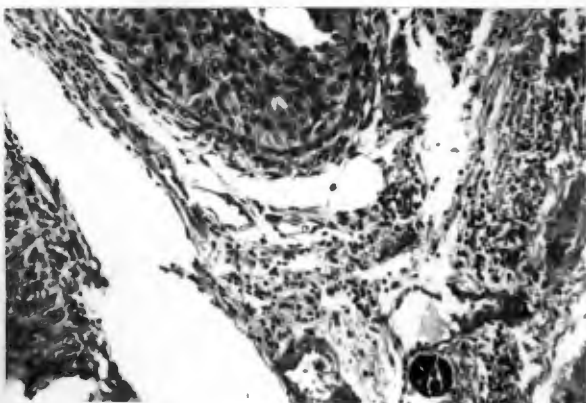
Operation specimen : papillary growth in bladder (lower arrow, a) and ureter (upper arrow a, and b.)

CASE 39:

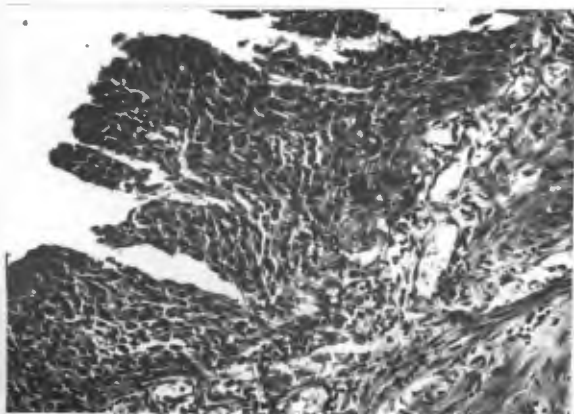
F.N ., African male patient aged 50 years first seen in April, 1962, complaining of pain in the left flank for a week and haematuria for 3 days. General health was good and chest x-ray normal. The intravenous pyelogram showed hydronephrosis on the left side with the right side normal. On cystoscopy a sessile papillary lesion was present on the trigone, obscuring the left ureteric orifice and almost reaching the right orifice. The bladder neck was not invaded. Biopsy confirmed transitional cell carcinoma (Fig.a.5.6.). At this stage the patient refused any operative treat-



a.
Calcified ova in bladder wall. Pa-
pillary growth.



b.
Papillary growth in ureter. Cal-
cified ovum.



c.
Papillary growth in renal pelvis.

Fig. A.5.4. Case 38.



Fig. A.5.5. Case 38:
Post operative cystogram. Ileal
bladder.

ment.

When seen 2 months later, haema-
turia had persisted. There was
now no function in the left kid-
ney on the intravenous pyelogram.
A filling defect was present on
the cystogram (Fig. A.5.7.).
At operation the ureters were mo-
bilized and transected 2 inches
from the bladder. The superior
vesical arteries were isolated and
preserved on both sides. Pelvic
lymphadenectomy was performed in
the area between the common iliac
bifurcation and the femoral canal.
The whole bladder base with the
terminal ureters, the seminal
vesicles and the upper half of the

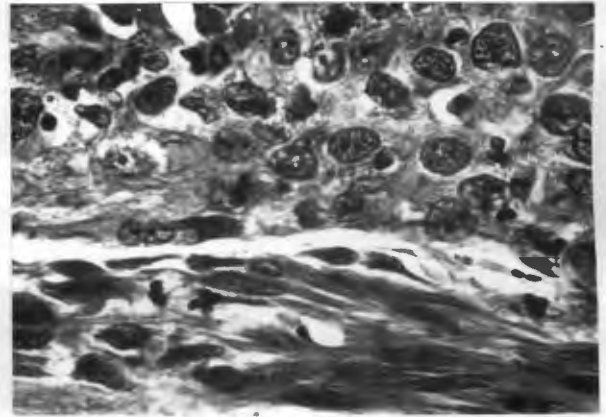
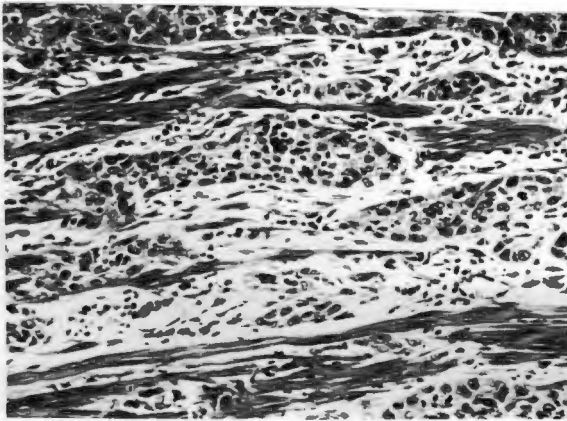


Fig. A.5.6. Case 39:
Invasive transitional cell carcinoma of the bladder.



Fig. A.5.7. Case 39:
Intravenous pyelogram. No function
on left side. Filling defect of
bladder.

prostate behind the urethra was excised (Fig. A.5.8 a,b,c.). The cut edges of the bladder wall bled freely. The pliable bladder wall allowed an easy closure of the defect. The only point in danger of necrosis following closure is the point A (Fig. A.5.9 a,b.). The ureters were retransplanted into the fundus of the bladder and a urethral catheter left indwelling for 12 days. Pathological examination showed that the tumour had been completely excised. The prostatic tissue, the extravescical connective tissue and the lymph nodes were not invaded. Cystoscopy was performed 5 weeks

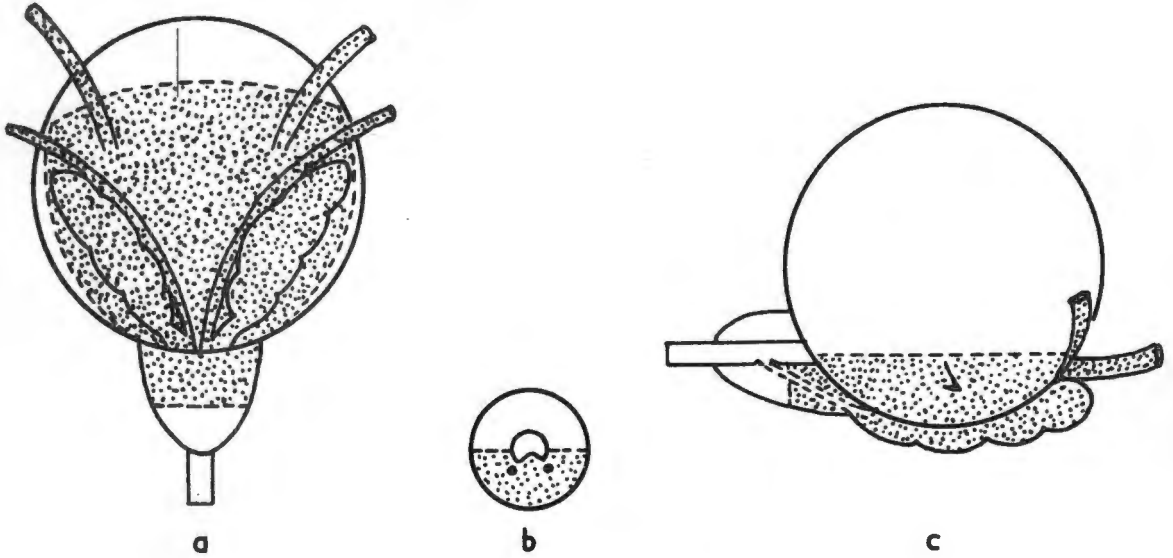


FIG. A. 5. 8: extent of bladder resection

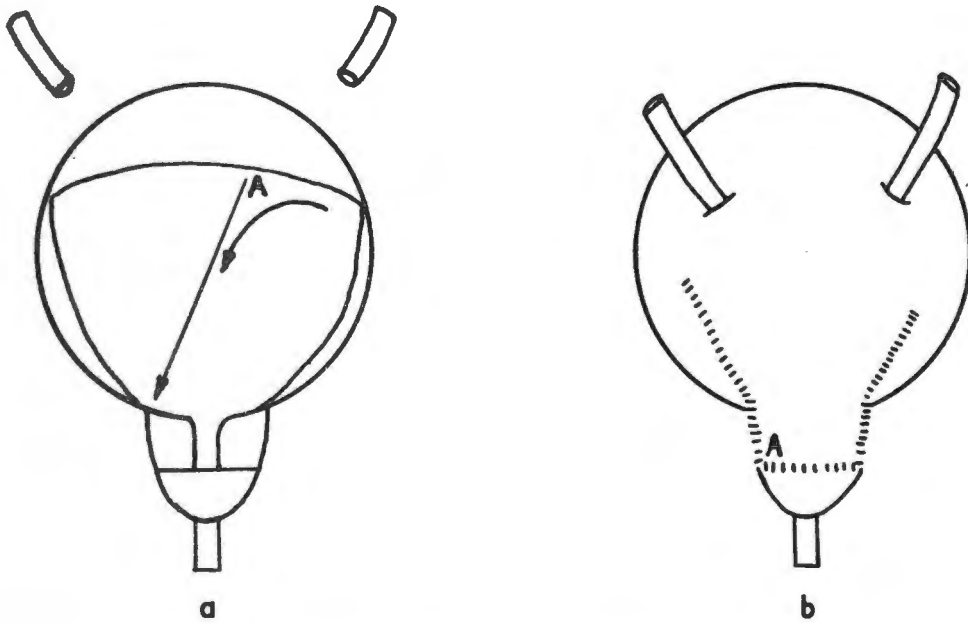


FIG. A. 5. 9 method of closure

RADICAL CENTRAL PARTIAL CYSTECTOMY

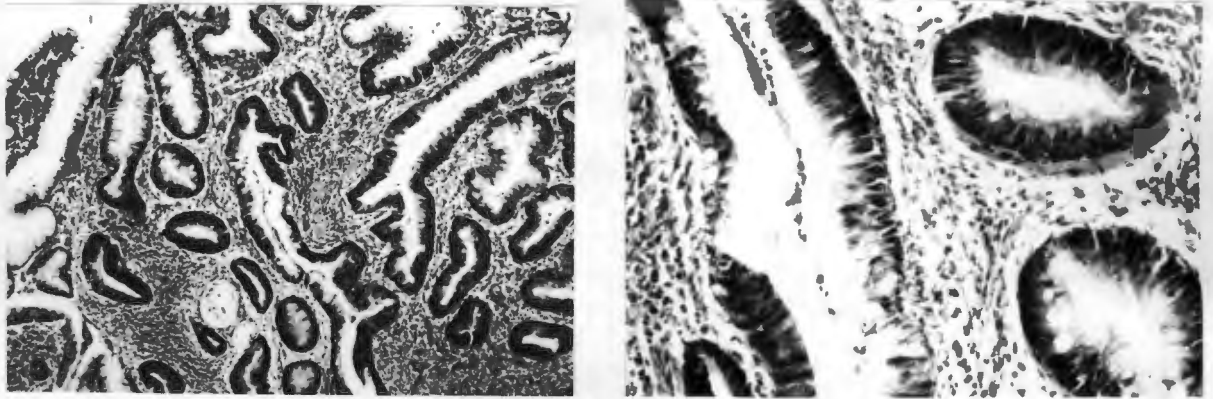


Fig. A.5.10. Case 40:
Adenocarcinoma of the vulva.

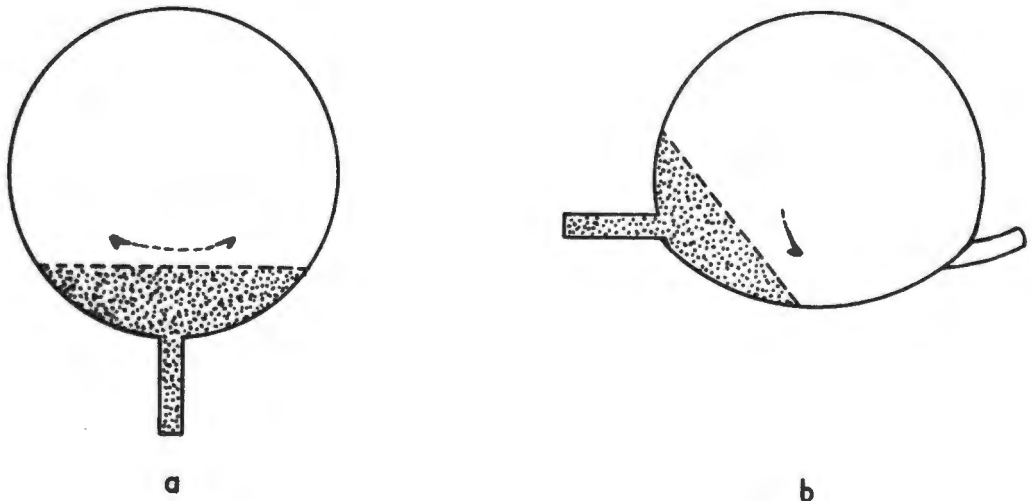


Fig. A.5.11. Case 40:
Distal partial cystectomy, showing extent of resection.

after operation. There was just perceptible breakdown at point A but no evidence of residual growth. Complete healing followed further catheter drainage. The patient left hospital 10 weeks after operation. News was received that the patient died about 4 months after his discharge, presumably from recurrent cancer.



Fig. A.5.12. Case 40:
Normal postoperative pyelogram.

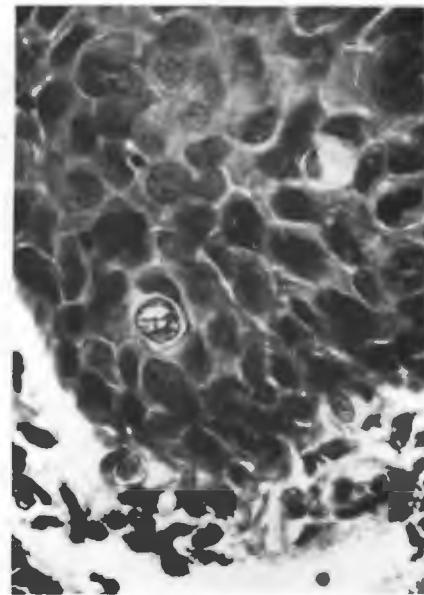
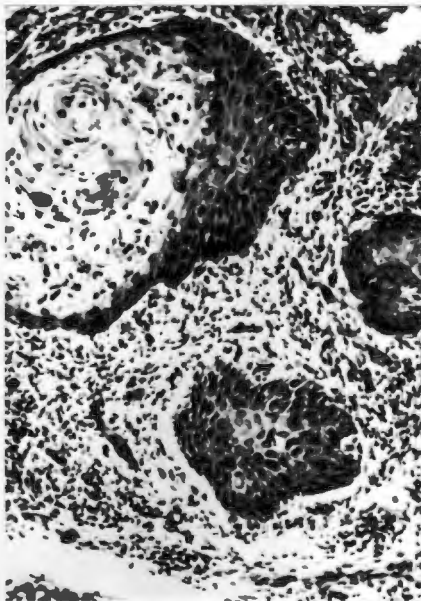


Fig. 5.13. Case 41.
Squamous cell carcinoma of the vulva.

CASE 40:

An African female aged 55 years was first seen early in 1961 suffering from a large well differentiated adenocarcinoma of the vulva involving the right labium majus and minus, the clitoris, the anterior vaginal wall and urethra and the anal canal. (Fig.a.5.10 a,b.). The intravenous pyelogram was normal.

Operation was performed by simultaneous perineal and abdominal approach. After exploration of the abdomen to check on the extent of a glandular and visceral spread, resection was started by doing a bilateral inguino-femoral block dissection. From the abdominal side the bladder was opened for inspection: no growth extended proximal to the internal urethral meatus. The bladder was mobilized, preserving the ureterovesical junctions and the main blood supply. The bladder was divided just distal to the ureteric orifices (Fig. A.5.11. a,b.) The sigmoid colon was mobilized, transected, the distal end closed and the rectosigmoid and uterus mobilized. From the perineal approach a radical vulvectomy was performed to include the urethra and vagina, and posteriorly the anal canal was mobilized. After completing the posterior pelvic exenteration, an end colostomy was established in the left iliac fossa. A short segment of lower ileum was isolated and ileal urethroplasty performed.

Apart from slight loss of the apices of the perineal skin flaps, the patient recovered without complications. Urinary control was poor. As it was thought that the ileal urethra lacked sufficient support, the gracilis muscle was mobilized on the left side and used as a sling. The appearance of the perineum was greatly improved but urinary control remained poor. When last seen 28 months following operation she had remained well with no evidence of recurrent growth. The intravenous pyelogram was normal (Fig. A.5.12.). The advisability of an ileal conduit was discussed but the patient preferred to carry on as before¹⁸.

CASE 41: Distal radical partial cystectomy with vesicorectoplasty:

M.N., an African female aged 60 years was first seen in November, 1960 suffering from lower abdominal pain, swelling of the vulva and severe pain on urination. Vulval ulceration followed.

On examination she was found to be in good general health. Blood

pressure 130/78 mm. Hg., chest x-ray clear. A large proliferative ulcer was present on the left labium minus extending upwards along the anterior vaginal wall to $\frac{1}{2}$ inch below the cervix. Inguinal nodes were enlarged on both sides. The intravenous pyelogram was normal. Biopsy showed a squamous cell carcinoma of the vulva (Fig. A.5.13.).

Radical vulvectomy including distal partial cystectomy and bilateral groin dissection was performed. The distal opening in the bladder was slightly narrowed by partial anterior closure and anastomosed to an incision in the anterior aspect of the lower rectum.

Apart from a plastic operative procedure to cover a small perineal skin defect the postoperative course was uncomplicated. The rectal sphincter maintained full faecal and urinary continence.

She was last seen 30 months after operation. There was no evidence of recurrence of growth. Minimal limb oedema was present. Urinary control remained excellent. The pyelogram showed a normal upper tract. Serum electrolytes were normal¹⁸.

DISCUSSION

The technique of proximal subtotal cystectomy with bladder substitution and maintenance of urinary control by the external urethral sphincter is well documented. Case selection should be rigid. Pelvic lymphadenectomy is recommended as a routine. Bladder substitution may be by a flat graft²⁹ or a loop of ileum or colon. If a loop is used the best arrangement for enterovesical anastomosis is probably the isoperistaltic 'cat's tail' technique as this ensures better emptying than other methods¹². The best method of uretero-intestinal anastomosis is the mucosa-to-mucosa technique^{6,7}.

Central radical partial cystectomy is a useful technique when the base of the bladder is involved in carcinoma or adherent to a growth of the cervix or the rectum in the male. As pointed out by Moore and his co-workers²², it is impossible to do an effective cancer operation for late stage 2 and stage 3 cancers of the cervix if the bladder base and the tunnel in the parametrium where the ureter runs, a centimetre lateral to the cervix, are not included in the resected tissue. A closely similar situation exists in some cases of carcinoma of the rectum in the male. Pelvic lymphadenectomy can be performed as part of the operation, proceeding as in lymphadenectomy combined with total cystectomy^{16,17}.

This operative technique represents a good cancer operation on the basis of the facts known about the lymphatic drainage of the bladder^{10,23,24} if an adequate margin of bladder wall can be resected. As the inferior vesical arteries (and the vesiculo-deferential arteries in the male) are included in the resected tissue, the superior vesical arteries should be isolated and carefully preserved to ensure an adequate blood supply to the remaining bladder wall¹⁹. The bulk of this portion of the bladder de-

rives its blood supply from the superior vesical arteries (Fig. A.5.14.) and the lower portion adjoining the bladder neck will be adequately nourished through the rich anastomotic network in the outer fibrous coat of the bladder.

The pliable bladder fundus allows of easy closure of the defect by permitting the proximal margin to be brought to the bladder neck or prostatic urethra. The ureters are anastomosed to the fundus of the bladder and the bladder is drained through an indwelling urethral catheter for 12 days postoperatively.

The advantages of this technique are that a urinary reservoir lined with transitional epithelium is retained and that full urinary continence is preserved by saving the external urethral sphincter.

The technique of distal radical partial cystectomy finds an application in a small number of cases with primary carcinoma of the urethra or

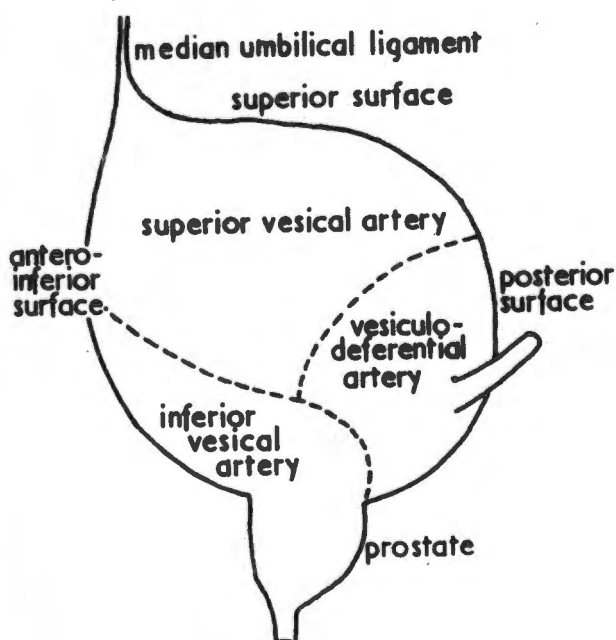


Fig. A.5.14.
Arterial territories of the bladder
(modified from Braithwaite).

carcinoma confined to the bladder neck and, more frequently, in cases where the urethra or bladder neck has been invaded by carcinoma of the vulva or cervix. The bladder is usually divided immediately distal to the ureteric orifices (although more proximal division with re-implantation of the ureters is possible), the resulting opening is narrowed by partial anterior closure to leave an opening about an inch in diameter. The bladder is then either rotated and

anastomosed to the anterior aspect of the rectum (see Section B.1) or an ileourethroplasty is performed (see Section C.2). Vesicorectoplasty in the female necessitates hysterectomy. There is seldom an indication, in primary urethral or vulval cancers, to perform pelvic lymphadenectomy, but inguino-femoral node resection is routinely advisable.

The advantages of this technique are that a transitional epithelium-lined urinary reservoir with normal ureterovesical junctions is preserved and that urinary continence is provided for in the majority of cases following both ileal urethroplasty and vesicorectoplasty. An external collecting apparatus is avoided.

Using these technical variations, partial cystectomy may be used in the management of a larger number of cases of primary carcinoma of the bladder or infiltration of the bladder and urethra by cancer of the vulva, cervix uteri or rectum.

By the use of these methods at least part of the bladder with its transitional epithelium is retained in many patients, the valve action of the normal ureterovesical junction is preserved in some cases while an abdominal stoma and external appliances are avoided in most cases.

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SECTION B.1

VESICORECTOPLASTY

CONTENTS

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VESICORECTOPLASTY

Not infrequently the need for diversion of the urine arises when the whole of the bladder or the bladder base with normal ureteric openings may be intact and free from disease. This state of affairs may exist following severe obstetrical injury to the bladder neck and urethra, destruction of the urethra and bladder neck by tumour or irradiation, operative resection of the urethra and distal part of the bladder, while, infrequently, urethral stricture in the male may give rise to complications necessitating diversion of the urine.

Under these circumstances operative procedures have been designed with the object of retaining the intact bladder reservoir and, especially, the undisturbed ureterovesical junctions. It is considered important to retain the effective valvular mechanism of the normal ureterovesical opening which is responsible for preventing regurgitation of bladder contents to the kidney when intravesical pressure rises during filling of the bladder and during urination. This valve action is considered even more important when the ureters or bladder have been anastomosed to the intact large bowel when the avoidance of reflux of infected bowel content to the kidney is a most important aim of operative technique.

A further important consideration in operative technique, if large bowel is to be used as a urinary reservoir, is the prevention of absorption of urinary constituents through the mucosa of the bowel. Such reabsorption may not be the sole cause of the hyperchloraemic acidosis so frequent after ureterocolostomy but it is undoubtedly an important factor.

With these considerations in mind an operative procedure has been developed which differs in details of technique and range of applicability from those previously described. The operation aims, essentially, at

complete mobilization of the bladder, with the ureters and main blood supply intact, and its anastomosis to the anterior aspect of the rectum immediately proximal to the anal canal. The application of this technique will become clear from a study of the case records.

B.1 CASE RECORDS

CASE 42:

S.M., a 16 year-year old African female had a stillbirth, following a five-day labour, in April 1955. Shortly afterwards she started leaking faeces and urine from the vagina. A left inguinal colostomy was performed a month following child-birth and in July, 1955 an attempt was made to close a large urethrovesicovaginal fistula. This failed. In January, 1956 both ureters were transplanted into the descending colon proximal to the colostomy and the rectovaginal fistula was repaired four months later. In July, 1956 the colostomy was closed. However, the rectovaginal fistula broke down shortly afterwards followed by recurrence of urinary and faecal incontinence.

At this stage the patient was referred. On examination her general condition was poor. She was found to have a tuberculous pleural effusion on the right side. Severe vaginal stenosis was present. The urethra was missing and a large vesicovaginal fistula was present. There was marked induration surrounding the rectovaginal fistula. Straight X-ray of the abdomen showed an abnormal symphysis pubis, the result, of a previous symphysiotomy. The intravenous pyelogram showed a normal upper urinary tract, while the 30-minute film demonstrated collection of dye in the sigmoid colon. The serum electrolytes and the blood urea were normal.

The patient responded well to treatment of the pulmonary condition. Two further attempts at closure of the rectovaginal fistula were unsuccessful. In February, 1957 abdominal operation was performed. The bladder was completely mobilized, hysterectomy performed, the rectovaginal fistula released from the dense scar tissue and the fistulous openings in the bladder and rectum accurately anastomosed by combined abdominal and vaginal approach. Postoperatively drainage of the rectum was instituted and maintained for twelve days.

The postoperative phase was without event and primary healing occurred. When last seen, eight months following operation, the patient was completely satisfied. She had full urinary and faecal control. She urinated three times at night. There was no history or clinical evidence suggestive of pyelitis and the serum electrolytes and blood urea were normal.

The intravenous pyelogram showed a normal upper urinary tract. A barium enema showed the bladder pouch as a small diverticulum of the lower rectum. Comment: In this case the bladder remnant was used solely as viable tissue to repair an otherwise incurable rectovaginal fistula. In this way vesicorectoplasty cured her faecal and urinary incontinence.

CASE 43:

F.J., an African female aged 24 years was first seen in July, 1957, three weeks after a difficult 5-day labour terminating in still-birth and followed by urinary and faecal discharge from the vagina.

On examination her general health was good. A large low vesicovaginal fistula was present as well as a rectovaginal fistula, one inch in diameter, with a third degree perineal tear not extending into the fistula. The cervix had sloughed.

Two weeks after admission the perineal tear was extended into the rectovaginal fistula and the whole defect repaired. Good perineal healing followed but the rectovaginal fistula recurred. A left inguinal colostomy was then performed. Two attempts each to repair the bladder and rectal fistulae were subsequently unsuccessful. These resulted in a very fibrotic bladder neck area, densely adherent to the under surface of the symphysis pubis.

In May 1957 vesicorectoplasty was performed. The bladder with the ureters and main blood supply intact was completely mobilized, the uterus removed, the rectal fistula released from the surrounding scar tissue and the bladder and rectal openings accurately anastomosed. Postoperatively both the rectum and bladder were drained via a rectal tube for 12 days.

Postoperative recovery was uneventful. The colostomy was closed after 6 weeks and when the patient left hospital 3 weeks later she was completely continent, voiding urine and passing stools separately. A barium enema demonstrated the small bladder diverticulum opening into the rectum (Fig. B.1.1.). The serum electrolytes remained normal.

Comment: In this case the operation served, in the first instance, to provide for successful closure of both the bladder and rectal fistulae. The rectal sphincter, in spite of the third degree tear, maintained complete urinary and faecal control. After the operation, and before the

closure of the colostomy, it was observed that there was never any regurgitation of urine through the distal opening of the colostomy. This fact plus the separate voiding of urine and faeces might indicate that the bladder remnant continued to serve, to some extent, as a urinary reservoir.

CASE 44:

T.M., an African female aged 30 years had been leaking urine from the vagina since a difficult labour two years previously. She had had operations for closure of a vesicovaginal fistula on two occasions without success.

On admission she was found to have a large vesicovaginal fistula with bladder mucosa prolapsing through it. The whole of the urethral canal was open. The ureteric openings could be seen and catheterized from the vagina. The cervix had sloughed and the apex of the vagina was replaced by an unyielding fibrous bar. On pyelography the upper urinary tract was normal while the cystogram demonstrated leakage of the opaque medium into

the vagina.

Three further attempts were made to close the vesicovaginal fistula and reconstruct the urethra using vaginal and labial tissues. All attempts failed and resulted in progressively increasing vaginal stenosis.

In March, 1959, five months following admission, vesicorectoplasty was performed. The bladder was completely mobilized, the remains of the uterus excised, the dense scar tissue in the vaginal vault cleared and the bladder opening accurately anastomosed to an opening of similar size made in the rectum just proximal to the anal canal. Rectum



Fig. B.1.1. Case 43:
Postoperative barium enema showing
'diverticulum'.

and bladder were drained for 12 days postoperatively.

Primary healing followed. Postoperative barium enema studies demonstrated the bladder 'diverticulum' (Fig. B.1.2.). The patient left hospital six weeks later, completely continent of urine and faeces. Serum electrolytes were normal.

Comment: In this case vesicorectoplasty was performed to cure an otherwise intractable vesicovaginal fistula, retaining at the same time the remaining bladder reservoir and the normal ureterovesical valves. Separate voiding of faeces and urine was again reported and observed.



Fig. B.1.2. Case 44:
Postoperative barium enema showing 'diverticulum'.

CASE 45:

L.N., an African female aged 28 years was first seen in November, 1955. A difficult and prolonged first labour was terminated by application of forceps. Subsequently all urine and faeces was passed per vaginam. On examination she was found to have a large 'cavity' deep to the introitus where vagina, rectum and bladder were in free communication. On the rectal side the deficiency measured about 3 inches in length while only the posterior one-third of the rectal circumference was still intact. Anteriorly the whole bladder base from vaginal vault downwards was missing, the edges of the fistula densely adherent to the symphysis and pubic rami. The bony pelvis was found to be very small with a very narrow subpubic angle. The intravenous pyelogram showed early bilateral hydronephrosis. A transverse colostomy was performed and three weeks later further operation was performed by combined abdominal and perineal approach. Preliminary symphysiotomy was performed which improved the perineal exposure very considerably. The bladder was completely mobilized and the remains

of the uterus excised. The part of the rectum involved in the fistula was excised, the sigmoid colon mobilized, pulled through and anastomosed to the proximal end of the anal canal. To the anterior part of this anastomosis and a longitudinal extension into the colon proximal to it, the bladder opening was anastomosed. The colon and bladder were drained for 12 days postoperatively.

Slight breakdown of the anastomosis, on the perineal side, occurred and a subsequent operation was necessary to repair the defect. The colostomy was closed in April, 1956.

When last seen in February of 1960 there was still a small fistula on the perineum. The patient claimed that she was continent at night. The renal function remained normal.

Comment: This represents the most extensive fistula amongst 248 obstetrical fistulae observed. Complete continence was not finally achieved, partly due to the small persistent fistula and partly to substitution of descending colon for rectum with the resulting loss of rectal sensation.

CASE 46:

A.N., an African female aged 25 years, had been leaking urine from the vagina since the birth of her last child 8 years previously. Six attempts at repair of a vesicovaginal fistula had been made without success. On examination there was complete absence of the urethra and a very shallow vagina with a large vesicovaginal fistula. The intravenous pyelogram showed a normal upper urinary tract.

At abdominal operation the bladder was completely mobilized and the uterus removed. The opening in the bladder was anastomosed to an incision made in the anterior wall of the rectum.

On discharge from hospital she was completely continent of urine and faeces. When last seen 20 months following the operation her only complaint was inability to perform the coital act. She was in excellent general health. Control of urine and faeces was normal. There was no history suggestive of recurrent pyelitis. The intravenous pyelogram, serum electrolytes and blood urea were all normal.

Comment: In this instance vesicorectoplasty was the procedure selected for the management of an intractable vesicovaginal fistula. As obstetri-

cal damage of this type occurs most frequently in young females, the closure of the vagina is an undesirable consequence of the technique. Vaginoplasty solved this problem satisfactorily in one of the patients.

CASE 41:

Details of this patient are given in Section A.5: carcinoma of the vulva treated by radical vulvectomy and distal partial cystectomy followed by vesicorectoplasty.

Comment: Following this radical operative procedure for carcinoma of the vulva, a standard ureterocolostomy, ileal conduit or other type of supravescical diversion of the urine would normally have been advised. Vesicorectoplasty would appear to have secured a very satisfactory post-operative course with minimal morbidity and with no external stoma.

THE OPERATION

The operation has been named vesicorectoplasty to distinguish it from vesicorectostomy, an operation that achieves the same end result but differs in its application and technique, and colpocleisis, where this is done in the presence of a rectovaginal fistula.

The bowel is thoroughly prepared for 5 days prior to the operation. An insoluble sulpha drug is used for five days and streptomycin by mouth for two days before the operation. An evacuant enema is given on the day before operation followed by a high bowel washout with saline followed by neomycin solution on the day of the operation. Blood is available during the operation. The patient is placed on the operating table in the 'combined' position so that both abdomen and perineum is simultaneously available. Abdominal operator, if right-handed, stands on the left side of the patient.

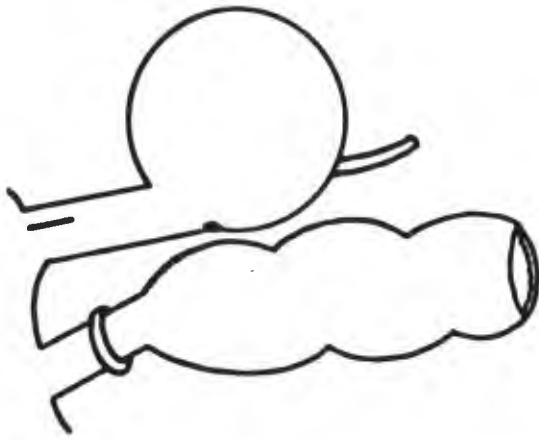
The abdomen is entered through a long lower left paramedian incision. Appendicectomy is performed routinely. Peritoneal flaps are prepared and the entire circumference of the bladder mobilized. Hysterectomy is performed in the usual way except that the uterine arteries are dissected and the ligatures applied to the vessels only. In the usual obstetrical case, mobilization at the lower end of the uterus will unavoidably open into the scarred vaginal vault. Where operation is performed for malignancy, mobilization from above proceeds only as far as the upper surface of the vaginal vault.

Further mobilization of the bladder is performed by separating the bladder from the pubic symphysis and rami. In longstanding fistulae and after repeated vaginal repairs the bladder is usually densely adherent in this situation and some tearing of the fistulous edge is unavoidable.

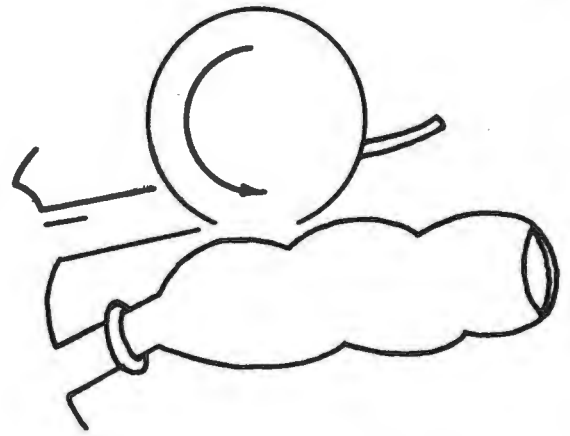
The lateral recesses are next opened up and the bladder completely mobilized leaving only the ureters and the inferior vesical pedicle. The preservation of an adequate blood supply is considered especially important. Lastly, the bladder is mobilized posteriorly so that the whole organ is free to rotate, in the sagittal plane, on the two uretero-vascular pedicles (Fig. B.1.3 a and b.). It is actually possible to rotate the bladder through 180 degrees although this is not required except while trimming the fistula when the bladder can be rotated so that the opening faces the abdominal operator. At this stage the ureteric orifices are identified and intubated. The ragged edges of the bladder opening are trimmed and the opening narrowed, if necessary, by partial posterior closure, to provide a stoma about one inch in diameter.

If an opening already exists in the rectum, e.g. where a rectovaginal fistula is present, the edges are mobilized and scar tissue excised. Otherwise a longitudinal incision, $1\frac{1}{2}$ inches long, is made in the anterior rectal wall, its lower end just above the proximal part of the anal canal. The vesical stoma is now anastomosed accurately to the rectal incision using a single all-coats layer of closely spaced interrupted 2-0 chromic gut (Fig. B.1.3.c.). The upper half of the anastomosis is made more conveniently from above while it is easier for the perineal operator to do the lower half. It is important for the lower limit of the opening in the rectum to be below that of the bladder fistula, otherwise faeces may slide forward into the bladder cul-de-sac and remain there³.

The operation is concluded by draining the bladder and rectum. A $\frac{3}{4}$ -inch tube is used for rectal drainage. Through this is led a pencil-size tube with its upper two inches, which projects through the side of the outer tube, lying in the bladder cavity (Fig. B.1.3.d.). The pelvis is completely reperitonealized and the abdomen closed without drainage.



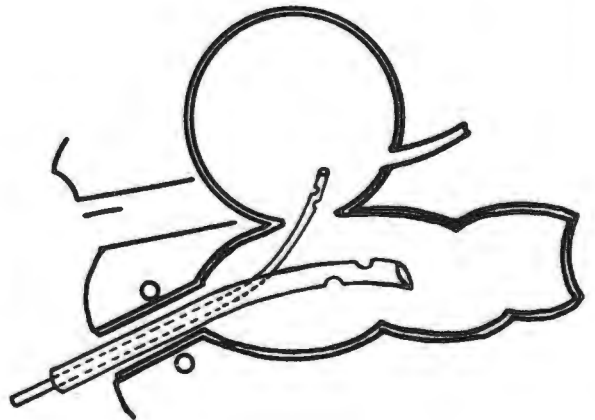
a. Vesico-urethro-vaginal fistula



b. Mobilization and rotation of the bladder



c. Vesico-rectal anastomosis



d. Method of post-operative drainage

FIG. B.1.3
TECHNIQUE of VESICORECTOPLASTY

Postoperative recovery has always been uncomplicated.

Abdominal distension does not occur. Simple dependent drainage of the rectum and bladder is maintained for twelve days.

DISCUSSION

Trigonocolostomy, vesicorectostomy and low ureterorectal anastomosis have been suggested as methods of urinary diversion with certain advantages over standard ureterosigmoidostomy.

Trigonocolostomy was first performed by Maydl¹¹ and Bergenhem² at the end of the last century, later by Peters¹⁷ and Moynihan¹⁶, and more recently by Rizzi¹⁸, Goodwin and Hudson⁷, Sanderud²¹, Wallace²³ and Scott and Ravitch²². The indication for the operation has usually been exstrophy of the bladder but it has also been used for patients after treatment for carcinoma of the cervix and for intractable vesicovaginal fistula²³.

Vesicorectostomy, with permanent colostomy, has been recommended in the treatment of exstrophy of the bladder by Boyce and Vest⁶. The operation was used by Moore¹⁵ in a case of intractable epispadias and in an adult with severe urethral stricture and perineal fistulae. He recommends the operation in urinary incontinence when urethral operations fail and the rectal sphincter is intact, in urethral carcinoma, some cases of urethral stricture, exstrophy of the bladder, severe interstitial cystitis not responding to other treatment, in the contracted bladder of healed tuberculosis and to allow of a more radical prostatectomy. Robbins^{19,20}, reported a series of six cases: rectourethral fistula and stricture following total prostatectomy, urethral stricture following fracture of the pelvis and other longstanding urethral strictures with perineal fistulae and stone. He suggests that the operation may be applicable as a bypass for prostatic malignancy and in bladder lesions causing severe contracture. Madsen¹⁰ reported a patient followed up for 4 years in whom he performed vesicorectostomy for an intractable urethral stricture. He suggests that the commonest indication for the operation would be exstrophy of the

bladder.

Low ureterorectal anastomosis is recommended by several authors. Wolff²⁴ reports one patient in whom he resected the distal portion of the bladder by the vaginal route and, by the same approach, transplanted both ureters into the rectum. Boyce⁴ recommends that the ureters be transplanted into the large bowel as low as possible.

All reports stress the importance of confirming that a normal anal sphincter is present.

In recommending these operative procedures rather than other methods of urinary diversion, two possible advantages are especially stressed: the preservation of the normal ureterovesical valve mechanism which will protect the kidneys by preventing reflux, and the decreased rate of reabsorption of urinary constituents from the lower part of the colon, thereby diminishing the incidence of postoperative biochemical disturbances.

The ureter, implanted into the large bowel, is exposed to a higher pressure than in its normal position. While the average intravesical pressure is 8 to 10 cm. water and may rise momentarily to 130 cm. during urination, the average resting intrarectal pressure is 27 cm. water, the urge to defaecate arises with a pressure of 54 to 68 cm. and the pressure may rise to 270 cm. during defaecation⁵. It is clear that under these conditions even the normal valvular mechanism of the intact ureterovesical junction may break down and this has actually been shown to occur in the experimental animal by Baker and Miller¹ and by Irvine, Allan and Webster⁸. It is thought that the valvular mechanism does not remain competent when subjected to persistently high intrarectal pressure and that deterioration is assisted by chronic inflammation and fibrotic changes, the result of exposure of the bladder trigone to infected bowel content. That this occurs also in the human patient is suggested by Sanderud²¹ in his report

of follow-up studies of 14 patients who had trigonocolostomy performed for exstrophy of the bladder.

However, many postoperative studies stress the good results obtained. Madsen¹⁰ believes that the results are better than with any other method of urinary diversion. Robbins²⁰ comments on the smooth postoperative course. Cystograms and barium enema studies in his patients did not show any ureteric reflux of opaque medium or air. Moore¹⁵ and Goodwin and Hudson⁷ stress the importance of retaining the normal ureterovesical valves, while Boyce and Vest⁶ note the normal postoperative pyelograms.

It is difficult to reconcile these conflicting impressions. It is the opinion of Rizzi¹⁸ that the maintenance of the normal blood and nerve supply to the transplanted trigone is of considerable importance. He believes that the total isolation of this structure as practiced by Maydl¹¹ and Moynihan¹⁶ is possibly responsible for the poor results reported and recommends only sufficient mobilization to make implantation into the sigmoid possible. Techniques recommending the isolation of only a button of bladder mucosa around each ureteric orifice⁷ could be criticized on the same basis.

Personal experience confirms the uncomplicated postoperative course of these patients. In no patient was there evidence of recurrent attacks of renal infection, deterioration of renal function, dilatation of pelvis or ureters or reflux of dye or gas into the ureters or pelvis. Preservation of the blood supply to the bladder and the avoidance of disturbing the normal anatomy at the ureterovesical junction are special features of the operative technique in vesicorectoplasty. It is also thought that the preservation of all the available bladder (as in vesicorectostomy), rather than the trigone only or a periureteric button of bladder mucosa, has the advantage of interposing a pliable organ with excellent

muscular accommodation between the high intrarectal pressure and the ureterovesical openings, an arrangement which might neutralise some of the strain on the ureterovesical valves.

The second advantage claimed for these operative procedures, that there is less reabsorption of urinary constituents in the lower colon, has often been disputed. Melick and Naryka¹² stress that the degree of reabsorption is directly proportional to the surface area of the bowel mucosa exposed to the urine. Although they accept that absorption diminishes progressively to little or no absorption from the rectum, they found that, if the large bowel is intact, urine will reflux back to the caecum no matter how near the rectum the ureters are implanted. The same observation has been made by Lapidus⁹. It is possible that such wide dispersal of the urine in the colon occurs only during the urge to defaecate or during defaecation and that, during the filling phase, urine would collect in the rectum only. Baker and Miller¹ suggest implanting the ureters in the mid-descending colon and believe that the greater volume of the urine will then be carried to the rectosigmoid reservoir below, from where evacuation may occur before the urine ascends to the anastomosis. The importance of transplanting the ureters as low as possible is stressed by Mitchell and Valk¹⁴ and also by Boyce⁴, who states that there is little or no absorption from the rectum. Moore¹⁵ believes that reabsorption occurs only when the ureters are inserted proximal to the rectosigmoid junction.

In this regard, two further observations would appear to be pertinent. In cases 2 and 4 an opportunity presented for observing patients with a colostomy after vesicorectoplasty - left inguinal in case 2 and a transverse colostomy in case 4. In these two patients there was no recognizable regurgitation of urine through the colostomy either during the fill-

ing phase or during defaecation. This is different from what has been observed in two other patients with standard ureterosigmoidostomies: it was usual for the patients to complain that their transverse colostomies were 'wet'. The second observation, made by three of the patients reported here, is the separate voiding of faeces and urine after vesicorectoplasty. This observation is also recorded by Moore¹⁵ after vesicorectostomy, while the patient of Madsen¹⁰ had an almost liquid bowel movement three to four times a day. In 7 cases of combined vesicovaginal and rectovaginal fistula treated by colpocleisis, Blaikley³ reports that while urine was voided through both urethra and anus, faeces, as a rule, was passed only per rectum. These observations suggest that, in some cases at least, the bladder, although open into the rectum, might accommodate a certain amount of urine before it is passed into the rectum and voided, or that, in the absence of the desire to defaecate, urine unmixed with faeces will accumulate in the rectum and be passed, while stool, derived from a higher level in the colon will be evacuated, at less frequent intervals, with only minimal admixture with urine. In other cases, no doubt, there is mixing of urine and faeces regularly, either by faeces accumulating in the urine-filled rectum or by free regurgitation of urine into the descending colon, then to be passed with the stool.

These observations may also provide an explanation for the infrequent occurrence of biochemical disturbance following vesicorectostomy or vesicorectoplasty. If the bladder continues to act, even partly, as a urinary reservoir, the reabsorption of urinary constituents will, to that extent, be diminished. If the secreted urine accumulates mainly in the rectum without continuous regurgitation into the more proximal parts of the colon, less reabsorption will again be favoured.

In the cases recorded here no instance of hyperchloraemic acidosis was

observed. All these patients had normal renal function and an almost normal upper urinary tract before operation and the period of follow-up was short. Possibly, if renal damage had been present and the period of observation longer, biochemical abnormalities might have developed.

Lesser advantages claimed for the operation is that the anastomotic stoma can easily be reached with a finger and dilated if necessary, that cystoscopy can be performed and the upper tract studied by retrograde pyelography, and that an abdominal stoma is avoided.

In vesicorectostomy the internal urethral meatus may have to be closed, a procedure that not infrequently fails. This difficulty is avoided in vesicorectoplasty.

In the female, vesicorectostomy or vesicorectoplasty is possible only after removal of the uterus. This was noted by Menville¹³. In the type of case reported here the loss of the uterus is not a serious consideration: in the obstetrical cases there is often traumatic amenorrhoea, the cervix had usually sloughed leaving an organ which could not perform its normal function, while the patients with vulval or urethral carcinoma are almost always in the postmenopausal age. Hysterectomy adds very little to the magnitude of the operation.

The closure of the vagina and the resulting inability to perform the coital act is a definite disadvantage in the young patient. In one of our patients this problem was solved by successful vaginoplasty, using the McIndoe technique, and this procedure could possibly be advised more frequently.

The operation is not possible unless a completely normal anal sphincter is present.

The idea of mobilizing the whole bladder on the two ureterovascular pedicles is not a new one. Maydl¹¹ described the same basic manoeuvre in ex-

strophy of the bladder: 'Endlich hing die ganze exstrophierte Blasenwand an zwei Stielen, welche je aus einem Ureter, etwas umgebendem Gewebe und . . . dem den Ureter begleitendem Gefässe bestanden'. In vesicorectoplasty not only the small vessels accompanying the terminal ureter but also the inferior vesical arteries are preserved. In the male the vesiculo-deferential arteries would also be retained.

CONCLUSION

The operation of vesicorectoplasty represents a reasonable alternative to other methods of treatment in patients with extensive vesico-vaginal fistula (especially where this is associated with destruction of the urethra and a rectovaginal fistula) and following operative resection of the urethra and bladder neck.

Patients have complete urinary continence without the use of any appliances and postoperative renal damage and biochemical imbalance are minimized or avoided.

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SECTION B.2

THE GERSUNY OPERATION

CONTENTS

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THE GERSUNY OPERATION

In trying to find the ideal substitute for the urinary bladder, the possibility of constructing a truly sphincter-controlled urinary reservoir has always been hoped for. Transplantation of the ureters into the intact colon nearly achieves this ideal. However the frequent occurrence, post-operatively, of recurrent ascending renal infection with progressive deterioration of renal function and dangerous biochemical disturbances, causes considerable morbidity and mortality and this is not diminished significantly by any of the numerous modifications of technique that have been suggested. Isolation of the urine-containing reservoir usually involves the presence of an abdominal stoma necessitating an appliance or regular catheterization. This is the objection against procedures like isolated rectal pouch bladder and ileocaecal bladder.

In 1895, Mauclaire²⁰ isolated the rectum in animals, transplanted the ureters into it and made a proximal colostomy - the present-day isolated rectosigmoid pouch. He suggested the possibility of making a perineal opening for the colostomy.

Shortly afterwards, Gersuny performed the operation, envisaged by Mauclaire, in two patients. This work was reported by Foges at a meeting of the Royal and Imperial Society for Physicians in Vienna and afterwards published^{5,6}. The rectum was separated from the sigmoid flexure and into the opening was implanted a portion of the bladder carrying the ureters. The distal end of the divided sigmoid was drawn through an opening in the recto-uterine fold in front of the anterior rectal wall, through the anal sphincter, and fixed there with sutures so that the bladder made of the separated rectal portion and the drawn-down rectum made from the sigmoid flexure were both under the control of the same sphincter muscle.

This technique would not appear to have gained popularity immediately, as it was next reported on only in 1912 by Heitz-Boyer and Hovelacque¹¹. They brought the sigmoid colon down posterior to the rectum and placed it immediately deep to the anal mucosa to obtain the full benefit of both the internal and external portions of the anal sphincter. This technique was reported on also by Grégoire in 1914⁹.

For the next forty years the field of urinary diversion appears to have been dominated by ureterosigmoidostomy which experienced its greatest popularity during this period, with a multitude of suggestions for improving the technique to avoid the postoperative complications¹².

The suggestion of Mauclaire and Gersuny was revived in 1953 by Lowsley and his co-workers¹⁸ and Levitsky¹⁷. Levitsky performed the operation in two stages. At the first stage the sigmoid colon was mobilised and sectioned where it joins the rectum. The rectum was closed. Dissection proceeded from above behind the rectum down to the levator ani. From below, working through the anus, the lower end of the mobilised sigmoid was pulled through an incision on the posterior aspect of the rectal wall and fixed there so as to project for 3 cm. beyond the incision. At the second operation any pelvic operative procedure, eg. cystectomy, was performed and the ureters transplanted into the rectal ampulla using the mucosa-to-mucosa technique. He claimed that upper urinary tract complications due to infection were minimized. It should be noted that in this technique the sigmoid opens into the lower rectum or anal canal and not on the perineum. A certain amount of mixing of urine and faeces would have been unavoidable.

A slightly different technique, designed as an improved surgical procedure for exstrophy of the bladder was reported by Powell and Hays^{23,24}. They considered taking an isolated ileal segment from the bladder under the rectal sphincter but found this unsatisfactory. They isolated the

rectum and reimplanted the distal end of the sigmoid as low as possible into the rectum. The isolated rectum was connected to the bladder by means of a short segment of ileum. To avoid regurgitation of faecal material the ileal segment was anastomosed to the rectum by invagination. Barium enema studies in two patients confirmed the competence of the ileosigmoid anastomosis. They regarded the preservation of the normal ureterovesical anatomy as important.

Lowsley and his colleagues¹⁸ reported a single case in 1953. After careful bowel preparation, the rectosigmoid was isolated low down and the ureters implanted into it by an intubated mucosa-to-mucosa technique. A curved incision was made 1 cm. anterior to the anal margin and through this dissection proceeded under the external sphincter ani muscle. The lower end of the mobilised sigmoid was drawn down through this incision. Their patient was completely continent after 3 weeks. They claimed that with this operation has been achieved continence of faeces with voluntary control, continence of urine with voluntary control, separation of the urinary and faecal streams with the possibility of a sterile urinary reservoir, no regurgitation of the urine to the proximal parts of the colon where greater reabsorption will occur, the avoidance of an artificial orifice in an unnatural site, the possibility of doing cystectomy or other pelvic operative procedure that might be indicated and the availability of the rectal bladder for cystoscopic examination.

In a later publication, Lowsley and Johnson¹⁹ reported two cases. The site of transection of the rectosigmoid was determined by ascertaining the lowest level at which the ureters may be easily transplanted. Ureteric transplant by an intubated mucosa-to-mucosa technique through the open end of the divided rectum was preferred. The perineal dissection started from a curved incision, convex anterior, $1\frac{1}{2}$ to 2 cm. anterior to the anus, and

proceeded to the peritoneum on the base of the bladder. They noted that mobilization of the sigmoid colon in the pelvis is limited almost entirely by its vascular supply and in its proximal portion by peritoneal attachments and its lack of a free mesentery. The capacity of the rectal bladder was 300 to 350 ml. and there was no significant residual urine. Both patients achieved voluntary control of faeces and urine and one of them could differentiate between faeces and urine. Neither patient had any evidence of stenosis at the perineal skin stoma.

In the subsequent publications^{13,14}, Johnson reviewed the technique and reported on longer periods of follow-up. The technique of ureteric transplant remained the same. Instead of pulling excess of sigmoid through on to the perineum, an accurate mucosa-to-skin anastomosis was made as it was found that, if the sigmoid was thoroughly mobilised and reached the anus without tension, marginal sloughing and retraction of the bowel end did not occur. In a series of 17 cases there were three surgical mortalities. Stricture of the perineal opening has not occurred. Functional results were uniformly good. Urinary control was usually established immediately after removal of the rectal tube. Faecal control required some re-learning but was usually complete after two weeks.

Stonington and Eiseman²⁹ reported the use of an essentially similar technique in 5 patients. The perineal opening was made anterior to the anus. They found that the inferior mesenteric artery or one of its major branches had to be divided to obtain a length of sigmoid sufficient to reach the perineum. In two patients the sigmoid was anastomosed flush with the skin. Both developed stenosis of the opening which had to be dilated repeatedly. Where some protrusion of the sigmoid was allowed no contracture occurred. No instance of pyelonephritis occurred. A rectogram in one patient showed reflux into the kidney. Biochemical values remained normal.

The technique of ureterorectostomy with pre-anal colostomy was used in 4 patients with exstrophy of the bladder by Kiefer and Linke¹⁵. They feel that, from the purely mechanical aspect, this type of operation gives the closest approximation to normal of any method for disposal of the urine and faeces. The ureters were transplanted, by the mucosa-to-mucosa technique, through two small incisions in the posterior wall of the rectum, working through the open end of the rectum. They also found it necessary to ligate the inferior mesenteric artery, and sometimes the vein, and divide the peritoneum laterally to obtain sufficient length of sigmoid. A small rosette of bowel was left on the perineal opening and trimmed later at the time of bladder excision. In two cases there was a tendency for the perineal opening to contract and digital dilatations were required. One adult patient could discriminate between faeces and flatus in the sigmoid. Pyelonephritis did not occur. The urine was not sterile but cell counts were low. Two patients had slightly high chloride levels.

The results of the operation in three men and three women were reported by Barnes and his associates¹. In one case the colostomy opening was sited between the rectum and the coccyx. Three of the patients had exstrophy of the bladder, one had hypoplasia of the bladder and bilateral ureteric ectopia, one had a tuberculous bladder with a single kidney while one patient was suffering from carcinoma of the bladder. Several of these patients developed narrowing of the colostomy stoma and required dilatations. Postoperative pyelograms were normal and biochemical values remained normal in all but one patient. Four patients were completely continent while two experienced some urinary leakage on holding the urine for longer than four hours. Faecal continence was complete except when diarrhoea was present.

Two patients with carcinoma of the bladder were operated on by Garske and his co-workers⁷. A sufficient length of sigmoid colon was obtained by

incising the lateral peritoneal reflection up to the splenic flexure and ligating the inferior mesenteric artery and vein just distal to the origin of the left colic artery. The perineal incision was placed 3 to 4 cm. anterior and anterolateral to the anal margin. Only the lower half of the external sphincter was dilated to pull the sigmoid through, and excess of bowel was allowed to remain. This was trimmed on the ninth day when the draining catheter was also removed.

Blandy² attempted to obtain a non-absorbative surface by fashioning a reservoir from a loop of small bowel from which the mucosa had been removed by stripping it in the submucosal plane. The inner surface of this pouch was covered by urothelium spreading from the ends of the implanted ureters. The pouch was shown to retain contractile ability and the danger of inducing ossification in the tissues underlying the regenerating urothelium was shown to be small. It was proposed to anastomose this pouch to the lower rectum. At the time of writing the technique had not been used in a human patient.

Duhamel⁴ describes his own version of the Gersuny operation and claims that there is no loss of control either of faeces or urine.

A different approach, also designed to use the anal sphincter to control the outflow of both urine and faeces, was suggested by Charlewood³. In 11 patients with severe stress incontinence following closure of a vesico-vaginal fistula, in whom very little of the vagina was left and menstrual function was permanently in abeyance, he closed what was left of the vagina and brought the urethra out between the anal mucosa and the anal sphincter. Results were excellent. In the presence of a normal vagina, attempts to create a urinary passage round the vaginal introitus were not successful. He suggested that the anal sphincter could be used for the same purpose in males who have lost sphincteric control of the bladder. Powell²² con-

structed a fistulous tract from a skin tube beneath the rectal sphincter and connected this to a mucosa-lined tube from the bladder. There was no urinary leak. In a female patient a similar tube was taken around the vagina. She was continent at times. In this regard an instructive case summary is recorded by Scott²⁷. A boy who was born without a penis, was found to have a urethra running alongside the rectum beneath the rectal sphincter, opening on the perineum just anterior to the anus. Urinary control was perfect.

Indications:

The technique of isolated rectosigmoid bladder with perineal colostomy is applicable to any case where the rectum is present and free from disease and the anal sphincter is completely normal. It should not be advised if there is a possibility that the rectum may become implicated in disease, eg. in advanced carcinoma of the cervix. It is probably unwise to use it if intensive radiotherapy to the pelvis is planned as both the ureteric anastomoses and the urine-filled rectum will be in the irradiated field. It has no place as a palliative procedure in advanced carcinoma of the cervix or bladder. In these cases an ileal conduit or, in an occasional case, ureterosigmoidostomy, will be a better choice.

In the reported cases the operation was used most often following total cystectomy for carcinoma of the bladder. It is also useful after anterior exenteration for carcinoma of the cervix, especially if it is the surgeon's impression that the disease has been eradicated. The operation has been used in exstrophy of the bladder^{1,15} and in a patient with a contracted tuberculous bladder¹. When used in cases of exstrophy it is especially important to confirm the presence of a normal anal sphincter and it would probably be unwise to use the technique in a very young infant.

THE OPERATION

The operation is performed with the patient in the 'combined' position on the operating table. After opening the abdomen, the first part of the operation will consist of the removal of the diseased organ, eg. total cystectomy or anterior exenteration. This will be followed by mobilization and division of the sigmoid colon, the dissection necessary to bring the colon to the perineum, transplantation of the ureters and lastly, after closing the abdomen, the fashioning of the perineal stoma.


The technique of the operation has been described in detail in several publications. The success of the operation depends on meticulous attention to four phases of the procedure.


1. Preoperative preparation of the bowel: The large bowel must be empty and sterile. Preparation is started five days before the operation by giving phthalylsulphathiazole, 6 Gm. per day in divided doses, with vitamin B complex and a low-residue diet. An aperient is given three days before operation. Streptomycin, 2 Gm. twice a day by mouth, is given for two days before operation. On the day before operation an evacuant enema is given and on the morning before operation the bowel is washed out with saline followed by neomycin solution.

2. Division and mobilization of the sigmoid, the siting of the perineal opening and the perineal dissection: If the large bowel is divided at the rectosigmoid junction, the rectal reservoir will have a capacity of 175 to 300 m.²¹. The capacity increases, as more of the sigmoid colon is included, to 300 to 350 ml. with division below the midpoint of the sigmoid^{16,19} and 400 to 500 ml. with division a little above the middle of the sigmoid loop^{25,26}. The optimum point of division is governed by several considerations. Too high a division exposes more bowel mucosa to

the urine and more reabsorption of urinary constituents will occur. From this point of view division below the midpoint of the sigmoid is advisable. The capacity of the rectosigmoid reservoir is important: it determines the intervals between evacuations and a larger capacity will permit better control by the anal sphincter. A certain minimum length of sigmoid is required to reach the perineum and this limits the portion that may be used to increase the capacity of the urinary reservoir. The optimum capacity of the rectosigmoid pouch would appear to be 350 to 400 ml. requiring division of the sigmoid colon a little below the midpoint of the loop, a length which will not permit a dangerous amount of reabsorption, which will leave sufficient sigmoid, if properly mobilised, to reach the perineum, and which will not require too frequent evacuations.

The technique of mobilization of the sigmoid colon is based on the known anatomical arrangement of the arterial supply to the descending and sigmoid colon. Steward and Rankin²⁸ demonstrated free communication between the middle colic and the left colic arteries through the marginal vessels of the left side of the transverse colon and the upper part of the descending colon. Goligher⁸ confirmed this observation and showed, during operations on the left colon and rectum, that, following high ligation of the inferior mesenteric artery, the marginal artery will ensure an adequate blood supply to the left colon in at least 70 per cent of the cases. The supposedly inadequate marginal anastomosis between the lowest sigmoid and the superior rectal arteries, described as Sudeck's critical point, has not been confirmed. A true critical point exists at the splenic flexure where the marginal artery is often quite small¹⁰.

Mobilization of the sigmoid colon is started by dividing the peritoneum on the lateral side of the lower part of the descending colon and extending the division downwards to include the left limb of the -shaped attach-

ment of the sigmoid mesentery. The bowel is stripped to the right as far as the apex of the  which overlies the left ureter at the bifurcation of the left common iliac artery. The ureter is identified and mobilization then proceeds further medially. The point where the sigmoid is to be divided is now selected. This is generally about 4 inches above the recto-sigmoid junction or about 3 inches below the apex of the sigmoid loop. At this point an opening is made in the mesentery close to the bowel, two Kocher clamps placed across the sigmoid and the bowel divided.

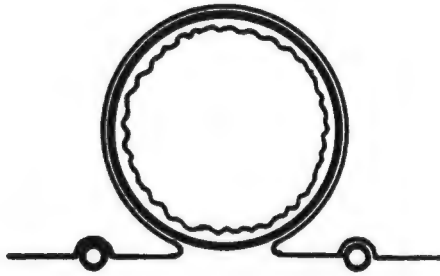
The superior rectal artery which follows a course downwards in the base of the right limb of the sigmoid mesentery does not usually need to be interrupted. The mesentery is divided to its left, starting at the point where the bowel has been transected, ligating any small branches crossing the line of division, and this is continued upwards along the inferior mesenteric artery, dividing the sigmoid branches at their origins. A prominent ramus transversus of the left colic artery¹⁰ or a very high first sigmoid artery or descending branch of the left colic artery with a distinct downward course can be similarly ligated at its origin from the left colic artery. The left colic artery usually runs upwards to the left or, less commonly, transversely and, with mobilization of the descending colon, can be displaced downwards to give greater length. The inferior mesenteric vein is divided just below the point where the left colic vein flows into it. All these vessels to be divided are cleared of peritoneum and individually ligated otherwise the cut edge of the sigmoid mesentery will be significantly shortened. In obese patients the arterial pattern may be difficult to define. It is important to divide the mesentery not less than $1\frac{1}{2}$ inches from its attachment to the bowel otherwise the marginal vessel may be interrupted.

The end result is that the proximal part of the sigmoid colon remains adequately supplied with blood through the marginal vessel and proximal anastomoses of the sigmoid branches from the left colic artery and can be completely straightened to provide maximum length. The lower part of the sigmoid and rectum receive their normal blood supply through the uninterrupted inferior mesenteric artery and its continuation the superior rectal artery. (Fig. B.2.1.a.)

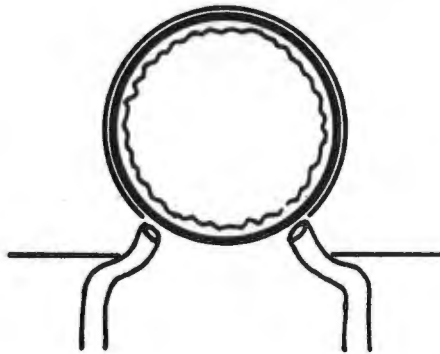
Following mobilization of the sigmoid colon and the dissection necessary to provide a tunnel for the bowel to the perineum, the ureteric transplant is performed. An adequate interval therefore exists after mobilization of the colon to check the viability of the bowel before performing the perineal colostomy. The colour of the bowel and the presence of pulsation in small vessels in the bowel wall are especially important to observe. In cases of doubt one of these small mural arteries is divided and the occurrence of bleeding noted.⁸

Dissection now proceeds downwards along the left anterolateral aspect of the rectum. If cystectomy had been performed the rectovesical peritoneal recess will have been opened up already. The margin of the puborectalis part of the pubococcygeus is defined adjacent to the rectum and dissection continued with between muscle and bowel. The space so defined is packed and attention turned to the perineum.

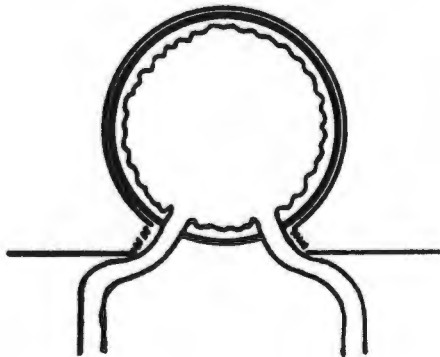
A curved incision is made $1\frac{1}{2}$ inches anterior and anterolateral to the anal margin. This is deepened through the subcutaneous tissue and the lower margin of the external sphincter is clearly defined. Dissection is continued upwards by separating the muscle from the rectal wall and gently stretching it. This part of the dissection is made easier if a finger or tube is placed in the rectum. By repeated gentle stretching and dissection a tunnel is formed connecting the perineum with the pelvis,



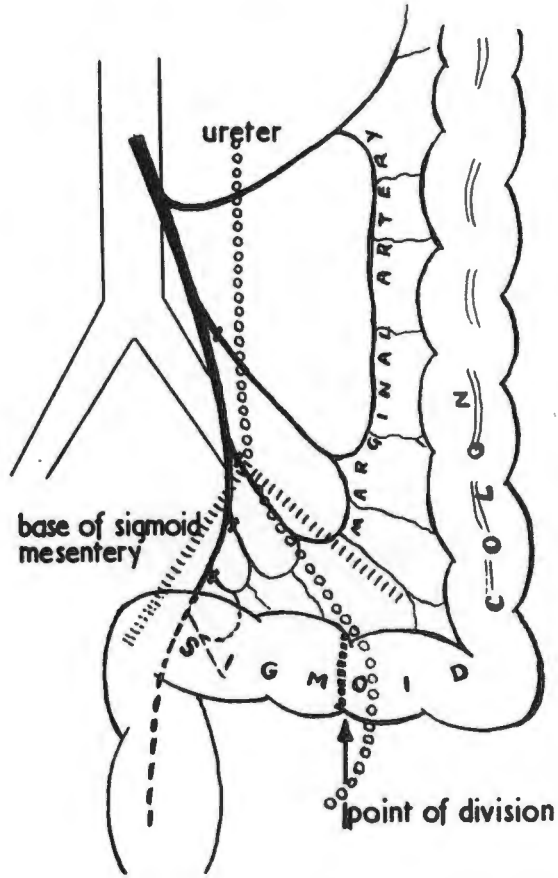
a. Ureters and rectum: normal relations



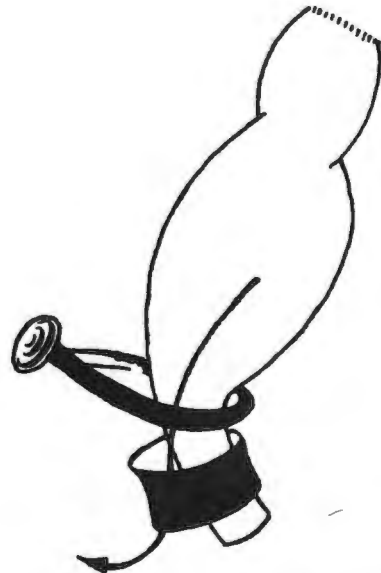
b. Mobilization of the ureters



c. Completed uretero-rectal anastomosis



d. Arterial supply to the sigmoid colon



e. Intra-sphincteric course of sigmoid to perineum

FIG. B.2.1: GERSUNY OPERATION: aspects of operative technique

wide enough to accommodate the index and middle fingers comfortably (Fig. B.2.1.b.).

3. Transplantation of the ureters: This is done after division and mobilization of the sigmoid, closure of the rectosigmoid pouch and the dissection to establish a tunnel to the perineum have been completed. No manipulations are performed through the open end of the rectal pouch. The ureters are divided according to the level at which they are to be transplanted, spatulated and anastomosed by the mucosa-to-mucosa technique to each side of the rectal pouch. No intraureteric catheters or tubes are used. As the ureters lie adjacent to the sides of the rectum (Fig. B.2.1.c.), only a small length of ureter needs to be mobilised and the ureter is brought to the rectum through a retroperitoneal tunnel (Fig. B.2.1.d.). Following anastomosis, the small opening at the peritoneal reflection is closed to leave the entire anastomosis extraperitoneal (Fig. B.2.1.e.).

4. Fashioning the perineal colostomy stoma: When the ureters have been transplanted, a long curved clamp is passed from the perineal side, the crushed edge of the sigmoid colon is picked up and pulled down, taking care not to rotate the bowel. If the colon has been properly mobilised, it will reach the perineum without tension. About one inch is made to protrude from the perineal incision.

The abdomen is now closed, in the usual way, without drainage.

The peritoneal coat of the sigmoid colon is fixed to the skin margin with four stitches. The remainder of the perineal incision is then closed just sufficiently to accommodate the sigmoid colon without constricting it. A drainage tube is left in the rectum for a week after the operation.

Fourteen days later the patient is examined in the lithotomy position under general anaesthesia. The degree of protrusion of the bowel mucosa

is noted and the size of the stoma estimated by passing the index finger into the bowel. If there is too much protrusion, the excess bowel wall and mucosa is trimmed off flush with the perineal skin. The thickened skin margin is excised and the size of the skin opening adjusted by enlarging it or partially closing it, as necessary. A careful mucosa-to-skin anastomosis is then performed using closely-spaced chromic gut sutures.

It is not considered advisable to attempt the final preparation of the perineal stoma at the first operation. Usually it will result in excessive mucosal protrusion which will require trimming. Sometimes the terminal portion of the sigmoid will undergo necrosis, possibly by being constricted in the perineal tunnel even though the blood supply might have been adequate⁸, and retraction of the mucosa will occur - a condition that leads to stenosis, will need constant attention and is almost impossible to correct surgically. A planned minor secondary procedure will overcome most of these difficulties.

THE RESULTS

The operation of isolated rectosigmoid pouch with perineal colostomy gives the closest approach to the ideal bladder substitute of all techniques that have been suggested.

It provides for continence of urine and faeces. This feature is stressed by all surgeons with experience in the technique. Faecal continence is usually acquired only after a short period of re-learning but eventually it is complete and the patient may even be able to distinguish between flatus and faeces^{15,19}. This observation has not been adequately explained. It is possible that the sensation of fullness may actually originate in the true rectum, stimulated by the pressure on it from filling and distension of the adjacent new rectum.

With a capacity of 350 to 400 ml. the patient will not need to empty the pouch more frequently than four-hourly, an interval compatible with personal comfort and convenience. With this interval between voidings the rectosigmoid pouch will not be overfilled (except with gross polyuria) and urinary leak will not occur during periods of stress or during sleep.

There does not appear to be a real risk of excessive re-absorption of urinary constituents from the rectosigmoid pouch. Isolation of the rectum diminishes the area of mucosal surface exposed to the urine. During filling of the pouch the urine probably collects in the rectal ampulla in the first instance, where reabsorption is minimal, and only later, and for a shorter period, does it come into contact with the mucosa of the lower sigmoid. Biochemical disturbances following operation are unusual.

There is little evidence that repeated attacks of ascending renal infection occur after this operation. This is due to the isolation of the rectosigmoid reservoir from faecal contamination. A further factor may

be the fact that the intra-rectal pressure is lower than in the normal rectum, due to the absence of peristaltic waves and rise in pressure during efforts at defaecation¹⁵. The tendency to regurgitation of urine into the ureter and renal pelvis will therefore be diminished.

No external appliance is necessary. This is a most attractive feature from the patient's point of view. However efficient modern colostomy or ileostomy appliances might be, to the patient it constitutes a considerable nuisance and encumbrance. Instead, the urinary and faecal orifices are located on the perineum, requiring almost no adjustment in personal habits in the female, while male patients appear to accept the changed conditions readily. However, an incontinent perineal stoma is much more difficult to manage than an abdominal one and no efficient appliance for the perineum is available. This emphasises the care that must be taken to confirm the presence of a normal anal sphincter before operation and to avoid damage to the sphincter during operation, and keeps the surgeon alert to the responsibility he accepts when advising the procedure.

The technique allows any other operative procedure in the pelvis eg. cystectomy or anterior exenteration, to be performed. Postoperatively it is possible to examine the pouch by cystoscopy and catheterise the ureters. Identification of the ureteric orifice may be possible only after injection of indigocarmine.

Apart from the requirement of ensuring full faecal and urinary continence, the success of the procedure is determined by two factors: the efficacy of the ureteric transplant and the establishment of a stricture-free perineal stoma. The best method of ureteric anastomosis is a meticulous mucosa-to-mucosa technique. No valve-formation is attempted. Narrowing of the perineal stoma is the complication most frequently reported^{1,15,29}, and also observed in two personal cases. A technique designed to avoid this

complication has been described. A slight tendency to stenosis can be managed by regular calibration and gentle dilatation of the stoma.

In most of the reported cases the perineal stoma has been made anterior to the anal orifice^{5,7,15,18,29}. The sigmoid has also been brought down behind the rectum^{1,11}. In a personal case the stoma was placed lateral to the anal orifice on the left side. An important technical point arises in this regard. With the patient under general anaesthesia, the external anal sphincter relaxes and a point on the perineum, selected in relation to the anal orifice, will be considerably closer to the anal margin in the conscious patient. This can be overcome in two ways: either by selecting a point well away from the anal orifice eg. $1\frac{1}{2}$ inches⁷, or by marking the site for the perineal stoma before anaesthesia is induced. The perianal tissues are more mobile posterior and lateral to the anus than anteriorly. This fact again favours placement of the stoma anterior to the anus.

With these complications eliminated - and this is possible with careful technique - the operation of isolated rectosigmoid pouch with perineal colostomy may be considered the ideal method of urinary diversion where anatomical conditions permit. Its more general adoption is recommended.

B.2 CASE RECORDS

CASE 47:

G.C., African female aged 19 years, seen in 1958. She had a prolonged and difficult confinement at home. This was followed by severe pelvic peritonitis with a gas-forming organism. She recovered from this and was left with a large vesicovaginal fistula, involving the whole bladder base and urethra. One attempt at closure of the fistula was made, with complete failure, and further attempts were not considered worth while. Abdominal operation was performed, the ureters transplanted into an isolated rectal pouch and the sigmoid colon brought down deep to the anal sphincter. Recovery was uncomplicated. She was re-admitted $3\frac{1}{2}$ months later with acute small intestinal obstruction due to adhesions. She recovered following laparotomy. When seen 6 months after operation the perineal stoma had contracted and had receded almost to the anal margin. Dilatation was performed. She was last seen 9 months after operation, in good general health and fully continent of urine and faeces. The stoma again needed dilatation. Intravenous pyelogram showed a normal upper tract while a 45-minute film showed the rectosigmoid pouch filled with dye.

CASE 48:

W.K., African male aged 48 years, came under observation in 1959, complaining of haematuria, painful urination and increased frequency for two months. On examination he was in reasonably good general health, chest x-ray normal, haemoglobin 14.1 Gm., blood urea 45 mg. per cent. The liver was firm and slightly enlarged. Blood pressure 170/110 mm. Hg. X-ray of the pelvis showed calcification of the bladder of the type seen in bilharziasis (Fig. B.2.2.a). The intravenous pyelogram showed a non-functioning right kidney, marked dilatation on the left side and a large irregular filling defect of the bladder (Fig. B.2.2.b.). Bimanual examination revealed a firm, mobile, bladder mass. Cystoscopy was made difficult by marked bleeding and friable growth at the internal urethral meatus.

Total cystectomy and pelvic lymphadenectomy was performed, the ureters transplanted into the isolated rectum and the sigmoid pulled down inside



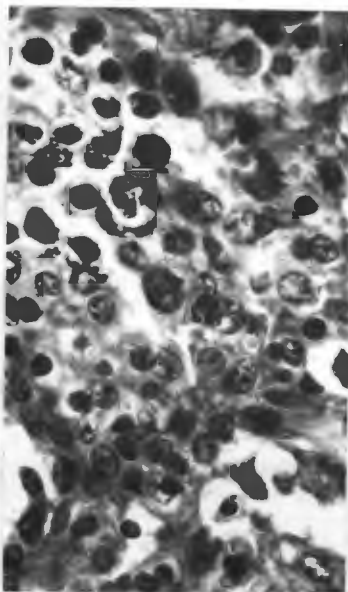
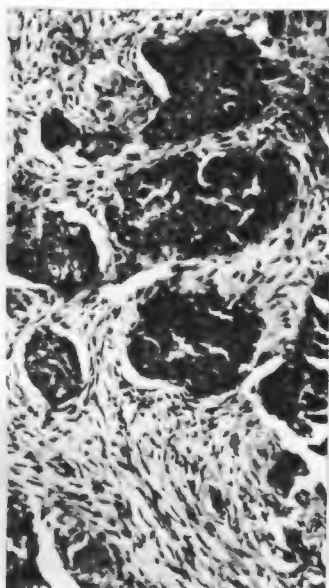
a.

Bladder calcification.



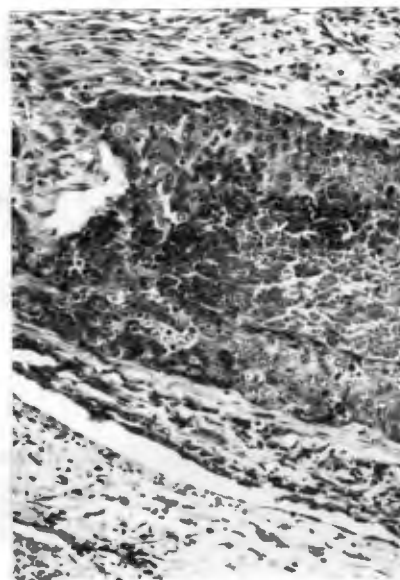
b.

Intravenous pyelogram. Non-functioning right kidney, hydronephrosis left. Filling defect of bladder.



c.

Anaplastic carcinoma



d.

Lymph node infiltration.

the external sphincter. An uneventful recovery followed. Histopathology confirmed the presence of fungating anaplastic carcinoma with invasion through the bladder wall and infiltration of the lymph glands. (Fig. B.2. 2. c and d.). A course of deep therapy was given.

When the patient left hospital, two months after operation, he was in good health and continent of faeces and urine. There was no tendency for the colostomy opening to contract.

CASE 49:

E.K., African male aged 43 years, seen in 1960, complaining of suprapubic pain, and haematuria with clots. General health good. Liver 3 fingers enlarged. Nodular tender hypogastric mass, palpable bimanually. Blood pressure 130/100 mm. Hg. Lungs clear. Haemoglobin 11.5 Gm. Blood urea 28 mg. per cent. Intravenous pyelogram: bladder calcification characteristic of bilharziasis and marked bilateral hydronephrosis (Fig. B.2.3.a.& b). Cystoscopy was unsatisfactory due to brisk bleeding. Pieces of papilliferous growth were evacuated.

Total cystectomy was performed, the ureters transplanted into an isolated rectal pouch and the proximal sigmoid pulled down under the anal sphincter. The specimen showed a large sessile tumour almost filling the bladder arising chiefly from the base, transitional-cell type. Bilharzia ova were present in the bladder wall, ureters and prostate. (Fig. B.2.4. a and b.).

The patient did well for two weeks, then developed fever and a rising blood urea. A pelvic abscess was evident two weeks later, acute parotitis developed and the patient died 6 weeks after operation. Necropsy showed a pelvic abscess (probably on the basis of a small perforation of the rectum) and acute bilateral pyelonephritis. The ureteric transplants and the perineal colostomy were normal.

CASE 50:

G.R., African male aged 46 years, seen in 1960, complaining of lower abdominal pain, burning dysuria, increased frequency and a few drops of blood at the end of urination on two occasions. He was in good general health. Clubbing of the fingers (a family trait). Rectal examination showed in-



a.

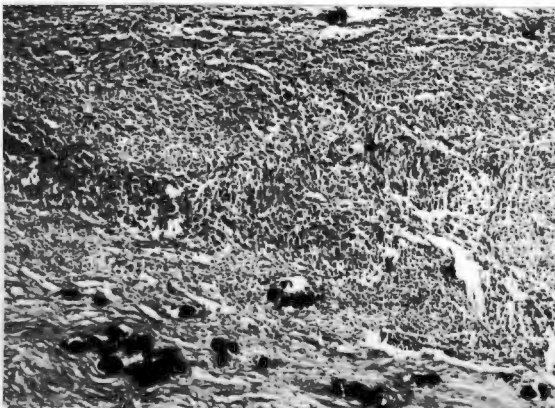
Bladder calcification.



b.

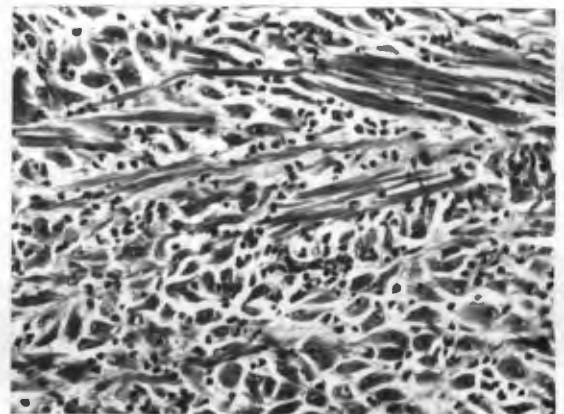
Intravenous pyelogram. Bilateral hydronephrosis.

Fig. B.2.3. Case 49.



a.

Transitional cell carcinoma of bladder.



b.

Bilharzial ova.

Fig. B.2.4. Case 49.

duration of the bladder base above the prostate. Blood pressure 120/65 mm. Hg. Lungs clear. Intravenous pyelogram: calcified bladder, normal upper tract. Cystoscopy: diffuse bilharzial lesion, active in parts. Ulcerative lesion on the margin of the bladder neck, left side. Biopsy: anaplastic mucus-secreting carcinomatous tissue.

Total cystectomy was performed, the ureters implanted into an isolated rectal pouch and the sigmoid brought down under the anal sphincter. Examination of the specimen confirmed a mucus-secreting adenocarcinoma, the growth penetrating the bladder wall. Bilharzia ova were present (Fig.B.2.5.). An uneventful recovery followed. The perineal stoma was calibrated before discharge and was not contracted. Six months after operation the stoma was slightly narrow. Intravenous pyelogram was normal. The cystogram outlined the rectosigmoid pouch. When last seen 10 months following operation his general health was good, haemoglobin 12.3 Gm., urea 30 mg. per cent and intravenous pyelogram normal (Fig. B.2.6.). The perineal stoma admitted an index finger easily. Control of faeces and urine was normal.

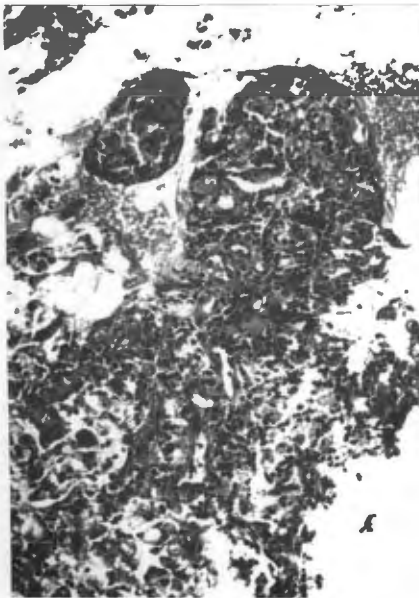


Fig. B.2.5. Case 50:
Carcinoma of the bladder.



Fig. B.2.6. Case 50:
Normal postoperative pyelogram.

CASE 51:

An African male patient, aged 32 years, from Portuguese East Africa, was first seen in October, 1965, complaining of haematuria for 10 days, and increased frequency of urination. He was found to be in good general condition. Blood pressure normal, normal chest x-ray. A large soft bladder mass was present. The intravenous pyelogram showed calcification of the bladder of the type usually seen in bilharziasis while the upper tract showed early bilateral hydronephrosis (Fig. B.2.7.a and b.). The cystogram showed irregular filling of the bladder. Examination of the peripheral blood revealed a leucocyte count of 19,900 cells per *cmm.*, with an eosinophilia of 9%. The haemoglobin content was 10.4 Gm. per cent. The urine was macroscopically bloodstained and showed numerous red cells and white cells as well as ova of *schistosoma haematobium* on microscopic examination. Cystoscopy was unsatisfactory due to bleeding and filling of the whole bladder with friable growth.

After preparation of the bowel and bloodtransfusion, operation was performed. The growth had not extended beyond the bladder wall. A few small soft lymph nodes were present along the right internal iliac artery. Total cystoprostatectomy with pelvic lymphadenectomy was performed. The ureters were transplanted into an isolated rectosigmoid pouch and the proximal colon brought down, inside the external anal sphincter, on to the perineum. The operative specimen (Fig. B.2.8.) showed the bladder filled with friable growth, with evidence of previous haemorrhages. The bladder wall showed evidence of chronic bilharziasis. Histopathology showed the tumour to be a leiomyosarcoma of the bladder (Fig. B.2.9.a,b.).

An uneventful recovery followed. When the rectal drainage tube was removed 12 days later, the patient had immediate urinary control. Three weeks after cystectomy, the protruding colon on the perineum was trimmed and the stoma adjusted (Fig. B.2.10.a and b.). Full faecal control was established 5 weeks after operation. At this stage the intravenous pyelogram showed slight increase in the dilatation of the upper tract. The rectosigmoid bladder was clearly outlined (Fig. B.2.11.). The final appearance of the perineum was very satisfactory and there was no tendency for the stoma to contract.

At the time of discharge, 2½ months following operation, the patient was in good general condition. The serum electrolytes remained normal throughout.



a.

Cystogram: Irregular filling and
calcification.



b.

Intravenous pyelogram.

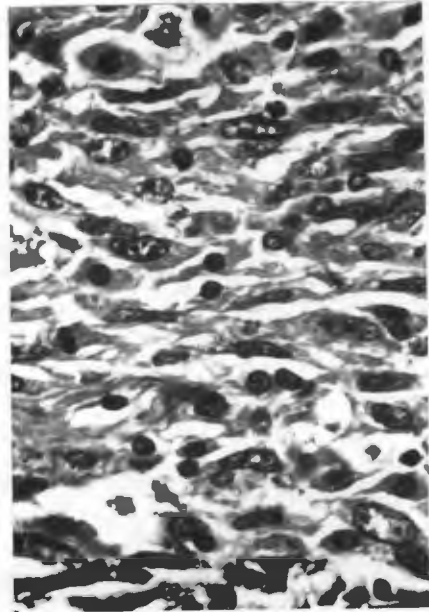
Fig. B.2.7. Case 51.



Fig. B.2.8. Case 51:
Operative specimen : cystoprostatectomy.

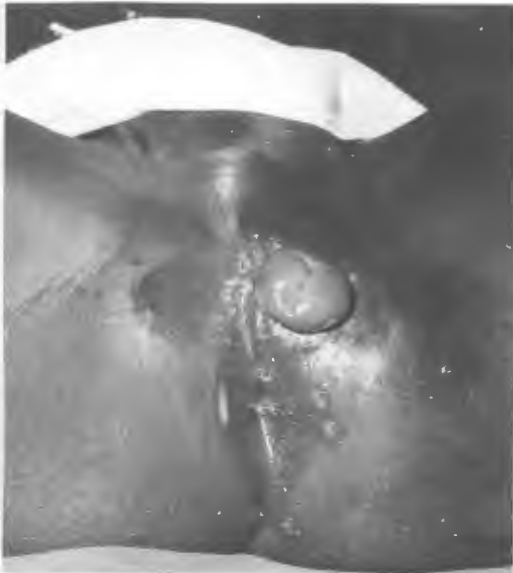


a.



b.

Fig. B.2.9 Case 51:
Leiomyosarcoma of the bladder.



a.
Perineal colostomy.



b.
After trimming.

Fig. B.2.10. Case 51.
Appearance of perineum following the Gersuny operation.



Fig. B.2.11. Case 51:
Postoperative pyelogram and cystogram.

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SECTION B.3

URINARY DIVERSION IN THE PALLIATIVE TREATMENT OF
INOPERABLE CARCINOMA OF THE CERVIX

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URINARY DIVERSION IN THE PALLIATIVE TREATMENT OF
INOPERABLE CARCINOMA OF THE CERVIX

Carcinoma of the cervix is quite frequently complicated by involvement of the urinary tract in the spreading malignant process. Because the bladder base, urethra and lower end of the ureters are in close anatomical relation to the uterine cervix, these are the parts of the urinary tract most frequently involved.

Urinary complications are responsible, according to Schewe and Sala²³ for two-thirds to three-quarters of deaths in carcinoma of the cervix. This is also the opinion of Parente²¹. Palumbo et al²⁰ found a malignant vesicovaginal fistula in 15 of their 378 cases of carcinoma of the cervix. In the stage IV tumours, 70 per cent of the pyelograms were abnormal and, on cystoscopy, the bladder showed some abnormality in nearly all cases. Additional urinary complications were associated with radical pelvic operations. Of the 292 lower urinary tract fistulae in women studied by Miller and George¹⁸, pelvic carcinoma was responsible for 34.2 per cent of all cases. Kerr¹¹ studied 735 consecutive cases of carcinoma of the cervix. In 17 per cent of these he found evidence of urinary tract complications: ureteric obstruction, bladder infiltration, vesicovaginal fistula or urethral involvement. If only stage IV growths were considered, urinary tract involvement was present in 48 per cent. An even higher incidence of urinary tract involvement is reported by Green¹⁰ who found 19 of his 24 cases, mostly stage III and IV growths, suffering from urethral obstruction, bladder invasion, vesicovaginal fistula or ureteric obstruction.

During the period June, 1954 to December, 1963 ($9\frac{1}{2}$ years) 483 cases of carcinoma of the cervix in African females were admitted to Edendale Hospital, Pietermaritzburg. These patients were drawn mainly from the central and northern parts of Natal. (Fig. B.3.1.a and b.). The majority of these

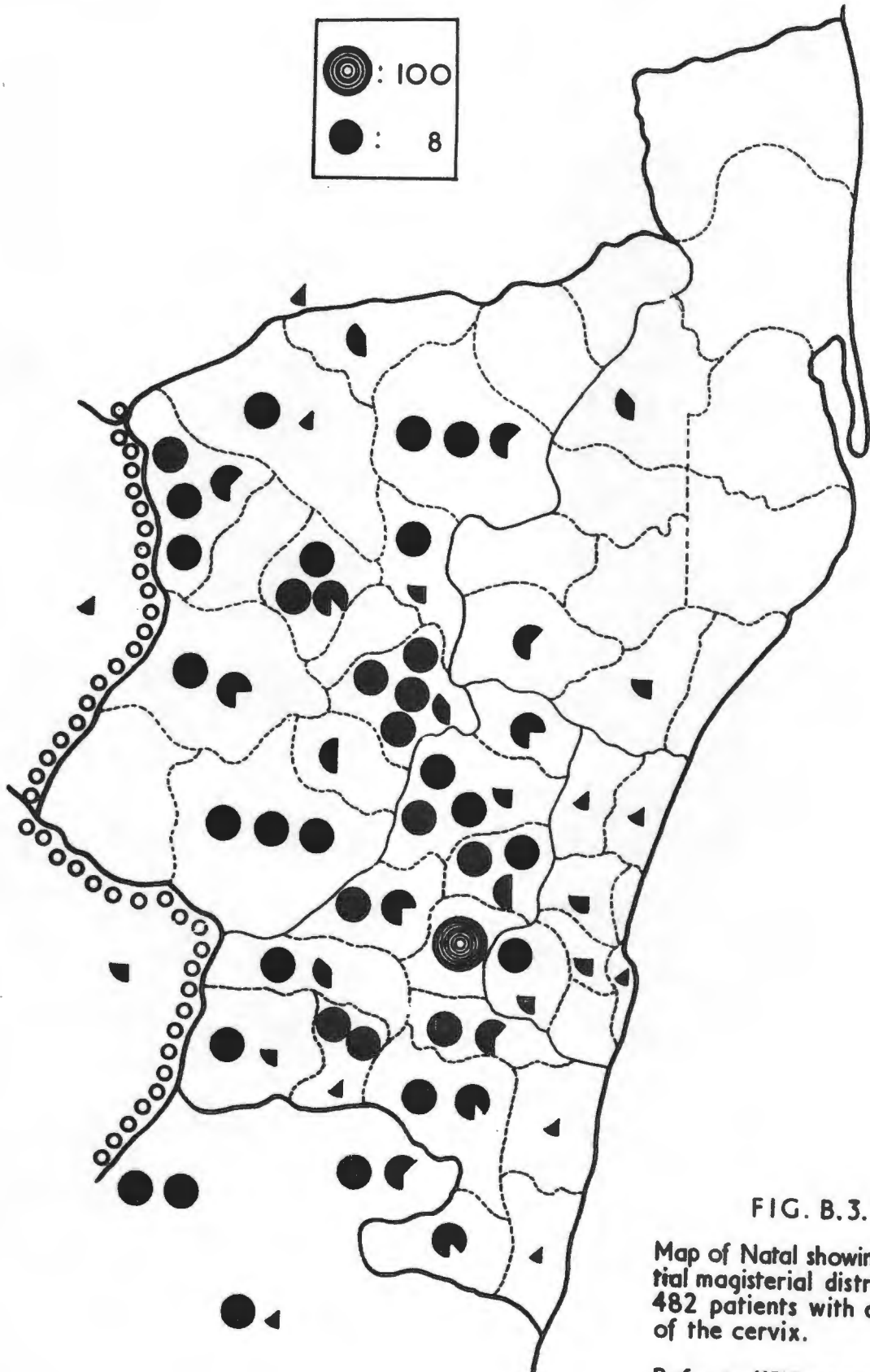




FIG. B.3.1.b

KEY to Map: Fig. B.3.1.a

patients-417 or 86.3 per cent - were stage III and IV cancers when they first presented. Involvement of the urinary tract was quite frequently present, as shown by the following findings:

1. Malignant vesicovaginal fistula was present in 52 cases. (10.8 per cent)
2. Amongst 41 patients in whom cystoscopy was performed, displacement of the bladder base and neck was recorded in 7 cases, localized oedema in 15 cases, pre-ulcerative invasion in 3 cases, malignant ulceration in 7 cases, while normal findings were noted in 9 cases.
3. The findings on intravenous pyelography are recorded in 232 cases. These were normal in 109 cases, 67 cases showed dilatation of the upper urinary tract on one or both sides while in 56 cases one or both kidneys failed to excrete the dye. A filling defect on the cystogram was noted in 17 cases.
4. The results of the blood urea estimation in 108 cases show a level below 50 mg. per cent in 62 cases, between 50 and 100 in 19 cases and above 100 mg. per cent in 27 cases.
5. Records made at operation and necropsy showed invasion of the bladder in 8 cases, and involvement or obstruction of one or both ureters with hydronephrosis pyelonephritis, suppurative pyelonephritis or pyonephrosis in 22 cases. There were 97 deaths in hospital but postmortem examination was not performed in all of these.
6. As an associated illness, vesical bilharziasis was found in 2 cases, a bladder calculus in one, one patient had polycystic kidneys while 6 patients were pregnant when the diagnosis was first made.
7. Of the 483 cases, 50 (10.3 per cent) were in the age-group 20 to 30 years, while 146 patients (30.2 per cent) were below 40 years.

These observations confirm that the urinary tract is frequently involved in patients with advanced carcinoma of the cervix. As such involvement

presents most often as an obstructive lesion in some part of the tract, the possibility of urinary diversion as a means of palliation and prolongation of life by relieving urinary obstruction and halting progressive renal destruction has often been considered in practice. The part played by therapeutic irradiation and inflammatory reaction in the production of obstructive lesions in the urinary tract is uncertain but it is generally accepted that the malignant process itself is by far the most important factor^{11,21,23}.

The value of diversion of the urine in these cases is much debated. Kerr¹¹ states that analysis of his data indicated little, if any, prolongation of life by palliative operations. Green¹⁰ feels that urinary diversion is necessary in the presence of bilateral ureteric obstruction. Palumbo et al²⁰ occasionally recommend palliative diversion of the urinary stream in selected patients. The operation was performed in 5 cases, in whom a malignant vesicovaginal fistula and ureteric obstruction were present, by Annis et al¹. Baker and Graf³, out of a series of 20 cases, performed palliative urinary diversion in 5 patients with advanced carcinoma of the cervix invading the bladder. They feel that the procedure was definitely beneficial in these cases. Godfrey⁹ considers urinary diversion, alone or with exenteration, a valuable palliative measure in advanced uterine carcinoma. Miles and Barry¹⁷ regard palliative urinary diversion indicated in non-resectable pelvic carcinoma with progressive ureteric obstruction. Folsom and O'Brien⁷ reports 6 cases in whom cutaneous ureterostomy was performed for ureteric obstruction or malignant vesicovaginal fistula. The patients lived in reasonable comfort for periods of 5½ to 16 months. They consider palliative diversion worth while. Minton and co-workers¹⁹ performed palliative cystectomy and ileal conduit in 38 females with carcinoma of the cervix. Their patients survived for 2 months to 8 years following operation. Parente²¹ performed palliative diversion in 91 patients and

found that most had symptomatic relief and lived in reasonable comfort for one to 9 months. More extensive radiotherapy or chemotherapy could be applied following diversion. Yonemoto and colleagues²⁵, on the basis of urinary diversion in 20 cases, conclude that those patients with urinary fistulae were treated most successfully. They stress careful selection of cases.

It is the opinion of many experienced workers that urinary diversion will prolong the life of many of these patients for months or even years.

Indications:

In this series of 483 consecutive cases of carcinoma of the cervix, palliative urinary diversion was performed in 18 cases. In two cases palliative operation was considered indicated but the local condition was too advanced and the patients' general condition too poor for operative intervention. In 5 cases urinary diversion was performed as part of a radical operation (total pelvic exenteration in two and anterior exenteration in 3 cases). These patients will not be considered further.

The decision to do palliative urinary diversion is based on several considerations, the emphasis varying from case to case:

1. Evidence of urinary obstruction is the most important consideration. The site of obstruction is most often in the pelvic portion of the ureters, but growth may infiltrate the bladder neck or urethra and cause obstruction before a urinary fistula is formed. The site of the obstruction is determined by local examination, intravenous pyelography and cystoscopy. Residual renal function is estimated by the pyelographic record and by renal function tests.
2. The presence of a malignant vesicovaginal fistula influences the decision. It is felt, and this is born out by experience, that collection of urine is much more conveniently performed by a well-fitting enterostomy

appliance than by perineal pads.

3. An estimate of the survival period is a further important consideration. Such an estimate should be based, primarily, on the extent of spread of the disease and an assessment of the rate of dissemination. The previous history, a record of previous physical examinations and the histological grading of the tumour will assist. The age of the patient is probably not significant in this regard: a survey of this series has not shown any evidence of more rapid dissemination in the younger age groups or a tendency for younger patients to have more anaplastic growths. Extreme age may have an indirect bearing on the decision because of the greater likelihood of associated serious systemic illness. A very low haemoglobin value and marked loss of weight are unfavourable findings. If, on this evidence, it is confidently expected that the patient will live for longer than 3 months, palliative operation may be considered worth while.

4. If radiotherapy is to be used in treating the primary growth it may be a factor favouring palliative urinary diversion. There is evidence that radiotherapy, especially during the early reactive phase, but possibly during the later stage of fibrosis as well, will by itself produce ureteric stenosis or aggravate an already existing incomplete ureteric obstruction. Preliminary urinary diversion will therefore allow more intensive radiotherapy to be given and will prevent progressive renal damage or uraemia that may result from an increased degree of ureteric obstruction.

Radiotherapy also influences operative technique. The urine-filled rectum appears to react more severely to irradiation than the 'dry' rectum. For this reason ureterosigmoidostomy or isolated rectosigmoid pouch as a method of diversion would be contra-indicated. For the same reason it is advisable to place an ileal loop, used for urinary diversion, well above the pelvis.

5. Marked vaginal bleeding may influence the decision. The ulcerating type of growth may, by eroding a bloodvessel, cause severe and recurrent vaginal bleeding. The bleeding tendency may be enhanced in the presence of an incipient uraemia. If, under these conditions, no response is obtained from packing or haemostatic radiotherapy, ligation of the internal iliac arteries may have to be performed, and urinary diversion, if indicated for other reasons, could be performed at the same time.

6. Assessment of renal function is another important consideration. An accurate decision on this point is not always possible but useful evidence may be obtained from various sources.

- a. The duration of obstruction: The kidney is extremely tolerant to incomplete ureteric obstruction and will continue to function for very long periods in the presence of severe degrees of obstruction and, on relief of obstruction, tend to return to normal as regards both anatomy and function. The extreme period during which complete obstruction will be tolerated, and function again return is unknown. It probably depends on several factors including the degree of normality of the other kidney and the presence of infection. Linn and co-workers¹⁴ performed unilateral ureteric ligation in the experimental animal. The ureter was deligated and the opposite kidney removed one to four weeks later. Of these animals in which the ureter was ligated for four weeks, only a single animal survived. Young²⁶ released an accidentally ligated right ureter after complete obstruction for 60 days. Fourteen months later, when the opposite kidney was obstructed by recurrent tumour, the right kidney kept the patient alive. Lewis and Pierce¹³ re-implanted a ureter that had been completely obstructed for 69 days into the bladder. Nineteen months later there was prompt excretion on in-

travenous pyelography with normal renal anatomy. The opposite kidney was normal.

- b. The nature of the obstruction: Obstruction due to acute or chronic inflammatory disease or obstetrical or operative injury is more likely to be incomplete or intermittent. An acute inflammatory episode may cause a complete obstruction in a tight but incomplete stricture and this may improve on suitable conservative treatment. The passage of debris, thick pus, blood clot or a stone may do the same. An obstructing ligature may cause the full thickness of the wall of the ureter to slough with resulting fistula and partial or complete relief of the obstruction. Periods of obstruction will most often be associated with colic or renal tenderness or other symptoms directing attention to the state of affairs and inviting suitable action. Malignant disease on the other hand causes a progressively increasing ureteric obstruction with no remissions, very often as an asymptomatic process until the patient presents with the symptoms of uraemia if the obstruction is bilateral or a 'silent' kidney is discovered on routine investigation if obstruction is confined to one kidney. It is clear that if non-function is due to neoplastic obstruction, the kidney is less likely to regain function when the obstruction is relieved.
- c. Clinical evidence: Estimation of renal function and an intravenous pyelogram are methods of study used routinely in cases where diversion of the urine is contemplated. If the total renal function is normal and the kidneys secrete the dye, it is generally considered reasonable to proceed with the operation although the degree of hydronephrosis and the presence of infection may influence the choice of the operative procedure. The non-secreting kidney presents a

more difficult problem. The time-honoured observation in this type of case is the determination, by palpation at operation, of the thickness of the renal cortex. A favourable case will have a substantial, firm renal substance, while, in the worst case, the kidney will consist of a thin hydronephrotic sac with no actual or potential function.

Personal experience suggests that the degree of perinephric inflammatory reaction, as observed at operation, may constitute a most important indication of the recoverability of renal function. Previous attacks of ureteritis and pyelonephritis produce a thick-walled ureter, difficult to mobilise and manipulate and showing no waves of contraction. The lumen is frequently not significantly dilated, even though obstructed. The kidney may be of normal or slightly decreased size, its normal mobility restricted or lost and its normally pliable and smooth perinephric tissue altered to a knotty adherent layer. The renal substance may appear sufficient but possibly firmer than normal. These changes are the result of suppurative pyelonephritis. In an obstructed kidney, 'silent' on the intravenous pyelogram, these findings at operation indicate a negligible possibility of recovery of any useful function.

- d. Other observations: Meigs and Ulfelder¹⁶ believe that it is justifiable to transplant the ureter into the bowel although no kidney function is demonstrable preoperatively. They warn against anastomosing heavily irradiated ureter to bowel. Pool and Cook²² also transplanted the ureters, in spite of non-function, in 11 cases, and reported return of varying degrees of function in 5 of these. Bourque⁴ advises transplant of both ureters unless there is absolute proof of destruction of a kidney. Hydronephrosis, of relatively

short duration, is expected to return to normal following ureterosigmoidostomy. He observes the dilated ureters at operation: if they shrink considerably after division, while draining, return to normality may be expected. If non-function of a kidney persists it may be necessary to do a secondary nephrectomy. Schmitz²⁴ who used an ileocaecal bladder after surgical treatment of advanced genital carcinoma, feels that this method is justified only when the PSP test shows a total excretory function equal to that of one normal functioning kidney. Edvall⁵ advises renal vein catheterization and determination of the extraction ratio of PAH in the evaluation of the quality of the parenchyma of the non-excreting kidney and considers it a reliable method of deciding whether removal of the obstruction is worth while. Lewis and Pierce¹³ regard a finding of below 50 per cent in the excretory and secretory phases of the radioactive renogram as indicative of a non-functioning kidney. However, they report return to normal after relieving the obstruction in such kidney. In the evaluation of the obstructed kidney, Linn et al¹⁴ take into account the period of obstruction, the result of renal biopsy (the presence of tubular atrophy in the cortical zone had a very ominous prognostic significance) and the level of creatinine and urea nitrogen in the renal vein blood at operation - a high level was present in the obstructed kidney. They noted that the values of creatinine, phosphorus and urea in the peripheral blood levelled off or decreased at about the third postoperative day if renal function was returning. The haemoglobin and haematocrit levels, urine analyses and gross pathology of the kidney were not helpful in coming to a decision. Elkin and co-workers⁶ studied the behavior of the acutely obstructed kidney during intravenous pyelography.

They noticed that recoverable function was indicated by the kidney becoming progressively more opacified. This nephrogram effect was still observed after 5 days of complete obstruction.

- e. **Aortography:** in a small group of cases of carcinoma of the cervix it was decided to extend the range of preoperative investigations by doing a per-femoral aortogram, with the tip of the Seldinger catheter at about the level of the renal arteries, and placing tourniquets on both thighs to concentrate the opaque material in the pelvic vessels. The cases selected were those in whom operability of the growth was doubtful. This line of investigation has been reported in a study of the staging of bladder tumours by Lang¹² who reported the finding of numerous corkscrew vessels, marked increase in vascularity, a dense sustained blush of the tissues and early visualization of the draining veins in the more undifferentiated tumours. He demonstrated a very accurate correlation between the angiographic findings, the histological pattern and the clinical staging of the tumour. A similar study by Maranta and his colleagues¹⁵ confirmed these findings. They stressed the early filling of the veins, in 6 to 10 seconds, instead of the normal 13 to 15 seconds. The investigation was performed in 7 cases in this series. Special attention was given to the lateral walls of the pelvis where, it was expected, increase in vascularity, sustained tissue blush, irregular pooling or early venous filling might be observed as indicative of infiltration of the parietes at a stage that would not be perceptible on clinical examination. Figure B.3.2 shows the pyelogram and aortogram of a patient (Case 52) with a well-differentiated squamous carcinoma of the cervix, stage IV in whom invasion of the lateral wall of the pelvis on the left side was suspected on clinical



Fig. B.3.2. Case 52:
Pyelogram and aortogram (see text).

examination. The kidney on the same side showed no function on the intravenous pyelogram. The aortogram demonstrated irregular pooling of the opaque medium on the left side. Parietal invasion was confirmed at laparotomy. Figure B.3.3. shows the pyelogram of a patient (Case 53) with well-differentiated squamous carcinoma of the cervix, stage IV in whom invasion of the lateral wall of the pelvis on the left side could not be excluded on clinical examination.

There was no function on the left side



Fig. B.3.3. Case 53
Intravenous pyelogram. No function on left side.



Fig. B.3.4. Case 53
Normal aortogram.

and a filling defect of the bladder on the same side. The aortogram (Fig. B.3.4.) was completely normal. At laparotomy the growth was found operable and an anterior exenteration was performed. Filling of intestinal (especially small bowel and left side of colon), mesenteric and ovarian venous channels was also looked for as this may indicate malignant invasion of these organs. Partly on the basis of the angiographic findings, two patients had an anterior exenteration performed with good results. However, the evidence obtained was not considered of sufficient importance to advise aortography as a routine pre-operative investigation. During the course of this investigation it was noticed that, in some cases, a kidney that did not show any function on the intravenous pyelogram would show a clear 'nephrogram' on aortography. Such opacification, on selective renal angiography in the experimental animal, at a stage when renal function was still recoverable after acute obstruction, was also recorded by Elkin and co-workers⁶. These kidneys tended to regain some function after relief of obstruction in the course of urinary diversion either as a palliative procedure or as part of a pelvic evisceration. It is therefore suggested that, in the evaluation of the obstructed silent kidney, the observation of a nephrogram effect on aortography might indicate the possibility of recovery of function and favour conservation of the kidney. The size of the renal arteries and their major branches, as shown in the aortogram, was observed and an attempt made to bring this into relation with renal function and the response of the kidney to relief of obstruction. No clear correlation was established.

Choice of operative procedure:

Granted that urinary diversion serves a useful purpose in the palliative management of some cases of inoperable carcinoma of the cervix, the best operative procedure has to be selected. Standard ureterosigmoidostomy is distinctly out of favour. When dilatation of the upper urinary tract is present and renal damage already exists, the operation carries a very definite risk of further progressive renal damage and biochemical disturbances postoperatively. If the rectum is involved in the disease, or likely to be involved later, or if urinary diversion is part of a total pelvic evisceration, ureterosigmoidostomy or other procedures utilizing the rectum as a urinary reservoir eg. isolated rectosigmoid bladder, is not advisable or possible. Although an ileocaecal bladder or a wet colostomy is occasionally employed³ and nephrostomy is sometimes used as a method of temporary or permanent diversion, the most popular methods are ileal conduit and cutaneous ureterostomy. Of these two procedures, cutaneous ureterostomy would be used in cases where marked dilatation of the ureters is present, permitting the construction of a single ureterostomy stoma with a mucosa-lined nipple, suitable for an external collecting device. In other cases an ileal conduit would be the method of choice. Where ileal conduit has been selected it may sometimes be advisable, in patients with uraemia, to do a preliminary tube ureterostomy for decompression of the obstructed kidneys. Ileal conduit is done when the blood urea level is at a normal or relatively low level²⁵.

Ileal conduit was selected as the operative procedure in all 18 cases in this series in whom palliative urinary diversion was performed.

THE OPERATION

The technique of ileocutaneous ureterostomy (ileal conduit, ileal bladder) has been described in numerous publications. Certain details, regarded as important in order to ensure an uncomplicated post-operative course, and certain other aspects of importance in the use of the procedure in advanced carcinoma of the cervix specifically, will here be stressed.

All patients have had full preparation of the bowel before operation. If it was definitely known before operation, that an ileal conduit and nothing else was to be performed, this preparation may not be necessary as the small intestine is frequently opened and anastomosed during other operative procedures without significant risk of peritoneal infection. However, the operative program is only finalized after the abdomen has been entered and procedures may well be required that can be conducted with safety only on sterilized bowel. For the same reason the operation is always conducted with the patient in the 'combined' position on the operating table so that any type of radical pelvic operation may be performed without a change in the patient's position. The whole abdomen perineum, vagina, and the upper two-thirds of the thighs are prepared and available during the operation.

The bowel is prepared by giving phthalylsulphathiazole, 6 Gm. per day, with vitamin B complex for 5 days before the operation and streptomycin by mouth for two days before operation. On the day before operation an enema is given, and the lower bowel is washed out with normal saline followed by neomycin solution on the morning before operation. In addition it is considered wise to administer a wide-spectrum antibiotic (oxytetracycline is the usual choice), starting three days before operation and continuing for about five days thereafter. This will serve to control urinary infection which is not infrequently present and at times may cause peritoneal contamination

at operation (case 57). Other types of infection are also sometimes found unexpectedly eg. in case 61 a pyosalpinx was opened into at operation. Furthermore, almost all these patients are in very poor general condition, some are pre-uraemic, more often than not they have been grossly anaemic for a long time, and all will be prone to develop pulmonary complications after operation.

Transfusion of packed cells is given preoperatively until the haemoglobin has reached 12 Gm. per cent or more. Adequate time is permitted for normal haemodynamic conditions to be restored and for the myocardium to return to normal. Massive blood transfusion, immediately before operation, in a grossly anaemic patient, is to be especially avoided. Blood is available during operation.

If the patient is sufficiently well she is instructed in simple breathing and coughing exercises and shown how to move and contract the various muscle groups in the lower limbs. This program makes postoperative mobilization much easier and may lessen the incidence of chest complications and venous thrombosis. With the patient standing erect a point most suitable for placing the ileostomy stoma is scratched on the abdominal skin. This should be sufficiently far away from umbilicus, iliac crest, the hollow of the groin and any scars of previous operations.

The abdomen is entered through a long lower left paramedian incision extending down to the pubis. The extent of the disease is determined, first by checking for remote spread to liver, peritoneum and glands, and then the degree of local spread. The ureters are located, examined for the presence of dilatation, periureteric infiltration and the extent of involvement in growth. Lastly, the kidneys are palpated to determine their size, consistency and mobility. On these findings and the results of the preoperative investigations the most suitable operative program is finally settled.

The bowel is packed away with only the lower 2 feet of ileum in the operation field. This is generally easy with the patient in a moderate Trendelenburg position. Otherwise the small bowel may conveniently be packed in a polythene bag with drawstring and placed on the patient's epigastrium. The bowel remains moist and warm for any length of time, without warm packs adhering to the serosal surface, if care is taken that there is no kinking against the upper end of the abdominal incision.

The segment should be 8 to 9 inches long and its distal end not closer than 6 inches from the ileocaecal junction, otherwise manipulations during ileal re-anastomosis may become awkward and the full length of the ileal mesentery will not be available. The limits of the ileal segment to be isolated having been marked by two Kocher clamps across the bowel, the peritoneum of the ileal mesentery is incised, on both surfaces for a distance of $2\frac{1}{2}$ to 3 inches, starting from the clamp, and the mesenteric vessels crossing the line of division then individually ligated. Clamping the mesentery in sections, without division of the peritoneum, will markedly shorten the length of the mesentery when the bloodvessels are ligated. After placing occlusion clamps across the ileum 3 inches above and below the crushing clamps, the ileum is divided, with a scalpel, against the Kocher clamps. The ileum is now reconstituted by end-to-end anastomosis anterior to the isolated segment. This anastomosis is done by the standard 4-layer technique using 3-0 atraumatic chromic gut throughout. The mesenteric edges are carefully sutured on both sides, the most proximal stitch picking up the anterior layer of the mesentery of the isolated segment to obliterate the small tunnel leading down to the loop. The reconstituted ileum can now be put away with the remainder of the small bowel with only the isolated segment remaining in the field. The Kocher clamp is removed from the proximal end of the loop - the crushing having sealed the marginal bleeders - and the

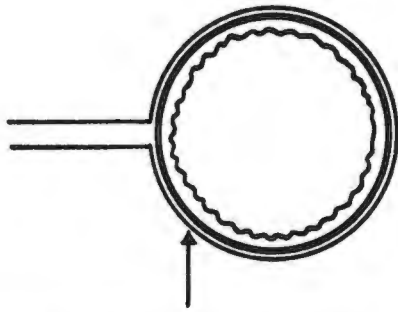
bowel closed in two layers, using the same suture material.

The ureters are again identified at the level of the common iliac bifurcation, mobilised, clamped, divided above the clamp and the lower end ligated using 2-0 black silk. On the left side the ureter is brought out above the mesosigmoid. Both ureters are left free to drain.

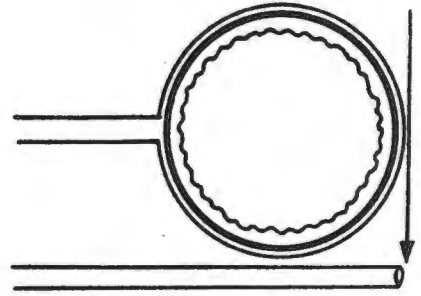
The ureters are now anastomosed to the ileal segment. The left ureter will be inserted one inch from the proximal end of the loop and the right ureter two inches to the right. The most important part of this phase of the operation is to determine the proper length of the ureters so that there is no kinking or redundancy which could interfere with the flow of urine.

The position of the ileal segment is just below the attachment of the small bowel mesentery to the posterior abdominal wall, sloping upwards to the left. This places the segment well above the pelvis so as not to interfere with subsequent operative procedures in the pelvis, relatively remote from spread of malignant disease from the pelvis, and out of the field if radiotherapy is to be used. The slope downwards to the right encourages the flow of urine towards the stoma. The correct site for implantation of the ureter is just distal to the mesenteric attachment, on the posterior surface of the bowel (Fig. B.3.5.a.). With the loop in the position indicated the ureter is trimmed back so that its end is opposite the lower border of the bowel (Fig. B.3.5.b.). The anterior wall is split upwards for 1.5 cm. and the corners trimmed (Fig. B.3.5.c.). It will be clear that not more than one inch of the ureter needs to be mobilised from its retroperitoneal bed.

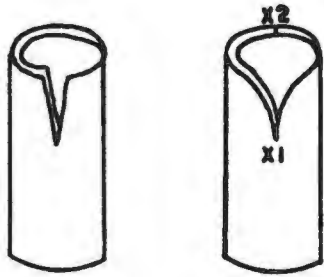
An incision, 1 cm. long, is made in a direction at right angles to the long axis of the ileal segment, beginning just distal to the mesenteric attachment on the posterior surface of the bowel (Fig. B.3.5.d.). This incision is deepened to the mucosa which is picked up on a mosquito forceps,



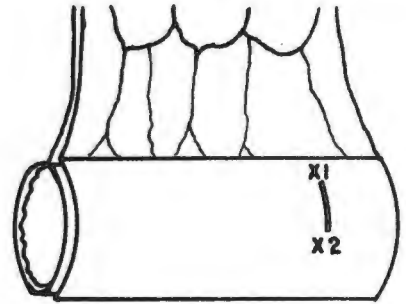
a. The site for anastomosis



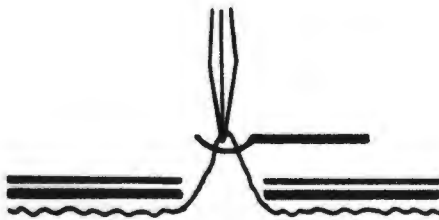
b. Adjusting the length of the ureter



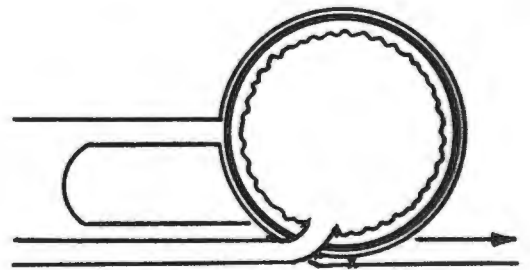
c. Preparing the ureter for anastomosis



d. Placing the bowel incision



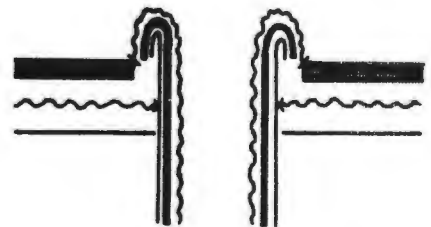
e. The mucosal opening



f. The completed anastomosis



g. The skin stoma



h. Anatomy of the ileostomy nipple

FIG. B.3.5
ILEAL CONDUIT: TECHNIQUE.

pulled up and cut off with scissors to open into the bowel (Fig. B.3.5.e.). Two stay sutures are inserted at the points X_1 and X_2 on the ureter (Fig. B.3.5.f), uniting these to the corresponding points on the incision in the bowel. Black silk, size 4-0 on a round-bodied needle is used, taking mucosa only on the bowel side and full thickness of wall of ureter, with the knot on the outside. The bowel mucosa moves quite freely on the submucosa allowing eversion of the mucosa for easy anastomosis. The anastomosis is completed by placing closely-spaced interrupted 4-0 silk sutures round the circumference of the ureter and mucosal opening in the bowel. In the average case twelve sutures would be required to complete the anastomosis. By releasing the slight everting traction, the mucosal edge will tend to return to its normal position in the bowel and this is assisted to give about 0.5 cm. invagination of the anastomosis into the bowel lumen. With the ureter in this position, four sutures of the same material are inserted taking adventitia of ureter and peritoneum of bowel. The mucosa-to-mucosa sutures represent the effective ureter-to-bowel anastomosis, the adventitia-to-serosa sutures serve only to maintain the slight invagination. When the anastomosis has been completed, a single suture is placed taking bowel peritoneum just distal to the point X_2 (Fig. B.3.5.d.) and a corresponding point on the posterior abdominal peritoneum, selected to produce, on tying the suture, a slight downward slide or roll of the bowel in order to finally straighten the terminal ureter (Fig. B.3.5.f.). The same procedure is repeated on the opposite side. The incisions in the posterior parietal peritoneum, through which the ureters were mobilised, are closed.

An opening, in the abdominal wall, is now prepared for the distal end of the ileal segment. At the site previously marked on the skin, a button of skin, one inch in diameter is excised. The easiest way of doing this is to make two skin incisions crossing each other, each one inch long, and then

excise the four quadrants (Fig. B 3.5.g.) A button of similar size is excised from the external oblique aponeurosis. The underlying fleshy muscle is incised in a cruciate manner and the peritoneum entered. The opening should permit the little and ring fingers of one hand to pass through into the peritoneal cavity easily. A Kocher clamp is passed through from the outside, the clamp on the distal end of the loop is removed and the bowel pulled through the abdominal ostium by gripping the crushed margin with the second clamp. By pulling gently on this clamp the isolated bowel segment can be made to lie with just the correct amount of tension. It will generally cross the caecum just below the ileocaecal junction and about an inch will project beyond the skin opening. Apart from the two fixation sutures already mentioned, only one further suture is inserted between the loop and the anterolateral aspect of the caecum just below the termination of the ileum.

Four sutures of 3-0 chromic gut is used to fix the serosa of the emerging bowel to Scarpa's fascia. The clamp is removed, the crushed bowel edges separated and a 24 F catheter introduced and guided along the loop so that its tip will lie just distal to the opening of the right ureter. The catheter is immediately secured in this position with a bridge-suture taking skin on each side of the abdominal ostium.

The abdominal incision is closed after a final peritoneal toilet and the removal of packs or return of the small bowel to the peritoneal cavity. The peritoneum is closed with a continuous suture of 2.0 chromic gut, special care being taken to include the posterior rectus sheath in the upper part of the incision. The anterior rectus sheath is closed with closely-spaced interrupted sutures of 3-0 black silk and the skin with 2-0 black silk. Lastly the margin of the protruding bowel is turned back and sutured to the skin edge of the abdominal opening to produce a mucosa-covered nipple

of bowel projecting about $\frac{1}{2}$ inch beyond the surrounding skin (Fig. B.3.5.h.). A longer nipple becomes floppy and is a disadvantage at a later stage when an ileostomy appliance is fitted.

Apart from routine postoperative care, the patient is maintained on intravenous fluids until flatus is passed, usually about three days. Nasogastric suction is seldom necessary and abdominal distention is not a problem. Special biochemical care may be required in patients who are pre-uraemic before operation.

Urine is drained through the indwelling catheter for 12 days postoperatively. Excess of intestinal mucus is sometimes a problem. If the catheter becomes blocked it is cleared by gentle irrigation with a bicarbonate solution. On the twelfth day the catheter is removed and a 'stick-on' ileostomy appliance, of the Chiron or Rutzen type with disposable polythene urine containers, applied. The patient is already out of bed and is soon able to manage the appliance herself. Before the patient leaves hospital, the abdominal ostium is calibrated by passing an index finger along the lumen of the bowel into the peritoneal cavity. The finger should not be gripped tightly.

THE RESULTS

The patient with advanced carcinoma of the cervix might benefit from diversion of the urine in various ways. In general it is hoped that the patient's life will be prolonged and that she will be made more comfortable.

Prolongation of life is achieved mainly by relieving urinary obstruction. In this way death from uraemia is prevented. By by-passing the urine sepsis is diminished (especially in those cases with a malignant vesicovaginal fistula) and secondary haemorrhage lessened. Both these may allow the patient to deteriorate less rapidly. More intensive radiotherapy may be used following urinary diversion - this may again prolong the patient's life. Ligation of the internal iliac arteries at operation may prevent the massive haemorrhages which is responsible for death in a few cases (Case 56).

The patient is made more comfortable chiefly by the relief of severe bladder symptoms (burning, increased frequency and haematuria) resulting from bladder invasion, and by substituting an efficient ileostomy appliance for a leaking vesicovaginal fistula.

In this small personal series of 18 cases, the preoperative intravenous pyelogram showed a dilated upper urinary tract and/or non-functioning kidney in 16 cases, an indication of the extent to which the presence of urinary obstruction influences the decision to advise urinary diversion. A malignant vesicovaginal fistula was present in 11 patients and invasion of the bladder was noticed at cystoscopy or operation in a further 5 cases. The relief of a constant urinary leak from the vagina was prominent amongst the indications for operation. Preoperatively the haemoglobin level varied from 4.3 Gm. to 14.5 Gm. per cent with an average of 8.5 Gm. per cent. Haemorrhages due to eroding growth, aided by sepsis and continuous urinary discharge, occurred quite frequently.

An improvement in the patient's condition, both subjective and as reflected in gain in weight, better appetite, improvement in haemoglobin values and falling blood urea levels, was recorded in 14 cases.

Although the operation of ileocutaneous ureterostomy is not a very major procedure, it is not without complications in these severely ill patients. Seven patients are known to have died. Four of these died 5 - 17 days after operation from progressive renal failure not responding to the removal of the ureteric obstruction. It might be considered that the decision to operate in these cases was not a wise one; they might have lived a few days or weeks longer without interference. To this extent, the decision to operate reflects against the accuracy of assessment of the potentially recoverable renal function. The other three deaths occurred 2, 4 and 12 months after operation, the first two dying in renal failure and the third one following a massive vaginal haemorrhage. All three were much more comfortable while they lived.

The remaining 11 patients were last seen alive at periods varying from 4 weeks to 12 months following operation. One required revision of the ureteric anastomosis on the third postoperative day and made normal progress thereafter (Case 55). Case 56 had a slight recession of the ileostomy nipple but managed well with her appliance. Wound dehiscence occurred in two patients (Cases 69 and 70) but this did not materially interfere with their progress. In two patients (cases 64 and 70) the ileostomy nipple was eroded by the flange of the ileostomy appliance, inexpertly used, to produce a lateral fistula - a complication that has also been reported by Annis² and Glaser⁸. After revision and training, normal progress was maintained.

These figures are perhaps not convincing. Personal daily contact with these patients and comparison with other patients with disease of comparable

extent leaves no doubt that they derived very considerable benefit from the operation and that, in many cases, life was considerably prolonged.

CASE 54:

M.S., aged 38, the mother of 10 children. Irregular vaginal bleeding for 3 months, vaginal discharge and burning on urination for 2 months. Presented with a hard hypogastric mass, size of a 16 weeks pregnancy. Stage IV carcinoma cervix. Histology: undifferentiated squamous cell carcinoma. Cystoscopy showed gross bullous oedema of the bladder base. Blood urea 29 mg.%. Hb. 10.5 Gm. Chest clear. Intravenous pyelogram showed bilateral hydronephrosis. Aortogram showed lateral displacement of the right internal iliac artery with pooling of dye in this area (Fig. B.3.6.). Exploratory laparotomy revealed an extensive growth with solid infiltration of bladder and spread to sidewalls of pelvis. The appendix was adherent to an area where growth had penetrated the pelvic peritoneum. The ureters were markedly dilated and thin-walled. An ileal conduit was performed. Five weeks after operation the patient was transferred for a course of deep therapy. She was in good general condition and managed the enterostomy appliance easily.



Fig. B.3.6. Case 54:
Aortogram. Lateral displacement of
right internal iliac artery.

CASE 55:

A.Z., aged 30, complaining of lower abdominal pain and pain in the right thigh for 4 months. An offensive bloodstained vaginal discharge had been present for 3 months and urine was leaking from the vagina. On examination she had a stage IV well differentiated squamous cell carcinoma. A malignant vesicovaginal fistula was present. There was massive fixation to the sidewall of the pelvis on the right side. Chest clear: Bloodurea 25 mg %, Hb. 8.9 Gm. Intravenous pyelogram showed a non-secreting right kidney while the left side was normal. The

aortogram demonstrated diminished vascularization of the right half of the pelvis.

Laparotomy revealed spread to the pelvic wall on the right side, involving the ureter which was grossly dilated. The ureter on the left side was dilated to a lesser degree. An ileal conduit was performed. She developed severe oliguria and a rising bloodurea. The abdomen was reopened on the 3rd day and the ureteric anastomosis on the left side revised. Thereafter she made normal progress. When last seen 10 weeks after the operation the enterostomy was functioning well. She was markedly anaemic, Hb. 5.9 Gm. Blood transfusion was given.

CASE 56:

D.S., aged 43, treated for carcinoma of the cervix with radium and deep therapy one year previously. Vaginal bleeding recurred. On examination she had a grade IV growth with fixation to the pelvic side wall on the left. Normal chest. Hb. 10.5 Gm. Blood urea 14 mg.%. No secretion on the left side on intravenous pyelography, right side normal. An ileal conduit was performed, the left ureter markedly dilated.

She was a stout woman and the bowel end retracted slightly into the abdominal wall. However she managed the appliance well. Six months later both kidneys showed excretion of dye on the pyelogram. Blood urea 23 mg. per cent. She died a year after operation following a recurrence of severe bleeding.

CASE 57:

N.N., aged 68, incontinence of urine and bloodstained vaginal discharge for 3 months. Had had radium and radiotherapy. Poor general condition. Stage IV carcinoma cervix, squamous cell in type, with extension to left side-wall of pelvis and glands along the sacrum. Cystoscopy: carcinomatous infiltration of bladder base, trigone and posterior urethra. Chest clear. Hb. 8.0 Gm. Blood urea 80 mg. %. Intravenous pyelogram: Hydronephrosis on right, no function on left (Fig. B.3.7.). An ileal conduit was performed. The left ureter was thickened and adherent. On division it was found full of pus. Tied off. Only right ureter trans-

planted. The patient died in uraemia 5 days after operation. At postmortem there was a suppurative pyelonephritis on the left while the lungs showed metastatic carcinoma.



Fig. B.3.7. Case 57:
Intravenous pyelogram. No function on left side.

CASE 58:

M.M., aged 70, showed on examination a stage IV, well differentiated squamous cell carcinoma of the cervix, with malignant vesicovaginal fistula. Satisfactory general condition. Hb. 15 Gm., blood urea 40 mg %. Intravenous pyelogram: no function left side, normal right, filling defect bladder. Ileal conduit was performed: extensive infiltration of bladder with fixation to left sidewall of pelvis. No glandular or visceral secondaries. On discharge from hospital six weeks later, ileostomy functioning well and patient managing it perfectly.

CASE 59:

J.L., aged 57; seen following treatment with radium and deep therapy, complaining of vaginal discharge and abdominal pain. Grade IV undifferentiated squamous cell carcinoma with vaginal stenosis and malignant vesicovaginal fistula. Poor general condition, blood urea 60 mg%. Intravenous pyelogram: marked hydronephrosis right side, no function left side. An ileal conduit was performed. The patient died on the 12th postoperative day in uraemia.

CASE 60:

N.Z., aged 48 complaining of lower abdominal pain for 4 months, urinary leak from the vagina for 3 months and loss of weight. She had a stage IV carcinoma cervix. Histology: squamous cell carcinoma, numerous mitoses (Fig. B.3.8.). Malignant vesicovaginal fistula present. Satisfactory general condition. Blood urea 10 mg. %. Intravenous pyelogram : normal right, no secretion left, filling defect left side of bladder.

An ileal conduit was performed. The uterus was firmly attached to the left side wall of the pelvis. Bladder invaded. Enlarged mesenteric nodes (no metastasis on histology).

When last seen six weeks after operation appeared very well : not febrile, chest clear, blood urea 42 mg %, Hb 12.5 Gm. Ileostomy functioning well.

CASE 61:

N.S., aged 40 complaining of lower abdominal pain for one month and incontinence of urine and vaginal bleeding for 2 weeks. On examination : carcinoma cervix Stage IV, poorly differentiated squamous cell carcinoma. Malignant vesicovaginal fistula. Hb. 7.5 Gm,

blood urea 60 mg.%. Intravenous pyelogram : no secretion left side, poor secretion right, with renal outline enlarged.

An ileal conduit was performed. The para-aortic glands were enlarged and there were secondaries in the liver. A pyometra and right pyosalpinx were drained. Both ureters were dilated. The left kidney was small and fixed, the right kidney enlarged.

After operation the bloodurea continued to rise and the patient died 11 days later.

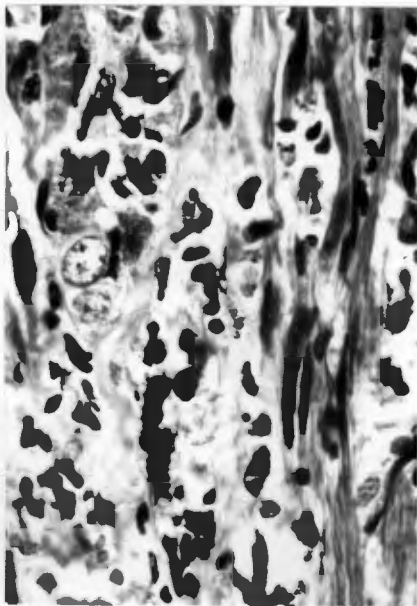


Fig. B.3.8. Case 60:
Squamous cell carcinoma cervix.
Numerous mitoses.

CASE 62:

P.P., aged 56 years, anaplastic (probably squamous cell) carcinoma cervix stage IV. (Fig. B.3.9.). Had been treated with radium and radiotherapy. On examination : malignant vesicovaginal fistula. Blood urea 26 mg %. Intravenous pyelogram: normal left upper tract, no secretion on right side. An ileal conduit was performed - direct extension to right side of pelvis with massive glandular enlargement along the iliac arteries and extension into the base of the bladder. Markedly dilated, thin walled right ureter, slight dilatation left side. When seen 5 months later the ileal conduit was functioning well. Hb. 9.8 Gm, bloodurea 38 mg %, intravenous pyelogram: perceptible excretion right side.

CASE 63:

B.M., aged 38 years, first seen October 1959, stage 1 carcinoma cervix, but refused all treatment. When seen again in October, 1960, stage IV carcinoma cervix spreading to rectum. Hb. 5.8 Gm, bloodurea 25 mg%, chest clear, intravenous pyelogram normal. She had 2 radium insertions and deep therapy.

In May, 1961 she had developed a rectovaginal fistula and a left inguinal colostomy was performed.

In August 1961 Hb. 9.3 Gm, bloodurea 39 mg.%, intravenous pyelogram: hydro-nephrosis right side. An ileal conduit was performed : the growth had extended into the rectum and bladder with fixation to sidewall of pelvis on right side.

She lived for 2 months following urinary diversion.

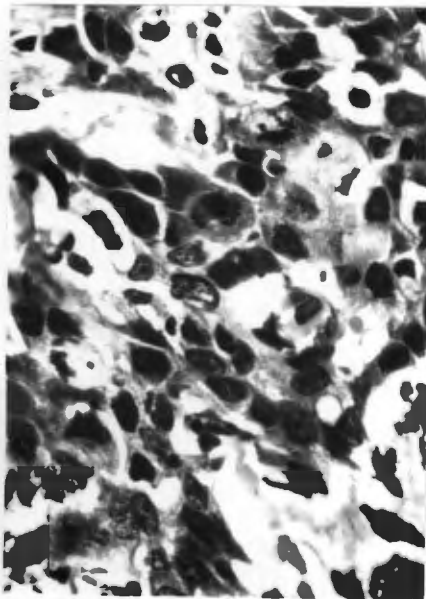


Fig. B.3.9. Case 62:
Anaplastic carcinoma of the cervix.

CASE 64:

M.M., aged 27 years, complaining of vaginal discharge, vaginal bleeding and backache. Carcinoma cervix, stage III, adenocarcinoma in type. (Fig. B.3.10.). Intravenous pyelogram : early right hydronephrosis, and filling defect right side of bladder (Fig. B.3.11.).

She had 2 radium insertions, and was improved.

When seen again a year later she was markedly emaciated. The carcinoma had progressed to a stage IV., Hb. 9.2 Gm., bloodurea 24 mg%. A malignant vesicovaginal fistula and rectovaginal fistula were present. She had a drop foot on the right. Intravenous pyelogram showed increase in the hydronephrosis on the right side.

An ileal conduit was performed. There was a dilated thin-walled ureter on the right side while the left side was normal.

Four months after operation she was severely emaciated. The left inguinal glands had become enlarged. The ileostomy nipple had become eroded by pressure of the appliance to form a lateral fistula. This was repaired.

Three months later there was further progress of the malignant process.

The ileostomy was functioning satisfactorily.

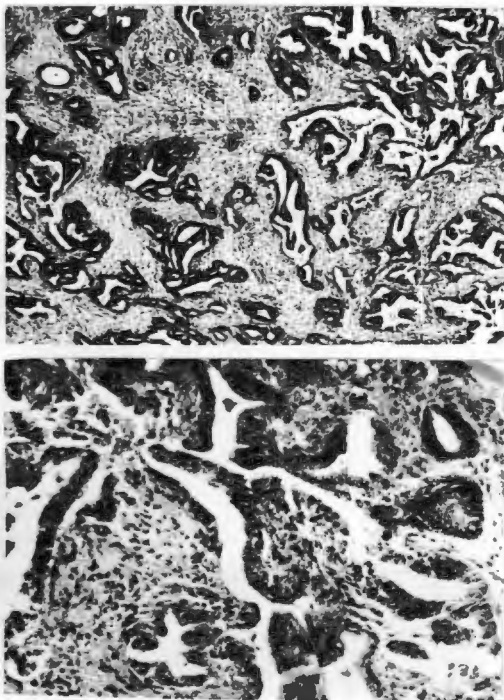


Fig. B.3.10. Case 64:
Adenocarcinoma of cervix.



Fig. B.3.11. Case 64:
Intravenous pyelogram. Right hydro-
nephrosis, filling defect of bladder.

CASE 65:

F.X., aged 50 years, presented with a stage IV carcinoma cervix, poorly differentiated in type. Malignant vesicovaginal and rectovaginal fistulae were present. Hb. 7.0 Gm., bloodurea 74 mg%. Chest clear, intravenous pyelogram : right hydronephrosis, and bilateral poor function. An ileal conduit was performed.

When seen 3 months later there was increased perirectal infiltration. Hb. 8.4 Gm., bloodurea 52 mg.%, serum electrolytes normal. The intravenous pyelogram showed a normal upper tract. The patient managed the ileostomy appliance very well and the enterostomy nipple was healthy.

CASE 66:

E.M., aged 30 years, complaining of lower abdominal pain, vaginal discharge and dysuria. She was found to have a poorly differentiated squamous cell carcinoma cervix stage IV. A malignant vesicovaginal fistula present. Hb. 5.8 Gm., bloodurea 42 mg.%. Intravenous pyelogram showed hydronephrosis on the right side, the left side showed no secretion. An ileal conduit was performed.

When seen again 2 months later the patient's general condition had deteriorated. She died 4 months after the operation. The ileostomy was functioning well.

CASE 67:

S.M., aged 60 years, complaining of vaginal bleeding for 1 month. A fungating carcinoma cervix was present, stage IV, squamous carcinoma in type. Intravenous pyelogram did not show any excretion of dye. Cystoscopy showed malignant invasion of the bladder floor, especially of the area surrounding the right ureteric orifice. Bladder biopsy confirmed squamous carcinoma. An ileal conduit was performed. The right ureter was thickened and rigid and the kidney fixed. The left ureter was dilated. The patient died 17 days after operation, the blood urea rising to 238 mg.% before death.

CASE 68:

D.T., aged 34 years, complaining of incontinence of urine and faeces. Malignant vesicovaginal and rectovaginal fistulae were present. Hb. 11.2 Gm., bloodurea 57 mg.%. The intravenous pyelogram showed bilateral hydronephrosis. An ileal conduit was performed. The growth had extended to the sidewall of the pelvis on both sides.

The patient was last seen when she left hospital four weeks after operation. She was managing the appliance well.

CASE 69:

A.S., aged 45 years, complaining of abdominal pain for 5 months and a leaking of urine from the vagina for 2 days. On examination : carcinoma cervix stage IV, squamous cell in type, with malignant vesicovaginal fistula. Hb. 14.5 Gm., bloodurea 31 mg.%. Chest clear. Intravenous pyelogram : bilateral hydronephrosis.

An ileal conduit was performed. Both ureters were markedly dilated and thin walled. Wound dehiscence occurred on the 9th postoperative day - this was resutured.

When last seen 5 months later, she had lost weight, lower abdominal pain was still present and there was a constant bloodstained vaginal discharge. Hb. 10.5 Gm. The rim of the ileostomy appliance had eroded and caused a lateral fistula in the ileostomy nipple. The distal portion was removed and the appliance functioned very well subsequently.

CASE 70:

S.S., aged 45 years, complaining of lower abdominal pain radiating down right thigh and a bloodstained vaginal discharge. She was found to have a poorly differentiated squamous cell carcinoma cervix stage IV. Hb. 10.6 Gm., bloodurea 27 mg., blood W.R. negative, chest clear. Cystoscopy showed bullous oedema of the bladder base. Intravenous pyelogram : dilated calyces vaguely visible on the left side, no secretion on the right.

Radiotherapy was started. However, the bloodurea increased progressively. An ileal conduit was performed. Both ureters were grossly dilated. There was solid invasion of the bladder and the growth had extended to the side-

wall of the pelvis on the right side.

The abdominal wound ruptured on the 7th postoperative day and was resutured. When she left hospital four weeks after operation, the ileostomy was functioning well and her general condition had much improved.

CASE 71:

J.K., aged 40 years, complaining of menorrhagia for 3 months and urine leaking from the vagina. She was found to have a well differentiated squamous cell carcinoma of the cervix, stage IV (Fig. B.3.12.), with a malignant vesicovaginal fistula. Hb. 4.3 Gm., bloodurea 16 mg.%. The intravenous pyelogram was normal.

A course of deep therapy was given.

Ileal conduit was performed and this was followed up with further deep therapy and two radium insertions. Following a fairly severe radiation reaction, the local condition was much improved.

She was discharged from hospital three months following operation in good general condition with the ileostomy functioning very satisfactorily.

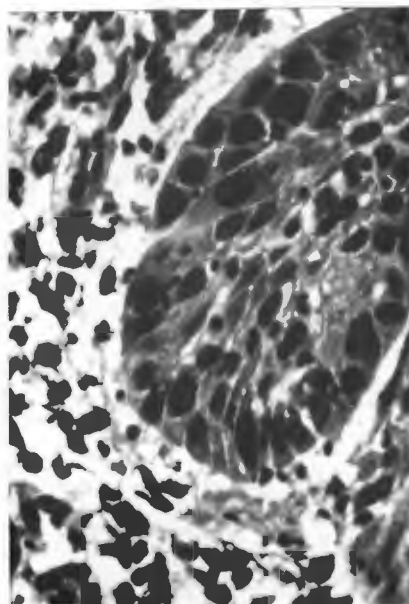
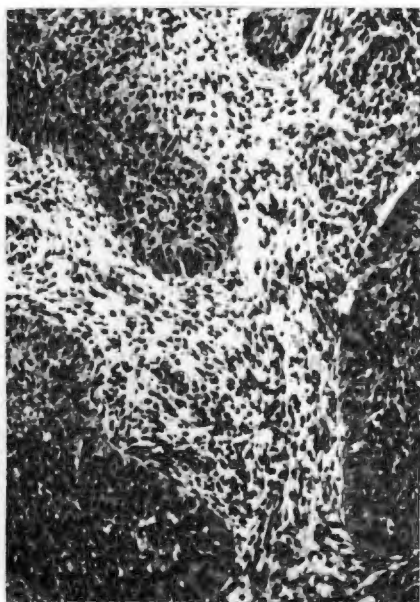


Fig. B.3.12. Case 71:
Well differentiated squamous cell
carcinoma of the cervix.

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SECTION B.4

CUTANEOUS URETEROSTOMY : ITS USE AS A
METHOD OF URINARY DIVERSION

CONTENTS

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CUTANEOUS URETEROSTOMY : ITS USE AS A
METHOD OF URINARY DIVERSION

Gignon¹⁷ is usually credited with first suggesting the possibility of transplanting the ureters to the skin as a method of supravescical diversion of urine, in 1856. Shortly afterwards le Dentu³³ probably actually carried out the operative procedure of cutaneous ureterostomy for the first time. During the following 50 years the operation was used mainly to divert the urine from a grossly contracted or irritable tuberculous bladder, in some cases of irreparable vesicovaginal fistula, in malignant growths of the bladder or female pelvic viscera following extirpation or obstruction of the ureters by growth, and in injuries of the ureter, especially in the presence of a single kidney. With the increasing popularity of ureterosigmoidostomy, especially after 1920, cutaneous ureterostomy was used less often. However, even in 1925, it was still used as a method of urinary diversion in 100 out of 181 cases after total cystectomy by Papin³⁸, while Beer³ preferred it to ureterosigmoidostomy in 7 out of 8 cases in whom total cystectomy was performed for carcinoma of the bladder. The main attraction of ureterosigmoidostomy was the avoidance of the need for an external appliance to collect the urine.

After a sufficient period of time had permitted assessment of the post-operative results following ureterosigmoidostomy, it was realised that the operation carried a considerably higher mortality rate and that patients with ureters dilated by obstruction and thickened by inflammatory infiltration did poorly when such ureters were implanted into the colon. In such cases, and in those where life expectancy was too uncertain to risk the hazards of the more extensive procedure, there was therefore a tendency to advise cutaneous ureterostomy more frequently.

This was more or less the position in 1949 when the first of several new

methods and modifications of older methods of urinary diversion came into use, especially the mucosa-to-mucosa technique of transplanting the ureter, ileo-cutaneous ureterostomy, the ileocaecal bladder and the isolated rectosigmoid pouch. These operations avoided some of the postoperative complications of ureterosigmoidostomy, especially the recurrent attacks of pyelonephritis, but had the disadvantage of an abdominal stoma and the need for a collecting apparatus. The larger mucosa-lined bowel stoma did not tend to retract or stenose as often as the ureterostomy opening and the indwelling ureteric catheters, liable to introduce infection to the kidney, were eliminated. Moreover there was only one opening to look after instead of two ureterostomy openings.

There was no doubt however, that very favourable long term results were obtained in a reasonable proportion of patients following cutaneous ureterostomy. Keyes³⁰ reported a follow-up study of 6 cases for periods of 3 to 19 years. In 3 of these patients indwelling catheters were not necessary and urine collection was satisfactorily achieved by using a Bard-Whitfield cup. He noted the great relief given by the procedure in patients with irritable tuberculous bladder. A similar opinion was expressed by Colby⁹ who treated 10 patients with active renal tuberculosis by cutaneous ureterostomy - bilateral in two and unilateral in 8 who had had previous nephrectomy. Folsom and O'Brien¹⁵, in reporting a series of 12 cases, stressed the low mortality of the procedure even in the debilitated patient and the fact that the ureter and kidney are accessible for treatment and direct medication. They felt that it was the only method providing complete renal drainage in grossly dilated ureters. Of 6 cases with advanced carcinoma of the cervix and ureteric obstruction, 5 lived for periods of 5½ to 16 months in reasonable comfort. Goldstein¹⁹ used the operation in contracted tuberculous bladder, for incontinence due to spina bifida and in interstitial

cystitis. He reports definite palliation in 7 cases with inoperable carcinoma of the bladder in that the patients were relieved from increased frequency, urgency, tenesmus, haematuria and pain. To avoid sloughing and retraction of the stump of the ureter, Goldstein and Berman²⁰ did the operation in two stages. At the first operation a loop of ureter was mobilised and brought on to the abdominal wall. In the second stage the ureter was divided and the end brought out on the skin. In this way the blood supply to the ureter was preserved and local infection avoided. They used indwelling catheters for collecting the urine. Vose and Dixey⁴³ prefer the technique of ureterostomy in situ. There is no displacement of the ureter so that its blood supply is undisturbed, the necessary surgery is minimal and any length of ureter is satisfactory, the granulation tissue-lined fistula from skin to ureter tolerates the indwelling catheter very well and changing the catheter is easy. The method is useful when temporary diversion is required. Greene²² used cutaneous ureterostomy in 14 patients suffering from urinary tuberculosis, carcinoma of the bladder and prostate and neurogenic bladder disturbance. He is of the opinion that the operation is the only practical method when there is considerable dilatation of the ureters with infected kidneys. Mathe³⁶ reports 2 cases surviving 16 and 23 years following ureterocutaneous anastomosis. A collecting apparatus devised by the author was used³⁵. He advises the operation when there is obstruction of the ureters in malignant disease of the bladder or female adnexae, intractable sclerosing cystitis following nephrectomy for tuberculosis, non-tuberculous interstitial cystitis failing to respond to local measures, incurable ureteric strictures, eg. following irradiation for carcinoma of the cervix, intractable vesicovaginal fistula and in some cases with incontinence due to spina bifida. He emphasises that the diseased ureter should be transplanted to the skin rather than to the sigmoid. De Vries¹² also stresses the same

point. He obtained views on then current practice amongst 350 urological surgeons in the United States of America and found that cutaneous ureterostomy was used as the method of urinary diversion in 33 per cent of all cases. It was especially popular in the management of tuberculous cystitis following nephrectomy. He points out that the operation is unsuitable for high ureteric obstruction. Johnston²⁹ used temporary cutaneous ureterostomy in the management of advanced congenital urinary obstruction in 10 children. All his patients improved on this type of drainage and were in better condition for operative correction of the primary urinary obstruction. Burns and colleagues⁷ used bilateral cutaneous ureterostomy as a salvage procedure in a patient who had a ureterosigmoidostomy performed for exstrophy 18 years previously. Their patient was considerably improved, using the Mathé appliance without the need for catheters. Cordonnier¹⁰, Daniel and Brunschwig¹¹ and Band¹, reviewing methods of urinary diversion, all emphasise the unfavourable features of cutaneous ureterostomy : high incidence of periureteric abscess, dilatation of the upper tract, recurrent renal calculi, recurrent urinary infection, difficulty in collecting the urine and ureteric stricture. They suggest that the operation may still have a place in the management of intractable tuberculous cystitis and in cases with extensive scarring of the ureter in the pelvis. Marked obesity would be a definite contraindication.

Apart from the Bard-Whitfield cup and the ureterostomy collecting apparatus designed by Mathé³⁵, most efforts, during this earlier phase, were directed at designing catheter-holding devices^{2,21,45} as indwelling catheters were accepted by most surgeons as the most suitable method of urine collection. At the same time it was realised that the presence of the catheters was directly responsible for some of the most frequent postoperative complications : recurrent renal infection and renal calculi.

The continued use of cutaneous ureterostomy as a method of urinary diversion therefore appeared to depend on the successful solution of two problems: the prevention of sloughing, retraction and stricture of the terminal ureter with, instead, the formation of a projecting ureteric nipple, and secondly, the design of a really satisfactory urine collecting device for external application. It was also thought desirable to investigate the possibility of constructing a single ureterostomy stoma instead of two widely separated openings.

The design of an externally applied collecting apparatus was considerably assisted by the fact that the more frequent use of ileocutaneous ureterostomy as a method of urinary diversion and ileostomy in ulcerative colitis called for a similar type of collecting device. The Chiron, Torbot and Rutzen types of apparatus, designed primarily for use with colostomy and ileostomy, were also used for ureterostomy, while the same basic design (essentially a ring, cemented on to the skin, carrying disposable collecting bags) was modified for use in ureterostomy specifically⁴⁴. Further modification and improvement in the design of these appliances are continuing. Hurwitz¹⁶ used a new type of double-backed, non-irritating disc, rather than the liquid latex cement of other types to which the patient may become allergic. Lapedes and co-workers³¹ constructed an appliance with a lightweight rubber ring sufficiently streamlined to be worn under form-fitting clothes. A very neat appliance, with the collecting bag placed on the thigh to prevent a tendency for it to dislodge the ring; was designed by Glenn¹⁸. An ileostomy appliance, designed by Benfield and Barnhart⁶ uses a base of silicone rubber, custom-fitted to yield an exact imprint of the stoma and surrounding skin. In this way skin irritation and breakdown can be prevented. Some of these appliances can be fitted at the completion of the operations, more often they are used after wound-

healing is complete.

Attempts to construct a satisfactory ureterostomy nipple have been numerous. Heckel²⁴ buckled the skin edges on each side of the ureter and sutured the split end of the ureter to the top of the ridge on each side. Schinagel and Sewell⁴⁰ brought the ureter out to project 4 to 5 cm. and covered it with skin pedicle. A similar technique with a different method of constructing the skin flap was used by Dodson¹³ and Benaim⁵. The last author had the opportunity of doing a postmortem study on two of his patients. He found the ureteric mucosa normal and the ureter surrounded by a well-nourished skin covering. Hudson, Wolan and Marden²⁷ constructed a raised skin bridge through the centre of which the ureter was brought out, the end split and sewn over. Simple bivalving of the terminal ureter and turning the edges back to the skin margin permitted Colby⁹ to manage all his cases with a colostomy bag without indwelling catheters. McDonald and Heckel³⁷ were able to manage 18 of their 22 patients without indwelling catheters. Young and Powder⁴⁶ point out that the normal ureter will not reach the usual ureterostomy site in the iliac fossa without tension. They brought the ureter out in the anterior flank between the end of the tenth or eleventh rib and the iliac crest. A high cutaneous ureterostomy was also advised and used by Lloyd and his colleagues³⁴ in 21 patients. They found it advantageous to prepare skin flaps that are inverted and anastomosed, by ureter-to-skin sutures, to the fish-mouthed ureter. This technique was used especially in the poor-risk patient with only one functioning kidney in which obstruction of the ureter was present or developing. Rickham³⁹, on his experience with cutaneous ureterostomy in 26 children, found that a ureteric opening sutured flush with the skin avoided stricture formation. All his patients were controlled with a Bullen bag.

The fact that two widely separated ureterostomy openings were usually

present and the increased difficulty of successful collection of urine was an additional factor which previously made cutaneous ureterostomy unpopular. Many ingenious attempts to provide drainage through a single stoma have been reported. There is of course no problem if the operation is performed on a single remaining kidney as is frequently the case in intractable tuberculous cystitis. If a single ureter is to be transplanted and the lower end of the opposite ureter is present and normal, eg. after previous nephrectomy or with a non-functioning kidney, skin ureterostomy may be completely avoided by doing a contralateral ureteroureterostomy. This aspect is discussed in detail in Section A.2. In many instances where palliative urinary diversion is performed for advanced malignant disease eg. in carcinoma of the cervix, a non-functioning kidney could probably be disregarded and only the better side transplanted. Little or no renal function will be sacrificed and the magnitude of the operation is halved. This idea was applied in practice by Huggins and Scott²⁸ who selected the more normal of the two ureters for ureterostomy. They pointed out that the care of bilateral ureterostomy is more than twice as difficult as the care of a single stoma. Swenson and Smyth⁴¹ brought the ureters out, side by side, through a short transverse incision midway between the umbilicus and symphysis pubis leaving about 4 cm. to project beyond the skin. After removing adventitia and muscle from the distal 2 cm. the mucosa is turned back and sutured to the skin. They used this technique, with excellent results, in 3 children with bilateral aperistaltic megalo-ureters with severe infection and progressive renal damage. Chute and Sallade⁸ brought the ends of both ureters through the abdominal incision in a patient undergoing cystectomy for carcinoma of the bladder. Both ureters were slit upwards for 1.5 cm. and the edges sutured together to form a single stoma. The edges were then turned back to form a mucosa-lined nipple. Eight months later the ureterostomy was func-

tioning well. Young and Powder⁴⁶ advise placing the ureterostomy stoma high in the anterior flank. One ureter is brought, retroperitoneally, across the midline in front of the aorta and inferior vena cava, its end spatulated and anastomosed to a longitudinal incision in the opposite ureter. The receiving ureter is brought out on the abdominal skin with 1 to 3 cm. projecting, the adventitia anchored to the skin, and a collecting apparatus applied. They used this technique in more than 40 cases and secured a healthy stoma functioning well for periods up to 5 years. Thompson and Ross⁴² brought both ureters through the abdominal skin just below the umbilicus. After suturing their adjacent edges together the single stoma was elevated by sewing the edge to a skin flap. There was no tendency for the opening to narrow down over a period of two years following operation. Lapidès³² reports his technique of butterfly cutaneous ureterostomy used in 4 patients. A common stoma is made halfway between umbilicus and symphysis pubis and the ends of the spatulated ureters anastomosed to the skin by a Z-plasty technique. All patients did well. Eckstein¹⁴ feels that cutaneous ureterostomy is the treatment of choice in cases with congenital neurogenic bladder in which incontinence is associated with sacculation of the bladder and gross dilatation of the ureters. He observes that, in a group of 149 children undergoing urinary diversion during the period 1950 to 1962, ureterocolic anastomosis has almost not been used since 1959. He regards the iliac fossa as the best site for the stoma. The longer ureter is brought across, retroperitoneally, and both ureters brought out through a circular opening in the skin and aponeurosis. The projecting ends are everted and the margin sutured carefully to the skin edge. If one ureter is almost normal, and end-to-side anastomosis is made retroperitoneally and only the dilated ureter brought out. Higgins²⁵ brings the ureters out through the umbilicus. The ureters are mobilised and brought out through

the lesser sac and omentum. Their medial borders are sutured together so that a single stoma results. Satisfactory control without the use of catheters was obtained.

Skin ureterostomy is not necessarily a permanent condition : if sufficient improvement takes place in the dilated upper tract, or if it is thought that more satisfactory arrangements can be made for collecting the urine, the ureters can be detached from the skin and implanted into the colon⁴, into an isolated loop of ileum or, occasionally, into the bladder, usually with a short ileal loop interposed.

If a single ureterostomy stoma can be satisfactorily established in every instance and if a satisfactory collecting device is available, cutaneous ureterostomy as a method of urinary diversion has several advantages. Compared to operations like ileal conduit and isolated rectosigmoid pouch, it is a much simpler and less traumatic procedure and is tolerated much better by children and the seriously ill and debilitated patients in whom this type of procedure is most often required. The peritoneal cavity need not be opened and bowel or ureteric anastomosis is not required. This avoids the risk of post-operative ureteric obstruction, abdominal distension, wound dehiscence and adhesions. The possibility of reabsorption of urinary constituents and biochemical disturbances does not exist after cutaneous ureterostomy whereas it is a definite hazard after any type of operation utilizing bowel as a reservoir or conduit for the urine. After cutaneous ureterostomy the ureter and kidney are readily accessible for treatment eg. drainage, irrigation or medication, and for retrograde urographic and renal function studies. The secretion of mucus, which is sometimes quite troublesome in bowel conduits, is avoided in skin ureterostomy. Recurrent urinary infection and, consequently, recurrent renal calculi, is avoided if suitable external collection of urine can be arranged.

An ideal ureterostomy stoma is not obtained in every case. This is true also for ileostomy stoma. However, if the operation of cutaneous ureterostomy is limited to cases in which the ureter is dilated a satisfactory single ureterostomy stoma will be possible in almost every case. The operation should probably only be done in such cases. In the dilated thick-walled ureter there is a very adequate periureteric vascular network³², ensuring a good blood supply after mobilization of the ureter. This will prevent sloughing of the terminal ureter. Only the dilated ureter will permit the edge to be turned back as a cuff to produce a mucosa-lined nipple - a technique which, in cutaneous ureterostomy as in ileostomy, overcomes the tendency for the ureteric opening to harbour chronic infection in its granulating edge and contract and retract progressively. It is precisely these cases with grossly dilated and tortuous ureters, in whom cutaneous ureterostomy is easiest and most successful, where other types of urinary diversion are difficult and often liable to complications.

It would appear that skin ureterostomy, in properly selected cases and properly performed, has a definite place in urinary diversion and will probably be used even more frequently in the future.

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SECTION C.1

THE USE OF BOWEL IN REPLACEMENT OF THE
URETER AND BLADDER

CONTENTS

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THE USE OF BOWEL IN REPLACEMENT OF THE
URETER AND BLADDER

During the first half of this century attempts at urinary diversion and bladder substitution consisted mainly of the performance of transplant of ureters into the intact colon, with the alternative of bilateral cutaneous ureterostomy. The dangers and complications of ureterosigmoidostomy were realised but no better alternative was available until after 1950 when isolated intestinal loops first came into use. This new technique was accepted with enthusiasm and used in an increasing number of circumstances in the repair and replacement of parts of the urinary tract.

Certain undesirable features, however, remained, and other techniques are constantly being suggested and applied in the experimental animal and in the human patient. Attempts are being made to modify intestinal segments to make them more acceptable, especially from the point of view of avoiding reabsorption of urinary constituents. Material other than intestinal segments have been tried. These have been discussed in relation to replacement of the ureter (Section A.1.). In the bladder, fascial grafts have been used to repair defects by Neuhof in 1917⁷⁰ and later by Koontz⁵² and DeMuth and his colleagues^{8,25}. DeMuth quotes Kirschner as having repaired a defect in the bladder of a human patient by using a free fascial graft. The patient died too early to allow evaluation of the procedure. These authors noted the overgrowth of the inner surface of the graft with transitional epithelium and also the frequent formation of bone at the site of the graft. Vascularized flaps of rectus and external oblique or gracilis muscle have been used to repair large bladder defects³³. Again, these muscle grafts have been observed to acquire a lining of bladder mucous membrane. A technique of cystoplasty, using polyvinyl sponge, in the dog, proved unsuccess-

ful⁵³. A substitute bladder, draining through an abdominal stoma, has been fashioned from part of the gastric fundus after cystectomy for carcinoma⁹⁹. The pouch functioned well over a period of 4 months. None of these techniques have found general application.

Several aspects of repair and replacement of the damaged or surgically resected ureter and bladder have been discussed in Sections A.1, A.2 and A.5. In this section the discussion will be limited to those methods using parts of the ileum or colon for replacement of part or the whole of the ureter or bladder. These bowel segments may either be used intact or modified in one of several ways. Methods designed to retain urethral voiding will be emphasized.

a. REPLACEMENT OF THE URETER

In the experimental animal the feasibility of draining the urine through a bowel conduit has been investigated since 1938 when Matsumoto^{61,62} implanted the ureters into partly and completely isolated segments of small bowel. Using segments of 35 cm. all animals died 7 to 10 days after operation. Mersheimer and his co-workers⁶⁶ implanted both ureters into isolated 10 cm. loops of terminal ileum, in dogs. Observation over a period of 18 months showed that the kidneys remained uninfected. Some dilatation of the ureters were present. McLean and Fais⁶⁴ fashioned a 20 cm. segment of small intestine into which one or both ureters were transplanted or anastomosed as a diverticulum to the bladder. They noted considerable contraction of the segment a year later. They confirmed that the animals remained well for periods of up to 18 months, without significant elevation of serum and chloride levels, even during a normal pregnancy. Annis³ demonstrated normal renal function and anatomy for 12 to 14 months following replacement of half to three-quarters of the ureter with a loop of ileum in the dog, the contralateral kidney having been removed. He suggested that this procedure may prove useful where part of the ureter requires removal during radical operation for carcinoma, for multiple ureteric strictures (eg. those associated with tuberculosis) and in any case where an extensive gap in the ureter has to be bridged. Davids and Lesnick²³ reported their findings following replacement of part of one or both ureters with small bowel in the dog. Renal function remained normal for periods up to 2 years. They thought that the technique may find application for reconstruction following removal of primary neoplasms of the ureter and in the management of megalo-ureter. Shoemaker⁹⁴ used a segment of ileum as a seromuscular tube to replace the ureters in the dog. Preliminary results were very promising.

In 1932 Nissen replaced a strictured section of the left ureter with a 20 cm. segment of small bowel. This operation was reported in 1940⁷¹. Aboulker² reported a similar case. Muller⁶⁹ used the same technique to replace the ureters following trauma during radical hysterectomy. Rack and his colleagues^{80, 81, 82} used the procedure in several human cases. A palliative by-pass was constructed in a patient with inoperable carcinoma of the rectum obstructing the ureter. In a Roux-en-Y arrangement, two segments of ileum were used in a salvage procedure following bilateral cutaneous ureterostomy. Other patients included cases with fibrotic obstruction following irradiation, radical resections for carcinoma involving the ureter and a damaged ureter. In one patient the proximal anastomosis was made direct to the renal pelvis after resection of a cyst in the lower pole of a single kidney. Complete replacement of the ureter has also been reported by Ulin¹⁰³ in two patients with recurrent renal stones and by MacDonald and Kataria⁵⁹ following cystectomy in a patient who also had a stenosis of the right ureter.

In the patient reported by Foret and Heusghem³² the lower parts of both ureters were replaced with a 50 cm. loop of ileum, for the relief of bilateral meatal stenosis. There was definite improvement one year later. A similar case is reported by Davis and Nealon²⁴. Ortvad⁷³ replaced the lower ureter with a 15 to 20 cm. segment of small bowel in a male patient following trauma to the ureter as a result of manipulation for ureteric stone. A significantly diminished degree of hydronephrosis was noted 8 months later although there was free reflux on cystography. Baum¹⁰ recorded four clinical cases in whom one or both ureters were replaced with a segment of small bowel. In one instance the proximal anastomosis was made directly to the renal pelvis. He also noted the regular occurrence of reflux.

Pyrah and his colleagues^{76,77,78} have reported extensively on the use of

ileal segments in the surgery of the ureter. These segments were used to re-implant the ureters into the bladder following injury, previous cutaneous ureterostomy or previous ureterosigmoidostomy, or to bridge a gap in the ureter following excision of a papilloma. Pyrah stresses the point that the section of the ureter replaced must extend down to and include the ureterovesical orifice : a central segment of ureter cannot be replaced. Wells¹⁰⁹, in reporting 56 cases, found application for this technique in the management of tuberculous strictures, ureteric damage or tumour, mega-ureter and as a salvage procedure following ureterocolic anastomosis. The operation has been used successfully in correcting hydronephrosis due to pelvi-ureteric obstruction in infants and adults^{28,47,54,58}. It is advised in cases of long duration where plastic procedures have failed, where only a single functioning kidney remains and where the dilated pelvis has lost its powers of contraction permanently. The advantages over permanent nephrostomy are pointed out.

Repair of a damaged ureter constitutes a frequent indication for ileal replacement^{27,55}. Moore and his colleagues⁶⁸ recorded four cases. They observed free reflux from the bladder into the ileal ureter but this did not complicate the postoperative course.

Replacement with an ileal segment was sometimes required following resection of primary neoplasms of the ureter^{22,76}. This is accepted as sound operative management for low grade papilloma localized to the ureter by other authors¹⁰⁵.

The possibility of using a segment of ileum, in an antiperistaltic arrangement, as a valve, has been investigated by several authors. In the dog, Rieger⁸⁷ and Rieger and Harris⁸⁶ interposed a 15 to 20 cm. loop of small bowel between the bladder and the colon. Infection of the bladder was not prevented. Abbott and his co-workers¹ did not consider the diver-

sion of urine to the sigmoid via an ileal loop a satisfactory procedure.

Clinical cases have been recorded by Hudson and Fox⁴⁶ who used it successfully in 3 patients, Powell and Hays⁷⁵ who used it as a conduit between the bladder and the rectum in 3 cases of exstrophy, and by Houtappel⁴⁵ in 12 patients.

Houtappel used, in addition, a nipple-shaped ileo-sigmoid anastomosis to assist the valve action.

CONCLUSIONS

The operation of ileal replacement of the ureter may be accepted as finding useful application in the following circumstances:

- i. In malignant disease: In replacing a segment of the ureter that has been excised to remove a primary low-grade neoplasm or as part of a wide excision of a neighbouring growth which is considered operable; As a bypass in the management of cases where the ureter has become obstructed by inoperable carcinoma, usually of the large bowel.
- ii. In severe trauma when a large part of the ureter requires to be replaced. This is usually the result of damage during operative procedures in the pelvis (with or without fistula formation), or after repeated operations for calculi in the lower ureter or for meatal stenosis.
- iii. In extensive post-irradiation or post-inflammatory strictures of the ureter. This usually follows irradiation for carcinoma of the cervix, urinary tuberculosis or bilharziasis with involvement of the ureter.
- iv. In advanced hydronephrosis with progressive renal destruction due to pelvi-ureteric stenosis not amenable to plastic operations.
- v. In some cases of mega-ureter.
- vi. In a rare case with recurrent renal stones.
- vii. As a salvage procedure following cutaneous ureterostomy or uretero-sigmoidostomy, either to facilitate urine collection or to prevent progressive renal damage or electrolyte imbalance.
- viii. In providing a valve mechanism between the ureters and the intact colon. Its usefulness in this application has not been established.

C.1.a CASE RECORDS

CASE 5:

This patient is reported in Section A.1: Ileal replacement of 15 cm. of lower ureter following operative injury.

CASE 72:

An African female, aged 37 years, had bilateral ureterosigmoidostomy performed for a large vesico-vaginal fistula in 1952. She was seen again 9 years later requesting that normal urinary function be restored again. The vesico-vaginal fistula, in the dry bladder, had become significantly smaller. The intravenous pyelogram showed a normal right side but no function on the left side (Fig. C.1.a.1.) The fistula was closed successfully after two vaginal operations. However the bladder capacity was very much reduced. The ureters were disconnected from the colon and re-anastomosed to the bladder via a U-shaped loop of ileum (Fig. C.1.a.2.), enlarging the capacity of the



Fig. C.1.a.1. Case 72:

Intravenous pyelogram. No function on left side.

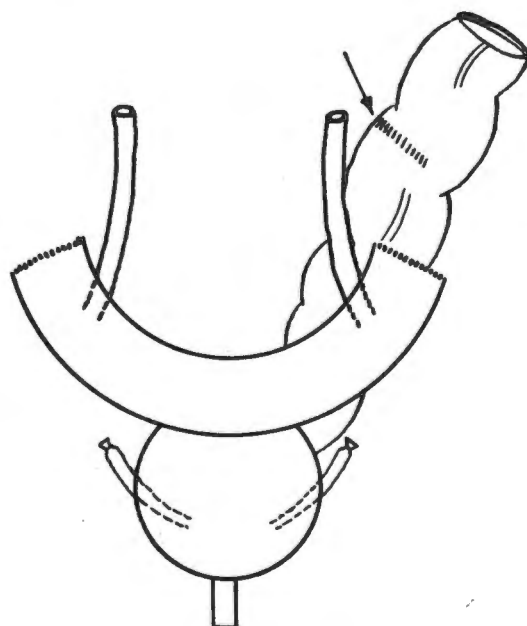


Fig. C.1.a.2. Case 72:

Uretero-ileocystoplasty.

bladder at the same time.

When last seen 8 months following operation she was passing urine, with full control, about every 4 hours. The serum electrolytes were normal. The intravenous pyelogram showed mild hydronephrosis on the right side. No function had returned to the left side.

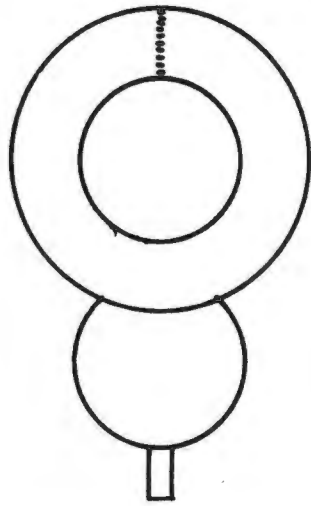
(This case is mentioned in Section A.3, Group 3 (g).)

b. REPLACEMENT OF THE BLADDER

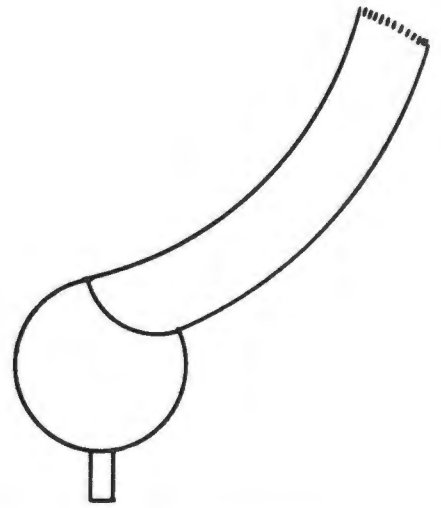
Although reported as an experimental procedure since 1923^{91,93}, the use of an isolated segment of bowel to replace part or the whole of the bladder, to enlarge a contracted bladder or to serve as a conduit for re-implantation of the ureters into the bladder, has found frequent application in human patients only for the past 15 years. Either ileum or colon may be used for this purpose.

ILEUM:

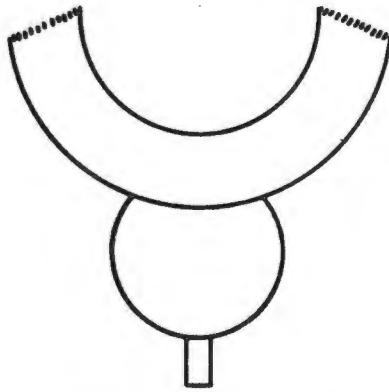
A segment of the required length is isolated from the lower ileum, the distal point of division so selected as to allow reconstitution of continuity of the ileum by end-to-end anastomosis in front of the mesentery of the isolated segment without difficulty. The segment is usually sited opposite a strong branch, from an ileal artery, that communicates freely with the mesenteric arcades on both sides. Every part of the loop can usually be brought into apposition with the bladder without tension or the need for special mobilization. The method of anastomosis of the loop to the bladder may be one of several types (Fig. C.1.a.3.). The emptying of these loops have been studied with the x-ray image amplifier by Hanley⁴⁰. He found that with the 'cat's tail' anastomosis (Fig. C.1.a.3.d.) emptying is better than with any other method. The ileum can be opened up and applied to the bladder in the form of a flat graft^{101,102} to enlarge the size of the anastomosis and to eliminate a possible 'diverticulum' effect and residual urine - difficulties which may arise after tubular ileocystoplasty. Yeates¹¹⁰, in the grossly contracted bladder, splits the bladder in the sagittal plane from the peritoneal reflection to the interureteric ridge and then anastomoses an open loop to this opening. Ferris^{29,30} uses a long transverse opening to which he sutures the antimesenteric border of the loop and obtains an



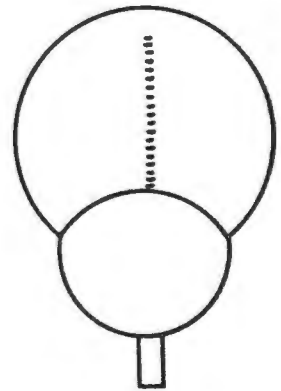
a. Ringplastik of Scheele



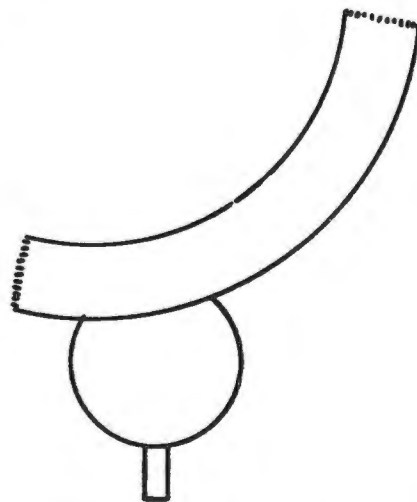
d. Cat's tail anastomosis



b. Symmetrical U-loop



e. Open flap method: Tasker patch



c. Asymmetrical U-loop

FIG. C.1. a. 3: Various methods of entero-vesical anastomosis

adequate anastomosis in this way. Cibert¹⁸ advises resection of the whole detrusor part of the bladder in tuberculous cystitis to avoid secondary stenosis after anastomosis. If the whole bladder has been resected an ileal loop is connected to the bladder neck or prostatic urethra and continence so preserved^{31,34,63,78,83}. If the ureters are re-anastomosed to the bladder through the loop, an end-to-side anastomosis of ureter to ileum is generally used rather than implantation of the ureter into the end of the bowel. The ileal loop is generally 15 to 25 cm. in length. If 25 cm. length is exceeded the possibility of metabolic imbalance becomes increasingly likely³⁰. During the early postoperative stage excessive mucus secretion is often troublesome, blocking draining catheters and needing frequent irrigations. The tendency to excessive secretion of mucus appears to diminish progressively.

Cibert¹⁵⁻²¹ has reported extensively on the use of ileocystoplasty in chronic tuberculous cystitis. He noted the need for preliminary resection of the diseased detrusor part of the bladder. His patients were relieved from their distressing increased frequency and usually considerably improved in general health. Incontinence, due to small bladder capacity, usually improved, and vesicoureteric reflux disappeared unless the changes were too advanced. Electrolyte imbalance was observed in only one case. Intestinal fistulae developed in 3 cases. Cibert used the same technique in one case with a neurogenic bladder presenting with nocturnal incontinence, dysuria and markedly increased frequency of urination. The operation would be suitable only in those cases where the disordered function was entirely or partly due to disease of the detrusor muscle.

Pyrah, in several reviews of the subject⁷⁶⁻⁷⁹ emphasised that the ileovesical anastomosis should be as wide as the contracted bladder permitted. He tried to obtain a bladder capacity of 400 ml. The operation was used in

cases of contracted bladder due to tuberculosis or interstitial cystitis, for bladder enlargement after extensive partial or total cystectomy and as a salvage procedure following previous ureterosigmoidostomy. In a survey of 55 cases, Wells¹⁰⁹ reported that clinical assessment of his cases after several months showed excellent results in 50 per cent of the cases. Urinary mucus was troublesome in only one case. Orr⁷² regarded it as a more annoying feature. Kisner⁵¹ thought that the administration of an alkaline mixture (eg. potassium citrate) diminished mucus formation. It is the opinion of Jacobs^{49,50} that an ileal loop, with ureters opening normally into the bladder, may eventually be bypassed by the urine and become a useless diverticulum. In such cases a Tasker flap is more useful, alternatively the ureters could be transferred to the loop. Moonen⁶⁷ considered the most important indication for ileocystoplasty to be the patient where tuberculous ureteric stricture threatened the function of a sole remaining kidney. In a case of this type, Ljunggren⁵⁶ reported a satisfactory post-operative course. Goodwin and his colleagues³⁷ recorded the case of a woman who became pregnant 5 months following ileocystoplasty for tuberculous cystitis. She delivered normally and the upper urinary tract did not appear to be damaged as a result of the pregnancy. Weinberg and Sinatra^{100,}
¹⁰⁸ studied the function of the bladder after ileocystoplasty. They did not find any evidence of electrolyte imbalance. They regard, as the main advantages of the procedure, the preservation of the normal ureterovesical junctions and the avoidance of the disabling consequences of procedures for urinary diversion that might otherwise have been indicated.

COLON:

If it is accepted that a segment of bowel can safely be used for enlargement or replacement of the bladder, it is necessary to decide which particular part of the bowel will be most suitable for this purpose. Both ileum and colon (especially its sigmoid part) are sufficiently mobile to be brought to any part of the bladder or bladder neck. No harm results from excising the required length from either of these divisions of the digestive tract. Both have abundant blood supply, allowing the isolation of a segment with little risk of disturbing its viability. Both ileum and sigmoid colon have a complete outer serous coat and a reliable two-layered anastomosis to the bladder or urethra is possible.

In addition, however, the colon has certain features favouring its selection for the purpose of cystoplasty. These have been pointed out by Riches⁸⁴, Vianna¹⁰⁶ and Loughran⁵⁷. It has a wider lumen: this safeguards against stenosis at the site of re-anastomosis of the colon, and length for length will give a greater increase in bladder capacity. The colon is designed for expulsion: it will give a better urinary stream with less residual urine. Reabsorption of urinary constituents by the mucous membrane of the sigmoid colon is less than in the ileum, with less risk of postoperative biochemical disturbances. Although the contents of the sigmoid colon is more infected than that of the ileum, this can be eliminated by careful preoperative sterilization and cleansing.

Rubin⁸⁸ used the isolated sigmoid colon as a urinary reservoir in the dog. He implanted the ureters into the proximal end while the distal end was anastomosed to the urethra. The dogs remained healthy and continent. He suggested that, in clinical application, a two-stage procedure might be adopted, implanting the ureters at the first operation and transferring the portion of sigmoid with the implanted ureters to the bladder at the second

operation. Barnes and his colleagues⁹ anastomosed a loop of sigmoid to the bladder, to increase its capacity, in 7 animals. Good results were obtained in 4 of these.

Following these experimental results, clinical application soon followed.

Baker and his co-workers^{4,7} used a loop of colon to transfer ureters, previously implanted into the colon, to the bladder. In other cases a colonic replacement was anastomosed to the posterior urethra after cystectomy for carcinoma. Similar cases were also reported by Palken⁷⁴, Ulin¹⁰⁴ and Vianna¹⁰⁶. The open patch technique is recommended by both Riches^{84,85} and Goodwin³⁶ as there is less likelihood of 'diverticulum' effect from a contracting stoma. The colon has often been used for enlargement of the contracted bladder resulting from interstitial cystitis^{7,67,84,106}. Riches⁸⁵ stressed removal of all the diseased detrusor if permanent relief is to be obtained.

No report of electrolyte imbalance following operation has been found. Vesico-ureteric reflux was found in several patients by Baker and colleagues⁷ but this did not constitute a clinical problem. No complaint of excess mucus secretion has been recorded.

CONCLUSIONS

The operation of ileo- or colocolocystoplasty may be accepted as finding useful application in the following circumstances:

- i. Enlargement of the contracted bladder. Bladder contracture may result from chronic tuberculous cystitis, chronic interstitial cystitis, intramural fibrosis following prolonged catheter drainage (eg. in the cord bladder), necrosis of part of the bladder wall, eg. from gangrenous cystitis, repeated vaginal operations for the closure of extensive vesicovaginal fistulae, and interstitial fibrosis following therapeutic irradiation.
- ii. Following radial partial cystectomy, or total cystectomy with preservation of the posterior urethra (distal to the colliculus seminalis) in the male and the bladder neck in the female.
- iii. As a salvage procedure for patients after previous cutaneous ureterostomy or ureterosigmoidostomy, by transfer of a loop of colon with the implanted ureters to the bladder.
- iv. In a small number of carefully selected cases of neurogenic bladder with persistent hypertonic neurogenic dysfunction, where the whole of the denervated detrusor is replaced with a segment of ileum or colon.

C.1.b CASE RECORDS

CASE 73:

African male aged 52 had been suffering from painful urination and haematuria for a year. Anti-tuberculosis treatment was given and the left kidney removed 4 months before admission. There was no improvement in the bladder symptoms. The intravenous pyelogram showed mild hydronephrosis and hydro-ureter on the right side.

Ileocystoplasty was performed, using an 8-inch segment of ileum anastomosed at the midpoint of its antimesenteric border to the fundus of the bladder. The right ureter was re-implanted into the right extremity of the loop (Fig. C.1.b.4.). The patient was greatly relieved. Postoperative intravenous pyelogram showed slight increase in the hydronephrosis while the cystogram outlined the enlarged bladder.

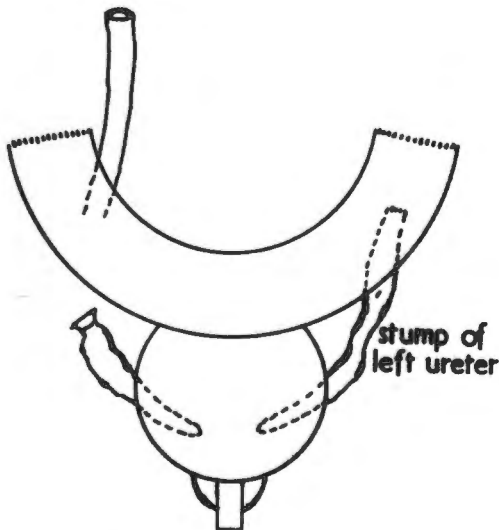


Fig. C.1.b.4. Case 73:
Uretero-ileocystoplasty.

CASE 74:

An African male aged 24 years was admitted with the symptoms and signs of an acute abdominal emergency. The chest x-ray showed old apical scarring on the left side and enlarged lymph nodes were palpable in the neck and axillae. X-ray of the spine showed a healed tuberculous lesion at L1 - 2. At laparotomy the bladder was grossly distended, and necrotic in the fundus area, with urine in the peritoneal cavity. The bladder neck felt irregular and firm. A pelvic abscess complicated the postoperative course. This was drained. Lymph node biopsy showed tuberculous adenitis and specific chemotherapy was started. At this stage it was felt that the patient had a tubercu-

lous prostatitis causing urinary obstruction. There was no renal function demonstrable on the intravenous pyelogram.

A further complication developed in that the patient passed faecal material, including tape worm segments, through a colo-vesical fistula, in the urine. The fistula was repaired.

Seven months after admission the abdomen was re-opened. The bladder was reduced to a small cavity with a capacity of about 30 ml. It was enlarged with a 10-inch segment of ileum anastomosed as a 'cat's tail'. The initial response was satisfactory but increased frequency and painful urination recurred. On re-exploration it was found that the anastomosis had contracted. This was revised and the right ureter transferred to the loop. (Fig. C.1.b.5. The left ureter and kidney was firm and shrunken and was considered functionless.

The postoperative course was most satisfactory. The patient gained weight and was relieved of his disturbing bladder symptoms. The ileal bladder was outlined on cystography. (Fig. B.1.b.6.)

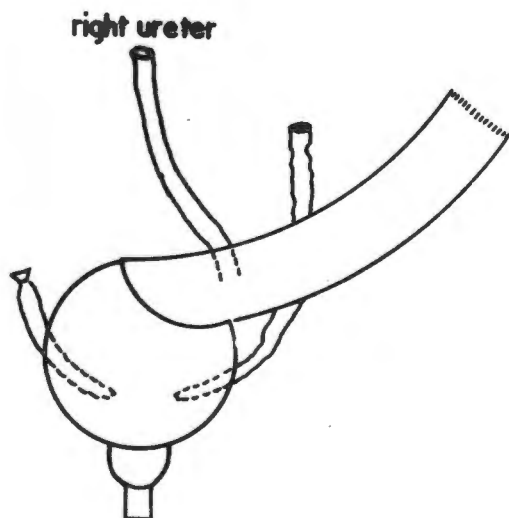


Fig. C.1.b.5. Case 74:
Uretero-ileocystoplasty.



Fig. C.1.b.6. Case 74:
Postoperative cystogram.

CASE 75:

An African male aged 72 years was admitted after acute urinary retention for 24 hours. There was enlargement of the prostate, benign in type. A urethral catheter was passed and left indwelling. Severe infection developed, associated later with repeated obstruction of the catheter. Five weeks after admission suprapubic cystostomy was performed revealing a large slough, saccular in shape, representing almost the whole of the bladder detrusor. Surrounding loops of small bowel had prevented urinary extravasation into the peritoneal cavity.

A self-retaining drainage tube was placed in the cavity. Four weeks later the intravenous pyelogram showed mild bilateral upper tract dilatation. The bladder was re-explored. Prostatectomy was performed. Bladder enlargement was performed using an 8-inch segment of ileum, split along the antimesenteric border for 4 inches and anastomosed to the margin of the bladder residue (Fig. C.1.b.7.).

The postoperative course was uneventful. Cystography outlined the enlarged bladder. When the patient left hospital 20 days after operation he was voiding at normal intervals with full control.

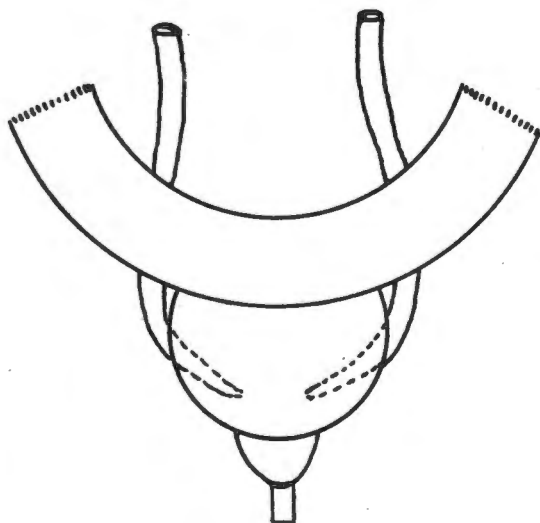


Fig. C.1.b.7 Case 75:
Ileocystoplasty.

CASE 76:

An African female aged 42 developed a large vesicovaginal fistula as a complication of prolonged labour 9 months before admission. An attempt at vaginal repair, before admission, was unsuccessful. She presented with an extensive urethro-vesico-vaginal fistula. Intravenous pyelography showed a normal upper tract. Two further attempts at vaginal repair with urethroplasty were unsuccessful. The bladder capacity was considerably reduced. Bladder enlargement, using colon in the way described by Riches⁶⁶, was performed. The residual vesico-

vaginal fistula was subsequently repaired, and normal urination restored.

CASE 77:

An African female, aged 21 years, had an 8-day labour with her first confinement, terminated by caesarean section. She presented with an extensive fistula extending from the cervix to the proximal urethra with eversion of the bladder and involvement of the right ureteric orifice. The intravenous pyelogram showed a normal upper urinary tract.

Both ureters were transplanted to the colon (Fig. C.1.b.8.a.) and the patient was permitted to return home. Ten months later she was re-admitted and the vesico-vaginal fistula repaired in one operation. The bladder capacity was reduced to 50 ml. Five months later a 10-inch segment of sigmoid colon, carrying the transplanted ureters, was transferred to the bladder (Fig. C.1.b.8.b.).

The patient was completely continent, passing 5 to 8 ounces of urine at three- to fourhourly intervals. (This case is mentioned in A.3, Group 3 (g).)

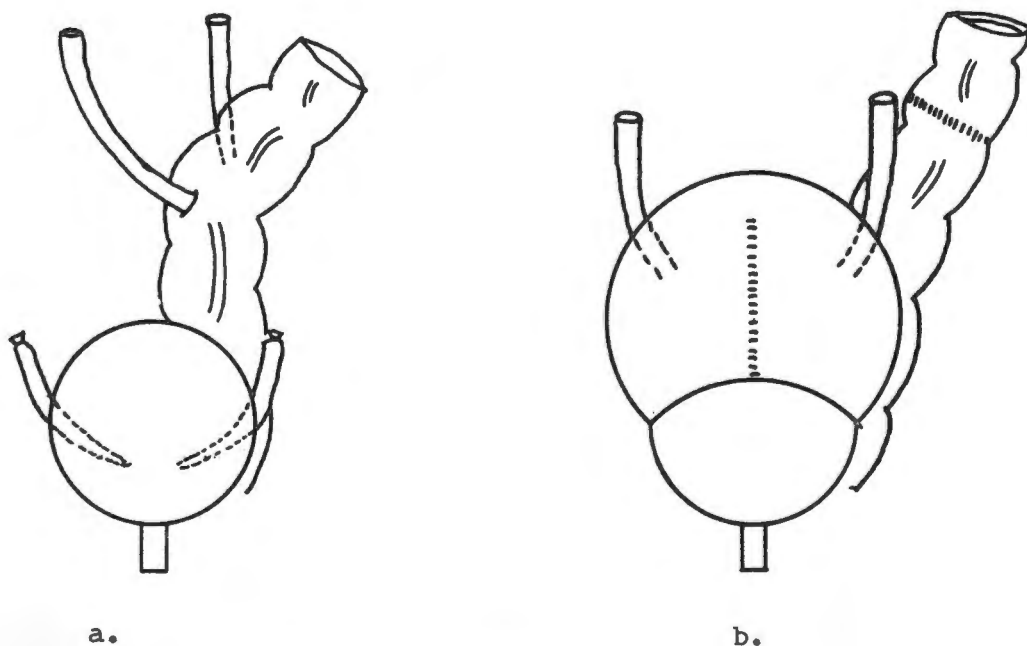


Fig. C.1.b.8. Case 77:
Colocystoplasty following previous ureterocolostomy.

C.1.c THE USE OF MODIFIED INTESTINAL SEGMENTS

In the techniques discussed so far, contact of urine with intestinal mucosa in the urinary conduit or reservoir has been unavoidable. This has been accepted as an unfavourable feature because of the re-absorption of urinary constituents that takes place through the intestinal mucosa, leading to electrolyte imbalance if the contact area is sufficiently big and the contact period sufficiently long. The risk of electrolyte imbalance increases if the renal function is in any way impaired.

To avoid re-absorption, two modifications have been suggested:

- i. Modification of the intestinal segment by removing its mucosa or by so altering its mucosa that re-absorption will be diminished or abolished;
- ii. Using non-intestinal tissues to create a urinary reservoir.

i. The seromuscular part of ileal or colonic segments are used after stripping the mucosa, superficial or deep to the submucosa. This technique has been developed by Shoemaker and his co-workers^{38,94 - 98} who used mainly the reversed sero-muscular graft, ie. with the serosal surface facing the lumen, to enlarge or replace the urinary bladder or ureter. In their experimental work the authors demonstrated that the inner (serosal) surface became lined with transitional epithelium, spreading from the bladder edges, within 2 to 3 weeks, that the outer raw surface became peritonealized and that the intestinal muscle layers became broken up in bundles and assumed a plexiform appearance resembling bladder muscle. The technique was used in 4 human patients with good results. The graft can be sutured to the bladder neck or urethra, following cystectomy, with the ureters transplanted to it, or to the trigone, leaving the ureterovesical junctions undisturbed. The technique found an interesting application in the management of the neurogenic bladder. After subtotal resection of the bladder in paraplegic dogs, the bladder was reconstructed with a reversed seromuscular graft of ileum. Subsequently, vagal stimulation produced a pronounced rise in intravesical pressure. The dogs developed a normal urination pattern, with adequate bladder capacity, no significant residual urine and full continence. No record of the application of this technique in a human patient has been found. The authors feel that the operation may find a place in replacement of the bladder following cystectomy for carcinoma, in enlarging the contracted bladder and in the management of the neurogenic bladder.

Blandy^{11,12}, in his experimental work on dogs, used a seromuscular graft of ileum after removal of mucosa and submucosa. Stripping the mucosa at this level is easier and it avoids mucosa reforming from remaining islands of mucosa, which is almost unavoidable with more superficial stripping.

The seromuscular graft was not reversed. Its inner surface was covered with transitional epithelium spreading from the ends of the implanted ureters (even a single ureter was sufficient), often within 6 weeks. The pouch so constructed was shown to have contractions identical with those of an unmodified intestinal pouch. The possibility of ossification, at the area of contact of regenerating urothelium and underlying intestinal muscle, was investigated. This may occur but will be limited in extent and will not interfere with muscular contraction. The possibility of neoplasia in the regenerating urothelium could not be excluded. Blandy proposed implanting the seromuscular pouch into the distal rectum to obtain control of urinary outflow by the anal sphincter.

Similar results were observed in the experimental animal, using grafts of bladder mucosa to line the stripped ileal pouch, by Martin and his co-workers⁶⁰.

A clinical case has been reported by Campbell¹⁴. Following subtotal cystectomy for carcinoma, a reversed seromuscular graft from ileum was used to repair the bladder defect. He stressed removal of the ileal mucosa deep to the submucosa to avoid regrowth of intestinal mucosa, which may grow into the pouch through stitch-holes.

A similar technique may be used for replacement of part of the ureter. Two other methods have also been suggested. In the experimental animal Schein and Sanders and their colleagues^{89,92} replaced the middle third of the ureter with an arterial autograft (splenic or carotid artery) embedded in the submucosa of the adjacent sigmoid colon to provide the graft with a blood supply. Although the endothelial lining of the vessel was replaced by transitional epithelium, the muscle layer of the artery was completely replaced by fibrous tissue and all animals developed obstruction and loss of renal function due to degeneration of the graft. Hirschhorn^{43,44} constructed

a seromuscular sleeve of ileum which he placed around the intact ureter in a case with dilatation and decompensation of the ureter to assist urinary drainage. This technique was used in a human patient.

A different approach to the problem of reabsorption of urinary constituents through the intestinal mucosa has been the use of pre-operative irradiation. Godfrey³⁵ reported that preliminary irradiation of the ascending colon greatly reduced the secretion of mucus and probably also the reabsorption of electrolytes. Prior irradiation also lessened reabsorption of electrolytes in 8 of 13 patients with ureterosigmoid anastomoses. Irvine and his co-workers⁴⁸ used intraluminal radio-active yttrium in varying doses and measured the absorption of sodium and chloride from loops of colon in the dog. Dosage that will reduce absorption with no gross morphologic damage to the mucosa was determined. No report of the application of this technique in the human patient has been found.

Drinker²⁶ attempted replacing part of the ureter and bladder with heterogenous grafts in the experimental animal. All the transplants were rejected. It was suggested that if these grafts were stored in plasma of the donor animal 'despecialization' might occur and that the grafts might thereafter be better tolerated when implanted in other species.

No reports suggesting the transplantation of a bladder homograft has been found. Although it would be possible to establish an adequate arterial anastomosis, venous reconnection would be impossible. Furthermore, as the function of the bladder and its sphincters is so dependent on an intact nerve supply, the transplanted organ would be functionally useless even if its rejection can be prevented. As the urinary bladder is not an organ essential for life, its successful replacement is a less urgent problem than that of the kidney, heart and liver, and future efforts will probably continue to be directed at finding the best method of using expendable autogenous material.

ii. In attempting to create a replacement for the ureter or bladder without the use of bowel, work has been directed chiefly at the formation of a reservoir of suitable size and its lining with transitional epithelium.

McMinn and Johnson⁶⁵, in studying epithelialization of a defect in the bladder mucosa, noted that not only the marginal epithelial cells, but also the migrating cells themselves, showed mitoses. The process of re-epithelialization is therefore very rapid. Bohne and his co-workers¹³ studied regeneration of the bladder in dogs following cystectomy. An acrylic mould was placed in the extraperitoneal space adjacent to the bladder neck. After 6 to 10 weeks the pouch surrounding the mould was lined with transitional epithelium, covered with granulation tissue with some smooth muscle fibres. Sanchez and his co-workers⁹⁰ used this technique in a human patient following cystectomy for carcinoma of the bladder. Indwelling ureteric catheters were removed after 4 weeks and the mould 2 months later. The cavity was lined with transitional epithelium surrounded by connective tissue, infiltrated with round cells but no plain muscle fibres.

Baker and his co-workers^{5,6}, following subtotal cystectomy for carcinoma of the bladder, simply anchored the ends of the ureters to the anterior wall of the rectum as close to the urethra as possible, without re-peritonealizing the pelvic floor, and provided suprapubic drainage for 3 to 5 weeks. A new bladder cavity formed increasing from 175 to 410 ml. over a period of 4 to 6 months. Biopsy specimens showed full-thickness regenerated bladder. They believe that regeneration of the bladder always occurs, unless urine is diverted from the area.

Harada and his colleagues^{41, 42} transplanted strips of bladder mucosa into muscle or sutured it against the peritoneum, in experimental animals. A cyst, lined with transitional epithelium, was formed into which the ureters were transplanted. The cyst drained on to the skin. The authors

suggested that, in most clinical cases, a healthy portion of bladder mucosa was available to use in the formation of a uroepithelial cyst. This could be done before cystectomy.

In the ureter, regeneration, following excision of part of the ureter, was studied by Hamm and Weinberg³⁹ and by Weaver¹⁰⁷. There was regularly complete regeneration of the mucosa, especially if part of the circumference of the ureter was left intact. Muscle fibres entered the defect and the muscle layer was re-formed, thin at first but normal later.

CONCLUSIONS

From a review of the literature it would appear that the use of intestinal seromuscular grafts, relined with transitional epithelium regenerating from ureter, bladder neck or mucosal grafts, holds considerable promise. Reservoirs constructed in this way can be made continent either by anastomosis to the urethra (if this is permitted by the postoperative anatomy) or to the isolated rectum, with placement of the faecal opening on the perineum (as in the Gersuny operation) or on the abdomen as a colostomy. If neither of these is possible, an abdominal stoma can be constructed for the pouch, and an external appliance used for urine collection.

The technique of bladder regeneration round an acrylic or other mould is not suitable for clinical application.

C.1.c CASE RECORD

CASE 78:

An African male, aged 20 years, had been treated for a neurogenic bladder following a transverse myelitis 7 years previously. Initially the bladder was drained through an indwelling urethral catheter. Periurethral abscess and epididymitis followed and suprapubic drainage was instituted.

When first seen there was severe deformity of the bony pelvis, with marked rotation of the pelvis in the sagittal plane, causing such severe angulation of the bulbous urethra that no instrument could be made to traverse the urethral canal.

As a first stage, both inferior pubic rami and most of the pubic symphysis were resected. The urethra could then be replaced and instrumentation was easy.

Suprapubic exploration followed. The bladder capacity was reduced to the size of the terminal phalanx of the thumb with a firm fibrous wall. It was laid widely open and a previously prepared acrylic mould laid against it in the extraperitoneal space. The ureters were drained by inlying polythene tubes taken through the urethra.

The mould was removed 3 months later. It was lying free in a cavity lined with transitional epithelium (proved on biopsy) and surrounded with granulation without evidence of smooth muscle. The cavity was closed and the bladder drained by urethral catheter for 14 days. Initially the urinary function was very satisfactory. After 2 months the pouch had contracted down and urinary frequency was intolerable. The bladder was reopened, trimmed down to its original size and ileocystoplasty performed. The patient was considerably improved with full continence, passing urine at 3-hourly intervals.

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SECTION C.2

ILEAL URETHROPLASTY

CONTENTS

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ILEAL URETHROPLASTY

Following injury, disease or operation a condition may exist where the bladder neck and urethra have been completely destroyed or removed, but where the main part of the bladder with good capacity and normal lower ureters and ureterovesical openings is still intact. In such circumstances supravescical diversion of the urine eg. by ureterocolostomy or ileal conduit, is often advised, with permanent suprapubic cystostomy as the alternative. In the female this state of affairs is usually the result of prolonged labour with sloughing of the anterior vaginal wall, urethra and bladder neck, sometimes aggravated by vaginal operations eg. application of forceps or craniotomy. In other cases carcinoma of the vulva or urethra, or the operation necessary for its eradication, is responsible.

Realising the importance of the bladder reservoir with its intact ureteric openings, many techniques have been used in an attempt to retain its usefulness by constructing a continent outlet for it.

By plastic operations, using the tissues of the vaginal wall or more remote sources, a urethral tunnel may be constructed. This has little functioning muscle tissue in its wall and further operations eg. muscle slings, are usually performed to try and confer continence. Where the bladder neck had been destroyed such operative procedures have little success in providing a continent bladder reservoir.

A new urethra has been constructed using a flap of bladder wall. Thus Barnes and Wilson¹ used a bladder flap to construct a urethra, with its distal opening in the normal situation, in a female aged 72 years in whom the urethra and bladder neck were excised for carcinoma of the distal urethra. They suggest that, in the male, the lower end of the tube may be sutured to the perineal skin. Their patient had almost normal control and no leakage

of urine - a fact which they found surprising as the reconstructed urethra had no definite sphincter. Barnes et al² also replaced the posterior urethra with a bladder flap, in a man with fibrosis of the posterior urethra. This patient remained incontinent but was relieved of his stricture. Young and Mills²⁴ isolated a flap from the anterior bladder wall, the base of the flap in the posterolateral position close to the entry of the main vesical blood supply, and sutured the lower end of the tubed flap to the vaginal mucosa in the position of the normal external urinary meatus. Their patient could void up to 120 ml. at a time with a residual urine of 30 ml. but she had some dribbling. Charlewood⁶, in 11 patients with severe stress incontinence following closure of a vesico-vaginal fistula, in whom very little of the vagina was left and menstrual function was permanently in abeyance, closed what was left of the vagina and brought the urethra out between the anal mucosa and the anal sphincter. Results were excellent. In the presence of a normal vagina, attempts to create a urinary passage round the vaginal introitus were not successful. He suggested that the anal sphincter could be used, in a similar manner, in males who had lost sphincteric control of the bladder. Powell¹⁸ constructed a fistulous tract from a skin tube beneath the rectal sphincter and connected this to a mucosa-lined tube from the bladder. There was no urinary leak. In a female patient a similar tube was taken around the vagina. She was continent at times. Scott¹⁹ records the case of a boy who was born without a penis. He was found to have a urethral canal running alongside the rectum beneath the rectal sphincter, opening on the perineum just anterior to the anus. Urinary control was perfect.

Grana and King¹¹ replaced the proximal urethra with a segment of distal ureter in the experimental animal. The ureter, with blood supply intact, was turned downwards. Over a period of 11 to 14 months none of the animals operated on showed any tendency to hydroureter or hydronephrosis in the

remaining kidney. At the time of reporting the technique had not been used in a human patient. DeNicola¹⁰ replaced $3\frac{3}{4}$ inches of the urethra, just distal to the external sphincter, with a silicone tube. His patient had urethral strictures and fistulae. Good urination and full control were still maintained 14 months later. Bruce⁵ described a device for insertion into the female urethra for the control of incontinence. This is made from a core of steel covered with silicone rubber. Its ball-valve mechanism is opened by bringing a small magnet, of similar polarity, to about a centimetre from the valve seat. The valve is inserted under local anaesthesia through a 32F tube after dilating the urethra. It was tolerated well over a short trial period.

Many attempts have been made to replace a destroyed or incontinent urethra with a continent suprapubic opening. Lapedes¹⁵ believes that, at rest and during the filling stage, urinary continence is maintained by the intraluminal resistance of the bladder neck and urethra. In an elderly man with an uninhibited neurogenic bladder he fashioned a new internal sphincter and a suprapubic urethra using a bladder flap. In later publications Lapedes and his co-workers^{16,17} review the technique and complications of cutaneous vesicostomy in 200 patients. An external appliance for urine collection was regularly required. In Blocksom's method for prolonged tubeless cystostomy⁴ the mobilized bladder wall is sutured to the rectus sheath and the skin edges to the bladder margin. Initially sump drainage is used, later an ileostomy bag is fitted. An attempt to construct a continent suprapubic outlet by the insertion of a plastic valve²² was not successful, due to technical reasons. Shun-Shin²⁰ constructed an artificial abdominal urethra from a flap of the anterior bladder wall. His patient, a boy of 11 years with a stricture following rupture of the urethra, was completely continent 6 months later, urinating only once at night, with a residual urine of 5 ml.

An isolated segment of ileum has often been used to construct a new urethra. Cordonnier⁷ fashioned an abdominal urethra from an ileal loop, the proximal end of which was anastomosed to the bladder (after excision of excess detrusor if the bladder was very flabby) and the distal end brought out in the iliac fossa. He used this technique in three cases of meningomyelocoele. Urinary continence was not aimed at and a Rutzen bag was used for collection of the urine. In a later publication, Cordonnier⁸ recorded his experience with 14 cases. He experienced difficulty in closing the bladder neck. The ileostomy stoma had to be revised in seven cases, calculi formed in the bladder in four cases and in seven there was difficulty with the skin around the ileostomy. Beck and Grady³ used a 12 cm. loop of ileum to fashion an abdominal urethra in a boy aged 14 years suffering from extensive injury of the posterior urethra. The distal end of the loop was brought out through the middle of the right rectus muscle. Their patient achieved good control, could void freely with a large stream, slept for 9½ hours without voiding or leaking and only a small protective pad was required to cover the stoma. Smith and Hinman²¹ applied several techniques, in the experimental animal, to obtain a continent suprapubic opening. A skingrafted fistula and a Janeway-type cystostomy were both totally incontinent. An ileocaecal cystostomy (using the ileum as the external opening) required catheterization. The animals were continent and this type of operation was considered applicable where bladder enlargement was indicated. The best results were achieved by constructing an intussuscepted ileal cystostomy, with 2 to 3 cm. of intussusception. Spontaneous voiding was sometimes observed. This technique was subsequently applied in children with spina bifida and atonic urethral and rectal sphincters. It was suggested that it might find application as a substitute for ureterosigmoidostomy and conceivably in exstrophy, after inversion and closure of the bladder.

Krahn and his co-workers¹⁴ tried the various reported methods of tubeless cystostomy. All their patients with a Lapides cutaneous vesicostomy reverted to intubated drainage. Four of 7 patients with a Cordonnier ileocystostomy required supravescical diversion. They concluded that none of these methods were satisfactory.

Torbey²³ reported that, in the experimental animal, the proximal urethra could be replaced with a segment of ileum and the animal be completely continent. De la Pena⁹ replaced the proximal urethra, using an ileal segment, in a man who had a severe stricture of the urethra as a result of a fractured pelvis. This patient remained continent. Harp and Powell¹², in discussing the enlargement of the exstrophic bladder by using various intestinal segments, report an attempt to extend the intestinal segment to form an outflow tract to the perineum. In one of 10 patients continence was achieved. Jordaan¹³ replaced the urethra, using a 6 inch segment of ileum, in a woman aged 61 years in whom the urethra was destroyed after excision and irradiation for a papilloma of the urethra. The proximal end of the loop was attached to a new opening in the bladder made just anterior to the previously existing one, while the distal end was sutured loosely to an opening below the clitoris after pulling the loop through a subcutaneous tunnel. The patient was continent. She had to pass urine fairly quickly when she felt that the bladder was full and could not cut off the stream while voiding.

Since March, 1961 an isolated segment of ileum has been used to construct a new urethra in five female patients.

C.2 CASE RECORDS

CASE 40:

This patient is reported in Section A.5: adenocarcinoma of the vulva treated by radical vulvectomy and distal partial cystectomy with urethral replacement by ileal urethroplasty.

CASE 79:

A young African female had a difficult first labour terminating in forceps delivery and stillbirth after four days. Incontinence of urine and faeces followed. She was found to have an enormous vesico-vaginal fistula while the urethra was completely missing. The bladder capacity was considerably reduced. The cervix had also sloughed. There was a large rectovaginal fistula present.

Closure of the rectovaginal fistula was performed first. Thereafter, by abdominal approach the remains of the uterus was excised and a 6 inch loop of lower ileum isolated. The proximal 3 inches was opened along the anti-mesenteric border and anastomosed to the bladder base along the margins of the fistula. The distal 3 inches was placed in a bed made by dissecting flaps of anterior vaginal wall laterally so that the distal opening was situated just below the clitoris. The bladder was drained by urethral catheter.

An uneventful recovery followed and three months following operation the anterior vaginal wall had healed firmly and the patient was fully continent. When last seen 10 months following the operation, slight eversion of the mucosa of the ileum had occurred. The stoma was trimmed and slightly narrowed, improving the appearance considerably.

CASE 80:

An African female aged 35 years had been incontinent of urine since prolonged labour and application of forceps 18 years previously. One attempt at repairing a vesicovaginal fistula had been made. On examination the vagina was almost completely obliterated with unyielding scar tissue. A vesicovaginal fistula was present and the proximal end of the urethra, at the margin

of the fistula, completely obliterated. The intravenous pyelogram showed moderate bilateral hydronephrosis. Three attempts at vaginal repair was made, without success.

Abdominal operation was performed. The remains of the uterus was excised, the bladder freed from the dense scar tissue and the bladder neck trimmed. A 4 inch segment of terminal ileum was isolated, brought down through the vaginal vault, and its proximal end anastomosed to the bladder. The bowel was placed in a bed in the anterior vaginal wall and its lower end sutured to the lower margin of the vaginal flaps below the clitoris. The bladder was drained by urethral catheter.

On examination 3 weeks later, there was slight recession of the stoma. The patient claimed full continence and passed 3 ounces of urine on request. When last seen nine months after operation she had increased urinary frequency, passing about 4 ounces at a time. She leaked if urination was postponed. The intravenous pyelogram demonstrated slight increase in the degree of hydronephrosis. Cystoscopy and cystography confirmed a bladder of small capacity. Ileocystoplasty was advised.

CASE 81:

An African female aged 39 years gave a history of leaking urine per vaginam since a difficult labour 5 years earlier. On examination she had a large fistula extending from the canal of the cervix to the bladder neck. No urethra could be found. She had a large fibroid uterus. Intravenous pyelogram showed a normal upper tract and a bladder with adequate capacity. Hysterectomy was performed and an attempt made by combined abdominal and vaginal approach to reconstruct the bladder. This failed completely. The abdomen was reopened, the adherent bladder neck completely mobilized and the resulting opening trimmed and slightly narrowed anteriorly. A 4 inch segment of ileum was isolated, brought down along the left side of the bladder and used as a substitute urethra.

When the patient left hospital 4 weeks later she was dry and passing urine at normal intervals with full control.

CASE 82:

A young African female had a difficult and prolonged labour with her first pregnancy. Application of forceps failed and she had an abdominal operation because rupture of the uterus was suspected. On admission she was found to have a footdrop on the right side. The whole bladder base and urethra was open on the anterior vaginal wall. The intravenous pyelogram was normal. Two attempts at vaginal closure left her with no urethra and a patulous opening into the bladder from which urine leaked continuously. Abdominal operation was performed and 4 inches of terminal ileum isolated to fashion a new urethra. The bladder was drained by urethral catheter. Three weeks after the operation she was dry day and night and passed urine with complete control.

OPERATIVE TECHNIQUE

A few points in the operative technique need to be elaborated.

A long ileal mesentery is necessary to allow the segment of bowel to be brought to the position normally occupied by the urethra. It is sometimes necessary to depend on a large marginal vessel with its juxta-ileal anastomotic arcade to mobilize the ileal segment to secure sufficient length. With care this is probably always possible and in none of these cases was the viability of the bowel doubtful. The ileum is re-anastomosed by careful end-to-end suture and the mesentery reconstituted in front of the isolated segment.

The orientation of the ileal segment as regards direction of peristalsis is probably unimportant. In these cases an isoperistaltic placement was selected but this may have to be adjusted depending on the 'reach' of the two ends of the segment.

The shortest route for bringing down the ileum is along the anterolateral or posterior aspect of the bladder. Hysterectomy facilitates this phase of the operation. A subcutaneous tunnel has not been used.

It would appear that the ileal urethra functions best if provided with adequate support. In obstetrical cases sufficient vaginal tissues is generally available to provide full circumferential embedding. Where vulvectomy and urethrectomy had been performed the ileal segment can be supported either by bringing some viable tissue from elsewhere (as in Case 40) or by taking the loop through a subcutaneous tunnel¹³.

In longstanding vesicovaginal fistulae the lower part of the bladder is usually densely adherent, especially to the symphysis and pubic rami. Mobilization of the bladder neck is a necessary preliminary to allow accurate anastomosis. This often leaves a large ragged opening which has to be

trimmed and sometimes narrowed by partial anterior closure to reduce the size of the opening to that of the ileum.

Care must be taken in preparing a bed for the substitute urethra. The anterior vaginal wall is divided in the midline and flaps dissected laterally. These flaps cover the bowel segment and their lower margins are sutured meticulously to the lower ileal stoma. This stoma may be narrowed slightly by excising a small wedge, based on the margin, to give a neater appearance. Narrowing of the whole segment is unnecessary.

Urethral catheter drainage has been completely satisfactory in the post-operative management.

An essential requirement for success is an adequate bladder capacity. It is not always realised to what extent the bladder capacity may be diminished by fistula formation and repeated attempts at repair. Mobilization and trimming of the bladder neck will have the same effect. Unfortunately it may be difficult to assess the bladder capacity reliably in the presence of a large fistula and digital exploration or palpation with the cystoscope may be the best guides. There is no doubt that a diminished bladder capacity is an important factor in the failure to close some vesico-vaginal fistulae and in the occurrence of stress incontinence following successful closure. The contracted bladder cannot be expected to increase in size after the operation of ileourethroplasty - the required bladder neck and urethral resistance cannot be provided. Where a diminished capacity is present or suspected, provision can be made for simultaneous enlargement of the bladder (as in Case 79) or ileo-or colocystoplasty can be performed as a separate procedure (as advised in Case 80). The planned use of preliminary supravescical urinary diversion and bladder enlargement to facilitate closure of certain vesicovaginal fistulae is discussed in Section A.3.

If the appendix is present it is routinely removed. Although the post-

operative course in these cases was particularly uneventful, complications may arise and appendectomy will eliminate an important source of confusion in the differential diagnosis of the postoperative acute abdomen.

The most exacting part of the operative procedure is the anastomosis of the bladder neck to the proximal end of the ileal segment. It is an advantage to have both the perineum and abdomen accessible during the operation. The patient is placed on the operating table in the 'combined' position. The anterior half of the vesico-ileal anastomosis is done from above while the posterior half of the anastomosis is done more conveniently from the perineal aspect. A single layer of interrupted sutures, taking full thickness of bladder and bowel, suffices. The indwelling catheter is placed in the bladder via the ileal segment before doing the anastomosis.

CONCLUSIONS

The results achieved would appear to confirm the impression that urinary continence is maintained, under normal conditions, by the intraluminal resistance of the bladder neck and urethra, the result of collapse of its pliable wall and of its muscular tone. A short length of ileum will supply these basic requirements and may serve as a useful substitute in a small number of cases in whom the urethra and bladder neck have been destroyed by injury, disease, operation or irradiation.

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SUMMARY and COMMENT

- A.1 1. Injuries to the ureter occur sufficiently frequently to give rise to concern.
2. The avoidance of this accident depends, basically, on adequate supervised training in surgery, an awareness of the ureter and its usual anatomical position, the principle of identification of all structures handled, adequate exposure at all times and gentleness in the manipulation of tissues.
3. The ideal opportunity for repair of the injured ureter is when the injury is recognised at operation. If recognised subsequently, the basic approach is to establish a complete anatomical diagnosis and follow immediately with operative exploration and repair. The basic aim of repair is the provision of adequate drainage for the injured ureter (if possible by restoring a stricture-free communication with the bladder) so as to conserve functioning renal tissue. Techniques known to be associated with definite morbidity and a diminished survival period are avoided if at all possible.
- A.2 4. In a few carefully selected cases, adequate drainage for an injured, diseased or resected ureter may be provided by anastomosing it to the opposite ureter.
5. The ideal indication for this technique exists where a diseased ureter, draining a sole remaining kidney, can be anastomosed to a normal ureteric stump on the opposite side.
6. Other applications of this operation are discussed.
- A.3 7. Most hospitals, in the Republic of South Africa, serving the African population, admit a considerable number of women suffering from ob-

stetric fistulae.

8. Experience and interest in the surgery required for these fistulae and devoted nursing care in the immediate postoperative stage are important factors in securing a successful outcome.
 9. Disappointments will be experienced by anybody who has handled a large number of these patients. These are chiefly postoperative stress incontinence, vaginal stenosis, residual pinhole fistulae, traumatic amenorrhoea and bladder calculi.
 10. Attention is drawn, especially, to a group of cases where local repair of the fistula is impossible and the importance of a reduced bladder capacity is emphasized. Temporary supravescical urinary diversion to permit fistula closure and bladder enlargement to relieve postoperative stress incontinence are suggested as useful procedures in management of some of these difficult cases.
- A.4 11. A small number of vesico-vaginal fistulae can best be managed by exposing and repairing them by the abdominal approach. These fistulae generally follow abdominal operation for complicated obstetrical cases eg. rupture of the uterus, or elective operative procedures in the pelvis.
12. The main indications for abdominal repair are the situation of the fistula high up in the bladder (generally in relation to the apex of a scarred vaginal vault) and its close relation to or involvement of the ureteric orifice.
 13. The essential factors for successful operation are adequate mobilization of the margins of the fistula in the bladder, its meticulous apposition and reliable postoperative drainage of the bladder.
- A.5 14. Partial cystectomy has a definite place in the management of malig-

nant disease of the bladder. The range of applicability can be extended by certain modifications of technique.

15. In radical proximal partial cystectomy any portion, or the whole, of the bladder as far distally as the openings of the ejaculatory ducts in the posterior urethra may be resected. Bladder replacement is generally by ileo- or colocolocystoplasty.
 16. In radical central partial cystectomy the whole of the posterior aspect of the bladder, including the terminal ureters, trigone and posterior half of the upper part of the prostate, may be resected. The ureters are re-implanted into the bladder. Primary bladder closure is usually possible; bladder enlargement may be necessary. The technique is also applicable when the bladder base is invaded by an otherwise operable carcinoma of the rectum or cervix.
 17. In radical distal partial cystectomy the distal part of the bladder, bladder neck and, in the female, the whole urethra may be resected. This is followed by ileal urethroplasty or vesicorectoplasty. This modification is used when the bladder neck and urethra are involved in malignant disease or have been destroyed by injury, disease, operation or irradiation.
 18. The advantages of these operative procedures are the preservation of the normal bladder residue (with its transitional epithelium) in many cases and of the normal ureterovesical openings in some cases, with the avoidance of an abnormal stoma and external appliances in most cases.
- B.1 19. The operation of vesicorectoplasty achieves the same end result as vesicorectostomy and colpocleisis (in the presence of a rectovaginal fistula).

20. It is useful when a normal bladder or bladder remnant carrying the normal ureterovesical openings is present, following destruction or resection of the urethra and bladder neck, with a normal rectum and anal sphincter. In these patients the bladder may be mobilised, with its neurovascular pedicle unimpaired, and anastomosed to the rectum.
 21. This technique promotes diminished reabsorption of urinary constituents (because the urine collects in the bladder and lower rectum) and less morbidity due to ascending renal infection (probably because of the bladder residue and the intact ureterovesical junctions interposed between the rectum and the ureters).
- B.2
22. The Gersuny operation (isolated rectosigmoid bladder with intrasphincteric perineal colostomy) allows the closest approach to normal anatomy and function of all available techniques. Where a normal rectum and anal sphincter are present in a patient with a long life expectancy, it would appear to be the procedure of choice.
 23. Three aspects of operative technique are emphasized : sufficient mobilization of the sigmoid colon to reach the perineum without tension, provision of a reliable sphincter for the perineal anus, and the establishment of a stricture-free perineal stoma.
 24. Satisfactory urinary and faecal control may be expected with confidence. The improved sensation and control reported after use of the Heitz-Boyer and Hovelacque submucosal transplantation is more than balanced by the almost constant occurrence of faecal contamination of the urinary reservoir in this procedure.
- B.3
25. Life can be prolonged, and existence made a good deal more comfortable, in a small number of patients with advanced carcinoma of the

uterine cervix by the establishment of supravescical diversion of the urine.

26. A most important and difficult factor in the selection of cases is the assessment of the residual renal function. The clinical and arteriographic investigation of this aspect is stressed.
 27. The most generally applicable technique for diversion in these cases is the ileal conduit.
 28. Life is prolonged by the relief of urinary tract obstruction and existence is made less miserable by providing controlled urinary drainage (instead of a constantly leaking malignant vesico-vaginal fistula), by diminishing sepsis and bleeding, by relieving distressing bladder symptoms and by permitting more intensive radiotherapy.
- B.4
29. Following a survey of the history of bilateral cutaneous ureterostomy, its place, as a method of urinary diversion, at the present time, is discussed.
 30. It is an advantage to procure a healthy and stricture-free uretero-cutaneous junction, that can be managed without indwelling catheters.
 31. The development of an easily manageable external appliance has done a great deal to popularise the use of uretero-cutaneous transplant.
 32. The establishment of a single ureterostomy stoma (either by joining the two ureters at the skin stoma or by doing a retroperitoneal uretero-ureterostomy) simplifies urine collection considerably.
 33. The most suitable case for this type of diversion is the patient with grossly dilated and tortuous ureters.
- C.1
34. In many circumstances where repair or replacement of the ureter or bladder is indicated, the use of bowel offers the best solution.
 35. For replacing more than half of the ureter, an isolated loop of ileum

is the best available tissue. It should be placed in a retroperitoneal position and need not be modified in any way.

36. For repair enlargement or replacement of the bladder, an isolated segment of ileum or sigmoid colon may be used. The colon offers certain advantages in this application.
 37. To avoid the absorption of urinary constituents (that always takes place when urine remains in contact with the columnar-celled mucosa of the digestive tract) attempts have been made to modify intestinal segments in various ways.
 38. The value of preliminary irradiation (either external or intracavitary) has not been determined with certainty.
 39. The use of only the seromuscular component of the intestinal segment, allowing it to acquire a transitional cell lining regenerating from ureters or bladder residue, promises to be a definite improvement.
 40. Regeneration of full thickness functioning bladder over a mould has not proved a successful procedure.
- C.2
41. In a small number of patients where the ureter and bladder neck have been destroyed, and a normal bladder detrusor and intact ureterovesical openings remain, a short isolated segment of ileum may be used to replace the urethra.
 42. The intestinal segment appears to have sufficient tone and intraluminal resistance to provide satisfactory urinary continence under normal conditions and with a normal bladder capacity. If a grossly reduced bladder capacity is present bladder enlargement may be done or vesicorectoplasty performed instead.
 43. Following radical vulvectomy, the procedure is less successful. It is suggested that there is not sufficient local tissue to pro-

vide adequate support for the transplant.

CONCLUDING REMARKS

Although some concluding remarks have been made at the end of each section and in the final Summary, it is now intended to mention some, more general, conclusions with a bearing on the broad field of diversion and repair in the urinary tract.

It would be almost impossible to work in this field for any length of time and not to arrive at certain personal impressions of what considerations are of basic importance in the management of these cases.

Firstly, where transplantation of the ureters are indicated, it is regarded as more important to secure a permanently stricture-free anastomotic stoma (usually by mucosa-to-mucosa anastomosis) than to attempt valve formation. This attitude may find general agreement where the transplantation is made to an isolated conduit or pouch, and it will be more understandable if it is confessed that I regard it as at least debatable whether transplantation of the ureter directly into the intact bowel, as a permanent arrangement, should still be considered. That ureteric reflux occurs regularly is not disputed, but whether it is always, or even often, significant in determining the patient's postoperative course, is by no means certain. Attempts at valve formation, especially by techniques involving interstitial embedding, more often lead to stricture than to valvular action.

Secondly in assessing the patient's progress and prognosis, great importance is placed on close, frequent, personal observation of cases. It is agreed that radiological and laboratory data are very important - measurement is, after all, the very basis of the scientific method. But a record is also required of whether the patient thinks she is better, to what extent she

may be able to enjoy life, whether she is eating well, interested in what goes on about her, managing her external appliance, if any, with enthusiasm - aspects only infrequently discussed in the multitude of reports compounded of serial pyelograms and blood chemistries. It is suggested that close, regular, personal observation of these patients in this way may assist the experienced observer to get closer to a true assessment of the prognosis of his patient than by any other method. Again, it is confessed that I would rather see my patient enjoy life for 12 months than merely exist miserably for fifteen.

Thirdly, as has already been pointed out in the Introduction, and repeatedly confirmed in the sectional discussions, it is the whole of the urinary tract that is the concern of the surgeon, no matter how localized the lesion may appear to be. The condition of the urinary tract both proximal and distal to the lesion may have a very important bearing on the selection of the best programme of management. Omission of such a survey will reflect in more frequent failure of treatment, and it will tend to complicate matters for subsequent management. In this regard, it hardly needs to be pointed out that no single operative manoeuvre will be suitable for all patients. The specialist (and enthusiast) in ileal conduit or rectosigmoid bladder or ileocaecal bladder will tend to apply his favourite technique to every patient and this may frequently not be the ideal management for the particular case. Careful selection of the surgical programme best suited for the individual patient is the better approach. This requires much broader experience and technical equipment.

Lastly, while doing this work, I had the opportunity of very close association with my colleague in the Department of Gynaecology. We both found this a refreshing and satisfying, as well as a very constructive association.

It is commonly accepted that the whole is more than the arithmetical sum of its component parts, and this is certainly true where two surgical disciplines combine in close collaboration. It is sincerely believed that this approach has reflected to the benefit of the patients, and it can be recommended to our colleagues in other institutions.

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