Retrospective comparison of hydrostatic and pneumatic reduction of childhood intussusception at Red Cross Children's Hospital (1989-1997)

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INTRODUCTION

Intussusception is the invagination of one portion of the intestine into another segment. Despite occurring infrequently, intussusception is one of the commonest abdominal emergencies in paediatric surgery. Seventy-five per cent of cases occur in children under the age of two years and most are ileo-colic (1). The peak age of occurrence is between the fifth and ninth months of life (2). As the clinical and anatomic concepts of intussusception have changed over time, the terminology has reciprocated. No fewer than 12 names have been used to describe the condition. These have included such strange terms as misere mei (translated means "Lord, have mercy") and iliac passion (3).

Various methods and devices have been used in the past 300 years for the treatment of intussusception. These have included enemas (air and fluid), oral medications, bloodletting, ingestion of heavy metals and electricity (3). The first account of intestinal insufflation for the treatment of intussusception was by Ulhoorn in 1741. "Double intrusion" was treated by blowing tobacco smoke through a pipe into the rectum. The type of tobacco was considered important, with better results obtained with higher quality tobacco (3).

There have been many influences on the evolution of the treatment of intussusception. One of the most profound was the discovery of X-rays. Medical developments have not been the only influences. Reestablishment of political and cultural ties with China in the 1970's helped to reintroduce the technique of air insufflation to the Western World. To date, the largest single series of pneumatic reductions has come from China (4). This single series recorded results in 6,396 cases. The use of air in China was partly based on the expense of barium. This has

important parallels in all developing countries.

Enema reduction has become an established method of treatment, obviating the need for surgery in the vast majority of patients (5). The non-operative treatment of intussusception has a long and controversial history. This is particularly related to the advocates of pneumatic and hydrostatic reduction methods.

Hydrostatic reduction under fluoroscopic monitoring using liquid barium sulphate as the contrast agent was the most popular first line of treatment for years. Despite the excellent results using gastrograffin enemas for reduction claimed by Swischuk (6), there is no large series to back this up and this alternative fluid enema would not seem to be a widely used practice.

In recent years the pneumatic reduction of intussusception has gained increasing support with most large series reporting greater safety and improved efficiency than seen with liquid barium reduction (1,4,7,8,9). No study to date has shown reduction with barium to be more successful than air (11) and most studies show a significantly higher success rate with air (7). Despite these positive reviews, a number of local and international centres have remained reluctant to use the pneumatic method (10,11). A survey conducted in the United Kingdom by Jewell et al. (11) found that although most teaching hospitals and specialist paediatric units use the pneumatic technique, most district general hospitals still used the barium technique.

In accordance with consensus of the current literature, we have been using pneumatic reduction by preference at Red Cross Children's Hospital (RCCH) since the early 1990's. The aim of this study is to evaluate the results of our experience since 1989 as we have gradually moved from

the hydrostatic method to the pneumatic method. This study will present results of 100 cases seen over a seven year period at the Red Cross Children's Hospital. The results of the respective reduction techniques will be discussed with special attention on complication rates, efficiency and cost implications.

MATERIALS AND METHODS

The hospital folders of all children treated at the Red Cross Children's Hospital with proven intussusception were accessed using the hospitals disease classification facility. The initial time period studied was expanded to ensure adequate patient numbers as a number of folders could not be located. The chronological distribution of missing folders was uniform and it is unlikely that this influenced the results of the survey.

The clinical notes and radiological reports were scrutinised. The variables examined included: age, sex, symptoms at presentation, duration of symptoms before presentation, initial position of the intussusception, success rate of radiological reduction, findings at surgery and length of hospital stay.

On admission all patients were first assessed by members of the surgical team. After clinical assessment, review of the plain films, and consultation with the radiologist, a decision was made as to whether to attempt non-operative radiological reduction or to proceed directly to surgery. Absolute contraindications to non-operative reduction included signs of peritonism, shock or evidence of perforation. The preferred method of treatment of intussusception was non-operative reduction for the period studied. The patients who were required surgical reduction either had

contra-indications to non-operative reduction, or had already had a failed non-operative reduction.

Sedation was used only in very restless patients. Dehydrated patients were rehydrated with intravenous fluid before the enema was attempted. All patients were required to have an intravenous line in situ.

The hydrostatic barium reduction is initiated by the placement of a Foley catheter into the rectum. The balloon is inflated with 30 ml of air under fluoroscopic control. The procedure is performed with the child positioned supine. The bag of dilute barium is elevated to 100 cm above the bed and the progress of barium monitored by intermittent screening. The intussusception was confirmed with the identification of an intraluminal mass causing obstruction of the colon (figure 1). The intussusception is considered reduced when no filling defect remains in the caecum and barium fills the terminal ileum (figure 2). A total of three attempts of five minutes duration are considered permissible with two subsequent attempts of 5 minutes duration allowed if the initial attempt is not successful. A break of 5 minutes between successive attempts is recommended (12).

The pneumatic method of reduction was first attempted at RCCH in 1992. Gradually, as this became the preferred method of reduction, the hydrostatic method has been abandoned. The pneumatic method is now the method of choice in almost all cases. The only possible exception to this would be in patients with extensive small bowel obstruction and dilated gas filled bowel loops on abdominal X-ray in whom reduction with barium may be easier as it limits confusion with the various gas filled bowel loops.

FIGURE 1

Figure 1: Single contrast barium enema demonstrates an intussusception (arrow) in the mid-ascending colon. The intussusceptum is partially outlined by barium.

FIGURE 2

Figure 2: Single contrast barium enema of the same patient as shown in figure 1, showing barium flooding the distal ileum (arrow), thus confirming successful reduction.

The equipment used for the air enemas consists of a simple modification of a sphygmomanometer using a three-way-adaptor . One of the adapter limbs is attached to an appropriately sized Foley catheter, the second to the sphygmomanometer and the third to the bulb and pump routinely used with the sphygmomanometer. The hand pump is used for increasing the air pressure and the sphygmomanometer allows pressure measurement. The arm cuff is strapped with elastoplast to prevent expansion. A Foley catheter is placed in the rectum and the balloon inflated with 25-30 ml of air under fluoroscopy. The catheter and balloon are then pulled gently down into the distal rectum. The pneumatic reduction technique is performed with the child supine and the thighs were held together by an assistant. Air is introduced into the large bowel up to a maximum pressure of 120 mmHg. An assistant is assigned to the task of constantly monitoring the pressure displayed on the sphygmomanometer. Fluoroscopic monitoring is used to attempt to recognise the filling defect representing an intussusception. This is confirmed with visualisation of a reducible mass in the large bowel (figure 3).

Criteria for successful reduction are fluoroscopic demonstration of reduction of the mass to the caecum, with reflux of air into the terminal ileum (figure 4). Three attempts of three minute duration are permitted with a three minute rest period between attempts. All patients in whom successful reduction is not demonstrated by these criteria are taken to theatre for surgical reduction.

Recently, a second and in some cases a third subsequent reduction has been attempted in patients where reduction to the caecum is demonstrated but in whom air reflux into the terminal ileum is not visualised. This is only attempted if the patient's clinical condition is stable and is attempted approximately two hours following the initial reduction procedure.

FIGURE 3

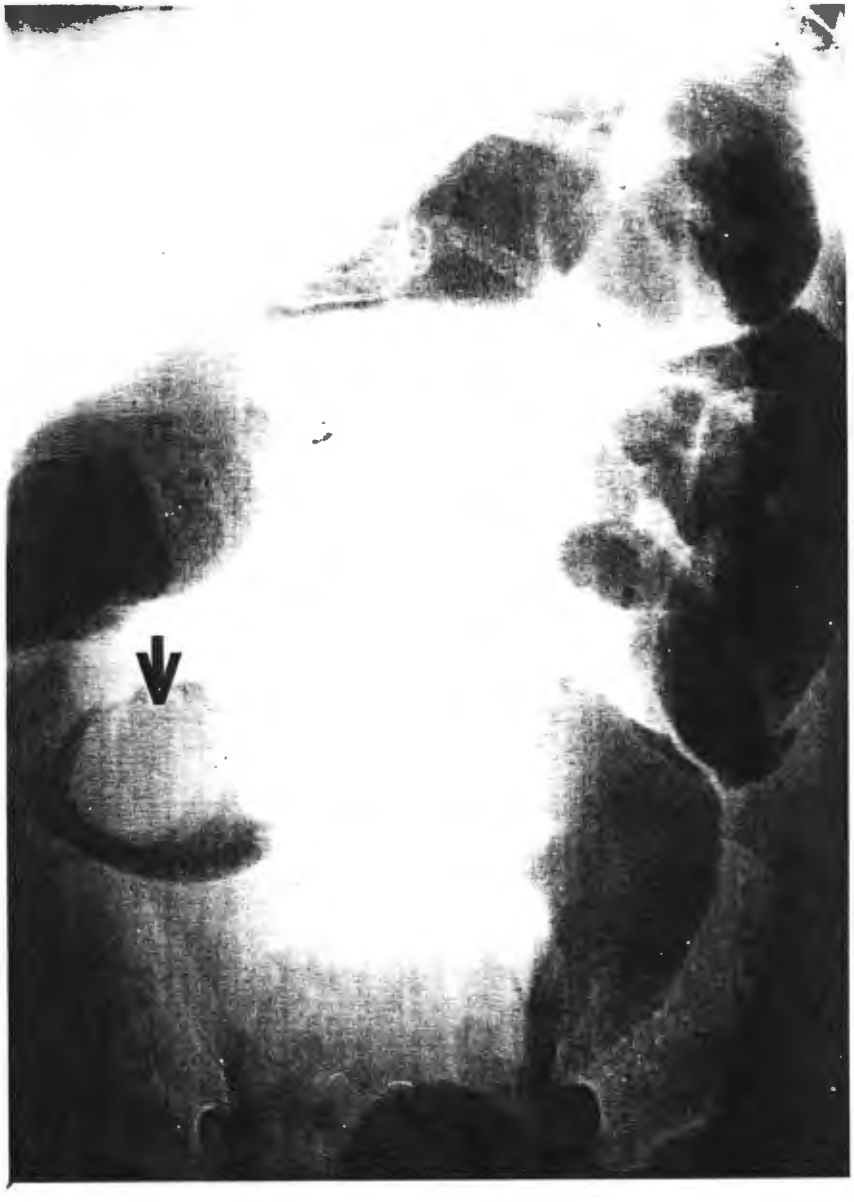


Figure 3: Air enema demonstrating an intraluminal mass (arrow) in the caecum. Subsequent successful reduction confirmed that this was an intussusceptum.

FIGURE 4

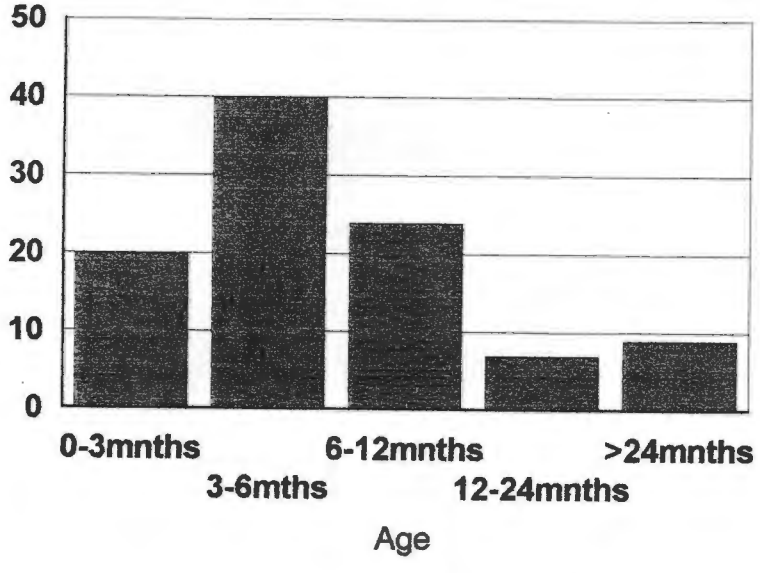
Figure 4: Gas enema with extensive gas refluxing into the ileum (arrow), confirming successful reduction of the intussusception. No intraluminal mass is visualised in the caecum (twin arrow) (different patient to figure 3).

The procedure is frequently recorded on videotape for later re-evaluation and discussion. Individual overall screening times are not recorded.

RESULTS

A total of 100 cases of confirmed intussusception were seen during the period 31 October 1989 to 30 April 1997. There were 55 boys (55%) and 45 girls (45%). Table 1 shows the age distribution in more detail.

Table 1:Age distribution (n=100)



The age range was 1 ½ months to 9 years. The great majority of the patients were younger than 1 year (84%) with most also younger than 6 months (60 %). The commonest presenting symptom was vomiting in 81 cases (81%), blood and/or mucus per rectum in 72 (72%) and a palpable abdominal mass in 55 (55%). Table 2 includes a more comprehensive list of presenting signs and

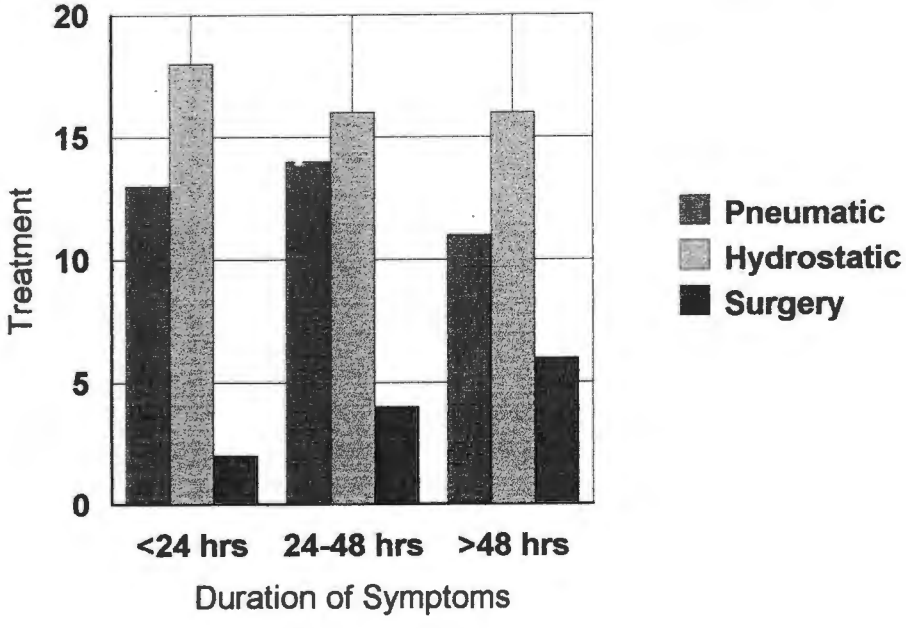
symptoms.

TABLE 2: Initial signs and symptoms

	Non-operative	Operative
Vomiting	69	12
Mucus PR	66	6
Abd. mass	51	4
Blood PR	39	6
Abd. pain	27	3
Tenderness	17	4
Dehydration	13	6
Diarrhoea	13	4
Constipation	5	4
PR mass	5	2

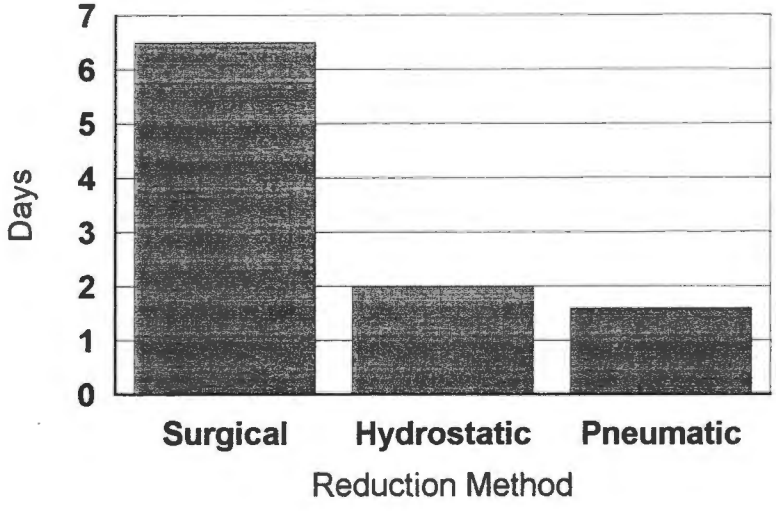
The duration of symptoms varied greatly. The majority of patients requiring primary surgical reduction presented after 48 hours (Table 3).

TABLE 3: Duration of symptoms



Overall 12 patients underwent primary surgical reduction, 50 liquid barium reduction and 38 pneumatic reduction. The commonest reason for primary surgical reduction was poor clinical condition. All 12 of the patients who required primary surgical reduction had radiological evidence of small bowel obstruction and all but one was dehydrated. One of these patients suffered a respiratory arrest prior to surgery. Findings at surgery in this group of patients included a ileal polyp in a patient with Peutz-Jeghers syndrome, a patient with a large worm bolus and a case with a Meckel's diverticulum. The mean hospital stay for patients undergoing primary surgical treatment was 6.5 days.

Table 4: Duration of hospital admission



Hydrostatic reduction was attempted in 50 cases. Reduction was successful in 20 cases (40%). All unsuccessful cases were taken to theatre and reduced surgically under general anaesthesia. Surgical findings included one patient who was found to be successfully reduced despite absence of passage of barium into the small bowel. Two patients with lymphoid hyperplasia, a patient with

Meckel's diverticulum and a patient with appendicitis were also treated in this group. The mean hospital stay for patients with successful hydrostatic reduction was 2 days.

Pneumatic reduction was attempted in 38 cases. Reduction was successful in 24 (63%) cases. All unsuccessful reductions proceeded to surgery. Two patients were found to be successfully reduced at surgery despite the failure to demonstrate passage of air into the small bowel under fluoroscopy. The remaining 11 cases included a patient with appendicitis, a patient with a large worm bolus and a patient with mesenteric adenitis. The mean hospital stay for the patients with successful pneumatic reduction was 1.6 days. This included one patient with cystic fibrosis who was hospitalised for 8 days following respiratory infection.

Recently the patients with clinically suspected intussusception in whom no palpable mass is evident or where no mass is identified on plain films, were routinely examined with ultrasound prior to fluoroscopy. Positive ultrasound findings included the identification of "Swiss Roll" or "kidney" shaped masses representing the transverse and longitudinal views of the intuscusseption respectively. Positive ultrasound findings were confirmed at fluoroscopy in 10 patients with 2 cases of falsely positive ultrasound diagnosis. The reason for the false positive diagnosis was not documented in either of the 2 cases.

The major complication of both methods of non-operative reduction was perforation. Perforation occurred in 3 cases of hydrostatic reduction. One of the patients died due to multiple organ failure following surgery. The other two patients were eventually discharged, but have been lost to subsequent follow up. Perforation occurred in 1 case of pneumatic reduction. This patient developed a tension pneumoperitoneum which was easily decompressed percutaneously in the

procedure room by use of a syringe and an 18 gauge needle. The patient underwent surgery and made an uneventful recovery.

The head of the intussusception at the commencement of the enema was in the transverse colon in 37 cases, caecal in 18 cases, in the descending colon in 17 cases, in the sigmoid colon in 17 cases and in the rectum in 2 cases.

DISCUSSION

Successful management of intussusception depends on early diagnosis and early reduction. It is now generally accepted that non-operative reduction should be attempted in most patients with acute idiopathic intussusception (2). The contrast medium used in the diagnosis and treatment of paediatric intussusception has been a matter of widespread debate in both surgical and radiological literature over the past few years with both barium and air having been used successfully.

The overall incidence of occurrence of intussusception is approximately 2.4 per 1000 live births in the USA, but may be higher in developing countries. In temperate regions, a seasonal incidence has been reported with a peak in summer (2).

A combination of clinical, radiological (including ultrasonic) and surgical techniques may be necessary for complete diagnosis and treatment. The frequency of typical symptoms are age and anatomical site related. Vomiting is the commonest feature and may be the sole presenting sign in infants, while older children may complain of colicky abdominal pain. Unfortunately these are relatively non-specific symptoms. The history of passage of pink mucus ("red current jelly") or

even blood per rectum is more specific and is fortunately seen relatively frequently, as was the case in 72% of the patients seen by us (Table 2).

On clinical examination a sausage shaped mass is typically palpable in the right hypochondrium or epigastrium. The mass is often ill defined and may occur at any location site along the line of the colon (2). A palpable mass was present in 55 of the cases in this study.

Plain abdominal radiography commonly shows a paucity of gas in the right iliac fossa, with the intussusception visible as a soft tissue opacity (figure 5) in up to 50% of patients (2). Small bowel obstruction is a late sign. Ratcliffe et al. (13) have suggested that circular radiolucent lines ("target sign") superimposed on the right kidney on plain abdominal radiographs constitute a useful diagnostic feature of intussusception and may be present in up to 26% of cases.

Recently ultrasonography has emerged as a sensitive and specific diagnostic tool in the condition. On longitudinal scan, the mass has a tubular appearance and on the transverse plane there is a typical "swissroll" or "doughnut" sign (2). The correct initial diagnosis was made correctly in 8 of the patients studied with 2 false positive results also obtained. Ultrasound can also be useful to confirm the persistence of the intussusception before a repeat enema (11). This may help to spare the small percentage of children in whom the intussusception has reduced, despite absence of reflux into the ileum, an unnecessary repeat reduction attempt (8). It is well recognised that intussusceptions may reduce spontaneously (14), and this can also occur before the repeat air enema. This may have been the case in 3 of our patients who were found to be reduced at surgery. It is therefore important to confirm the persistence of intussusception immediately prior to surgery.

FIGURE 5

Figure 5: Supine plain film of the abdomen showing a relatively well defined soft tissue opacity (arrow) in the left hypochondrium. A subsequent contrast enema confirmed that this represented an intussusception. Note the paucity of gas in the right iliac fossa (double arrow).

Successful radiological reduction decreases the hospital stay as the patient is usually discharged on the day following reduction (14). In our study the average stay for patients who underwent successful non-surgical reduction was significantly shorter than for patients undergoing primary surgical reduction (Table 4). This has significant cost implications, without taking into consideration the saving incurred by avoiding theatre time and consumables. The cost of a single day stay in a general paediatric ward in a private hospital (scale of benefits) is R614,40 and the estimated cost of a laparotomy R10 000. These costs are significantly higher than the cost of a single contrast barium enema which is approximately R280 (scale of benefits). The cost of an air enema is even cheaper, as the cost of the barium and bag is omitted giving a further saving of R68.

Intestinal perforation and clinical evidence of peritonitis are absolute contra-indications to enema, whether barium or gas. Any patient with this presentation was directly referred to surgery. Relative contra-indications to enema have been described previously, although their relevance has been questioned. These have included duration of symptoms exceeding 24 hours, small bowel obstruction, severe abdominal distension, patients under 3 months or over 4 years of age and passage of fresh blood per rectum (9). McDermott et al. (1) found that although there was a difference in the success rates for reduction in patients under 3 months compared to over 12 months (68% vs. 89%), this did not reach statistical significance and was not thought to be relevant.

An analysis of the clinical features associated with poor outcome led Katz et al. (15) to conclude that with the possible exceptions of maximum dehydration, a duration of over 12 hours and small bowel obstruction, no patient should be excluded from an initial attempt at air enema reduction,

unless clinical evidence of perforation or peritonitis is present. Beasley et al. (5) suggest that duration of symptoms over 24 hours, over 5% dehydration, small bowel obstruction and extremes of age are the most accurate predictors of an unsuccessful air reduction.

The cases in this study were permitted a more extended duration of symptoms, as few presented in under 12 hours (Table 3). The large proportion of patients presenting after 48 hours (35%) at RCCH may be related to factors including diagnostic delay, the hospital being a referral centre and the large number of patients from poor socio-economic backgrounds. These patients frequently were misdiagnosed at community level or lacked the means of transport to get to the hospital early.

McDermott et al.(1) found that the history of fresh blood per rectum was a frequent indicator of bowel ischaemia. Reduction in these patients should be attempted with caution because of the risk of perforation. These patients should be observed very carefully in the post-reduction period as irreversible damage may already have occurred.

The overall success rate of pneumatic reduction at our hospital during the period studied was 63% for pneumatic reduction and 40% for hydrostatic reduction The success rate for pneumatic reduction was lower than the general success rates quoted in current literature which vary from 74% to 94% (1,4,15). This probably reflects the fact that the procedures were largely performed by registrars in training. The success rate may also reflect the delay in patient presentation.

The recommended pressures for air reduction vary from 100 to 140 mm Hg (9). We have followed the majority of centres by using 120 mm Hg. Shiels et al. have presented evidence that

intracolonic pressures in excess of 120 mm Hg are frequently encountered during the Valsalva manoeuvre. Despite this, the transmural pressure gradient actually decreases during the Valsalva manoeuvre as peritoneal pressure also increases. Colonic perforation occurs at rest and not during the Valsalva manoeuvre (16).

Most authors make use of an insufflation device which automatically monitors the pressure and maintains the pressure at the predetermined level. This apparatus is expensive and due to lack of funds we opted to use a converted baumanometer with manual maintenance of pressure. This relatively inexpensive (R615-00, Protea Medical) apparatus is potentially useful in the setting of developing countries and smaller hospitals where funds are inadequate.

It is important to note that high insufflation pressures are not required for purely diagnostic enemas. This applies in the initial diagnosis of patients suspected of having an intussusception. The purely diagnostic enema is a simple procedure which serves to rapidly diagnose or exclude intussusception. Pressures of as little as 20 mmHg can be effective (17). The lower pressures have the advantage of lower risk of perforation. This is of particular importance in the postoperative patient suspected of having a recurrence of intussusception (17). The use of air as a contrast agent for diagnostic purposes is also more economical than barium.

The success rate of 40% for hydrostatic reduction is also below the rates quoted in recent literature (7,8). The procedures were performed under similar conditions to the pneumatic reductions, and the results may also reflect the learning curve and delay in presentation.
An important factor to consider however, is that the pressures generally used for barium reductions are significantly lower than with air reduction. The pressure exerted by a 1-m column

of 25% w/v barium is approximately equivalent to a pressure of 85 mmHg (7). A height of 1.5-m would bring the pressure closer to an air equivalent of 120 mmHg. The pressure exerted may also decrease as the bag empties (9). Swischuk (6) has suggested that it may be the increased pressures rather than the air which contributes to the apparent increase in reduction rates with pneumatic reduction techniques.

Despite our own findings, a number of authors have not found any statistical difference between barium and air in the rate of diagnosis and reduction of intussusception (7,18).

Air does however have a number of added advantages over barium. It is cheaper, less messy and therefore more pleasant to work with. It also has low viscosity, probably exerts more even pressure and decreases frictional forces between the intussusceptum and the intussuscepiens (2). These may all result in quicker and more even reductions.

Although air is safer in the peritoneal cavity than barium, tension pneumoperitoneum is a dangerous complication that can occur with air (16,19). Any person attempting a pneumatic reduction should always be prepared for this possible complication, which can cause rapid clinical deterioration and even death. An 18 gauge needle should therefore be kept at hand for quick relief of the rapid build up of increased intra abdominal pressure. This was necessary in one of the patients included in the study.

Daneman et al. (19) found the peritoneal cavity to be relatively free of contamination in patients with perforation due to air, but soiled in patients with perforation due to barium. Surgically it may be almost impossible to completely clean the peritoneal cavity in these patients, and staining of the peritoneum with barium can be demonstrated radiographically many years after the operation.

This may lead to barium peritonitis with multiple adhesions and subsequent bowel obstruction (19). Surgery is subsequently far easier in the patients with perforation due to air (19).

Shiels, in a study using young pigs, found that the size of perforation was significantly smaller with air than with barium (16). This may relate to the fact that because of its lower viscosity, the air escapes (unaccompanied by stool) more rapidly through a perforation thus equalising intraluminal and extraluminal pressure quickly (19).

The diagnosis of perforation during attempted non-operative reduction can be made by detection of escape of barium or air into the peritoneal cavity. No missed leaks or perforations were identified at surgery in this series.

The most important predictor of risk for potential perforation is duration of symptoms (1,5,8,15). The four patients who perforated in this study all had symptoms exceeding 48 hours. This reinforces the view that patients with symptoms lasting over 2 days should therefore be attempted with great care. Despite this concerning statistic, four of the successful pneumatic reductions and six of the successful barium reductions had symptoms exceeding 48 hours duration. The length of presenting symptoms alone should not influence the decision to attempt a non-surgical reduction. It is possible that in some of these patients the obstruction is initially intermittent, with episodes of spontaneous reduction and recurrence.

Our perforation rate of 2.6% with air enemas compares with the upper range of quoted incidences (8,9), although the study is not large enough to assess the true significance of this finding. The higher rate may be partly due to the tertiary referral nature of our centre. Patients are often

referred after initial treatment has failed at other centres, often a significant delay. The perforation rate with air is significantly better than the rate of perforation with barium in our hands (6%), which is also close to the higher rage of results in other series (3,11).

Our experience with barium perforation differs from that reported by Poznanski in a recent editorial (11). The patients who had perforations with barium did not do well clinically with the only mortality occurring in this group. Daneman et al. similarly found that patients with barium perforations all required resections, and often a longer anaesthetic time. They also recovered more slowly, with longer hospital stays and increased morbidity compared to patients with air perforations (19).

Although bacteraemia or septicaemia may occur in up to 23% of barium enemas, the incidence following air enemas ranges from 0-11% (20). This is of particular relevance in patients with pre-existing cardiac abnormalities, when bacterial inoculation can predispose to the development of bacterial endocarditis.

The location of the intussuscipiens was demonstrated in 55% of cases to be within the ascending or transverse colon. This differed somewhat from the general opinion that over 80% were found within this region. This may reflect the fact that colocolic intussusception is more common in Southern Africa (2).

The wall of the terminal ileum of young children is rich in lymphoid tissue. In approximately 90% of cases of intussusception there is no obvious cause other than hyperplasia of this lymphoid tissue. An upper respiratory tract infection or enteritis commonly precedes development of the condition. Adenovirus and to a lesser extent the Rota virus have been implicated in up to 50% of

cases (2).

A potential weakness with air enema reduction is the difficulty in identifying lead points, which are better outlined by barium (8,21). A barium enema or endoscopy (in older children) may thus be required in the proper clinical setting and in cases of multiple recurrences.

In 7-10% of patients the condition is secondary to a distinct pathological lead point or underlying abnormality (21). This occurred in 8 of our patients (Table 4), which corresponds with the rates quoted in the literature. Meckels diverticulum is thought to be the commonest cause of secondary intussusception in childhood, with other commoner causes including duplication cysts, appendicitis, polyps and lymphomas. The presence of a pathological lead point increases in children older than 2 years and may occur in up to 33% of these older patients (2).

TABLE 4:
Pathological lead points

Cause	**No. of patients**
Appendicitis	2
Meckels diverticulum	2
Worms	2
Cystic fibrosis	1
Peutz Jeghers syndrome	1

Another difficulty with air is that reflux of air into the terminal ileum does not always occur following successful reduction. During the enema, the intussusception usually rapidly and easily reduces as far as the caecum, but reduction through the ileocaecal valve may be difficult. When

the reduction fails, it usually fails at this point. This may be due to oedema of the ileocaecal valve (22), and has prompted some centres to examine the option of repeat reduction attempts following initial failure (4,14,22). A repeat enema performed some time later may thus achieve reduction when the first attempt failed. Guo et al. (4) achieved reduction in 50% of repeat attempts, and Saxton et al. (22) achieving success in 52%. Partial reduction of the intussusception at the first enema may allow some of the oedema and venous congestion to subside. The 3 patients found to have reduced at surgery, together with these reports prompted us to adopt a similar approach. Our initial results were less impressive, with only 1 successful repeat attempt out of 6. This together with the logistic problems have led us to be more conservative regarding repeat attempts at present.

The interval between enemas can be used to allow the infant to rest and for fluid replacement to continue. Second enemas should not be attempted in children whose clinical conditions have worsened or are unstable (22). Close co-operation with the surgeon and careful monitoring of the patient are essential in these cases. Repeat barium enema has been used to differentiate a swollen ileocaecal valve from residual intussusception, and to achieve confirmatory reflux into the terminal ileum (14).

CONCLUSION

Pneumatic and hydrostatic reductions are the preferred methods of reduction of uncomplicated childhood intussusception. Surgery is reserved for failure of the radiological technique and for complicated cases. Air insufflation is safer, at least as effective and more

cost-efficient in the diagnosis and treatment of intussusception when compared to liquid barium. In spite of this, we must appreciate the limitations of non-operative reduction and strict attention to the clinical condition of the patient is imperative.

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