ORIGINAL ARTICLE

Pneumatic Reduction of Intussusception Using Equipment Readily Available in the Hospital

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Summary

The purpose of this study was to determine the effectiveness of pneumatic reduction of intussusception using equipment readily available in the hospital. Twenty-two children aged between four months and four years had pneumatic reduction of intussusception. The device used was assembled using (i) a hand-held pump attached to a pressure gauge, and (ii) a 3-way Foley's balloon catheter. There was a 73% success rate and there were no complications. The device used was effective and safe for the pneumatic reduction of intussusception.

Key Words: Intussusception, Pneumatic reduction

Introduction

Intussusception is the invagination of one portion of intestine (intussusceptum) into the contiguous distal segment (intussuscipien), the most common being ileocolic intussusception. It is the most common cause of bowel obstruction in the infant-toddler age group.

In Malaysia, hydrostatic reduction of intussusception using barium solution has been the practice since the 1980's. A paper on the early experience of barium reduction at Hospital Kuala Lumpur between 1986-1989 reported a success rate of 47%[1]. Earlier success rates for hydrostatic reduction were reported to be between 40-50% and more recently, 70-85% success rates have been reported[2].

Pneumatic reduction of intussusception has been practiced since the 1950's. It involved per rectal insufflation of air at a pressure of between 80 to 120 mmHg. Success rates of greater than 90% have been reported with pneumatic reduction[2].

Encouraged by these reports we decided to replace hydrostatic reduction of intussusception with pneumatic reduction. The purpose of this study was to determine the effectiveness of pneumatic reduction using equipment that is readily available in the hospital.

Materials and Methods

Patients:

This was a 4-year prospective study conducted between July 2001 and June 2005. Twenty-two children aged between four months and four years had pneumatic reduction of intussusception. The 13 male and nine female children were symptomatic from between a few hours to four days with gastrointestinal symptoms such as vomiting, abdominal pain, diarrhoea, and blood-stained mucoid stools.

Equipment:

The device used was assembled using equipment readily available in the hospital (Fig. 1). A hand-held pump (P) attached to a pressure gauge that is usually used for applying abdominal pressure during intravenous urography (IVU) was used to pump the air. A 3-way Foley's balloon catheter (F) that is usually used

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for urinary bladder irrigation was used to insufflate the air via the rectum. The pump was connected to the inlet {1} of the catheter. A urinary bag was connected to the outlet {2} of the catheter. After the catheter had been introduced per-rectum, the balloon was inflated with between 20-40 cc of air via the balloon inlet {3}.

The calibre of the catheter used ranged from 18FG to 22FG depending on the patient's age. While the pump fitted tightly into the inlet of the 18FG catheter, a connector was needed when bigger-sized catheters were used. Before the start of each procedure, air was pumped with the Foley's catheter clamped to check that the assembled device was airtight. With an airtight device, the pressure gauge maintained a fixed pressure. If the pressure dropped it indicated that there was air leakage and therefore all connections especially the one between the pump and the catheter inlet had to be tightened.

Technique:
Clinical diagnosis of intussusception was confirmed by ultrasound (Fig. 2). Before attempting the pneumatic reduction, it was ensured that the patient was well hydrated and did not have any clinical evidence of peritonitis. An abdominal radiograph was done to exclude pneumoperitoneum. Informed consent was obtained from the parents.

The Foley's catheter was introduced per rectum and the balloon was inflated with between 20 to 40 cc of air under fluoroscopy to ensure that the balloon completely occluded the rectum but was not over-inflated. The patient's gluteal folds were strapped together to further ensure no air leakage during the procedure. The catheter outlet {2} was clamped.

With intermittent fluoroscopy monitoring, air was insufflated using the hand pump to a pressure of between 80 to 100 mmHg. The pressure was maintained for three minutes. The catheter inlet {1} was then clamped, the catheter outlet {2} was unclamped and air was then released via the outlet into the urine bag. The clamping and unclamping of the inlet and outlet was important to prevent faecal material from soiling the pump and pressure gauge. After one minute, the insufflation was repeated. A total of three insufflations were performed for the duration of three minutes each. Reduction of the intussusception was observed during intermittent fluoroscopy (Fig. 3). The intussusception was considered reduced when air entered loops of small bowel within the central 'window' framed by the peripheral large bowel. The patient's vital signs were monitored throughout the procedure with a pulse oxymeter.

If the intussusception was not reduced by the end of three insufflations, and the patient's vital signs remained stable, the whole procedure was repeated after an interval of 4 to 12 hours. The pneumatic reduction was considered a failure when the intussusception did not reduce after the 2nd attempt and the patient proceeded to surgery.

Results

Pneumatic reduction was successful in 73% of cases (16 of 22 cases). Of the 16 successes, 6 were reduced by a single insufflation, 7 were reduced by 2 insufflations, 1 by 3 insufflations, and 2 after a second attempt (Table I). For the two cases where the second attempt was successful, only a single insufflation was necessary.

Of the six failed cases, one was found to have reduced spontaneously at laporotomy, four had difficult to moderately difficult surgical reduction, and one had resection of necrotic segment of bowel. Four of these cases had failed a second attempt at pneumatic reduction, while two were too ill to undergo a second attempt (Table I).

There was no incidence of bowel perforation. In patients where pneumatic reduction was successful, there was no recurrence of signs and symptoms of intussusception during the 24 hours observation before discharge. These patients were well at three weeks follow-up.

Table I: Result of pneumatic reduction.

	1st attempt No. of insufflations			2nd attempt No. of insufflations			Total
	1	2	3	1	2	3	
Successful reductions	6	7	1	2	-	-	16
Failed reductions-	-	-	2	1	-	3	6
Total	**6**	**7**	**3**	**3**	**-**	**3**	**22**

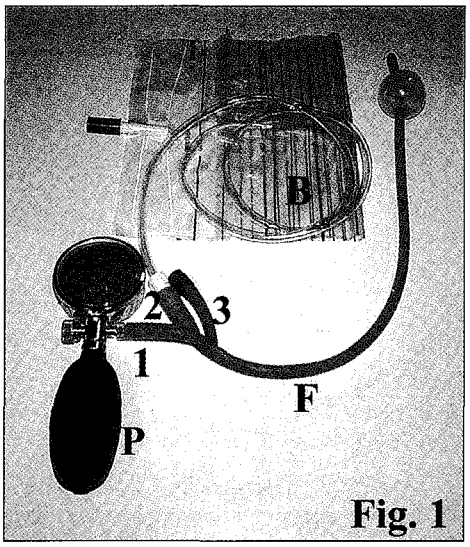


Fig. 1: Device assembled from readily available equipment. P: Pump with attached pressure gauge. F: 3-way Foley's balloon catheter. 1: Catheter inlet. 2: Catheter outlet. 3: Inlet for balloon.

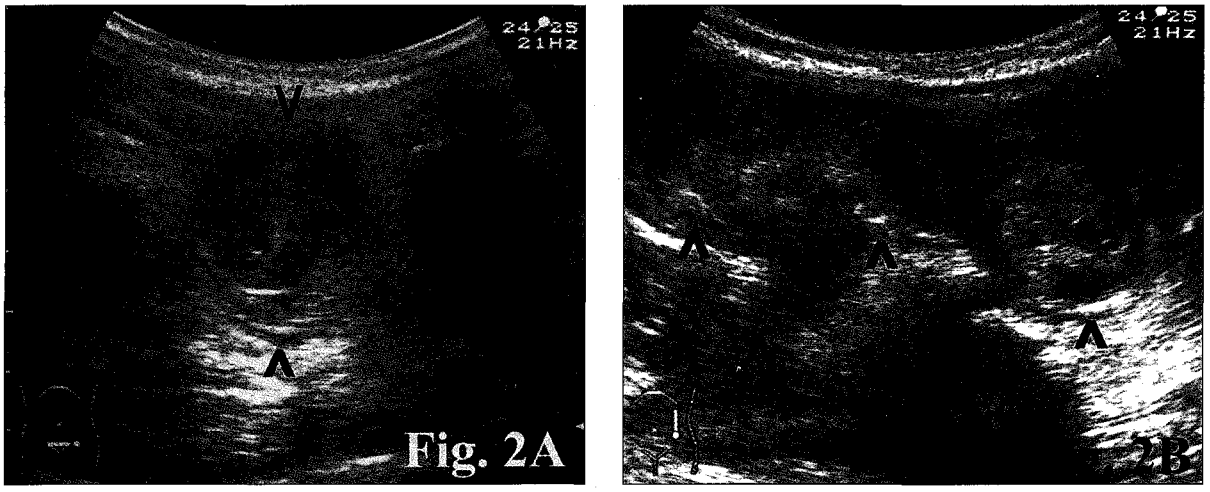
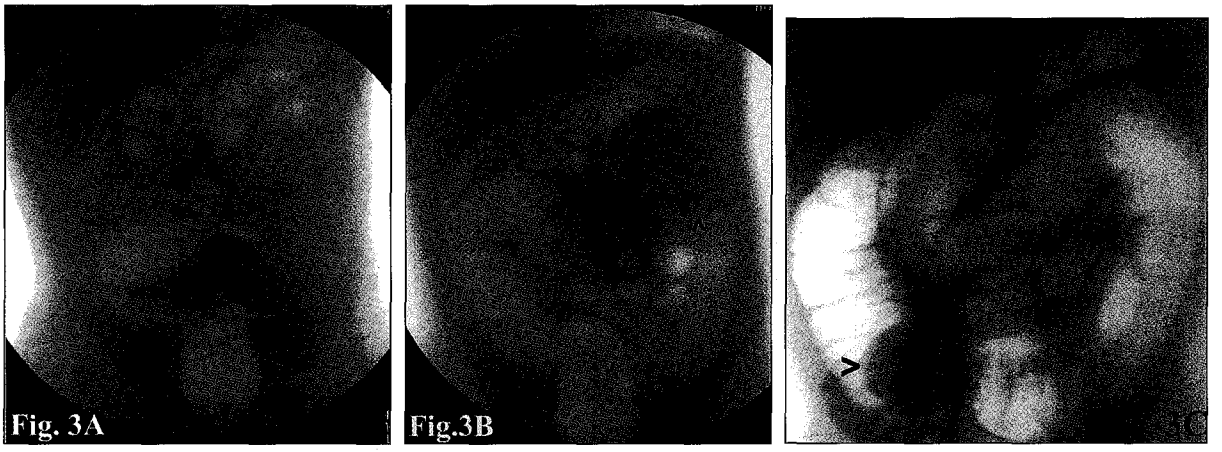


Fig. 2: (A) Tranverse image of the intussusception showing central hypoechoic area with concentric hyper- and hypo-echoic layers. The central hypoechoic area is fluid within the lumen of the intussusceptum and the concentric appearance is due concentric layers of echogenic gut mucosa, hypoechoic oedematous gut wall and hyperechoic mesenteric fat. (B) Longitudinal image of the intussusception.



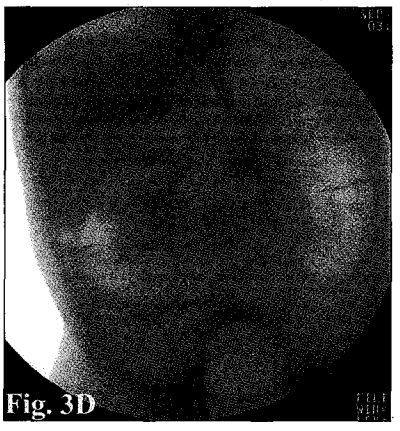


Fig. 3: (A) The inflated Foley's balloon in seen in the rectum (thin arrow heads). Air has been introduced and the intussusceptum (thick arrow head) can be seen within the air-distended sigmoid colon. (B) There is further reduction of the intussusceptum (arrow head) into the descending colon. (C) The intussusceptum (arrow head) seen at the ileocaecal junction within the distended caecum. (D) Air fills up loops of small bowel (arrow heads) following complete reduction.

Discussion

The reported success rates of pneumatic reduction ranged from 27% to 96% and many authors have reported it to be more than 90%[2]. The higher success rate compared to hydrostatic reduction is due to the inherent compressible effect of air that results in air dissecting between the intussusceptum and intussuscipien. This effect facilitates and expedites the reduction[3]. Our study had a success rate of 73%. It was interesting to note that five out of the six failures were among our 1st ten cases that underwent pneumatic reduction. It has been reported that the success rate of the radiologist using pneumatic reduction improved after reducing at least four cases[2]. Some of those who had reported high success rates had employed routine sedation and even muscle relaxant. We did not use sedation because it could mask the signs of shock during the procedure[4]. We did not use muscle relaxant because straining during the reduction procedure protects against bowel perforation [4]. Furthermore the increased intra-abdominal pressure caused by crying and straining resulted in rapid reduction[4,5].

Apart from higher success rate, pneumatic reduction has other advantages. Reduction was faster and therefore the patient received less radiation from fluoroscopy[3]. Radiation was further reduced because lower kilovoltage and milliamperage were required. The radiation dose during pneumatic reduction is half that of hydrostatic reduction[6]. Bowel perforation is a known complication in both air and barium reduction. If perforation occurs when barium is used, contamination of the peritoneal cavity with faecal-mixed barium is more detrimental than the pneumoperitoneum caused when air is used[7]. When pneumoperitoneum occurs, percutaneous puncture of the abdominal wall with an 18FG needle would prevent tension pneumoperitoneum and respiratory embarrassment[5,8].

Various devices for the purpose of pneumatic reduction have been described[3,5]. Some have been patented and are available commercially. However, because pneumatic reduction is not yet the norm in Malaysia these devices are not readily available. For this reason we decided to assemble our own device using equipment readily available in the Radiology Department. Our series has proven that pneumatic reduction with this device is effective and safe and can be easily performed in any hospital that has a fluoroscopy unit, a radiologist, and a paediatric surgeon in attendance.

Conclusion

A device assembled from a hand-held pump attached to a pressure gauge and a Foley's catheter was effective and safe for pneumatic reduction of intussusception.

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