THE DETECTION AND MANAGEMENT OF SUSPECTED CEPHALO-PELVIC DISPROPORTION IN THE AFRICAN PRIMIGRAVIDA USING THE CERVICOGRAPH

by

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ACKNOWLEDGEMENTS

In the preparation and presentation of this thesis I have received assistance from numerous sources, and in particular would wish to express my sincere appreciation to the following:

Professor D.A. Davey of the University of Cape Town who helped in the initial planning of the study and who gave advice during its progress. I would also express my appreciation to him for the clinical freedom given me in his Department during my Sabbatical Leave in 1973.

Dr. E.A. Friedman of Boston whose original work stimulated a consideration of its application to obstetric practice in Africa. He also visited our Department in Salisbury and reviewed the work that we were doing and gave valuable advice.

Dr. C.H. Hendricks and Dr. W. Brenner of Chapel Hill, N. Carolina, who answered many of my questions during my visit to their Department.

Dr. W.M. Castle, Clinical Statistician in the Department of Social and Preventive Medicine, University of Rhodesia. Dr. Castle gave advice on the statistical analysis of every stage of this study and personally checked the results in each chapter. This and other studies carried out in our Department would not have been possible without her skilled assistance.

Miss I. Edmonstone, Mrs. D. Ritchie, Miss D. Shepherd, Miss Marie Dawson and Miss S. Masvikeni, Research Midwives in the Department. These skilled midwives carried out many of the clinical observations and kept and retrieved clinical records. Their value during this study became so evident that we have since created permanent posts for Research Midwives in the Department and would recommend that other Obstetric Departments interested in research do the same. Miss Edmonstone has also been responsible for the laborious work of doing the basic mathematics from which the statistical analyses have been determined.

Mr. Alan Bedford, Chief Technician in the Department for maintenance of equipment in the Intensive Care Unit and for preparing the diagrams in the thesis and the audio-visual aids that accompany the thesis.

The doctors and midwives in the Department for their care of our patients and for their many valuable comments as we have developed graphic recordings and a regime of active trial of labour in the Department.

Miss Barbara Kwast, Sister Tutor, Blantyre, Malawi; Dr. Sam Bhima, Obstetrician, Blantyre, Malawi; Dr. R. Stoughton, Mission Doctor, Silveira, Rhodesia; Dr. Aldeth Lasbrey, Obstetrician, McCord's Hospital, Durban, South Africa; the doctors and midwives at Groote Schuur Hospital, Cape Town, South Africa. These colleagues assisted by applying my regime of management in their own Labour Wards and provided me with valuable comment and material for a prospective review of the regime.

Mrs. V.I. Purves for typing the manuscript for this thesis.

CHAPTER 1

INTRODUCTION AND BACKGROUND

The Medical School in the University of Rhodesia is one of the newer Schools in Africa, with its first class having graduated in 1968. The author is the first occupant of the Chair of Obstetrics and Gynaecology and was appointed in 1966. When considering a policy for the establishment of both personal and departmental research work, it was felt that certain factors and principles should be taken into consideration. Firstly, this is the only medical school in Rhodesia and, recognising the size and isolation of the country, financial resources for research would be fairly limited. Secondly, research interests should be directed to the particular clinical problems of Central Africa, rather than to subjects that could be better tackled in the well-equipped laboratories of developed countries. It would be important not only to study the major relevant clinical problems, but also to prepare regimes of diagnosis and management which would be suited to the personnel and facilities available throughout the whole country. Once these regimes had been evolved and taught, the task would be completed by evaluating their practical application in both central and peripheral units.

Taking these principles into consideration, the area of research covered in this thesis represents one of the major Obstetric problems seen in Rhodesia today. In addition, it would seem that the regime of management that has been evolved has practical application in parts of the world where cephalo-pelvic disproportion is less common.

THE EXTENT TO WHICH CEPHALO-PELVIC DISPROPORTION IS A PROBLEM IN RHODESIA.

This cannot be assessed accurately, as there are verying degrees of cephalo-pelvic disproportion. A reflection of the extent of the problem can be seen, however, in the following data:

A. Maternal.

During 1970, there were 81 new cases of vesico-vaginal fistula following obstructed labour admitted to the gynaecological wards of Harari Hospital in Salisbury. Of these, 12 had concomitant recto-vaginal fistulae. These were all referred patients from a catchment area of a population of about half a million people.

B. Fetal

Approximately 8 000 deliveries are conducted at Harari Hospital each year, with a perinatal mortality of about 50 per 1 000. During 1972 the distribution of these deaths according to aetiology was as shown in Table I.

Table I. Aetiology of perinatal deaths in Harari Hospital, Salisbury, in 1972.

Malformations	36
Serological incompatibility	4
Mechanical	120
Toxaemia of pregnancy	22
Antepartum haemorrhage	51
Maternal disease	3
Infection of infant	55
Prematurity	69
Unknown	56
Total	416.

It can be seen that, even with hospital care, the mechanical causes of perinatal mortality accounted for a disproportionate number of deaths. These mechanical causes were in the main due to cephalo-pelvic disproportion.

THE PRESENT STATE OF OBSTETRIC SERVICES IN RHODESIA

(a) Hospitals and Clinics

The main cities and towns of Rhodesia are fairly well served with hospital facilities which cater for the referral of specialty problems from all parts of the country. In the rural areas, where the majority of the population is resident, there are only a few government and mission hospitals scattered about the country.

A large number of potentially normal deliveries are conducted in small clinics related to the urban and rural hospitals. In these towns these clinics are not too distant from the hospitals, making communication and transfer of patients relatively easy, but in the rural areas the distances are often great with no standard means of communication. To help overcome the problem of distance, many hospitals and clinics have adjacent "obstetric villages" where patients reside for the last weeks of pregnancy.

The hospital bed situation in Rhodesia is such that only patients with complications can be delivered in hospital, and so all normal cases, including primigravidae, are selected for clinic delivery. This requires a careful screening system both at the antenatal clinic and during labour.

(b) Doctors and Midwives

The distribution of doctors in Rhodesia is shown on the map in Figure 1. Although the country-wide proportion of doctors to population

is one to 6 250, the doctors are mainly congregated in the major cities and towns, whilst in the rural areas the proportion becomes only one doctor to 80 000 population. The specialist Obstetricians are, with the exception of two, concentrated in Salisbury and Bulawayo. Of the 22 Obstetricians, 15 are in private practice, and only seven are working in the hospital service which caters almost entirely for African patients.

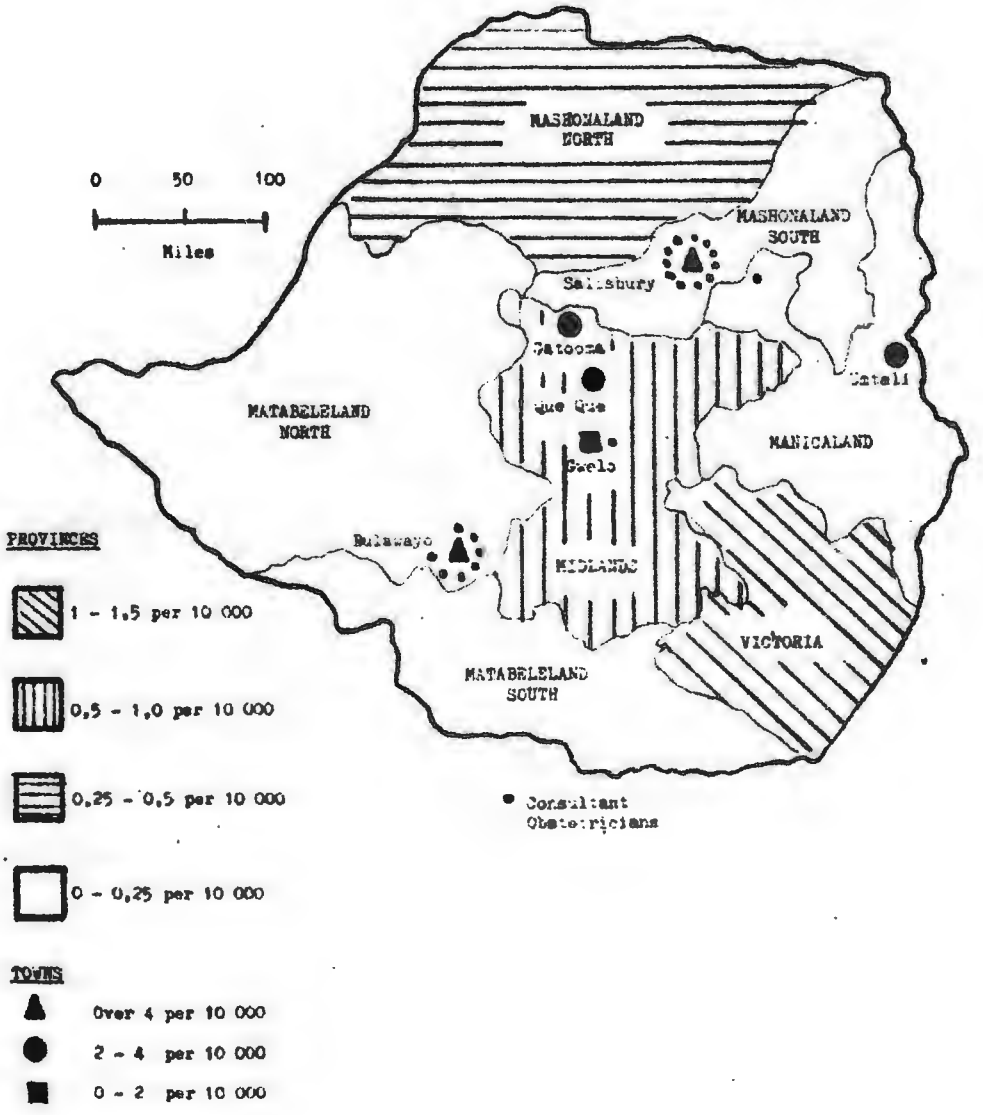


Figure 1. Distribution of Medical Officers in Rhodesia.

The distribution of trained midwives is similar though there is an increasing number being employed in the rural hospitals and clinics. A few of the rural hospitals have resident doctors, but many are without and are supervised by sisters and medical orderlies.

It is still true that in many of the rural areas of Rhodesia, deliveries are conducted in the villages by the patient's illiterate grandmother. These take place in a poorly-ventilated hut with mud walls, thatched roof and cow-dung floor. Problems are created not so much by unskilled intervention as by delayed referral for medical assistance.

FUTURE TRENDS IN THE RHODESIAN OBSTETRIC SERVICE

Recognising the near impossibility of recruiting and financing an extensive obstetric service run by doctors in the rural areas of Rhodesia, the Ministry of Health has budgeted for a pilot project in Mashonaland Province, utilising midwifery staff. The Province is to be divided into 16 districts with a rural government or mission hospital at the centre of each district. Each district would have a number of maternity clinics (with lying-in beds) at a distance from the base hospital. The clinics would be staffed by maternity assistants (two years basic nursing and one year midwifery training) and there would be two maternity sisters, with S.R.N. and S.C.M. qualifications, to supervise the work of each district and to do the bulk of the Obstetrics in the rural hospital. An Obstetrician is to be appointed to organise and develop the service, which would also cater for family planning and child welfare.

THE RESPONSE OF THE AFRICAN PRIMIGRAVIDA TO HER PREGNANCY, LABOUR AND METHOD OF DELIVERY

The author arranged a study of the attitudes of African primigravidae to their pregnancy, selecting groups of patients from different geographical areas and different social classes. The study was made by a research midwife of the University Department of Obstetrics and Gynaecology. It was decided that the best information would be gained by visiting and questioning the experienced midwives working in the different areas, as they would have gained a fairly accurate understanding of the attitudes of women in their particular area. These midwives belonged to the area in which they worked. As a result of the enquiry we found that we were able to divide the women into three groups according to attitudes expressed.

(a) The majority of city and urban dwellers

These women responded in the same way as women in general, whether they lived in Europe or America or any other developed part of the world. In particular, they accept advice and instructions given by informed medical personnel.

(b) A minority of the rural women

Apart from a desire for a large family (six or more), they would accept standard obstetric care and the advice given by midwives and obstetricians.

(c) The majority of rural women

In the main, these women have their first baby at the age of 16 or soon thereafter. This fits into the tradition of a type of "trial marriage", for the prospective husband will not accept a girl as his wife unless fertility is proven. When pregnant the girl is cared for by her grandmother and the labour takes place in one of the village huts.

If there is delay in progress the witch doctor (nyanga) is called in. The delay is believed to be due to infidelity and a confession is demanded. If this is not forthcoming the girl is punished in order to extract the confession. Punishment often takes the form of tightening leather straps around the head. It is believed that if confession is made, then delivery will be successful.

If there is still delay in progress then at that late stage the patient will be referred to a clinic or hospital. The patient's attitude to Caesarean section then becomes very important in considering her management. For most of these young girls, Caesarean section will be regarded in their home and village as a failure of womanhood. Women normally deliver vaginally and if they are not able to do so, then they are regarded as totally inadequate - inadequate to till the soil, to care for the home and inadequate as a sexual partner. As a result the usual response is for the husband to divorce his wife and look for another, who is capable of delivering babies by the natural route.

Furthermore, if the patient does become pregnant a second time after a previous Caesarean section, and she will often attempt this by any means just to prove herself, she will often prefer to labour alone at home. She will hope to deliver vaginally and so reinstate herself in the eyes of her family and village. This will, of course, often end in disaster.

This classification of patients into three types according to their response is by no means a static one. In the six years that the University Department of Obstetrics has been functioning in Salisbury we have witnessed a very evident trend towards the acceptance of standard obstetric teaching on behalf of both urban and rural communities. Where an efficient service is rendered the response soon follows.

As a result of the observations made in this survey of patient attitudes, we believe that the following principles should be taken into consideration in planning the management of the African primigravida -

(i) The background and response of the individual patient should be considered, rather than making assumptions based on tribal or racial backgrounds.

(ii) No unnecessary Caesarean sections should ever be performed.

(iii) The quality of the baby born should be optimal if ever planned parenthood is to be acceptable in the African community.

(iv) Every attempt should be made to raise the status of the midwife in the eyes of the local community.

THE STANDARD METHODS THAT HAVE BEEN USED IN DETECTING CEPHALO-PELVIC DISPROPORTION - WITH A CONSIDERATION OF THEIR LIMITATIONS.

The following factors are usually taken into consideration in the detection of cephalo-pelvic disproportion:-

1. Past History

In the primigravida there is no past obstetric history that will be of assistance in predicting outcome. However, it is important to take note of a past history of trauma to the pelvis or of disease affecting the spine, pelvis or lower limbs. Baird[1] has shown that the socio-economic status of the father runs parallel with the pelvic size of the mother, and this is reflected in the number of difficult labours. The lower the social class the greater prevalence of pelves of abnormal size and shape. In our practice, patients all tend to be of the same low socio-economic level and so this factor is of limited predictive value for the individual patients.

2. Height

Bernard[2] has stated that Caesarean section for disproportion is extremely rare among women over 5 feet and 2 inches in height and that the problems of disproportion tend to occur among shorter women, particularly if they are of a poor socio-economic class. Again, this fact is of limited predictive value in our practice as the mean height of primigravidae attending our clinic is under 5 feet and 2 inches and they all come from a poor socio-economic background.

3. Clinical pelvimetry

Standard teaching has been that, in the primigravida, clinical pelvimetry should be carried out by doing a vaginal examination at the antenatal clinic at about the 38th week of gestation. Skilled obstetricians who are in constant clinical practice may attain a high degree of accuracy in their assessment of pelvic size. The final clinical judgement is probably more difficult in the African patient than in the Caucasian for in the former the high angle of inclination at the brim of the pelvis causes the head to remain high and so makes a head-fitting test difficult to assess.

The majority of doctors and in particular the midwives who see most of our patients will have difficulty in accurately predicting the outcome based on clinical pelvic assessment. In a community where there is an increased prevalence of disproportion, the tendency then will be to revert to an unnecessarily high number of elective Caesarean sections.

4. X-Ray cephalo-pelvimetry

In the larger teaching hospitals of Southern Africa it has been the practice to carry out an X-ray pelvimetry on primigravidae whose clinical pelvic assessment has suggested the presence of disproportion.

Alternatively, in some institutions, X-ray pelvimetry is performed intra-partum in those cases where a trial of labour is being conducted and there is evidence of delay in the progress of the labour. Moir[3] has worked out a series of prediction charts to improve the accuracy of radiological prediction of cephalo-pelvic disproportion. Whereas it is easy to establish a radiological method of measuring the pelvis there is always difficulty in accurately measuring the fetal head due to positional problems and head moulding. Crichton[4] has determined mathematical formulae that can be used to correct for variations due to head position and head moulding.

The major limiting factor in the use of radiological prediction in the developing countries is the lack of adequate X-ray facilities and skilled X-ray interpreters outside the major centres. It is certain that such a service will not be available for the management of the vast majority of primigravid labours on the African continent in the next few decades. Furthermore, there is again the risk of doing more Caesarean sections than is absolutely necessary if decisions are made on ante-partum X-ray pelvimetry.

WHAT IS REQUIRED OF A PRACTICABLE REGIME OF MANAGEMENT OF PRIMIGRAVID LABOUR IN CENTRAL AFRICA?

The implications from this background information are that a regime of detection and management of cephalo-pelvic disproportion in the Rhodesian African must take into account the following principles;

(a) Costly equipment and skills such as X-ray pelvimetry, are not generally available.

(b) It is not possible at present to admit all primigravid patients to hospital for their delivery. The majority will have to deliver in a peripheral lying-in clinic under midwifery supervision.

(c) Assessments leading to the detection of problem cases, i.e. screening, must be of a type that can be carried out by the average midwife working in the periphery.

(d) Final decisions on method of delivery should be based on simple clinical measurements that produce a low Caesarean section rate, and at the same time healthy, intact babies.

This implies that the following instructions would be provided for the midwife working in the peripheral clinic with regard to her primigravid patients:

1. Patients with the following conditions should be referred to the central hospital immediately:

(i) a persistent breech, transverse lie, brow or face presentation.

(ii) Severe toxaemia or eclampsia.

(iii) Cardiac or other maternal disease.

(iv) Premature labour.

(v) Prolonged rupture of the membranes, and prolapsed cord.

(vi) Any ante-partum haemorrhage.

2. All others should have a trial of labour conducted in the clinic, whether disproportion is suspected or not. It is the purpose of this thesis to evolve a set of simple, safe guide rules for the conduct of such a trial of labour, with explicit indications as to when a patient requires immediate referral to the central unit.

3. This regime is based on the assumption that the clinic is within reasonable distance from a referral hospital. It certainly should not be more than four hours distant. If it is more than four hours away then conditions are not satisfactory and the midwife will just have to use her own clinical judgement based on patient height and pelvic assessment in selecting patients for earlier referral.

A PLANNED STUDY OF "TRIAL OF LABOUR"

It has been implied (see above) that the method of detection and final management of cephalo-pelvic disproportion in the otherwise normal primigravida will need to be based on a carefully and safely conducted trial of labour. For the purposes of this thesis, a trial of labour can be defined as follows:

A spontaneous labour at term in a primigravida in whom the possibility of cephalo-pelvic disproportion is suspected, conducted to determine, with safety to mother and fetus, whether or not there is in fact cephalo-pelvid disproportion, and if so, to determine the degree. To accomplish this purpose the labour will be permitted to continue as long as there is:-

(a) satisfactory progress in the labour;

(b) no significant fetal distress; and

(c) no maternal distress that cannot be corrected by simple means.

Maternal and fetal condition will be considered later in the thesis. Progress in labour is most accurately measured by the rate of dilatation of the cervix, a feature which has been highlighted by the studies of Friedman[5] . Cervical dilatation is simple to measure clinically and the rate of dilatation is a direct reflection of the rate of progress of the labour. The uterine contractions cannot be measured exactly by clinical means and, as Friedman[6] and Turnbull[7] have pointed out, their efficiency is not necessarily related to their strength and frequency. The use of a measure of descent of the presenting part as a guide in the assessment of labour progress will be analysed in this study and commented on in the discussion.

It is therefore to the rate of dilatation of the cervix during labour that we turned our attention in our search for a simple parameter of labour progress.

REVIEW OF PREVIOUS WORK DONE IN THE CERVICOGRAPHIC ANALYSIS OF NORMAL AND ABNORMAL LABOUR

The original and most extensive study of cervicographic progress in normal and abnormal labour has been carried out by Friedman. A list of relevant publications on the subject by Friedman are listed at the end of this thesis. Hendricks has also contributed in the study of this subject. Other published work is, in the main, a repetition or application of the work of Friedman and Hendricks.

1. The Work of Friedman (5, 6, 8, 9, 10).

This is based on his principle that "the end results of all the forces of labour, as they act upon the uterine contents and against the soft maternal parts, are apparent in the essential work that must be accomplished in order for labour to terminate normally, namely progressive cervical dilatation and progressive descent of the fetal presenting part".

Friedman has studied the rate of progress in normal labour by plotting the cervical dilatation on serial observations against elapsed time. He finds that the resultant cervicograph is represented by a sigmoid curve when cervical dilatation in centimetres is plotted on the vertical axis and time in hours on the horizontal axis. The descent of the presenting part is represented by a hyperbolic curve when station is plotted against time.

As shown in Figure 2, the sigmoid cervical dilatation pattern of the first stage of labour can be subdivided into a latent phase and an active phase. The latent phase extends from the onset of labour to the point in time when the curve swings upwards acutely. During this time, the major work accomplished is effacement of the cervix. The active phase of labour commences from the point of upswing of the curve until

full dilatation of the cervix. Friedman further subdivides the active phase into an early acceleration phase, a phase of maximal slope, and, finally, a deceleration phase. The phase of maximal slope is that phase when the cervix progressively dilates and is, therefore, a measure of the efficiency of the labour.

The pattern of descent of the presenting part can likewise be subdivided. The latent phase of descent continues into well on in the phase of maximal slope of cervical dilatation. From then onwards the active phase of descent progresses through the second stage of labour to delivery of the baby.

Friedman then goes on to subdivide labour into three functional units based on cervical dilatation and descent of the presenting part (Figure 3). These are termed the preparatory, dilatational and pelvic divisions.

The dilatation and descent curves just described represent the mean rates of progress of Friedman's primigravid patients. In order to study abnormal labour he then quantitated the various divisions of each curve and determined the statistical limit of normal for each division. A very large volume of work was then carried out in studying the various abnormalities in each of the functional divisions of labour.

The major abnormalities of labour are grouped under three headings:

(a) Disorders of the preparatory division - i.e. prolonged latent phase.

(b) Protraction disorders - i.e. protracted active phase dilatation and protracted descent patterns.

(c) Disorders of arrested progression - i.e. secondary arrest of dilatation, prolonged deceleration and arrest of descent.

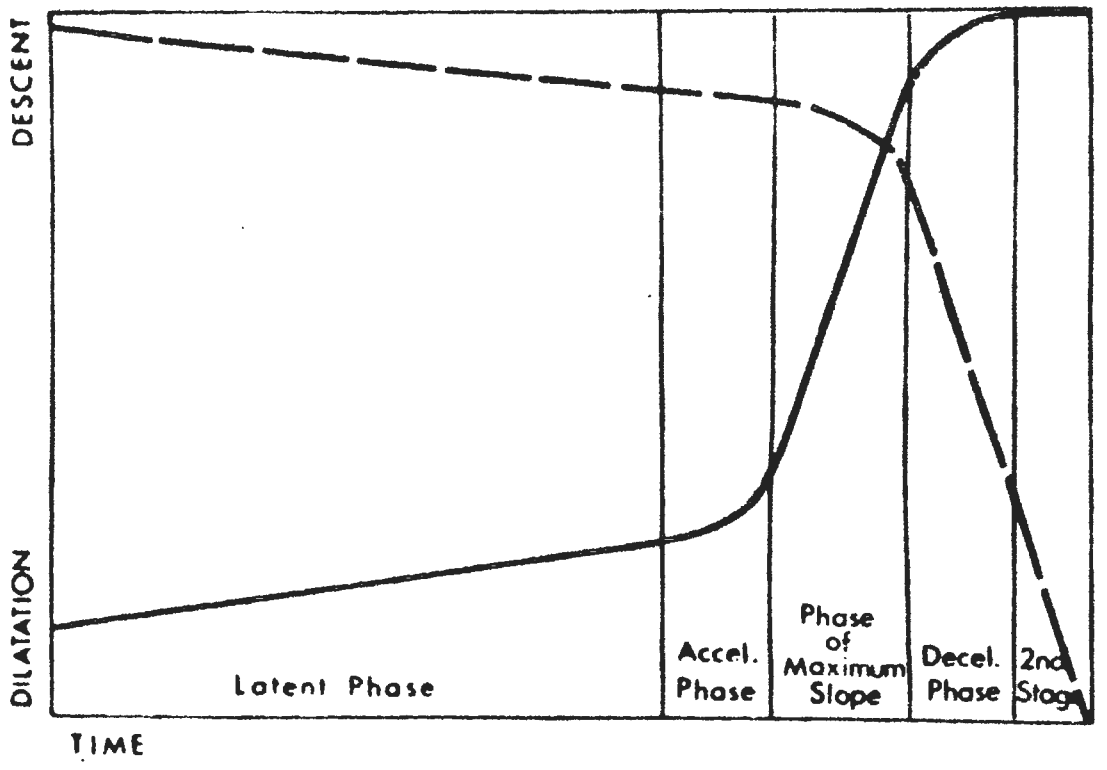


Figure 2. Graph of Cervical Dilatation and Head Descent in the Primigravida (Friedman).

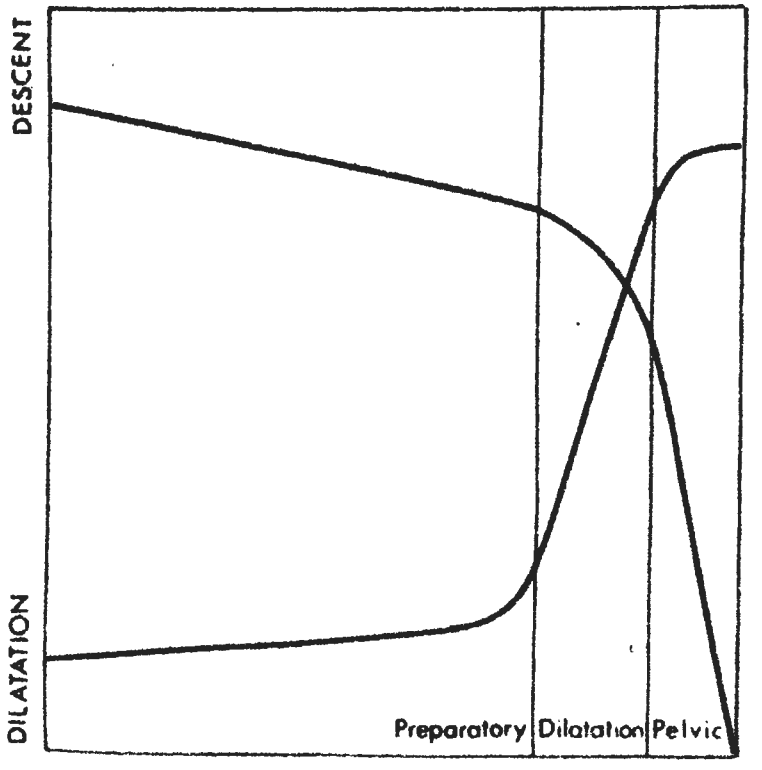


Figure 3. Functional Units of Cervical Dilatation and Head Descent (Friedman).

This grouping is based on similarities of the abnormal patterns in terms of aetiology, treatment and prognosis. As this work is very extensive, it is considered that a brief summary is all that can be included in this Introduction, and I present a Table from one of Friedman's publications[6] for this purpose (Table II).

Table II. Dysfunctional labour patterns (Friedman).

	Prolonged Latent Phase	Protraction Disorders	Arrest Disorders
Diagnostic features	Nulliparas: 20 hr. Multiparas: 14 hr.	Nulliparas: 1,2 cm/hr. dilatation 1 cm/hr. descent Multiparas: 1,5 cm/hr. dilatation 2 cm/hr. descent	Dilatation: 2 hr. arrest Descent: 1 hr. arrest
Aetiologic factors	Excessive sedation Unprepared cervix False labour Anaesthesia Uterine dysfunction	Unknown CPD* 28% Malposition Excessive sedation Anaesthesia	CPD* 45% Malposition Excessive sedation Anaesthesia
Therapy	REST	SUPPORT Avoid inhibitory factors	Section+ for CPD* OXYTOCIN (only if no CPD*)
Expected response	85% "cure" 10% out of labour	90% uninterrupted progression	94% "cure"
Delivery prognosis	Vaginal delivery	Vaginal delivery usually. Section+ for CPD*	Delivery prognosis varies with response
Fetal prognosis	No risk	Slightly increased risk	Threefold risk

* Cephalo-pelvic disproportion

\+ Caesarean section.

2. The Work of Hendricks, Brenner and Kraus[11]

Hendricks had noticed a difference between the labours of patients he had managed and the description given in standard textbooks. He then studied a series of 303 pregnancies personally and presented the following findings based on cervicographic recordings.

(a) The cervix started dilating progressively at least four weeks before the onset of active labour. In the final days of prelabour he found the mean cervical dilatation in the primigravida to be 1,8 cm and the multigravida 2,2 cm. The effacement of the cervix was then 70 per cent in the primigravida and 61 per cent in the multigravida.

(b) He found no evidence of a latent phase in labour or a phase of deceleration. He regarded the slower phase prior to active labour as prelabour, and that this was continuous with the slower rate of cervical dilatation in the latter weeks of pregnancy. He felt that, in normal labour, the phase of deceleration described by Friedman could be explained by the fact that continuous cervical assessments were not being made at the end of the first stage of labour and, therefore, the actual moment of full dilatation was missed and only recognised after a delay in time. When a deceleration was, in fact, present Hendricks regarded this as a form of dysfunctional labour.

(c) Hendricks recognised the difficulty of pinpointing the moment of onset of the first stage of labour. For practical purposes he commenced his recordings from the time of the patient's admission to the labour ward, regarding that as a good index of the onset of labour. All his analyses are made from that point.

When questioned about a method of pinpointing the actual time of onset of labour Brenner[12] stated that this could be done in retrospect

by extrapolating backwards on the curve of the cervical dilatation in active labour until it met the cervical dilatation curve of prelabour. However, as mentioned above, in practice they used the time of admission to the labour ward as representing the onset of active labour.

Cibils and Hendricks[13] used the point at which 3 cm cervical dilatation was reached as their reference point for the commencement of the first stage of labour.

3. The work of Ledger

Ledger applied the pioneering work of Friedman to clinical management with a few modifications. He recognised three abnormal cervical dilatation patterns:

(a) prolonged latent phase - a primigravida still in the latent phase of labour after 12 hours;

(b) slow active phase - a rate of cervical dilatation in the active phase of labour of less than 1 cm per hour; and

(c) arrest of active phase - no increase in cervical dilatation over a period of two hours or more in that phase.

When one of these abnormal cervical dilatation patterns was detected, the adequacy of the size of the pelvis relative to the size of the fetus and the quality of uterine activity were evaluated. In the majority of cases amniotomy was performed and an oxytocic infusion was administered.

Ledger found that the partograph permitted early recognition of abnormality and that an active regime of management produced excellent results.

(4) The work of Beazley

Beazley described the application of the partograph to labour management and combined this with an active regime of management. This controlled acceleration of labour reduced the frequency of prolonged labour and, in primigravidae, this was associated with a reduced frequency of babies with respiratory depression at birth.

CHAPTER 2

MATERIALS AND METHODS

PATIENTS

All patients studied were African primigravidae and, except where otherwise stated, were seen and treated at Harari Central Hospital, Salisbury. They were not selected according to tribe but in the main belonged to the Shona tribe of North-Eastern Rhodesia.

The Maternity Unit of Harari Central Hospital is responsible for about 8 000 deliveries each year. These consist of the complete range of normal and abnormal patients from the immediate vicinity, plus a large number of problem cases referred from outlying hospitals in Mashonaland Province. The major portion of the study in this thesis was carried out at a time when all women who wished to do so were delivered in the hospital. In the past year, however, the numbers became too great and it has been necessary to build a series of clinics with lying-in beds in the suburbs of Salisbury for normal deliveries.

The method of selection of the groups of patients for each of the various phases of the study will be described in detail as each phase is presented. All treatment given was described to the patients. The only unusual aspect of management was the hourly vaginal assessment of cervical dilatation in two of the phases of study. As will be emphasized later, we repeatedly ensured that infection did not occur and so were able to obtain patient acceptance for a study that was safe for both mother and fetus. Not only did the patients give their consent to this study, but they also showed appreciation for the continual personal attention from what amounted to their own private midwife.

To ensure that X-Ray studies carried no risk to the fetus, the X-Ray pelvimetries were carried out in the immediate puerperium, and as these were done mainly for research needs, patient consent was obtained.

DEPARTMENTAL RESEARCH MEETINGS

It is the policy in our University Department of Obstetrics and Gynaecology that all research projects should be presented to our weekly research meeting. Each phase of this project was presented for discussion and comment. Much helpful advice was obtained in this way, and valuable co-operation was received from each member of the staff. Dr. W. Castle, the Faculty of Medicine Statistician, is present at these meetings, and gives advice on the statistical aspects of all research projects before they are commenced.

RESEARCH MIDWIVES

In the early years of planning in the Department it became apparent that both midwives and doctors would be far too involved in a heavy clinical work load to be able to carry out time-consuming research studies. It was therefore decided to use two posts originally intended for laboratory technicians to employ two research midwives to assist in clinical research projects. To avoid personnel problems within the labour ward, the two midwives chosen were of exceptional merit, and readily acceptable to the others who were carrying out the heavy routine work of the ward.

These two midwives carried out all the assessments of cervical dilatation and were responsible for the bulk of the patient care in all of the studies. This helped considerably to ensure patient acceptance, accuracy in clinical measurements, and complete retrieval of patient records. The success of the early appointments to these posts has led to the permanent establishment of these posts in the Department.

THE INTENSIVE CARE UNIT

This is another innovation that was commenced specifically for this project and which has now become a permanent feature in the Department.

The Labour Ward is now divided into three areas - one area for normal patients in the latent phase of labour; a second for normal patients in the active phase of labour and a third for "at risk" labours, where either the mother or the fetus is "at risk". The latter is labelled the "Intensive Care Unit" and consists of a 3-bedded ward.

In this study, all the normal labours have been followed in the first or the second area of the Labour Ward and all patients whose cervicographic progress has crossed the Alert Line have been regarded as at-risk and have been managed in the Intensive Care Unit. Although the Intensive Care Unit is equipped with special monitoring instruments, these have not been used in this study, as the emphasis has been on the utilisation of simple clinical parameters. However, it is found that the standard of clinical assessments can be raised considerably within the discipline of intensive care.

GRAPHIC RECORDINGS IN LABOUR

The early interest in the graphic recording of cervical dilatation led to a consideration of the possibility of incorporating all the parameters of fetal and maternal condition in the first stage of labour on a single composite labour graph.[16] This composite labour graph has since become such an integral part of this whole study that a full description of the graph and its use is given at this point. Peripheral clinics in Rhodesia are using the same graph, and when patients need to be referred to a central hospital they come in with their graph.

The graph (example Figure 4) which measures 25 by 40 cm forms the double page spread of the centre of the patient's bound maternity record and is attached to a clipboard at the foot of the patient's bed. The recordings are made by the midwife or the doctor. The doctor's findings on admission are recorded on the previous page, and any extra intrapartum information, such as consultants' comments, are recorded on the succeeding page. The details are given in the order in which they appear on the graph.

Components of the Labour Graph

(a) Time

Zero time is taken as the time of admission to the hospital, rather than the problematical time of onset of labour. The actual time is recorded on two lines, one for each half of the record. In addition, the hours from admission are marked off to alert the observer to the passage of time.

(b) Fetal heart rate grading

We recognised that cardiotocographs could not become standard equipment in Central Africa, yet there was still need for greater accuracy in the recognition of fetal condition. Following the use of the cardiotocograph in our own Intensive Care Unit, an attempt was then made to categorise the various fetal heart rate patterns which could be picked up by clinical observation, i.e. by the hand on the uterus to detect contractions and with the fetal stethoscope to pick up the fetal heart rate.

The types of fetal heart rate patterns that we categorised are listed in Figure 5, though in the first instance they were not placed in a particular sequence. We then tested the ability of the research midwife

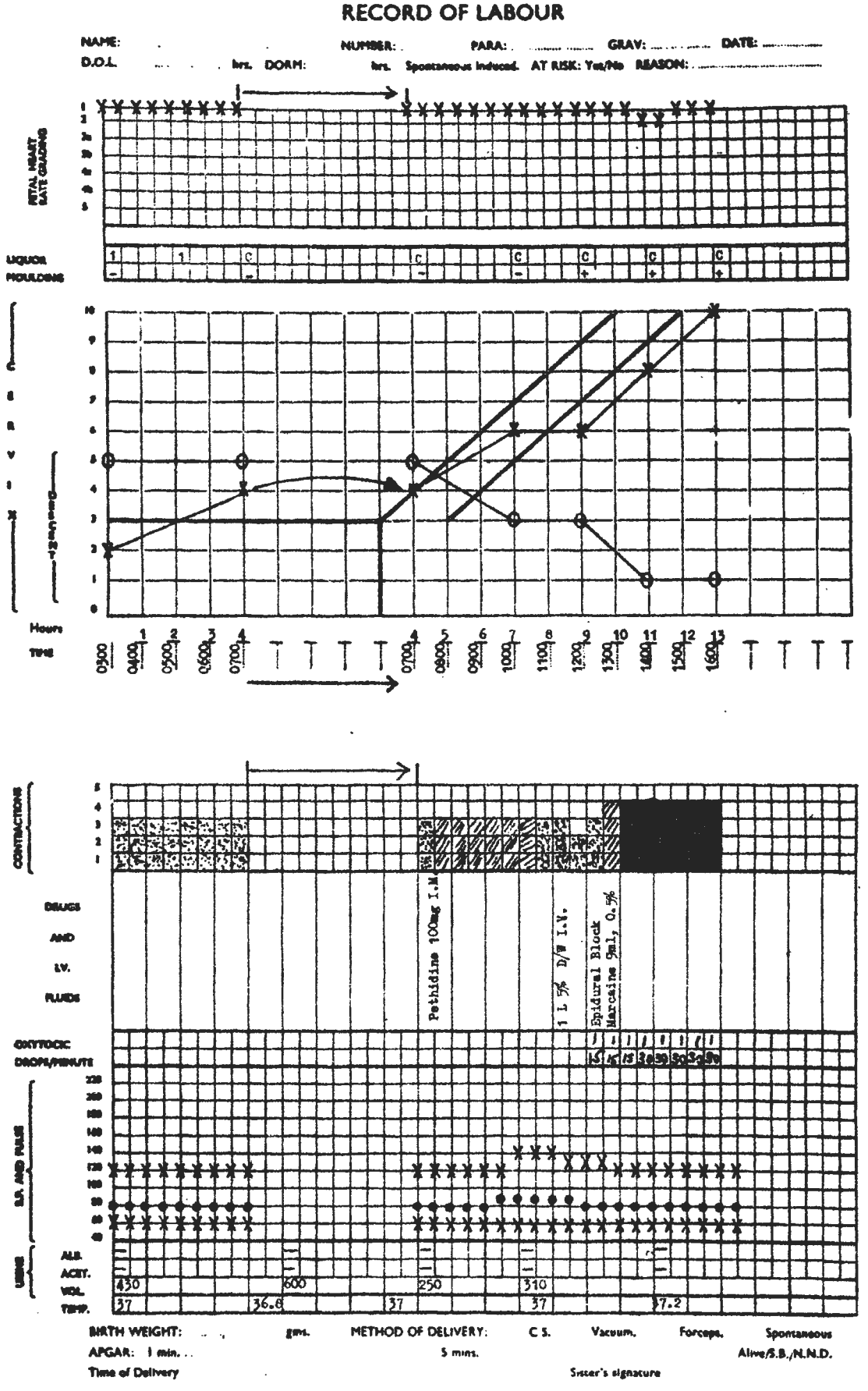


Figure 4. The Composite Labour Graph.

to detect these patterns clinically. This was done by asking the midwife to make her own assessment of a pattern clinically by listening before, during and after a contraction at the same time as it was being recorded on a screened-off cardiotocograph.

During the monitoring of 20 patients the midwife was tested on 100 segments of trace containing varying fetal heart-rate patterns. She was correct in her clinical recognition of these 100 patterns in 93% of cases.

It is not likely that all midwives will attain this degree of accuracy, but we feel that it is a standard worth aiming at. Where it is possible for a clinic or hospital to obtain a relatively inexpensive Sonicaid or Doptone fetal heart detector we feel that this is of great value in improving the ability to detect the fetal heart during contractions, at a time when it might otherwise be impossible. This has been clearly demonstrated by Beard[17].

We then endeavoured to grade fetal heart-rate patterns according to their severity in such a way that these gradings could be recorded graphically. This grading has evolved over four years of clinical practice and has been adjusted during that time. In the first instance it was determined by analysing the traces of eight primigravid African patients who had demonstrated early clinical evidence of fetal distress in the presence of marked cephalopelvic disproportion. These eight patients had adamantly refused Caesarean section, even when the situation had been carefully explained. The fetal heart-rate was then monitored on the cardiotocograph using scalp electrode and intra-uterine catheter, and the traces studied. In each of these patients the fetus died in utero prior to delivery.

It was felt that eight patients were not sufficient for a proper study, and we have not been able to add to this small series, as there have not been further cases of refusal of treatment. However, study of these few traces has shown that there was a trend in changing patterns as the fetus deteriorated, and that the grading recorded in Figure 5 represents the worsening condition of the fetus in this small series.

Normal: 1. 120 - 160. No change with contractions.

Abnormal: 2. (a) Tachycardia ↑160 Not changing with contractions

(b) Bradycardia 100 - 120

3. (a) Early deceleration - normal baseline (120 - 160)

(b) Early deceleration - abnormal baseline (<120 - >160)

4. (a) Late deceleration - normal baseline

(b) Late deceleration - abnormal baseline

5. Fetal heart less than 100 at all times.

Figure 5. Grading of Fetal Heart Rate Patterns

This attempt to grade clinically the fetal heart rate pattern is similar to that described by Day et al[18]. Caldeyro-Barcia et al[19] emphasized the greater seriousness of the fetal heart rate deceleration with a prolonged lag phase between peak of contraction and depth of deceleration (Type II dip- compared with the deceleration without or with only a short lag phase. Mendez-Bauer et al[20] showed that the percentage of these Type II dips on a trace reflected the condition of the fetus at delivery. Kubli et al[21] also showed that late decelerations were indicative of severe fetal asphyxia. Beard[22] analysed fetal heart rate patterns in relation to fetal pH at the time of the recording of the abnormal pattern. He demonstrated that if the

fetal heart rate showed no change in rate during contractions, and there was good beat to beat variation (a sign that can only be detected with a monitor), then one could be reasonably certain that the fetus was not asphyxiated. In particular, a baseline bradycardia that was not affected by contractions was innocuous. Late decelerations and variable decelerations with abnormal baselines were of particularly serious significance.

On our composite labour graph the fetal heart rate grading is recorded half-hourly.

(c) Liquor

If the membranes are intact, we record in the appropriate column an "I"; if the liquor is clear, a "C"; if the liquor is meconium-stained, an "M". If the membranes are ruptured on admission, the duration is recorded at the beginning of the line marked "Liquor".

(d) Moulding

This is an important sign that alerts one to increasing evidence of disproportion and is often the only sign of fetal distress in this complication.

Key: - = bones separated normally

\+ = bones touching each other

++ = bones overlapping, but on digital pressure can be easily separated

+++ = bones overlapping and on digital pressure cannot be easily separated.

(e) Cervicograph

The cervical dilatation is plotted at zero time on admission and thereafter according to time elapsed. After plotting the cervical dilatation with an "X", it is wise to decide then when one wishes to do

the next cervical assessment and to mark this by a bold arrow on the time scale. The position of the fetal head can be recorded next to the "X" for the cervical dilatation. This is done by recording a figure relating the occiput to the point on a clock - for example, right occipito-lateral 9, and left occipito-posterior, 4.

(f) Descent of the head

Rather than using the inexact terminology of "fixed" and "engaged", we have adopted the more exact terminology first described by Crichton[23] He defined the level of the head in relation to the brim of the pelvis (Figure 6). The number of fifths can then be plotted on the cervicograph with an "O" (as opposed to the "X" for cervical dilatation). The lines 0-5 on the cervicograph can be used for this purpose.

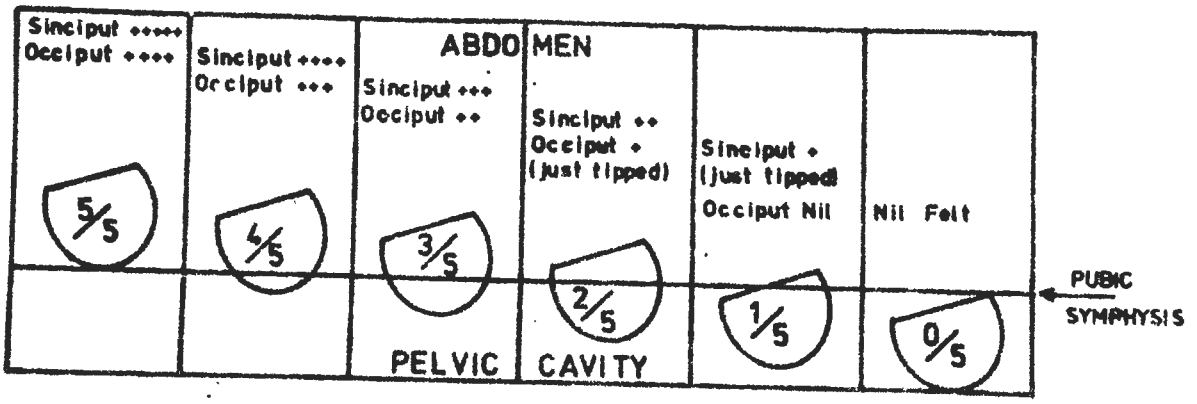


Figure 6. Level of the head in fifths above pubic symphysis (Crichton)

The recording of the level of the head in this way gives further evidence of progress of labour and is also of help in determining the final method of delivery in the second stage of labour. We find that this method is more meaningful than other methods of determining the station of the head in relation to the ischial spines, and can be assessed without having to do a vaginal examination. In the African, the pelvis is particularly shallow and vaginal assessment of head station can give a false impression of the amount of head that is in fact still above the pelvic brim.

(g) Contractions

This is the third feature in the assessment of the progress of labour. It becomes of particular importance in recognising types of uterine inefficiency, and also when oxytocin stimulation is used. The contractions are plotted immediately below the cervicograph according to the key and example described in Figure 7.

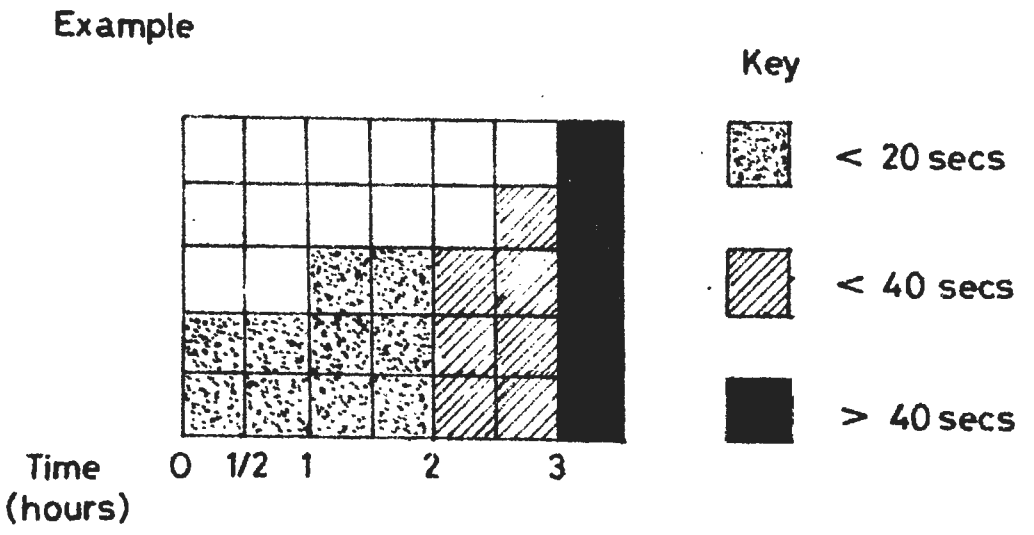


Figure 7. Method of recording uterine contractions

The frequency is recorded half-hourly as the number of contractions in the last ten minutes of each half-hour period, and this number of blocks shaded in according to the duration of the contractions. We find that the patients are able to help in counting the frequency of the contractions by using the labour ward clock.

(h) Drugs and intravenous fluids

These are recorded in the space provided and ticked off when they are given or started.

(i) Oxytocic stimulation

When oxytocic stimulation is used for induction of labour or the stimulation of inefficient labour this can be recorded in the two lines provided. In the first line marked "Oxytocic" the number of units in a litre is recorded and in the next line the number of drops per minute.

(j) Blood pressure, pulse and temperature

These are self-explanatory.

(k) Urine

Albumen and acetone content and urine volume are recorded every time urine is passed.

VAGINAL EXAMINATIONS

In carrying out assessments of cervical dilatation it has been my policy to do vaginal as opposed to rectal examinations. It is considered that these need carry no greater risk of introducing infection than rectal examinations and they are certainly more accurate. A distinction is made between the extensive "pelvic exploration" carried out when the patient is admitted in labour, and the simple cervical assessments made as labour progresses. For the latter procedure hands are washed in hexachlorophene soap, sterile gloves and face mask worn, introitus swabbed with "Hibitane"

solution and "Hibitane" cream applied to the fingers prior to doing the digital vaginal examination. This is essentially a quick prodecure that does not involve extensive exploration, and so should not create a hazard of introducing infection.

Except where otherwise stated, it is our policy to carry out a vaginal examination on all women admitted in labour and thereafter to avoid doing them in the latent phase but to repeat the examination at four-hourly intervals in the active phase.

To improve accuracy a reference board with ten circles of varying centimetre diameters is placed on the wall in each labour ward. Consideration was given to the use of a cervimeter, but we have not been able to design an instrument that would be simple to use. Friedman(24, 5) comments that the use of a cervimeter is impractical for standard use and that digital vaginal examinations produce satisfactory results.

In the series described later in which hourly vaginal examinations were done there was no increased incidence of infection and antibiotic treatment was not required.

ROUTINE MANAGEMENT OF LABOUR

(a) Fluid and carbohydrate requirements

As soon as these were needed they were given by the intravenous route. They were certainly indicated in liberal amounts in all patients whose cervicographic progress had crossed the Action Line on the cervicograph.

(b) Rupture of the membranes

This would be done at the first vaginal examination when the cervix was found to be five or more centimetres dilated. If the membranes had been ruptured for 24 hours or more then Penicillin and Streptomycin were administered to the mother.

(c) Oxytocic infusion

When this was indicated according to the regime described later, it was administered by a simple intravenous infusion set. Infusion pumps were not used in patients on this series.

(d) Normal deliveries

These were conducted by the midwife.

EPIDURAL ANALGESIA

This is administered to all patients whose cervicographic progress crosses the Action Line on the cervicograph. The details of the procedure adopted in our Intensive Care Unit are as follows:(25)

Procedure

The Boyle's anaesthetic machine must be checked and a functioning laryngoscope and endotracheal tube available. An intravenous infusion of 5% dextrose in water is set up and any dehydration corrected before giving the block.

Equipment

Two 20 ml syringes are used, the plungers of which run freely, and are checked for leaks. A No. 15 or No. 16 gauge Tuohy needle and stylette are assembled and a check made that the disposable polythene epidural cannula will easily traverse the needle. A small amount of 1% Lignocaine is used to anaesthetise the skin. Ten millilitres of 0,5 per cent Bupivicaine are drawn up into the other syringe and to this 5 ml of sterile water are added, resulting in a concentration of 0,375 per cent of Bupivicaine.

Technique

The patient sits erect, with her legs over the side of the bed, placed comfortably on a low stool. The skin is cleansed and sterilised

using Savlon and Tincture of Iodine and the area of the back draped. An interspace between L1 and L3 is identified and the skin anaesthetised with 1% Lignocaine. The patient's back is then flexed, ensuring that the vertebral column is straight. The Tuohy needle with stylette is inserted and gently advanced through the supraspinous and inter-spinous ligaments. The stylette is removed and the empty glass syringe, with plunger withdrawn, attached to the Tuohy needle. The resistance to air is noted. The needle is gently advanced, testing frequently for resistance against the plunger. As the needle approaches the ligamentum flavum, an increased resistance is noted. This sensation is a clear guide as to the position of the needle. With penetration of the ligamentum flavum, there is a loss of resistance and the plunger descends. The syringe is then removed.

The needle is usually rotated so that the bevel opens cephalad. There is, however, no significant difference in quality of anaesthesia or side effects when the catheter is directed upwards or downwards, (Romine, Clark and Brown [26]). After disconnecting the syringe, no blood or cerebro-spinal fluid should return.

The cannula is then introduced through the needle into the epidural space. It should pass easily, though sometimes there is slight hesitation at the angle of the Tuohy needle. The 20 cm mark on the cannula should reach the needle hub and the needle is then withdrawn. The cannula is strapped vertically to the patient's back, with a piece of one-inch translucent adhesive tape.

Two millilitres of 0,375 per cent Bupivicaine are slowly injected as a test dose. Should there inadvertently be dural puncture, toe paralysis will usually be present after two minutes have elapsed and the

catheter should then immediately be removed.

A further 8 ml of 0,375 per cent Bupivicaine are slowly injected over four minutes. Injection should only require pressure from the back of the little or ring finger to advance the plunger. Under no circumstances must the Bupivicaine be injected under pressure. Injection should be avoided during a uterine contraction, as there is then a rise in epidural pressure in the lumbar region (Bromage[27]) which predisposes to rapid and higher spread of local anaesthetic.

The patient is then returned to the supine position on the table, without excessive movement. The patient remains supine for ten minutes to ensure symmetrical distribution of the anaesthetic, and is then turned onto her left side and nursed in that position. If a perineal block is needed, the patient is allowed to sit until perineal analgesia is present. A Foley's catheter is inserted into the bladder for continuous bladder drainage if the patient cannot void urine spontaneously.

Top-up injections

Top-up injections are given at the earliest evidence of returning pain. A test dose of 2 ml of 0,375 per cent Bupivicaine is given over five minutes with the patient in the supine position. After ten minutes the patient is once again turned onto her left side.

Injection prior to delivery

The patient may feel no pain with contractions and yet complain of low backache or perineal discomfort when instrumental delivery is attempted. A further injection of 0,375 per cent Bupivicaine should be given with the patient sitting until perineal analgesia is achieved.

X-RAY PELVIMETRY

This was carried out for research purposes in selected cases in this study. As the measurements were not going to be used in the management of labour, the pelvimetries were carried out during the 24-hour period following delivery. Patient permission was obtained before carrying out this procedure.

The method of pelvimetry used in our Department is based on the principle of orthodiagraphy as described by Murray[28]. This method avoids excessive irradiation to the mother and, in pregnancy, to the fetus. The details of the technique as described by Murray are as follows:

The patient lies supine on the table with a small foam-rubber pillow under the lumbar spine to increase the lumbar lordosis, so bringing the plane of the pelvic brim parallel or nearly parallel to the table top. The light beam diaphragm is restricted to give a field of 10 x 4 cm at 100 cm focus-film distance with the long axis of the field in the long axis of the table. The tube is inclined 15 degrees towards the patient's feet and centred on the symphysis pubis. It is then moved 7 cm towards the patient's head until it is centred on the mid-line at the level of the anterior superior iliac spines. A 12 x 10 in. cassette placed transversely in the Potter-Bucky tray is then centred to the tube, and from this time onwards the patient and cassette are not moved. The tube is shifted 5 cm to the left of the patient's mid-line for the first exposure and then 5 cm to the right of the mid-line for the second, i.e. a transverse tube-shift of 10 cm, producing separate projections of the side walls of the pelvis on a single film. A true lateral of the pelvis is then taken with the patient erect and a centimetre metal ruler in the natal cleft.

The estimation of the transverse pelvic diameters is based on the geometric theorem that opposite sides of a parallelogram are of equal length. Consequently transverse pelvic diameters, or the portions of those diameters which are equal to the tube shift, are projected on to the film without distortion. Transverse diameters greater than the tube shift will be slightly magnified, and those smaller will be slightly reduced. The closer the transverse diameter is to the tube shift the smaller will be the distortion. A transverse tube shift of 10 cm is selected, as this is in the range (9 - 11 cm) which requires the most precise estimation in assessing the maternal pelvis.

With a constant focus-film distance of 100 cm, it is very simple to apply a correction factor of one-fifth at the brim, one-seventh at the mid-cavity plane and one-tenth at the level of the ischial spines. The correction factor is applied only to the difference between the actual measurement on the film and the tube shift. For example, if the transverse diameter of the inlet as projected on the film measures 13 cm, the corrected diameter is $13 - 3/5$ equalling 12,4 cm.

The sagittal diameters are read off from the projection of the metal ruler on the lateral view of the pelvis.

CHAPTER 3

THE SEARCH FOR AN ALERT LINE

As outlined at the end of Chapter 1, the purpose of this study is to determine criteria which will enable the midwife working in a peripheral maternity clinic, or a junior doctor in a hospital, to differentiate primigravid patients with dystocia due to either cephalo-pelvic disproportion or primary inefficient uterine action from those with no dystocia and no disproportion. Reasons have been presented to indicate that the differentiating criteria should be based on the cervicographic recordings of the first stage of labour. This chapter outlines our search for a guide line, or Alert Line, on the cervicograph which would provide the tool for the kind of screening mechanism envisaged above.

The requirements for an efficient Alert Line would be as follows:-

(a) It should be simple enough for the midwife or junior doctor to apply in clinical practice.

(b) Its application should separate the problems and potential problems from the non-problems. This would enable the midwife in the peripheral clinic to deliver all the primigravidae who have no mechanical problems in labour and to recognise early all those with potential labour problems.

(c) The differentiation between problem and non-problem should be made early enough to ensure that the transfer of the problem patient is made in sufficient time to allow for the safe delivery of a healthy baby in the central unit.

(d) The use of the Alert Line should then lead to a regime of management that efficiently determines which of the potential problem cases has definite cephalo-pelvic disproportion. This regime would continue to

utilise the cervicographic analysis of labour.

This search for an efficient Alert Line took the form of a series of studies over a three-year period. The outcome and results of one phase dictated the planning of the next phase until, finally, the most efficient Alert Line had been evolved. The initial clinical exercise was conducted in the Labour Wards of the Harari Central Hospital. The Alert Line that was evolved was then evaluated prospectively in the management of a series of primigravid patients in Harari Hospital. In Chapter 6 an account is given of the application of this Alert Line to practice in various parts of Southern and Central Africa. This latter study led to a few final modifications.

This chapter presents each of the phases that led to the evolution of the initial Alert Line. Each phase is necessarily presented in its entirety in the form of:-

(i) the problem studied;

(ii) material and methods;

(iii) results; and

(iv) conclusions and pointers to the next phase.

PHASE I

THE NORMAL PATTERN OF EVENTS - FRIEDMAN

In order to recognise inefficient uterine action, it is essential to have a reliable impression of the normal pattern of cervical dilatation in the community. As pointed out in Chapter 1, Friedman was the pioneer in this field, and a summary of his basic findings, relevant to this study, is given in that chapter. We hoped that our African primigravidae would be found to follow the pattern of Friedman's American patients, so that we could directly apply his vast experience to Obstetric practice in Africa.

Friedman[5] plotted the cervical dilatation against elapsed time in 500 nearly consecutive primigravidae. The 500 patients retained for study were those who presented themselves sufficiently early in labour to permit adequate observations. Those who arrived at the hospital in advanced labour were eliminated, and these were balanced by those who required an elective Caesarean section prior to or early in labour. The majority of Friedman's patients had hourly or bi-hourly vaginal examinations.

Friedman scrutinized his material to ensure that he was dealing with a cross-sectional sampling of his primigravid population. He looked at such factors as age, hospital status, race, height, weight, duration and outcome of labour, fetal position and presentation, gestational age and birth weight, fetal outcome, fetopelvic relationships, incidence of intrapartum administration of sedatives, analgesics, uterotonic agents and anaesthesia. By this survey, he was able to indicate that he had obtained an adequate sampling of his hospital population insofar as the features examined were concerned.

Mean values were found for each phase of the first stage of labour and a composite curve was constructed from these values. This is the

curve shown in Figure 2.

In endeavouring to compare findings from our own patient population we had particular difficulty in defining the commencement of labour. Friedman had used the classical definition as that time when regular uterine contractions had commenced. This was often very difficult to interpret from our patients. We therefore decided to compare the phase of maximum slope from 4 to 9 cm. As Friedman points out, this phase is a good measure of the overall efficiency of the machine and its slope is inversely related to the total duration of the first stage of labour.

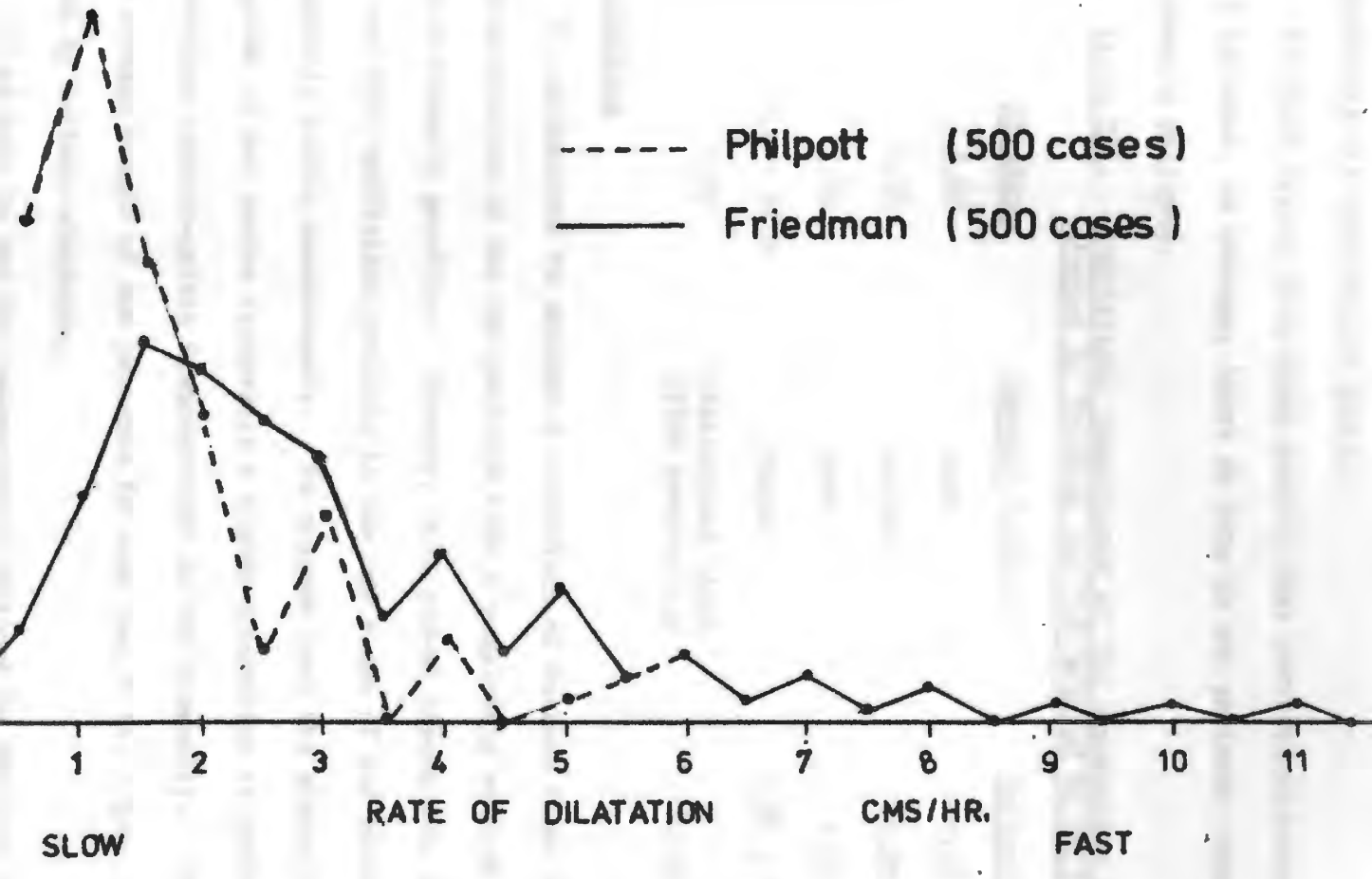
Material and Methods

We did hourly vaginal assessments of the cervical dilatation in 500 consecutive African primigravidae in the first stage of labour. It must be pointed out that though these patients were representative of a cross-section of patients entering our hospital, they were in fact a biased section of the women in the community, because the hospital tends to receive a high proportion of problem patients. In other respects our 500 patients were selected in the same way as Friedman's series, in that patients arriving in late labour were excluded, as were those who had a Caesarean section early in labour. We were not able to ascertain the age, social status or obstetric features of Friedman's series for purposes of comparison.

We then analysed the phase of maximum slope in our 500 patients and measured the average, median and mode for that phase.

Results

Table III gives a comparison of the mean, median, mode, range and statistical limit in the two series. Figure 8 shows the distribution curves of the rate of dilatation in both series. Because of the skewed distribution we have used the 95 percentile limit as the lower



Comparison of "Maximum" Slopes of Cervical Dilatation in the Primigravida.

statistical limit rather than the measurement of two standard deviations from the mean. This is likewise the method used by Friedman in calculating his statistical limit.

It would appear from these results that cervical dilatation from 4 to 9 cm takes, on average, twice as long in our patients compared with Friedman's patients.

Table III. Statistical comparisons of 500 consecutive primigravidae studied by Friedman and 500 studied by Philpott

Friedman	Measure (cm/hr.)	Philpott
3,00	mean	1,59
2,70	median	1,20
1,50	mode	1,00
0,4 - 12,0	range	1,25 - 6,0
1,20	Statistical limit (95th percentile)	0,50.

Conclusions

We endeavoured to arrange a comparison of maximum slope between a cross-section of our own patients with a completely matched series from Friedman's practice. However, this proved impossible, as Friedman[29] did not have sufficient patients in the age range of our patients with comparable pelvic measurements. We presume that the slower rate of progress in our series represents a higher proportion of patients with borderline cephalo-pelvic disproportion in our community. For example, the average height of our patients is less than 5 ft. 2 ins., which is short by Western standards.

If we were to use the measurements obtained by Friedman from his series as the criteria for selecting our problem patients, we would be faced with two particular difficulties:-

(a) Our inability to pinpoint the time of onset of labour with any degree of accuracy in the majority of our patients.

(b) The mean rate of progress in the phase of maximum slope was twice as slow in our patients compared with Friedman's series. Though this probably reflected a higher proportion of abnormal cases, it might be that a slower statistical limit of normal would efficiently separate our true problems.

Our next step was to study the work of Hendricks, who side-stepped the problem of pinpointing the time of labour onset by using the time of arrival in hospital as a possible zero point for further studies of the first stage of labour.

PHASE II.

THE NORMAL COURSE OF EVENTS - HENDRICKS

Hendricks[11] studied all primigravidae in whom no abnormality was expected from their initial history and physical examination. In his series of 77 primigravidae the individual patient was followed throughout her subsequent labour and a cervical dilatation curve was constructed by plotting cervical dilatation against time, from admission throughout labour. Vaginal examinations varied from hourly intervals to continously keeping the hand in the vagina. The time of complete dilatation was noted, with a definite examination, and no curve was extrapolated from incomplete dilatation to complete dilatation.

The patients were then grouped in quintiles on the basis of the length of time from admission to complete dilatation. Therefore, the fastest one-fifth were placed in the first quintile and the slowest fifth in the fifth quintile.

The mean curve of that quintile could then be calculated. As the points in each individual labour are connected by the best fitting line, the mean time taken to reach each centimetre of dilatation could be obtained for that quintile. Because the patients are admitted at various stages of cervical dilatation, the zero time plot has to be made from the mean initial cervical dilatation at admission.

Once a patient was placed in a quintile, determined by the time from admission to complete dilatation, she remained in that group for all computations. By constructing an individual curve for each patient and grouping them into quintiles for easier computation and comparison, one overcomes the problem of calculating means from individual observations at a variety of times and variable numbers of examinations on individual patients. The simple arithmetic mean cervical dilatation at each hour after admission can distort the curve.

Using this detailed information made available to us by Hendricks and Brenner, we embarked on a comparative study [12]. We followed 100 African primigravidae regarded as being normal when examined on admission and plotted their cervical dilatation progress at hourly intervals. They were placed into quintiles according to rate of dilatation from admission to complete dilatation. The mean curve for each quintile was determined in the same way as described by Hendricks. Figure 9 shows the mean curve of cervical dilatation in each of our quintiles, and Figure 10 shows a comparison between the mean curve of the slowest quintile in our series and Hendricks's series.

This latter comparison again shows that our patients tend to take twice as long to dilate between 4 and 9 cm. It is true that from arrival time in hospital they deliver quicker than Hendricks's patients, but this is because, on average, they arrive at the hospital later in labour.

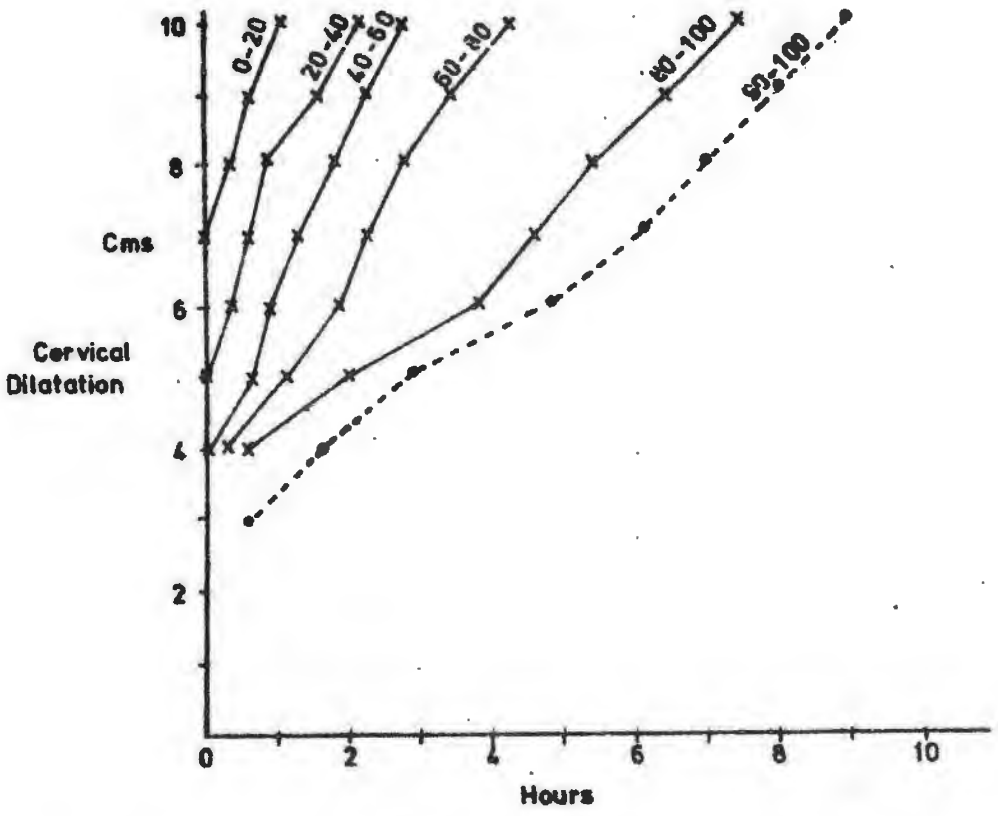
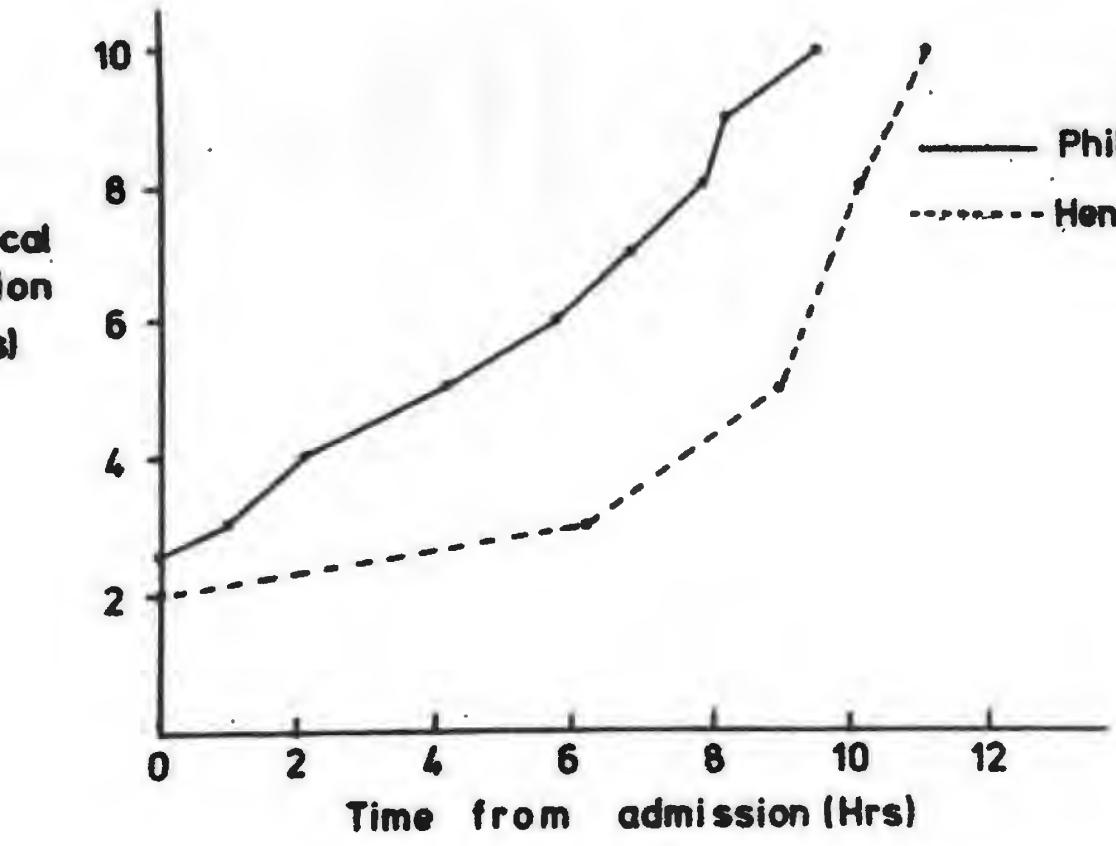


Figure 9. The Mean Cervical Dilatation, by Quintiles, of Normal Primigravidae Admitted Between 2 - 10 cms, Compared to Time Following Admission.



10. Mean Cervical Dilatation of Slowest 20% Primigravidae Compared to Time of Admission.

PHASE III

SHOULD WE HAVE DIFFERENT ALERT LINES FOR DIFFERENT "ARRIVAL CERVICAL DILATATION" GROUPS?

The Alert Line that we were seeking to create would represent a statistical limit of normal progress in cervical dilatation in our primigravid patients. Following our study in Phase II we decided that this should be based on the time of patient arrival in hospital as zero time. Our next question then was whether a single line would cater for all patients, or whether it would be necessary to construct a different Alert Line for each "arrival cervical dilatation group".

A necessary step in answering this question was to compare the cervical dilatation pattern on arrival at Harari Hospital with the patterns in three representative rural hospitals. Nyadiri Hospital is 80 miles to the east of Salisbury, Wedza Hospital 100 miles to the south-east and Karanda 180 miles to the north. We reviewed the last 100 consecutive primigravid admissions to each hospital and placed them in three groups according to admission cervical dilatation. Table IV gives the distribution of admission dilatation in the four hospitals.

Table IV. Distribution of Admission Cervical Dilatation in four Rhodesian Hospitals (percentages).

Cm	Harari	Nyadiri	Wedza	Karanda
0 - 4	52	52	44	43
4 - 6	26	25	27	22
6 - 10	22	23	29	35.

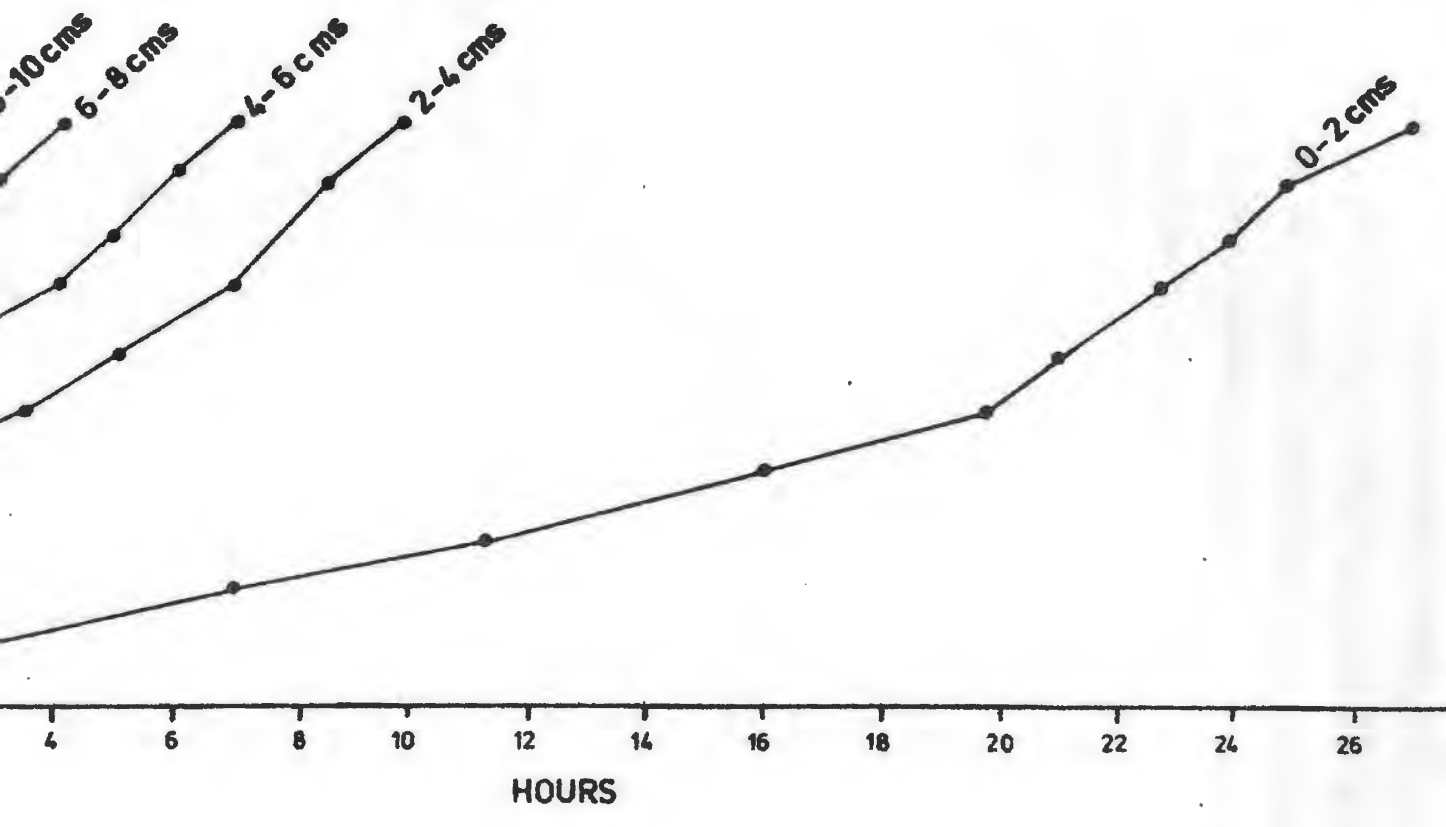
The distribution of admission cervical dilatation is fairly comparable in all four hospitals, thus showing that an Alert Line devised for patients admitted to Harari Central Hospital could, after validation, be suitable for rural hospitals in Rhodesia as far as the pattern for admission cervical dilatation was concerned.

Another step in determining whether a single Alert Line would be efficient for patients of all "admission cervical dilatation" groups or whether a different line would be necessary for each group, was to embark on a study of patients admitted to Harari Hospital between 0 - 2 cm, 2 - 4 cm, 4 - 6 cm, 6 - 8 cm and 8 - 10 cm. To do this we prospectively studied at least 50 normal primigravidae in each of these different admission cervical dilatation groups Normality was defined as a patient who at no time showed delay in cervical dilatation for four consecutive hours and who did not require an operative delivery. Vaginal examinations were carried out every hour by our midwife reaearch assistants. A series of Hendricks-type graphs were then constructed showing the mean cervical dilatation of the slowest 20% patients in each admission cervical dilatation group (Figure 11).

This series shows that it would not be advisable to construct one line to cater for all five admission groups. This is because the line for the 0 - 2 cm admission dilatation group shows this to be a particular problem group. Their mean cervical dilatation rate was very much slower than the slowest of the other groups. The probable reasons for the peculiarities in this group are:-

(i) many are only in false labour, or prolonged latent phase;

(ii) many are already showing evidence of early inefficient labour, possibly the earliest manifestation of problem cephalo-pelvic disproportion.



Mean Cervical Dilatation Rate of the Slowest 20% Patients in each Admission Cervical Dilatation Group.

It was recognised therefore that this group warranted separate study, and they were severed from the present study of primigravid labour.

Having excluded those patients admitted between 0 - 2 cm cervical dilatation, we now looked at each of the other admission cervical dilatation groups to see whether a common Alert Line representing the statistical limit of cervicographic progress of all patients admitted between 2 - 10 cm dilatation would be as efficient as a separate Alert Line for each admission group. The degree of efficiency of a particular Alert Line was measured by the proportion of normal deliveries whose cervicographic progress had been to the left of the line and the proportion of abnormal deliveries whose cervicographic progress had been to the right of the line. Abnormality in this context included all operative deliveries and all stillbirths and neonatal deaths.

For the purposes of this study we reviewed an entirely new group of patients, consisting of 538 consecutive unselected primigravid admissions and separated them into groups according to cervical dilatation on admission.

In each group we contrasted the effect of applying the line representing a statistical limit of cervicographic progress for that group with a similar line representing the statistical limit of cervicographic progress of all patients admitted between 2 - 10 cm. We chose to use as the most suitable statistical limit for a particular group of patients Hendricks's method of using the mean of the slowest 10%. This is the equivalent of the 95% limit which is an acceptable statistical limit which is generally used. We were not able to use the measure of two standard deviations from the mean as a statistical limit, as the analysis of the patient's cervicographic progress presented a skewed distribution.

The 2 - 4 cm Admission Cervical Dilatation Group

There were 230 patients in this group, of whom 63 were abnormal at delivery. Ideally, the 167 normals should deliver to the left of an Alert Line and the 63 abnormals to the right. The line representing the mean of the slowest 10% of the 2 - 4 cm admission group was contrasted with the line representing the mean of the slowest 10% of all admitted between 2 - 10 cm. Figure 12 shows the effect of applying the two lines to this group. The 2 - 4 line is to the right of the 2 - 10 line and therefore fewer normals and abnormals cross it.

In fact, 68 out of the 167 normals, or 41%, crossed the 2 - 10 line, and 58 out of 63 abnormals, or 92%, crossed. When applying the 2 - 4 line, 40 out of 167 normals, or 24%, crossed the line, and 53 out of 63 abnormals, or 84%, crossed. It would seem that, by using the 2 - 10 line, 5 extra abnormals would be detected while 28 extra normals would be transported from a clinic to hospital.

Further analysis showed that 71% of normals which crossed the 2 - 10 line did so on or before the 4 cm dilatation mark. Moreover, it was noted that the last segment of the 2 - 10 line (from 7 cm onwards) was straight. Extrapolation of this straight portion back to the admission zero line gave a line that was easy to reproduce and which now included the cluster of normal patients that had previously been found to cross the early part of the 2 - 10 line (Figure 13.).

At this juncture in our study, Friedman visited us in Salisbury and helped to clarify one of our problems. He pointed out that the explanation for the number of normals crossing the line early in labour was that those admitted bwtween 2 - 3 cm were probably still in the latent phase of labour. In studying the application of the two alternative lines, we therefore exoluded the 2 - 3 cm admission dilatation group from the 2 - 4 cm group.

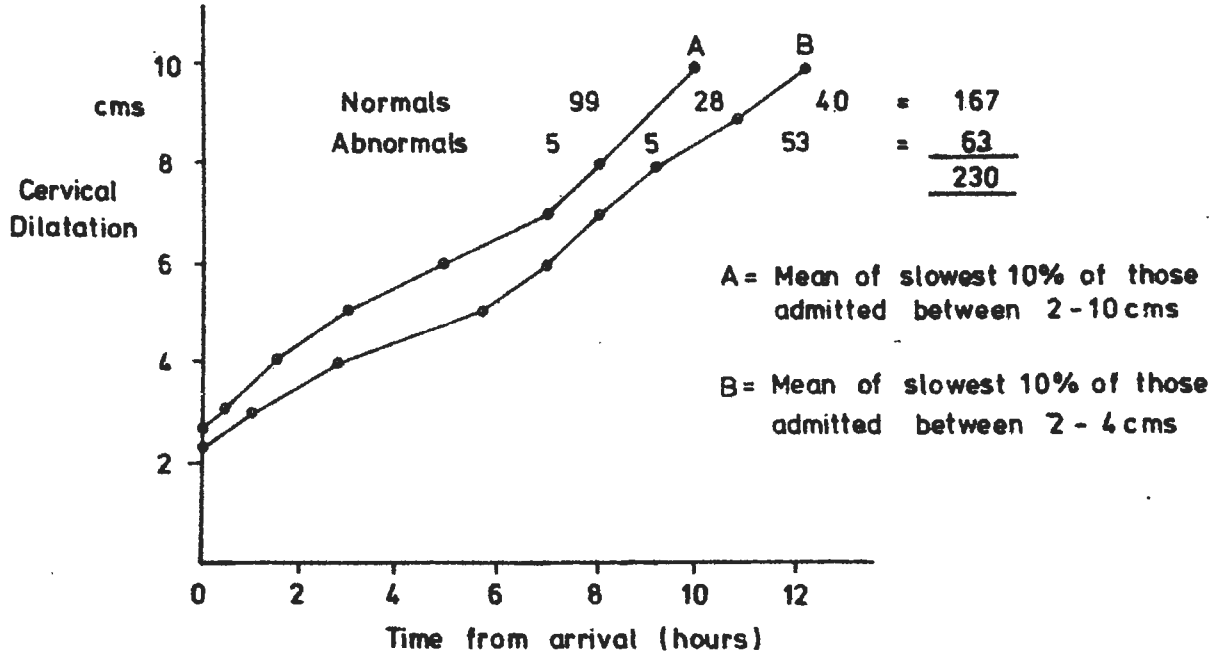


Figure 12. Patients Admitted with Cervix 2 - 4 cms, Showing the Numbers of Normals and Abnormals Which Crossed the 2 - 4 cm and the 2 - 10 cm Lines.

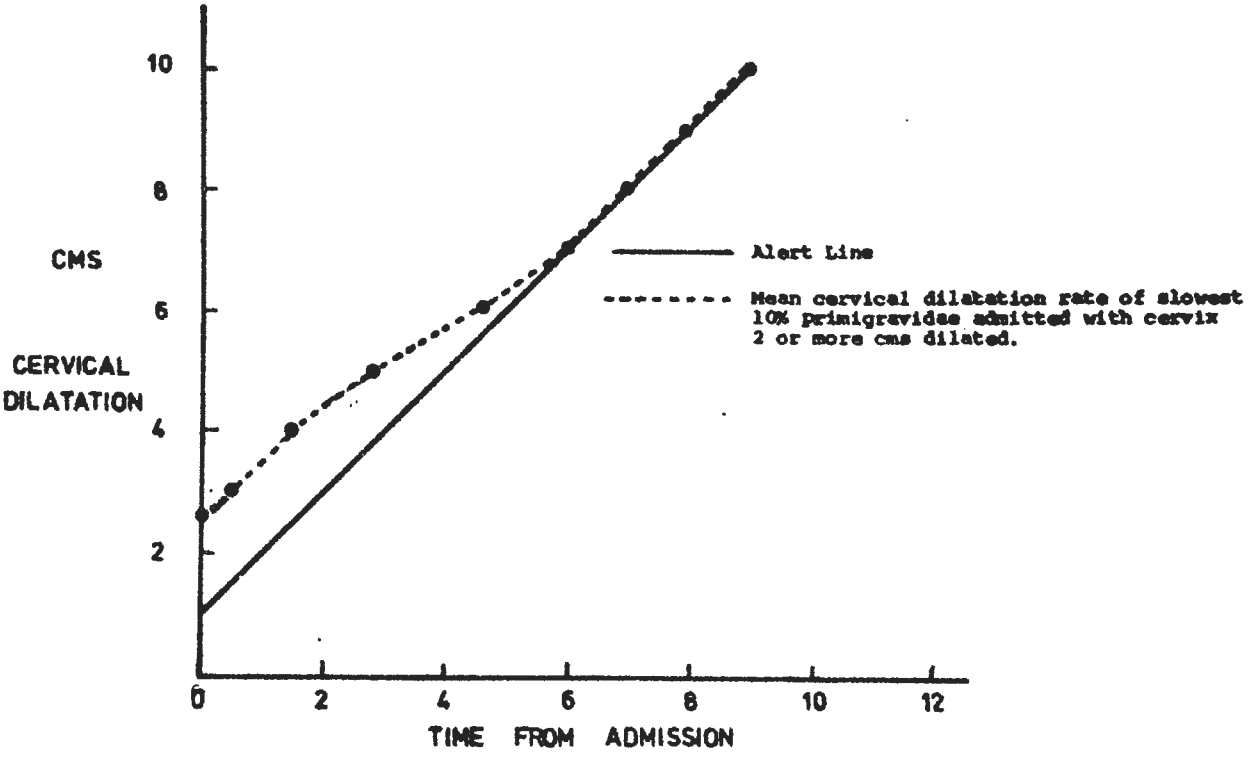


Figure 13. Construction of Alert Line as a Modification of the Mean Cervical Dilatation Rate of the Slowest 10% Primigravidae Admitted with Cervix 2 or more cms Dilated.

Then, out of the 127 cases admitted between 3 - 4 cm cervical dilatation, it was found that 23 out of 89 normals, or 26%, crossed the straightened 2 - 10 line, and 34 out of 38, or 90%, of the abnormals crossed. We therefore provisionally decided to apply in practice as an Alert Line this straightened 2 - 10 line for those patients admitted between 3 - 4 cm cervical dilatation.

The 4 - 6 cm Admission Cervical Dilatation Group

Of the 122 analysed in this group, 94 were normals and 28 abnormals at delivery. When the line representing the mean of the slowest 10% normals admitted between 4 - 6 cm was applied to this group, 89% of normals delivered to the left of the line and 86% of abnormals to the right. When the initial 2 - 10 cm line was applied, 94% of normals delivered to the left and 79% of abnormals to the right. An overall correct answer was therefore given in 92% of patients when the 2 - 10 cm line was applied, and 88% when the 4 - 6 line was applied.

The 6 - 8 cm Admission Cervical Dilatation Group

Of the 43 analysed in this group there were only ten abnormal cases at delivery. The 2 - 10 line allowed 97% of normal cases to deliver to the left of the line and 60% of abnormals delivered to the right of the line.

The 8 - 10 cm Admission Cervical Dilatation Group

As there were only two abnormals in this group, the group was not analysed further.

A review of the analyses in each of these groups of patients led us at this point to the following conclusion:

A single Alert Line could be applied to the cervicograph of patients admitted in or reaching the active phase of labour, using a simplified

definition of the active phase as being the phase of labour after cervicographic progress has reached 3 cm cervical dilatation. It seemed to us that by using as our Alert Line the line representing the mean of the slowest 10% of all normal primigravidae admitted between 2 - 10 cm, and straightening it by extending the already straight portion between 7 cm and 10 cm backwards to the zero admission line, we could achieve a situation which may not be as specific as applying a different line for every group, but which was much simpler to use.

Therefore, although we appreciated that we could continue in a theoretical study of alert lines for use in different admission groups, we decided that the need for practical simplicity was sufficient to warrant a prospective study of a clinical application of the modified 2 - 10 cm line as our Alert Line. The prospective study would ascertain whether the application of this Alert Line would serve to separate patients with problems of cephalo-pelvic disproportion from normal patients. The modified 2 - 10 cm line used as an Alert Line can be defined as a line on the cervicograph commencing at zero time at the 1 cm dilatation mark and progressing to full cervical dilatation at 10 cm at 1 cm per hour.

CHAPTER 4

PROSPECTIVE EVALUATION OF THE ALERT LINE

A prospective study was carried out in the labour ward of Harari Central Hospital, Salisbury, to evaluate the use of the Alert Line in differentiating primigravid patients with and without cephalo-pelvic disproportion.[30] The only patients excluded from this study were those with abnormal presentations (transverse lie and breech), placenta praevia, multiple pregnancy and eclampsia.

METHOD

A total of 624 consecutive African primigravidae who were found on admission to be in the active phase of labour were provided with routine labour management as described in Chapter 2. The writer personally supervised the management of all these patients, and the routine examinations were carried out by the Registrars in the Department of Obstetrics. Vaginal assessments of cervical dilatation were performed on admission and thereafter at four-hourly intervals. Progress in cervical dilatation was plotted against time on graph paper, the initial cervical dilatation on admission being plotted at zero time, regardless of that initial dilatation.

Other parameters recorded in all patients were:- patient's height; age; admission cervical dilatation; rate of cervical dilatation after 4 cm; pelvic true conjugate diameter; transverse diameter of the brim; brim area and baby's birth weight. The pelvic measurements were made by X-Ray pelvimetry 24 hours after delivery.

The patients were allocated into one of two groups according to whether their rate of cervical dilatation progressed to the left or the

right of the Alert Line. The arithmetic means of the various parameters were calculated for the two groups of patients and the statistical significance for each comparison was determined.

RESULTS

The mean values for each parameter in the two groups of patients are recorded in Table V, and the method of final delivery in Table VI.

CONCLUSIONS

These comparisons show that the application of the Alert Line separates patients with reduced pelvic capacity as evidenced by the significantly smaller transverse brim and brim area measurements of those patients whose cervical progress crossed the Alert Line. As would be expected, these patients progressed more slowly in the phase of maximum slope. They also arrived in hospital with less dilatation of the cervix, suggesting that labour was already progressing at a slower rate. The head level was higher at the time of admission in those whose cervical dilatation progress subsequently crossed the Alert Line, but it is important to note that even in those whose subsequent progress was satisfactory, the head was not engaged in early labour.

Although in patients seen in Aberdeen by Bernard[2] the outcome of labour was related to maternal height, in our patients there was no relationship between maternal height and dysfunctional labour. The probable explanation is that our patients had an average height of under 1,6 m, and this means that we cannot use maternal height as a screening method for planning hospital deliveries for Rhodesian Africans.

Analysis of delivery outcome in the two groups of patients shows that there was a significant number of patients requiring a vacuum extraction even though progress in cervical dilatation had been to the left of the

Alert Line. However, a review of these cases showed that they were simple vacuum extractions performed for delay in the second stage of labour in the absence of any bony disproportion. They fell into the category of straightforward extractions that are regarded as suitable for delivery by experienced midwives in rural practice in Rhodesia. Of the two Caesarean sections in the group whose progress in cervical dilatation was to the left of the Alert Line, one was for a prolapsed cord and the other was for severe intra-uterine infection on admission. Both of these cases would have been sent to a Central Unit in any event. Thus, in the absence of other complications, patients whose cervicographs keep to the left of the Alert Line may be safely managed in the peripheral unit. Table VI also reveals that the cervicograph of 22 per cent of patients crossed the Alert Line. Outside the Central Unit these would be considered for referral. In fact, as will be shown in the next chapter, half of them were delivered normally within the following four hours, while the rest were the problem cases requiring skilled attention.

V. Average of various parameters for patients whose cervicograph did not cross or did cross the Alert Line.

.ents whose cervicograph ; to left of Alert Line (488 patients)	Patients whose cervicograph crossed Alert Line (136 patients)	Parameter	Statistical conclusion
75 cm/hr.	0,44 cm/hr.	Rate of cervical dilatation after 4 cm	p <0,001
47 sq. cm	87,33 sq. cm	Area of brim	p <0,001
85 cm	10,90 cm	Transverse brim	p <0,001
75 cm	10,17 cm	True conjugate	Not significant
20 cm	3,84 cm	Cervical dilatation	p <0,001
30 (fifths of head above brim)	4,08	Head level on admission	p <0,001
29 years	18,34 years	Age	Not significant
578 m	1,571 m	Height	Not significant
989 kg	3,051 kg	Birth weight	Not significant

Table VI. Delivery Outcome in those patients whose Cervicograph did or did not cross the Alert Line.

	Alert Line not crossed	Alert Line crossed
Spontaneous delivery	438	54
Spontaneous delivery after oxytocin augmentation	0	19
Vacuum extraction	48	49
Caesarean section	2	14
TOTAL	488	136.

CHAPTER 5

PROSPECTIVE EVALUATION OF THE ACTION LINE

The Alert Line on the cervicograph was designed to help the midwife in a peripheral clinic and the junior doctor in a hospital to detect the mechanical problems of labour in the primigravida, in good time. When cervicographic progress crossed the Alert Line, the patient had to be referred to an experienced doctor.

Recognising that our referrals would come from a variety of clinics, we had to determine the maximum safe time to permit before active intervention. This would depend to a certain degree on the time taken to transport patients, but more particularly on the consequences of delay.

Reviewing the patients studied in Chapter 3, we applied a series of lines parallel, and at two-hourly intervals to the right of the Alert Line on each patient's cervicograph. We then determined the percentage of abnormals, according to the criteria set out for that series of patients, which delivered in relation to each of the parallel lines. Figure 14 shows that there is a marked increase in the percentage of abnormals delivering before the lines from the four-hour mark onwards. As a four-hour interval also represents the time taken for patients to reach our hospital from our farthermost peripheral clinic, we tentatively adopted the line parallel and four hours to the right of the Alert Line as our Action Line.

THE MANAGEMENT OF PATIENTS WHOSE CERVICOGRAPHIC PROGRESS REACHED THE ACTION LINE

Ideally, we would wish to determine at this juncture which patients had delay in labour due to cephalo-pelvic disproportion, and which patients had uncomplicated, inefficient uterine action. In practice,

Percentage of Abnormal Cases (Caesarean Sections and Assisted Deliveries) Delivering Prior to the Alert Line and then Prior to each of a Series of Lines Parallel and at Two Hours Intervals to the Right.

this has proved difficult, as clinical assessment is not always accurate, and intra-partum pelvimetry is not available to the majority of hospitals in Africa. Even when X-Ray pelvimetry is available, one is still faced with the difficulty of cephalometry and prediction of head flexion and safe moulding.

With these difficulties in mind, we formulated a clinical regime to test the degree of cephalo-pelvic disproportion by correcting the inefficient uterine action, and then watching maternal and fetal response over the next few hours. Past experience in our Department has shown that the information will be obtained within six hours of commencing uterine stimulation, and that nothing was to be gained by waiting longer to make a decision.

<u>The following are the details of the regime of active management employed as soon as it was discovered that a patient's cervicographic progress had crossed the Action Line:-</u>

1. The patient was transferred to the Intensive Care area of the labour ward, where maternal and fetal condition was monitored and recorded as outlined in Chapter 2.

2. A thorough assessment of the degree of cephalo-pelvic disproportion was carried out to form a base-line for later decisions. Evidence of suspected cephalo-pelvic disproportion was not in itself a contra-indication to active stimulation of labour.

3. Fetal condition was assessed. The following signs of fetal distress indicated immediate delivery rather than any stimulation of labour:-

(a) Evidence of severe head compression in the form of a high head with increasing moulding.

(b) fetal heart rate patterns of Grade 3b or worse that persisted for 30 minutes after turning the patient on to her left side and correcting any fluid or crabohydrate deficit. The presence of meconium in the liquor gave increased cause for concern when seen with any fetal heart rate abnormality.

4. A continuous lumbar epidural block was given, using Bupivicaine by the technique described in Chapter 2.

5. Adequate fluids and carbohydrates were given intravenously.

6. Oxytocic stimulation, using two and a half units of Oxytocin in one litre of dextrose in water, commencing at ten drops per minute. If necessary, this rate was increased by ten drops each half hour until uterine contractions lasting sixty seconds and occurring every three minutes were tailor-made.

<u>The following criteria were used to determine when a trial of labour should cease and Caesaran section be immediately performed:-</u>

1. If significant fetal distress, as defined above, developed before full cervical dilatation.

2. In the absence of significant fetal distress, the effect of the improved uterine action on labour progress was observed over a six-hour period. If reasonable progress was obtained, i.e. a rate of cervical dilatation of approximately 1 cm per hour, then the labour was allowed to continue to full cervical dilatation. If progress had not been satisfactory, then a Caesarean section was performed at the six-hour mark.

3. If, at full cervical dilatation and half an hour of bearing down, there was still more than two-fifths of head above the pelvic brim, with moulding of the head, a Caesarean section was performed.

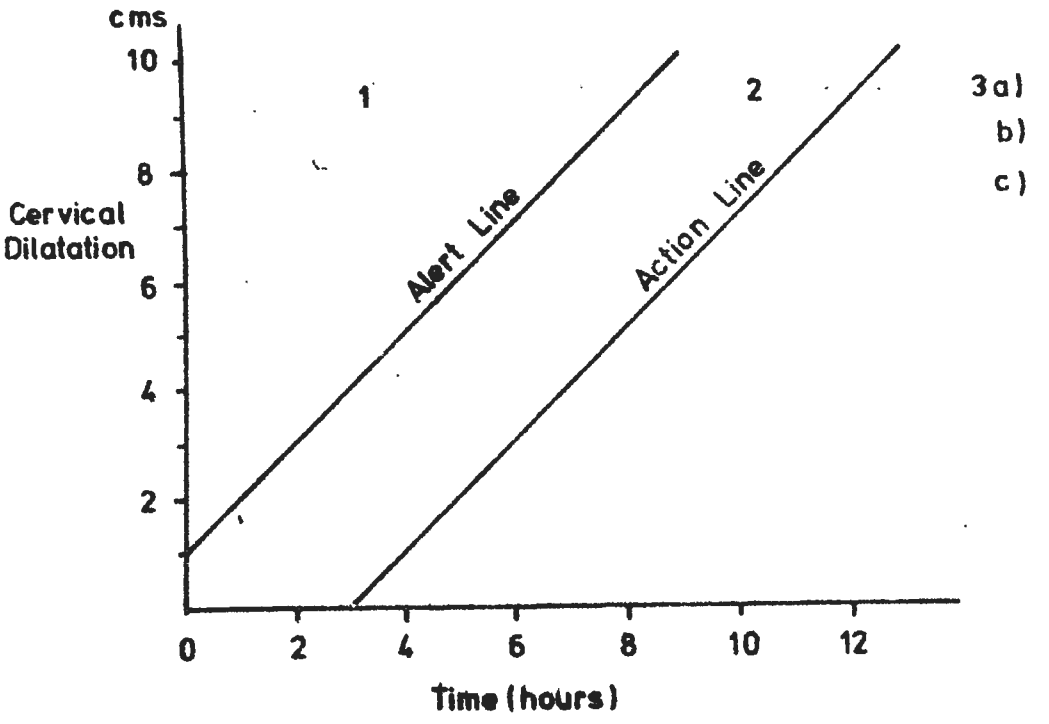
The above regime was applied in the management of the 624 African primigravidae described in Chapter 4. As shown in Figure 15, these patients were allocated into one of three main groups according to the outcome of their labour. Group 1 included those whose rate of cervical dilatation and eventual delivery occurred to the left of the Alert Line. Group 2 delivered between the Alert and the Action Lines, and Group 3 included those whose cervical progress and delivery were to the right of the Action Line. Group 3 was further subdivided into subgroups according to the method of final delivery. Group 3A delivered spontaneously after oxytocin stimulation. Group 3B required an assisted vaginal delivery with the vacuum extractor, and Group 3C required a Caesarean section. We analysed a variety of parameters to ascertain whether any would give information of prognostic value. The outcome was also studied to determine whether the regime was safe and efficient.(31)

RESULTS

Response to Management at the Action Line

Of the 624 patients in this study, 68 (11%) had cervicographs which crossed the Action Line. Following the regime of active management outlined above, 19 patients were delivered spontaneously (Group 3A), 35 were delivered with the vacuum extractor (Group 3B), and 14 required Caesarean section (Group 3C).

Table VII shows the averages of the parameters recorded on patients in each of the subgroups whose cervicographic progress crossed the Action Line, with the statistical conclusions when the three subgroups are compared.



Group	No. of patients	Category
1	488	Delivered to left of Alert Line
2	68	Delivered between Alert and Action Lines
3		Delivered to right of Action Line:-
A	19	- spontaneously
B	35	- with vacuum extraction
C	14	- with Caesarean section
Total	624	

Figure 15. Group allocations of 624 African primigravidae, according to labour outcome.

TABLE VII

various parameters in relation to method of delivery for patients whose cervicograph cross

	the Action Line			
arameter	Group 3A Spontaneous delivery (19 cases)	Group 3B Vacuum-assisted (35 cases)	Group 3C Caesarean section (14 cases)	Statistical concl for comparison an groups (p value in brack
.latation after i infusion	1,64 cm/hr.	0,86 cm/hr.	0,18 cm/hr.	3C slower than 3A 3B " " 3A but faster " 3C
	90,04 sq. cm	87,49 sq. cm	81,85 sq. cm	3C smaller than 3 (one tail)
i diameter of brim	11,2 cm	10,7 cm	10,6 cm	3B and 3C both sm than 3A (0,01) (0
igate	10,0 cm	10,4 cm	9,7 cm	No trend
i of cervix on on	3,71 cm	3,79 cm	4,00 cm	Not significant
. of cervix at ne	4,76 cm	4,77 cm	4,32 cm	Not significant
iead on admission*	4,00	4,13	4,36	Not significant
iead at Alert Line*	3,73	3,88	4,14	Not significant
iead at Action Line*	3,26	3,54	4,00	3C higher than 3B 3C higher than 3A
	17,84 years	18,08 years	18,14 years	Not significant
	1,581 m	1,562 m	1,556 m	Not significant
nt	2,943 kg	3,118 kg	3,211 kg	Not significant

* Stated in "fifths" above the brim (Crichton, 1962).

The Rate of Descent of the Fetal Head

Of the 624 patients studied, information on the rate of descent of the head was obtained from the records of 547 patients. This rate was measured in descent of the head in fifths above the brim per hour. Preliminary observation of the results showed that the distribution was skewed. My statistical adviser, Dr. W. Castle, therefore advised that comparisons between groups should be made on the basis of the Extension to the Median Test.

The overall median of the rate of head descent in the 547 patients was 0,8 fifths per hour. In theory, if the descent of the head was not related to the grouping of the patients, there should be approximately 50% in each group above the overall median. Table VIII shows the observed number of cases above and below the median in Groups 1, 2 and 3. The difference between the observed and expected can be assessed using X^2.

Similarly, the overall median of the rate of head descent in the 59 patients in Group 3 was 0,17 fifths per hour. Table IX shows the number of cases above and below the median in subgroups 3A, 3B and 3C. The rate of descent is statistically different and this is not surprising as, in fact, the median for Group 3A is 0,28 fifths per hour, for Group 3B is 0,17 fifths per hour, and for Group 3C is 0,05 fifths per hour.

Table VIII. Number of patients whose rate of head descent (in fifths per hour) was above or below the overall median of 0,8 fifths per hour

	Group 1	Group 2	Group 3
Above	273	0	1
Below	148	67	58
Total	421	67	59

Group 1 tends to be above the overall median, and the other two groups below. This is significant at $p < ,001$.

Table IX. Number of patients whose rate of head descent (in fifths per hour) was above or below the overall median for Group 3 of 0,17 fifths per hour.

	Group 3A	Group 3B	Group 3C
Above	14	15	0
Below	2	15	13
Total	16	30	13

Group 3A tends to be above the median for Group 3 and 3C below. This is significant at $p < 0,001$.

Clinical Outcome

Table X shows the outcome of labour in the 624 primigravidae. These results are compared with a strictly comparable group of primigravidae managed in the same Department during the first six months of 1966 when the regime of management was not clearly defined, and decisions on augmentation of labour were left to the judgement of individual clinicians.

Table XI gives the average Apgar scores five minutes after delivery for each of the clinical groups.

Table X. Comparison of clinical events in present series with those in similar primigravidae managed in 1966.

	1966 Series	Present Series	Statistical Conclusion
Total number	738	624	-
Oxytocic stimulation given	12,3%	9,7%	$p < 0,01$
Labour:			
Less than 12 hours	57,5%	94,7%	$p < 0,001$
12 - 24 hours	29,5%	4,6%	
more than 24 hours	13,0%	0,6%	
Vacuum extraction	9,1%	13,4%	$p < 0,001$
Caesarean section	9,9%	2,6%	$p < 0,001$
Perinatal deaths	5,8%	0,6%	$p < 0,001$.

Table XI. Average Apgar score at five minutes for infants of patients grouped according to the relation of their cervicographs to Alert and Action Lines and their method of delivery.

	Mean Apgar Score
Group 1 (graph to left of Alert Line)	9,9
Group 2 (graph between Alert and Action Lines)	9,7
Group 3 (graph crossed Action Line):	
A Spontaneous delivery	9,9
B Vacuum extraction	9,2
C Caesarean section	8,7.

DISCUSSION

Selection of patients requiring oxytocic augmentation of labour.

Placing the Action Line four hours to the right of the Alert Line has allowed a further 50% of patients whose cervicographs crossed the Alert Line to avoid being given oxytocic stimulation. This has saved pressure of work on the labour ward in the Central Hospital. This is of great importance, as the oxytocic augmentation of these high risk cases warrants meticulous observation of fetal and maternal response and, if this is not possible, then the active regime described should not be employed.

We have shown that the staff in our labour ward, which is very limited by overseas standards, can safely and satisfactorily handle the oxytocic augmentation of labour in the 11% of primigravidae whose cervicographic progress crosses the Action Line. The reduction in the percentage of cases that were given oxytocic stimulation in the present series compared with the previous practice, as shown in Table VIII, shows that the lowered incidence of prolonged labour has been achieved by better discrimination in the use of oxytocin.

Parameters of Prognostic value

An active regime of management in the form of a "trial of oxytocin" was applied to all cases showing delay in labour progress as evidenced by cervicographic progress which crossed the Action Line. Built into this regime were criteria which indicated the time and method of final delivery. The fact that the brim area and transverse diameter of the pelvic brim were significantly smaller in those who came to Caesarean section according to the criteria referred to, shows that the application of the regime was efficient in picking up major cephalo-pelvic disproportion and allocating the appropriate method of delivery. Certain parameters were of particular prognostic value in making the correct clinical decision.

1. Rate of cervical dilatation

The very slow mean rate of cervical dilatation in the group of patients coming to Caesarean section (0,18 cm/hr.) following the active regime of management demonstrates that this parameter is of particular importance in recognising the patients with major cephalo-pelvic disproportion or incorrectable, inefficient uterine action. Patients without disproportion responded more quickly with a cervical dilatation rate of 1,64 cm/hr. in the group that eventually delivwred spontaneously, and 0,86 cm/hr. in those that required an assisted delivery with the vacuum extractor.

The graphic display of the rate of cervical dilatation in response to oxytocic augmentation after the Action Line is therefore a simple and valuable guide to the correct method of final delivery.

2. The rate of descent of the head.

From Table VII it will be seen that, at the time cervicographic progress crosses the Action Line, the level of the head is significantly higher in the group that eventually require Caesarean section than in either of the other two groups, i.e. those who deliver spontaneously or those who deliver with the aid of the vacuum extractor.

Even more evident is the difference in the rate of descent of the head in each of the three major groups of patients, and also between the three subgroups of Group 3, as shown in Tables VIII and IX. In the group that came to Caesarean section following a period of oxytocic stimulation (Group 3C), there was minimal head descent with evidence of increasing moulding. This is well portrayed on the graphic record and, taken in conjunction with the rate of cervical dilatation, should give an accurate guide to the presence of significant disproportion.

3. The uterine contractions

Comment on this factor can at present be made only on clinical impressions. Further studies are being carried out in the Department to measure accurately the quality of the uterine contractions before and during oxytocic augmentation in the presence of suspected disproportion. However, it is apparent that only very small doses of oxytocin should be used to correct inefficient uterine action that has resulted in delay in labour progress. This is of particular significance when any degree of disproportion is present. In fact, the degree of difficulty in obtaining a satisfactory response to oxytocin became a useful additional pointer to the presence of disproportion. In such cases we often found the need to cut the oxytocin dose back to one unit per litre running at ten drops per minute.

4. Fetal response.

Again, the availability only of clinical impressions has stimulated a more detailed study in the Department of a number of parameters measuring fetal response to augmented labour. When any degree of disproportion is present, then it is obligatory to detect an adverse fetal reaction at the earliest possible moment. The criteria of fetal distress listed earlier in this chapter were strictly adhered to and often became evident concurrent with delay in the rate of cervical dilatation.

It became particularly apparent that evidence of increasing moulding with inadequate progressive descent of the head must be accepted as a sign of fetal distress. This implies a pathological degree of cerebral stress and indicates the need for immediate delivery. This sign should be treated with the same degree of urgency as an anoxic fetal heart-rate change, and will often warrant intervention before the completion of the six-hour test period. It is to be recognised that this sign may become very evident even before any serious change in the fetal heart-rate pattern.

Safety of the Regime

The low perinatal mortality rate and the acceptable mean Apgar scores in this series show that a trial of oxytocin, in the event of inefficient uterine action in the primigravida, can be conducted with safety for mother and fetus, even in the presence of cephalo-pelvic disproportion. We believe that the discipline of intensive clinical monitoring and the method of composite graphic recording of all parameters of maternal and fetal condition in labour has helped our staff to make the correct decisions at the right time.

Final Delivery Method

Not only has the Caesarean section rate been lowered in this series by the timely use of oxytocin, but operations have been done at an earlier stage of labour, thus reducing the hazards of infection to mother and fetus. An analysis of the individual Caesarean sections done in the 1966 series has shown that the higher incidence in that series is due in the main to the number of cases where the indication for section was fetal distress after a prolonged labour where the pelvis had not been adequately tried by efficient uterine action. Such cases were not permitted in the study series as the inefficient uterine action was augmented before fetal distress could develop.

Details of the management of the second stage of labour are outside the scope of this thesis. However, it became apparent that the graphic recording of labour progress and fetal response before and after oxytocic augmentation of labour was a valuable indicator to the safest method of final delivery. The following principles are of particular importance.(32) Firstly, there must be no difficult deliveries in the second stage of labour. If oxytocic augmentation has been necessary, then the response should have been to bring the head to a level not higher than two-fifths above the brim with a safe degree of moulding. If this has not happened and there is no advance with bearing down in the second stage, then Caesarean section is indicated.

The second principle is that if there is any fetal distress plus even borderline disproportion at the time assisted delivery is contemplated, the decision must be made to relieve the disproportion before delivering the baby. This entails either symphysiotomy or Caesarean section.

CHAPTER 6

CERVICOGRAPHS IN CLINICAL PRACTICE.

Following the establishment of the Alert and Action Lines on the cervicograph, and having carried out a prospective study on their use for patients admitted to the Maternity Hospital at Harari Central Hospital, it was decided that a review was necessary of their implementation in other parts of Southern Africa. The regime was taught by personally visiting many hospitals and clinics in Rhodesia, South Africa, Botswana, Malawi and Zambia, and also by the publication of articles[30, 31]. The opportunity for conducting the review was occasioned by the privilege of a sabbatical leave spent in the University of Cape Town during 1973.

The review was conducted in a number of institutions, each typifying a different type of clinical practice in widely differing environmental backgrounds. The four institutions chosen were Groote Schuur Hospital, Cape Town; Queen Elizabeth Hospital, Blantyre, Malawi; Silveira Mission Hospital, Victoria Province, Rhodesia; and Harari Hospital, Salisbury. In Cape Town the regime was taught to doctors and midwives, and three months later a prospective study was carried out covering a six-month period. In each of the other institutions the study was commenced prospectively one year after the regime had been in practice. The instructions given to each institution for the implementation of the regime were as follows:-

Instructions for the use of the Alert and Action Lines.

(1) A composite labour graph was to be used for recording purposes for all primigravidae admitted in true labour.

(2) The cervical dilatation on admission was plotted at zero time on the cervicograph.

(3) If the cervical dilatation on admission was 3 cm or more, then the Alert Line was drawn commencing at a point representing 1 cm dilatation at zero time and progressing to the 10 cm mark at the rate of 1 cm per hour. The Action Line was drawn parallel and four hours to the right.

(4) If the cervical dilatation was less than 3 cm, then Alert and Action Lines were not drawn until the point in time when the cervical dilatation was first found to be 3 cm or more dilated. At that point, which was now regarded as zero time for the active phase of labour, the Alert and Action Lines were drawn on the graph as described above.

(5) Subsequent vaginal examinations were done at four-hourly intervals. Once the Alert Line was crossed, they were to be done every two hours.

(6) If cervicographic progress crossed the Alert Line the patient, if seen in an outside clinic, was transferred to the hospital.

(7) If cervicographic progress crossed the Action Line the patient was transferred to the Intensive Care Unit in the Labour Ward. The active form of management outlined in Chapter 5 was then carried out and the method of final delivery was determined according to the criteria set out in that chapter.

Description of institutions where reviews were conducted

(1) Groote Schuur Hospital, Cape Town, South Africa.

The patients seen in the Maternity Department of this hospital are all classified as Coloureds, a South African term for half-castes. The regime of management was taught to midwives and doctors in January 1973, and after an introductory period of three months a six-month review was carried out from April 1st, 1973. A local variation requested in Cape Town, because of the relatively short distances between clinic and

hospital and the continuous availability in the labour ward of resident doctors, was that the Alert Line should also be used as an Action Line. In this way the active form of intervention was introduced as soon after the cervicographic progress was found to have crossed the Alert Line as was possible.

An outstanding clinical impression gained during the first three months of working in the labour ward at Groote Schuur Hospital at the beginning of 1973 was that the prevalence of major cephalo-pelvic disproportion in the Cape Coloured was much lower than that seen among Africans in Rhodesia. This impression was obtained in spite of the fact that Groote Schuur Hospital was a referral unit for problems seen over a fairly large population. During the period of study, observations were made by trained midwives until the Alert Line was crossed. Thereafter the observations and management were carried out by the resident medical staff.

(2) Queen Elizabeth Hospital, Blantyre, Malawi.

This hospital caters entirely for African patients. It is in the centre of the city of Blantyre but in addition to catering for the urban population it receives many referrals from the surrounding rural areas. The hospital is grossly understaffed by any standards. During the period of review there was one Obstetrician and three junior medical officers to care for a large Department of Obstetrics and Gynaecology doing about 5 000 deliveries per year. Fortunately there was a first-class team of midwives who very quickly adapted to the method of graphic recordings in labour, and who virtually managed the labour ward.

I first visited Blantyre in 1971 and was invited to instruct the staff in the use of the Alert and Action Lines on the cervicograph. I

returned in July 1973 and found that they had been using the regime with success and enthusiasm. For the midwives, it had taken the fear out of their very great responsibility of handling the care of so many primigravidae with such a high prevalence of cephalo-pelvic disproportion. Miss Barbara Kwast, the Senior Midwifery Tutor in Blantyre, was responsible for the initial and in-service training of the midwives and assisted greatly in the review of the patients studied.

(3) Silveira Mission Hospital, Victoria Province, Rhodesia.

This is a Catholic Mission Hospital in a very remote rural area of Rhodesia. The hospital is run by one doctor and three sisters. The routine management of the Obstetric Unit is carried out by maternity assistants who, in the first instance, refer their problems to a sister who had trained as a midwife at Harari Hospital in Salisbury. The sister had learnt the principles of using the Alert and Action Lines during her training in Salisbury and on return to her mission hospital had introduced the method to the hospital. The Medical Superintendent, Dr. Richard Stoughton, gave enthusiastic support and after an introductory period of one year carried out the prospective review on our behalf.

(4) Harari Hospital, Salisbury.

The review period, in fact, commenced two years after completing the initial studies described in previous chapters in this thesis. During this two-year period a number of changes had taken place in the nature of the patient intake to Harari Hospital, due to the escalating increase in the number of patients seeking Obstetric care. Whereas the number of deliveries undertaken five years ago was 7 500 per year, it is now over 16 000 per year. With no increase in hospital bed space, it has

been necessary to build seven satellite maternity clinics in the suburbs of Salisbury. These are run entirely by midwives for normal Obstetric cases and they are now delivering over 8 000 patients per year. The clinics have been using the labour graphs very efficiently and transfer of patients for delay in labour or suspected disproportion is determined by cervicographic progress in relation to the Alert Line.

This has meant that Harari Hospital has become more increasingly a referral hospital catering predominantly for problem cases. Again, with no increase in the number of medical staff, labour observations are the responsibility of the midwives and, even in the intensive care of those whose cervicographic progress has crossed the Action Line, the midwives have become very efficient in the recording and interpretation of the composite labour graph.

General comments from institutions visited.

Doctors and midwives working in the institutions that had adopted this method of graphic recordings were enthusiastic and keen to continue. Critical comments were sought and, in the main, the following three problems were expressed fairly universally:

(1) The need for fixed lines.

With suitable explanation, midwives were able to correctly plot the various parameters of labour progress. However, the instructions as to where the Alert and Action Lines were to be drawn, particularly if the patient was admitted in the latent phase of labour, were not always easily followed. It was recommended that a graph with Alert and Action Lines already printed would prove to be simpler and more efficient.

(2) Problems with the late arriver.

Most observers expressed the concern that the patient arriving with a cervical dilatation at 7 cm or more had too long to wait before her cervicographic progress could possibly reach the Action Line. Our earlier experience had shown that the majority of such patients were either in easily-recognisable obstructed labour on admission and therefore warranted immediate operative delivery, or else the explanation for their arrival at such an advanced cervical dilatation was that their labour was fast and efficient and they would deliver quickly and safely. In these circumstances, it was felt that the simplicity of the single Alert Line was justified. However, reports were given of a number of patients admitted with cervical dilatation of 7 cm or more and not in obstructed labour whose further progress was slow and who eventually showed evidence of cephalo-pelvic disproportion. A few such cases were also seen at Harari Hospital and are commented upon in the review reported below. It was therefore necessary to take cognisance of this problem.

(3) The problems of the latent phase of labour.

Initially it was felt that, for the sake of simplicity, progress of labour in the latent phase could be disregarded, as problems were so seldom seen in that phase. However, midwives, in particular, were anxious to have a guide as to the recognition of the prolonged latent phase, and we in fact began to recognise that some of the problems of the active phase showed advance evidence of their problems in the form of a prolonged latent phase. It was therefore decided that a guide to the management of the latent phase should be incorporated into the final regime.

A STUDY OF FOUR ALTERNATIVE REGIMES

During my travels in South Africa in 1973 I visited Dr. Aldeth Lasbrey at McCord Zulu Hospital in Durban. Dr. Lasbrey is the Obstetrician caring for a large number of normal and referred African patients at that hospital. She had been using our Alert and Action Lines on the cervicograph in the management of her primigravid patients and had met the types of problems mentioned above. She made a number of modifications to the application of the Alert and Action Lines and I in turn adapted these modifications, with minor changes of my own, to formulate what is described below as Regime 3.

With the background information and experience obtained from my visits to other hospitals, I conducted a study comparing four possible regimes in the management of primigravidae in the four institutions described above. A series of consecutive, completed labour graphs was obtained from each of the four institutions and the comparison was carried out by applying each of the four possible regimes to every graph in retrospect and analysing their predictive value.

The information sought in this analysis was:-

(1) The number of patients whose cervicographic progress crossed the Action Line of each regime being studied. This would indicate the amount of active intervention that would be required for each regime.

(2) The number of cases of major cephalo-pelvic disproportion picked up or missed by the application of each regime. Major disproportion was recorded in those patients warranting Caesarean section or symphysiotomy after the use of the active regime of management.

The four regimes studied were:-

Regime 1. The regime described at the beginning of this Chapter (see page 74).

Regimes 2, 3 and 4. These are based on the scheme described below. Regimes 2 and 4 are minor variations of Regime 3, which is described in detail below. Regimes 2 and 4 are defined following the description of Regime 3.

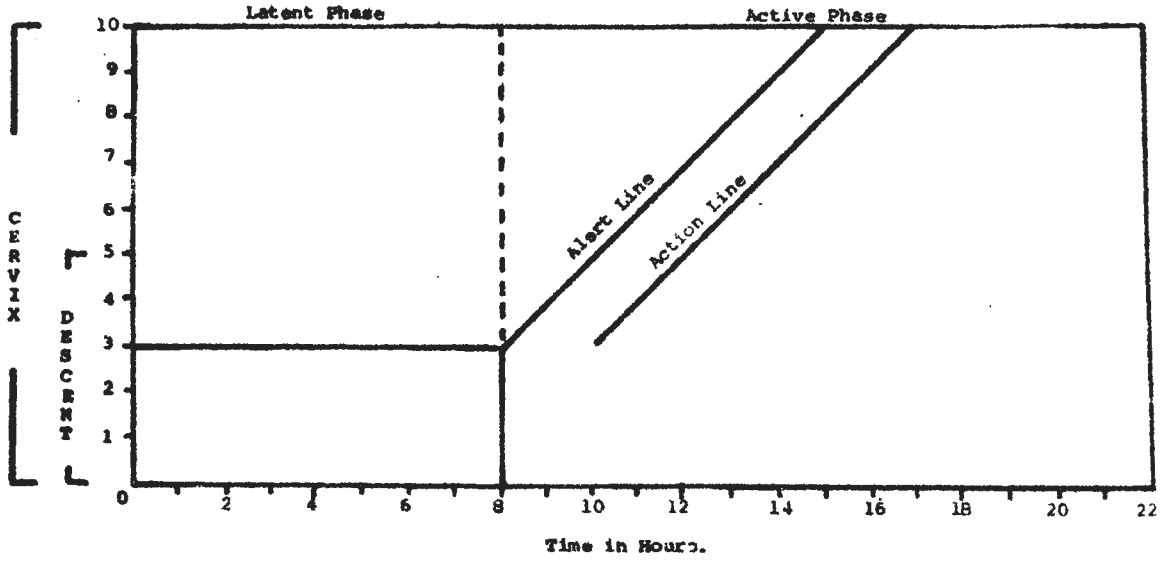


Figure 16. The application of the Alert and Action Lines according to Regime 3.

Regime 3. The graph (Figure 16) is divided into a portion for the latent phase and a portion for the active phase. Our definition of the time of transition from latent to active phase is a necessary over-simplification of the truth and is stated as the time when the cervix has reached 3 cm

dilatation. In Dr. Lasbrey's experience, primigravidae admitted to her Unit in the latent phase of labour and who then spent longer than eight hours in the latent phase, proved to develop a greater incidence of problems later in labour than those whose latent phase in hospital lasted less than eight hours. We then did a prospective study of patients arriving at Harari Hospital in the latent phase and, although the series was not large enough for statistical analysis, we gained a similar impression that intervention should take place if the latent phase in hospital lasted more than eight hours. This study is reported in Appendix A at the end of this chapter, fully recognising that a more detailed study of a larger series of patients in the latent phase is indicated. In the meantime, the guide line dividing the latent and active phases on the graph is drawn at the eight-hour mark, regarding a latent phase in hospital of longer than eight hours as being prolonged and warranting intervention.

The Alert Line applies to the active phase portion of labour and is drawn at 1 cm per hour from the 3 cm mark at eight hours. The Action Line is drawn parallel and two hours to the right.

The following points are to be used as guides in deciding when intervention is indicated in the latent and active phases:

(1) <u>If the patient is admitted in the latent phase of labour</u>, the dilatation and effacement of the cervix is recorded at the extreme left-hand side of the graph and this point regarded as zero time. The labour is reviewed four hours later. If regular contractions have continued unabated but there is no progress in cervical dilatation, then the question arises as to whether this is the true latent phase or

merely false labour. Pethedine 100 mg can then be given and the labour again reviewed at the eight-hour mark. If contractions have ceased, then this can be regarded as evidence of false labour and true, established labour can be awaited.

If contractions have continued but at the end of the eight hours progress has not reached the active phase, i.e. 3 cm dilatation, then this must be diagnosed as a prolonged latent phase. This patient should be in hospital and referred to a doctor. As long as there is no contra-indication (e.g. major cephalo-pelvic disproportion) the membranes should then be ruptured and an oxytocin infusion commenced. Further progress should parallel the Alert Line once the active phase has been reached. If not, either the dose of oxytocin is inadequate, and this can be assessed by the contraction recordings, or there is an abnormality, which needs to be sought.

(2) <u>If the patient is admitted in the latent phase of labour and four hours later is found, on vaginal examination, to be in the active phase</u> (i.e. 3 cm or more dilated) then the cervical dilatation recording is transferred by a curved arrow to the appropriate point on the Alert Line in the active phase portion of the graph. All subsequent recordings continue from that point.

(3) <u>If a patient is seen in the latent phase of labour with either prolonged rupture of the membranes or a high risk factor</u>, e.g. intra-uterine growth retardation or toxaemia of pregnancy, then the patient should be referred to a doctor for immediate stimulation of labour.

(4) <u>If, on admission, the patient is found to be in the active phase of labour</u>, the dilatation of the cervix is marked with an "X" at the point on the Alert Line representing the dilatation in centimetres. That

point on the Alert Line is now regarded as zero time for the patient's recordings. Subsequent vaginal examinations will be performed at intervals of not greater than four hours.

(5) If progress crosses the Alert Line then the patient should be transferred to the intensive care unit of the labour ward in the hospital. Subsequent vaginal examinations should be done at a maximum of two-hourly intervals.

(6) If progress crosses the Action Line then active management is carried out as described before.

Regime 2.

This regime is the same as Regime 3, except that the Alert Line of Regime 3 is also used as the Action Line, and therefore all patients whose cervicographic progress crosses the Alert Line have active intervention in the form of oxytocic stimulation at that time.

Regime 4

This regime is the same as Regime 3, except that the Action Line is four hours parallel and to the right of the Alert Line of Regime 3.

RESULTS

Table XII records the results of the retrospective analysis carried out on the graphic labour records of consecutive primigravidae delivered in the four different institutions. Each of the four regimes mentioned above were applied to every graph, and an assessment was made of the number of patients that would require intervention for each regime and also the number of cases of major cephalo-pelvic disproportion that would be picked up or missed by the application of each regime. The

most efficient regime would be the one that required the least intervention for the greatest pick-up.

Table XIII gives a breakdown of the indications for Caesarean section in the 47 cases of major disproportion in the Harari series. In an endeavour to ascertain why cases of disproportion were missed (i.e. were delivered to the left of the Action Line) by Regime 1, an analysis is given in Table XIV of the cervical dilatation on admission of the ten cases of disproportion that delivered to the left of the Action Line in the Harari series.

Table XII. Results from retrospective analysis of primigravid labour graphs.

Hosp./Regime	Cases	Major C-PD	Need Stimulation	C-PD Picked-up	C-PD Missed
Harari	484	47 cases 9,7%			
1			12,19	37	10
2			48,34	45	2
3			35,12	45	2
(4)			25,82	44	3
Silveira	209	18 cases 8,6%			
1			13,87	12	6
2			57,72	18	0
3			49,76	17	1
(4)			25,35	17	1
Groote Schuur	305	18 cases 5,9%			
*1			25	14	4
2			35	17	1
(3)			27	17	1
4			19	15	3
Blantyre	271	27 cases 10%			
1			25	20	7
2			55	27	0
3			43	26	1
(4)			34	25	2

*Regime 1 in Groote Schuur Hospital series uses the Alert Line as the Action Line.

( ) Regimes bracketed are the best regime for the particular hospital.

Table XIII The indications for Caesarean section in the 47 cases of major cephalo-pelvic disproportion in the Harari series.

		Cases
(1)	Fetal distress plus clinical evidence of gross disproportion at the Action Line	18
(2)	Fetal distress during the test period after crossing the Action Line	12
(3)	No progress in cervical dilatation after 6 hours of oxytocin stimulation	10
(4)	Gross disproportion at 10 cm dilatation	7
		47

Table XIV. Cervical dilatation on admission of the 10 patients with disproportion missed on Regime 1 in the Harari series.

Dilatation	No. of cases
10 cm	Nil
9 "	1
8 "	4
7 "	3
6 "	1
5 "	1
	10

DISCUSSION

Based on the results in Table XII, the following recommendations would be made for future practice in the different institutions studied.

(1) Harari Hospital and satellite clinics.

Of the 484 primigravidae studied, 9,7% had major cephalo-pelvic disproportion requiring Caesarean section or symphysiotomy. The most efficient regime would appear to be Regime 4 where only three cases were missed out of the 47 cases of major disproportion. To obtain that pick-up, it was necessary to stimulate labour in 25% of the 484 cases.

Regime 4 was certainly more efficient than Regime 1, and this is evident in each of the hospitals studied.

Table XIV shows that eight out of the ten patients whose disproportion was not picked up in Regime 1 in the Harari series were admitted with a cervical dilatation of 7 cm or greater. This would seem to pinpoint the main weakness of Regime 1, as these cases had to wait too long before being picked up by the Action Line. This weakness is rectified in Regime 4..

It is of interest to review the indications for Caesarean section in the 47 cases of major disproportion recorded in Table XIII. Thirty out of the 47 cases were sectioned for fetal distress either at the time cervicographic progress reached the Action Line or during the period of oxytocin stimulus after the Action Line was crossed. By the time delivery took place, clinical evidence of cephalo-pelvic disproportion was confirmed, but it was the fetal condition that precipitated the decision to deliver the baby immediately. This underlines the importance of careful and accurate assessments of the fetal condition throughout the

labour. The fact that no baby was lost from labour problems in this series shows that it is possible to get good results by standard clinical means. In particular, the careful assessment of the degree of moulding and the level of the head at the moment of crossing the Action Line and at each subsequent examination is of the utmost importance in making the correct decision as to final method of delivery.

(2) Silveira Mission Hospital

In the 209 cases studied, there was an 8,6% incidence of major disproportion. Again, Regime 4 would seem to be the most efficient and, in fact, at the time of writing, they have changed to Regime 4 and are finding it efficient and easy to follow. The practice in Silveira Hospital is typical of other rural hospitals in Central Africa, and we would therefore recommend the use of Regime 4 for all such hospitals and clinics. The nursing sisters in Silveira Hospital have demonstrated in recent months that they are perfectly capable of managing their primigravidae throughout labour and have needed to call the doctor only when a Caesarean section was necessary. They are doing all the assessments and recordings and are also handling the management of those patients whose cervicographic progress has crossed the Action Line.

(3) Groote Schuur Hospital, Cape Town.

The type of patient seen in this hospital is very different to that seen in the other three hospitals. They are all Cape Coloureds whose pelvic size and shape are more favourable than those seen in the African population. This is reflected in the lower percentage of cases of major disproportion and also in the lower incidence of cases of slow cervical dilatation. In this series it would seem that Regime 3 is the most

efficient, where the screening of 27% of cases for oxytocin augmentation missed only one of the 18 cases of major disproportion. There would certainly not seem to be any merit in giving oxytocic augmentation any earlier than at a two-hour Action Line, and delay till the four-hour Action Line of Regime 4 does mean that a few more cases of disproportion would be missed. Because of the lower incidence of major disproportion in the Groote Schuur series, there are no more cases crossing the line in Regime 3 than there are crossing the line in Regime 4 in the other hospitals. I therefore recommend that at Groote Schuur Hospital they can afford the "luxury" of using Regime 3.

It could therefore follow that in other institutions where disproportion is no more common than that seen at Groote Schuur Hospital Regime 3 would be the ideal regime of management.

After conducting this review at Groote Schuur Hospital I met with the midwives and doctors who were working in that Obstetric Unit and obtained from them the following recommendations:-

(a) The graphic records as described should be used for <u>all</u> patients in the first stage of labour.

(b) A graph with fixed Alert and Action Lines should be incorporated in each patient's record book.

(c) Spare labour graphs without Alert and Action Lines should be available for patients having inductions and for those not yet in true labour. Once true labour had commenced, the record should be transferred to the graph with the fixed lines.

(d) There should be space provided in the patient's record book for the doctor's full assessment of the patient on admission. This should appear immediately prior to the labour graph.

(e) Likewise, space should be provided immediately following the labour graph for four-hourly (or more frequent) assessments by the doctor of the state of the labour. This would include an evaluation of fetal condition, maternal condition and labour progress. It would not be a repetition of any of the recordings on the graph. It would conclude with a statement of the plans for further management at the time of each assessment.

(f) Augmentation of labour prior to the Action Line would be regarded as unnecessary and introducing a needless hazard.

(g) These graphs should be used by the midwives in the district clinics, and indications for transfer to hospital would be based on the instructions given in Regime 3 earlier in this chapter.

(h) Separate instructions for the management of the multigravida were discussed, but are not relevant to this thesis.

(4) Queen Elizabeth Hospital, Blantyre, Malawi.

Review of the figures from this hospital would suggest that, in the presence of a high incidence of cephalo-pelvic disproportion, Regime 4 is the most satisfactory. Even then, it would be necessary to screen and augment labour in 34% of the primigravid patients. Moving the Action Line two hours to the left, as in Regime 3, would mean augmenting labour in 43% of cases, which becomes unmanageable in a busy, under-staffed labour ward. To reduce the augmentation rate to 25% as in Regime 1 would be inefficient, as seven out of 27 cases of major disproportion were missed on that regime. Certainly the high prevalence of cephalo-pelvic disproportion in this community produces a very heavy work load for the staff in the hospital, and no regime of management can really lighten the load while maintaining good maternal and perinatal results.

It has become very apparent, while visiting so many clinics and hospitals in Southern and Central Africa, that a regime of management of this nature needs to be very thoroughly taught if it is to be accepted in practice. I have therefore prepared a tape/slide lecture with a complete set of notes, detailing the use of the composite graph and also describing the use of the Alert and Action Lines in the detection and management of disproportion. These teaching aids are available to institutions wishing to use the regime and are submitted with this thesis.

APPENDIX TO CHAPTER 6

STUDY OF PATIENTS ADMITTED IN THE LATENT PHASE OF THE FIRST STAGE OF LABOUR

The question has been raised by midwives working in our peripheral clinics as to whether the duration of the latent phase of labour should be taken into consideration in determining criteria for transfer to the Central Hospital. In the series studied by Friedman and Sachtleben[10] the following information was obtained on the latent phase.

The upper 95 percentile limit of latent phase duration in the primigravida was found to be 20,6 hours and this was regarded as abnormal. Of those permitted to labour beyond the 20-hour mark, 43,9% developed further dysfunctional labour patterns, and of these, 10,6% required Caesarean section, mainly for cephalo-pelvic disproportion. However, in the 56,1% of the prolonged latent phase group who went on to have a normal labour pattern, none required Caesarean section. It was not possible, during the latent phase, to determine which patients would go on to develop a dysfunctional labour pattern.

In Friedman's series, various modalities of treatment had been used. Excluding those who were given no treatment at all and those who had Caesarean sections, the rate of treatment effectiveness was 65,3%. Effectiveness, in the form of change from latent to active phase, was accepted as a result of the treatment if this occurred within three hours of giving the treatment. Comparable corrected data for the several treatment groups were:- 34,1% for amniotomy, 45,0% for sparteine sulphate, 60,7% for sedation, and 88,5% for oxytocin infusion. Response was most prompt with oxytocin and so delayed with amniotomy

that it was felt that rupture of the membranes contributed little or nothing to the treatment of the abnormal latent phase.

In endeavouring to assess problems of latent phase duration in our own hospital we were faced with the particular difficulties of determining the time of onset of labour. We therefore decided to study the duration of the latent phase from time of admission to hospital rather than from onset of labour. The study comprises 60 consecutive primigravidae admitted in the latent phase and who were regarded as being at term. The study is too small to be of statistical value and is merely being used as a guide to the management of the latent phase, pending a study of a much larger series.

For this study, instructions were given that labour should not be stimulated until 24 hours had elapsed, or some obstetric indication had occurred, such as fetal distress. Table XV shows the features that were studied and records these features for each of five cumulative groups according to time spent in the latent phase in hospital.

COMMENTS

It is to be emphasised that this series of latent phase cases is too small to analyse statistically. However, comments can be made on the trends seen and the information is used to guide management until a larger study is completed.

It will be seen that the mean rate of cervical dilatation in the active phase of labour becomes slower as more cases of prolonged latent phase are seen. The condition of the neonate is not affected

by the duration of the latent phase in this series, but maternal problems in labour and the puerperium appear to be accentuated.

These problems are seen particularly in the group of patients whose latent phase is prolonged beyond eight hours. Thus there is an increasing number of patients requiring oxytocic augmentation of dysfunctional labour in the active phase and also an increasing instrumental delivery and Caesarean section rate. The number of patients showing a temperature rise increases markedly after the eight-hour mark and consequently there is a greater incidence of puerperal sepsis and severe post-operative infection in this group.

We would therefore recommend that, until further studies are completed, patients whose latent phase of labour in hospital or clinic lasts longer than eight hours should have augmentation of their labour at that point in time in an endeavour to avoid the maternal problems recorded above. This guide has been built into our present regime of management.

It should be pointed out that where there is evidence of prolonged rupture of membranes or of chronic or acute fetal distress, active management should be commenced as soon as any of these features are recognised.

Table XV. Maternal and neonatal features recorded in relation to the duration of the latent phase of labour from admission to hospital.

Group		A	B	C	D	E
Number of cases		25	33	42	50	60
Latent phase duration	hrs.	0 - 6	0 - 8	0 - 12	0 - 18	All
Later oxytocin use for dysfunctional labour	%	32,0	30,3	38,1	38,0	41,7
Rate of cervical dilatation in the active phase	cm/hr.	1,46	1,32	1,22	1,08	1,04
Instrumental delivery	%	20,0	27,3	28,6	30,0	30,0
Caesarean section	%	12,0	12,1*	19,0	18,0	21,7
Temperature increase in labour	%	0	3,0*	11,9	16,0	18,3
Ketosis	%	52,0	45,5	38,1	40,0	38,3
Mean birth weight	g	3 062	3 131	3 115	3 102	3 115
Apgar 1 minute		8,0	8,2	8,1	8,3	8,2
Apgar 5 minutes		9,4	9,5	9,5	9,6	9,5
Apgar < 6	%	24,0	24,2	23,8	22,0	23,3
Paediatric complications	%	24,0	21,2	23,8	24,0	23,3
Perinatal deaths	%	4,0	3,0	4,8	4,0	3,3
Puerperal sepsis	%	0	0*	2,38	6,0	8,3
Cases of severe post operative sepsis		0	0*	1	2	5

* Marked increase from this point.

CHAPTER 7

PLANS FOR FUTURE STUDIES

The completion of the work outlined in this thesis has provoked an enquiring interest in a number of its facets that warrant further studies in greater depth. I would like to outline six aspects in particular, each of which is receiving attention at present in my Department. The study on fetal condition has already been completed by Research Fellow, Dr. K.S. Stewart, and is being submitted to the University of Edinburgh in the form of an M.D. thesis.

(1) The Latent Phase

As mentioned in Appendix A to Chapter 6, there is need for a larger study of patients admitted in the latent phase of labour, in order to determine whether the present method of managing this phase is satisfactory, or whether changes are needed.

(2) Fetal Condition

Consideration of the indications for Caesarean section in patients having a trial of labour for suspected cephalo-pelvic disproportion, shows that in the majority of cases the final decision is based on fetal condition. It is important, therefore, to ensure that the baby is born in optimum condition. There are a number of factors that influence fetal condition during such a labour, such as antepartum placental insufficiency, the effect of natural or augmented contractions on the placental circulation, the effect of increasing head compression, and the method of final delivery. We invited Dr. K.S. Stewart to come to the Department for 15 months as a full-time Research Fellow

to study fetal condition and its assessment in trial of labour, managed according to the regime outlined in this thesis. He was assisted by two skilled research midwives.

In the first part of his study he was able to make an impartial evaluation of our regime of management, and concluded that it was efficient in screening potential problems of disproportion and formed an efficient basis for the final determination of the correct method of dwlivery. He then carried out a very detailed study of the condition of the fetus in all labours where cervicographic progress crossed the Action Line. He made clinical assessments of fetal condition - liquor changes, fetal heart rate changes assessed with the fetal stethoscope and determinations of moulding of the fetal head in relation to head descent. He also recorded cardiotocographic measurements of fetal heart rate and intrauterine pressure changes and measured fetal pH. All these measurements were determined for each hour prior to final delivery. Comparisons were made between four groups:-

(a) Controls, who delivered to the left of the Alert Line;

(b) Those who crossed the Action Line and delivered spontaneously in response to oxytocin augmentation, i.e. cases of uncomplicated, inefficient uterine action;

(c) Those who came to Caesarean section after active management, i.e. cases of gross disproportion; and

(d) Those who required an instrumental delivery after active management, i.e. cases of borderline disproportion.

Dr. Stewart was able to determine the criteria of changing fetal condition as measured by sophisticated monitoring equipment and then,

for the benefit of the average clinician, correlated these criteria with parallel features that could be determined by careful clinical observation and measurement.

The next step in the analysis of fetal condition in trial of labour has just commenced in our Department. It is very evident from our past experience that the fetal heart rate pattern and fetal pH do not provide one with the total picture of fetal well-being. We are also very concerned about the fetal brain during a trial of labour. Though the fetal heart rate pattern and the fetal pH give some reflection of cerebral condition, and the degree of cranial moulding in relation to rate of head descent is of great importance, we would still wish to find more direct evidence of cerebral condition. Dr. Patricia Wilson is at present carrying out a study of fetal electroencephalographic changes in trial of labour. She has already been successful in manufacturing suction electrodes containing pins for EEG as well as ECG in the same electrode. Now that the methodology is established she plans to carry out a study similar to that of Dr. Stewart, with the addition of the electro-encephalographic evidence.

(3) Final Delivery Method

This thesis has been restricted to a study of the first stage of labour, and in particular to its active phase. However, it is very evident that excellent management in the first stage can be nullified by an incorrectly managed second stage of labour. We are at present studying the fetal and maternal factors in the second stage of labour in those patients whose cervicographic progress has crossed the Action Line, and are also working on a more efficient recording system that

will help midwives to recognise the problem patient in the second stage of labour.

We have established criteria for selecting the correct method of final delivery[32], but do need to carry out further detailed prospective studies to assess the safety of these criteria.

(4) Induction of labour in the presence of suspected cephalo-pelvic disproportion.

In parts of the world such as our own where cephalo-pelvic disproportion is very prevalent, the question of induction of labour poses particular problems. Because of the background fear of disproportion we find ourselves adopting an ultra-conservative attitude to induction and not infrequently find ourselves avoiding necessary inductions or meeting with problems of at least borderline disproportion in some induced labours. It is true that in the majority of cases where an induction of labour is indicated the fetus is smaller than normal, but still the small pelvis often poses a problem.

We are therefore conducting a study to determine the criteria that will ensure the safe conduct of induction of labour in a practice where disproportion is prevalent.

(5) The Multigravid Patient

This thesis has been limited to the study of disproportion in the primigravid patient. While carrying out this work it has become apparent that the detection of disproportion in the multigravida can be even more difficult. Our observations thus far have pointed to the following features, but more detailed study is necessary:

(a) Slow progress in the rate of cervical dilatation in the active phase of labour must be regarded seriously. It often indicates the presence of disproportion. The use of a "trial of oxytocin" can be conducted safely in the primigravida, but in the multigravida the uterine response might be difficult to control and is far more hazardous. We therefore recommend that oxytocin should be used only for the augmentation of inefficient uterine action in the multigravida if the head is already deep in the pelvis and there is absolutely no evidence of any disproportion. Oxytocin should certainly not be used to find out whether disproportion is or is not present in the multigravida. If in any doubt in such a case, Caesarean section is indicated.

(b) Not infrequently, in the multigravida, the rate of cervical dilatation can be rapid, in spite of the presence of major cephalo-pelvic disproportion. This is seldom seen in the primigravida. Furthermore, such uterine action can, even without oxytocic augmentation, go on to uterine rupture. This end catastrophe is virtually never seen in the primigravida. This means that an Alert Line, wherever placed, will not always help in picking up major disproportion in the multigravida. At present we recommend that labour in the multigravida should be plotted on the cervicograph and that our present Alert Line should be used to pick up the patient with slow progress, but that midwives and doctors should always be on the lookout for disproportion in those whose cervicographic progress is satisfactory. This will be detected in the first stage of labour by a failure of normal head descent with increased moulding, and in the second stage by failure of progressive head descent over a period of 15 to 20 minutes.

These comments represent uncontrolled observations, and therefore indicate the need for a well-planned study of the multigravida as has been carried out for the primigravida.

(6) Teaching methods

The scheme of management outlined in this thesis has been evolved with the midwife working in a peripheral clinic foremost in mind. Now that the regime has become established in a number of centres we feel that the next task is to teach the method in other developing areas where the need is so great.

Following the success of the methods used by Dr. David Morley (33), the paediatrician who pioneered "Under-Fives" clinics throughout the developing world, we are experimenting with sets of colour slides with accompanying notes and tape recordings to teach this method of labour management. Copies of our first attempts accompany this thesis, but we are certain that modifications will become necessary after we have received feed-back from those using the teaching aids.

In Rhodesia we have arranged for midwives working in peripheral urban and rural clinics to come to our hospital on an exchange basis to learn these methods of labour management in our own labour wards. In the Salisbury area, midwives from our own satellite clinics attend weekly perinatal study meetings and in this way contribute to new modifications of the regime and quickly keep abreast of new teaching. The establishment of a team relationship in every area is essential if the regime is to work in practice, and if high standards are to be maintained.

REFERENCES

(1) Baird, D. The cause and prevention of difficult labour. Amer. J. Obstet. & Gynec. 63: 1 200, 1952.

(2) Bernard, R.M. The shape and size of the female pelvis. Edinburgh M.J. 59: 1, 1952.

(3) Moir, J.C. The use of radiology in predicting difficult labour: forecasting the course of labour. Journ. Obstet. and Gynaecol. Brit. Emp. 54: 20, 1947.

(4) Crichton, E.D. Proc. R.S. Med. 45: 535, 1952.

(5) Friedman, E.A. Labor: Clinical evaluation and management. Appleton, New York, 1967.

(6) Friedman, E.A. Dysfunctional labor, Chapter 10 in Davis Gynaecology and Obstetrics, Vol. II. Harper and Row, 1972.

(7) Turnbull, A.C. Uterine contractions in normal and abnormal labour. Journ. Obstet. and Gynaecol. Brit. Emp. 64: 321, 1957.

(8) Friedman, E.A. Graphic analysis of labor. Amer. J. Obstet. & Gynec. 68: 1 568, 1954.

(9) Friedman, E.A. Primigravid labor: a graphicostatistical analysis. Obst. and Gynec. 6: 567, 1956.

(10) Friedman, E.A., and Sachtleben, M.R. Dysfunctional labor:

I Prolonged latent phase in the nullipara. Obst. & Gynec. 17: 135, 1961.

II Protracted active phase dilatation in the nullipara. Obst. & Gynec. 17: 566, 1961.

III Secondary arrest of dilatation in the nullipara. Obst. & Gynec. 19: 576, 1962.

IV Combined aberrant dilatation patterns in the nullipara. Obst. & Gynec. 20: 761, 1962.

V Therapeutic trial of oxytocin in secondary arrest. Obst. & Gynec. 21: 13, 1963.

VI Abnormal progress in the multipara. Obst. & Gynec. 22: 478, 1963.

VII A comprehensive program for diagnosis, evaluation and management. Obst. & Gynec. 25: 844, 1965.

VIII Relative accuracy of clinical and graphic diagnostic methods. Obst. & Gynec. 33: 145, 1969.

IX Delivery outcome. Amer. J. Obstet. & Gynec. 106: 219, 1970.

X Immediate results to infant. Obst. & Gynec. 33: 776, 1969.

XI Neurologic and Developmental effects on surviving infants. Obst. & Gynec. 33: 785, 1969.

(11) Hendricks, C.H., Brenner, W.E., and Kraus, G. Normal cervical dilatation pattern in late pregnancy and labor. Amer. J. Obstet. & Gynec. 106: 1 065, 1970.

(12) Brenner, W.E. Personal communication 1971.

(13) Cibils, L.A., and Hendricks, C.H. Normal labor in vertex presentation. Amer. J. Obstet. & Gynec. 91: 385, 1965.

(14) Ledger, W.J., and Witting, W.C. The use of a cervical dilatation graph in the management of primigravidae in labour. Journ. Obstet. and Gynaec. Brit. Comm. 79: 710, 1972.

(15) Beazley, J.M., and Kurjak, A. Influence of a partograph on the active management of labour. Lancet 3: 348, 1972.

(16) Philpott, R.H. Graphic recordings in labour. Brit. Med. J. 4: 163, 1972.

(17) Steer, P.J. and Beard, R.W. A continuous record of fetal heart rate obtained by serial counts. Journ. Obstet. Gynaec. Brit. Comm. 77: 908, 1970.

(18) Day, E., Maddern, and Wood, C. Auscultation of fetal heart rate: an assessment of its error and significance. Brit. Med. J. 4: 422, 1968.

(19) Caldeyro-Barcia, R. et al. Effects of uterine contractions on the heart rate of the human fetus. Digest of the Fourth International Conference on Medical Electronics, New York, 1961.

(20) Mendez-Bauer, C. et al. Relationship between blood pH and heart rate in the human fetus during labor. Amer. J. Obstet. & Gynec. 97: 530, 1967.

(21) Kubli, F.W. et al. Observations on heart rate and pH in the human fetus during labor. Obstet. Gynec. 104: 1 190, 1969.

(22) Beard, R.W. et al. The significance of the changes in the continuous fetal heart rate in the first stage of labour. J. Obstet. Gynaec. Brit. Comm. 78: 865, 1971.

(23) Crichton, E.D. A reliable method of establishing the level of the fetal head in Obstetrics. S. Afr. J. Obstet. Gynaec. 12: 22, 1974.

(24) Friedman, E.A. Electronic cervimeter: a research instrument for the study of cervical dilatation in labor. Amer. J. Obstet. & Gynec. 87: 789, 1963.

(25) Mercer, W.H., Simons, E.G., and Philpott, R.H. The use of lumbar epidural analgesia during the first stage of labour in high-risk pregnancies. S. Afr. J. Obstet. Gynaec. 12: 12, 1974.

27 APR 1976

(26) Romine, J.C., Clark, R.B., and Brown, W.E.
J. Obstet. Gynaec. Brit. Comm. 77: 722, 1970.

(27) Bromage P.R. Brit. J. Anaesth. 34: 161, 1962.

(28) Murray, J.P. Semi-orthometric pelvimetry: an appraisal.
Brit. J. Radiology 44: 524, 1971.

(29) Friedman, E.A. Personal communication, 1969.

(30) Philpott, R.H., and Castle, W.M. Cervicographs in the management of labour in primigravidae. I The Alert Line for detecting abnormal labour. Journ. Obstet. Gynaec. Brit. Comm. 79: 592.

(31) Philpott, R.H., and Castle, W.M. Cervicographs in the management of labour in primigravidae. II The Action Line and treatment of abnormal labour. Journ. Obstet. Gynaec. Brit. Comm. 79: 599.

(32) Oram, R.H., Simons, E.G., and Philpott, R.H. The use of the vacuum extractor in the Rhodesian African.
Centr. Afr. Med. Journ. 11: 250, 1969.

(33) Morley, D. Paediatric priorities in the developing world.
Butterworths, 1973.