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# Pneumatic reduction of intussusception in children at Korle Bu Teaching Hospital: An initial experience

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## ABSTRACT

**Background:** Intussusception is a common abdominal emergency in children which necessitates prompt diagnosis and management. Nonsurgical methods of managing this condition are rapidly gaining popularity with fluoroscopic-guided pneumatic reduction being one of such methods that has been used with great success in many countries. We present our initial experience with fluoroscopic-guided pneumatic reduction of intussusception at Korle Bu Teaching Hospital which is also the first time the technique has been used in Ghana. **Materials and Methods:** A total of 18 children were enrolled in the study between August 2007 and February 2008 at Korle Bu Teaching Hospital, Accra, Ghana. Patients were given air enema under fluoroscopic-guidance using locally assembled equipment. The intraluminal pressure was monitored with a pressure gauge and was not permitted to go above 120 mmHg. A total of three attempts of 3 min each were allowed. **Results:** There were 12 males and 6 females. The average age of the patients was 8.3 months (SD= 3 months). Twelve (67%) of the cases were reduced successfully while 6 (33%) failed to reduce. A majority of those that did not reduced had symptoms for at least 2 days. Bowel perforation occurred in three (16.7%) cases. **Conclusion:** Pneumatic reduction of intussusception is a cost-effective and rapid method of management of intussusception. It however has limitations like high reported rate of bowel perforation and limited ability to identify lead points. The benefits however seem to outweigh these challenges, such as fluoroscopic-guided pneumatic reduction has a very high success rate. Fluoroscopic guided pneumatic reduction should be considered as one of the primary modes of reduction in Ghana and other neighbouring countries that are yet to practice it.

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## INTRODUCTION

Intussusception is a common abdominal emergency in childhood which necessitates prompt diagnosis and management.[1,2] The incidence of intussusception at the Korle Bu Teaching Hospital is an average of 40 cases per annum. There are both surgical and nonsurgical methods of managing this condition. The nonsurgical methods include ultrasound-guided hydrostatic reduction, ultrasound-guided pneumatic reduction, fluoroscopic-guided hydrostatic reduction with barium and fluoroscopic-guided pneumatic reduction (air enema). These methods have been tried and accepted in many countries.[1-5]

The concept of pneumatic reduction dates back to 1889 by Holt. However the procedure only became popular in the 1950s in Argentina and China and in the late 1980s in North America.[2,6]

Air enema has several advantages:

- It can be used to diagnose and as well as treat intussusception in children.[1-5]
- It requires a lower radiation dose as compared to barium enema for both diagnosis and reduction.[1,2,5]
- It causes less peritoneal soiling in the case of perforation.[7,8]
- It is cheap, quick and very easy to perform.[1-6]
- It has a high success rate in many centres with some people quoting over 75% in their centres.[1-3,5,9]

Pneumatic reduction of intussusception has been used in many centres in the world since the 1950s. However until August 2007, it had not been used for reduction of intussusception in children at Korle Bu Teaching Hospital (KBTH), Accra, Ghana, though the procedure had been started 3.5 years earlier (January

2004) at Komfo Anokye Teaching Hospital (KATH), the second largest Tertiary Hospital in Ghana, located in Kumasi, with significant success.[10] This technique is a fairly simple, cheap, quick and safe method of intussusception reduction which needs to be promoted in Ghana and other neighbouring countries that are yet to practice it.

We present our initial experience with fluoroscopic-guided pneumatic reduction of intussusception in children at Korle Bu Teaching Hospital.

## MATERIALS AND METHODS

The prospective study was carried out at Korle Bu Teaching Hospital, from August 2007 to February 2008. Korle Bu Teaching Hospital is the largest Teaching Hospital in Ghana. It has 17 clinical and nonclinical departments, and a bed capacity of 2000 and attends to about 350,000 outpatients a year. It is the paediatric catchment area for hospitals across the Southern half of the country. The under14 population is approximately 4,863,866.[11,12]

A total of 18 children were enrolled in this initial study. These were children who had clinical features of intussusception and had been diagnosed using an abdominal ultrasound scan. They were selected using convenience sampling. Children who had significant abdominal distension, signs of peritonitis or whose symptoms had been present for more than 4 days were excluded. The parents/guardians of all children were informed about the options that were available at the time i.e. surgery as well as fluoroscopic-guided pneumatic reduction which was explicitly explained to them. Consent was then obtained. Parents were assured that refusing to take part was not going to affect their management in anyway. Children whose parents did not agree to the procedure were also excluded.

Patients were resuscitated adequately using intravenous fluids and antibiotics. Relevant laboratory investigations were done which included the hematocrit, sickling, blood urea electrolytes and serum creatinine. A nasogastric tube was also passed to decompress the bowel. When the patient was adequately resuscitated he/she was taken to the Radiology Department for the reduction to be done.

An initial abdominal ultrasound was done to confirm the presence of the intussusception. The child was then sent to the fluoroscopy room for the procedure to take place.

The equipment used for the reduction was custom-made/locally prepared, consisting of the part of the aneroid sphygmomanometer containing the handbulb, release valves and aneroid gauge, which was connected to a short tube (cut from the tube of a drainage bag), which in turn was also connected to a size 24 urethral catheter [Figure 1].

### Procedure

1. The child was then placed on the table of the fluoroscopy machine in the supine position.
2. He/she was sedated using ketamine hydrochloride at 1-2 mg/kg body weight.
3. The patient's respiratory rate and the colour his/her tongue were monitored during the procedure.
4. The catheter end of our pneumatic reduction equipment was inserted into the anus and the balloon of the catheter was then inflated with 7-10 ml of water [Figure 1].
5. A control film was taken.

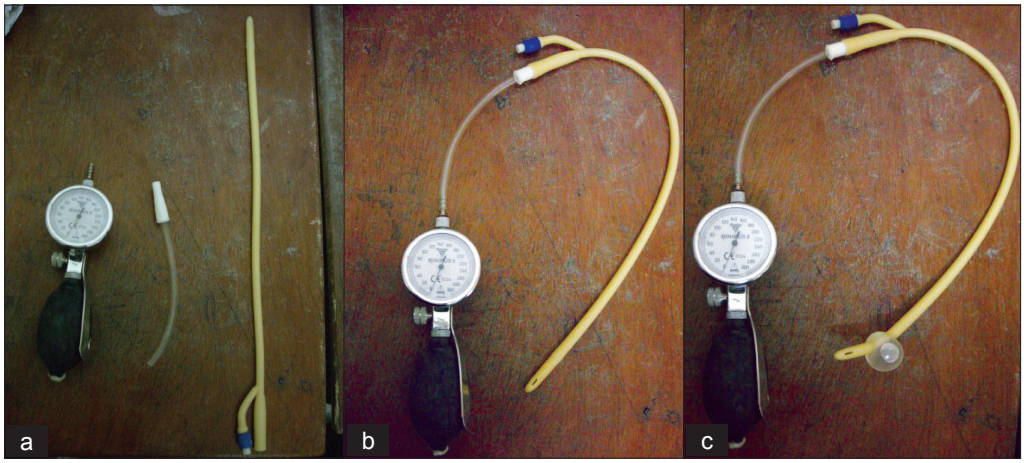



**Figure 1: Equipment for reduction of intussusception. (a) Individual components. (b) Assembled. (c) Assembled with an inflated balloon.**

6. The handbulb of the equipment was then squeezed intermittently to release air into the large bowel (The pressure was carefully monitored using the aneroid gauge and not allowed to go above 120 mmHg). The air column was followed using the fluoroscopy machine, as it reduced the intussusception [Figure 2] till the mass completely disappeared and gas was seen to move freely into the ileum [Figure 3].
7. The child was then taken back to the ultrasound room to confirm the reduction.

Criteria for complete reduction were as follow:

- Disappearance of the intussusception.
- Free movement of gas from the colon into the small bowel.
- Ultrasound confirmation of complete reduction after the procedure.

A total of three attempts of 3 min each were permitted.[1-5]

When the intussusception reduced the child was sent back to the ward and monitored. However when the intussusception failed to reduce or there was bowel perforation during the procedure, the child was immediately sent to theatre for surgical management.

## RESULTS

A total of 18 children were enrolled in the study out of which 6 (33%) were females and 12 (67%) were males, giving a female to male ratio of 1:2.

Eight (44.4%) of the children were between 0 and 6 months, seven (38.8%) were between 7 and 12 months and three (16.7%) were between 13 and18 months. The average age of the patients was 8.3 months (SD= 3 months). None of the patients was more than 18 months old.

The most common location of the intussusception at the time of diagnosis was the transverse colon as was seen in seven cases (38.9%). This was followed by the descending colon as seen in four cases (22.2%), the sigmoid colon in three cases (16.7%), the rectum/rectosigmoid junction in three cases (16.7%) and only one (5.6%) in the ascending colon.

The intussusception reduced successfully in 12 (67%) patients but not in the other 6 cases (33%). Of the six that failed to reduce, the process was abandoned in three (16.7%) of the cases because of bowel perforation, while in the other three (16.7%) the process was abandoned after three attempts without any evidence of major complications.

Of the cases that did not reduce, three had symptoms for 2 days, two for 3 days and only one for a day. In the three cases that were abandoned after three attempts, one had evidence of bowel ischaemia at surgery, another had enlarged lymph nodes acting as a lead point and no gross pathology was detected in the third patient.

In the three cases that had perforation, two had the symptoms for 2 days and one for a day. Two out of them had gangrenous bowel at surgery, but one did not have any obvious pathology.

None of the cases that were reduced recurred.

A hypodermic needle (G21) was used to decompress the abdominal cavity in the patients that perforated to prevent development of a tension pneumoperitoneum.

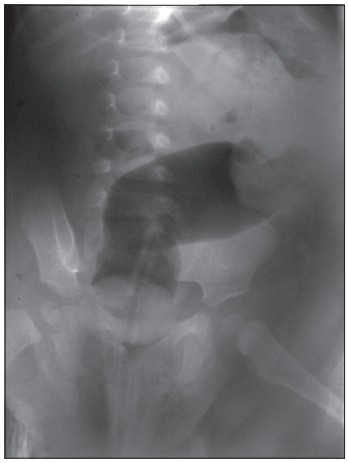


**Figure 2: Plain radiograph showing the intussusceptum projecting into the air column during reduction.**



**Figure 3: Plain radiograph showing gas in both small and large bowel after successful reduction.**

The average duration of the reduction process was 3 min with the duration ranging between 30 s and 7 min. The average pressure needed to reduce the intussusception was about 80 mmHg (range 60-120 mmHg). Most of the children (9) who had successful reduction were discharged after 2 days while three stayed up to the fifth day because of persistent fever of viral origin.

## DISCUSSION

Nonsurgical management of intussusception in children is not new. It has gained acceptance in many parts of the world in the last five decades.[1,5,6] Different centres have chosen particular types of nonsurgical method of reduction based on their successful experiences. For a long time, centres in North America preferred fluoroscopic-guided hydrostatic reduction while fluoroscopic-guided pneumatic reduction was more common in China.[1,5,6]

In Ghana, nonsurgical reduction was not started until January 2004 when it was commenced at Komfo Anokye Teaching Hospital.[10]

Fluoroscopic-guided pneumatic reduction of intussusception was the first nonsurgical management of intussusception in children to be popularized at Korle Bu Teaching Hospital and was started in August, 2007. The difference between the procedures as done in KBTH and KATH is that reductions were performed in the x-ray department in the former using the fluoroscopy machine to following the reduction process and in theatre, blindly (without fluoroscopy) in the latter, then confirmed with an abdominal ultrasound scan after the procedure. Further in KATH an anaesthetist was required to give general anaesthesia by intubating and ventilating the child while in KBTH ketamine hydrochloride was used and carefully monitored without the need for intubation or ventilation.[10]

Abraham *el al*.[13] in 2005 described a simple and safe technique for pneumatic reduction of intussusception where they used the height and water in an enema can to generate pressure for the reduction process. This technique is believed to reduce the increase perforation rate and thought to be associated with the use of Foley's catheter and sphygmomanometer attributed to an inadvertent increase in intraluminal pressure which occurs during reduction. We did not use this technique in our initial study but we hope to use it subsequently and compare the outcome from both procedures.

Pneumatic reduction of intussusception in children is a quick method of management of intussusception. This was shown in our study to take an average of 3 min (range 0.5-7min for the whole procedure) for the reduction to take place i.e. from the start of gas inflation to complete reduction. This short reduction time has also been reported in studies in many centres.[2-5] This means that it takes a much shorter time to complete one pneumatic reduction than for the patient to be ready for manual reduction by the surgeon in theatre.

The short duration of the procedure also means less radiation dose to the patient. This compared to fluoroscopic-guided hydrostatic reduction with barium makes it relatively safer in terms of radiation dose to the child.[4,5]

The procedure is cheap. The hospital charge for pneumatic reduction is far less than the fee for surgical management (i.e. about 20% in our hospital).

Patients have a shorter hospital stay (2 days) with this procedure compared to 5 days for uncomplicated cases who were sent for surgery for failed reduction. Clearly the cost of surgical management far outweighs that for pneumatic reduction especially in uncomplicated cases.

Another issue worth noting is that even though surgery is the only means of managing both the intussusception and its complications, it does not offer any significant protection against future recurrence in patients who do not have lead points.

We had a fairly high success rate of 67% which was higher than the 59.1% obtained in the other study in Ghana[10] but lower than the over 90% seen in studies in China and over 75% in North America.[2-5] Two factors that may have contributed to the apparently low success rate in our study were: delay in presentation to our facility (all but one of the cases that did not reduce had had the symptoms for at least 2 days) and the small numbers in our study where one patient was 5.6% of the sample.

Moreover, the cases that did not reduce and did not have complications during the procedure were not given a second chance at reduction as was done in some centres.[5] This is because at the time our focus was on assessing the feasibility of the technique in our hospital. This could also be a contributory factor for the lower success rate we had than is reported in other centres.

The most commonly reported problem with pneumatic reduction in all centres worldwide is bowel perforation.

Our study recorded a high perforation rate of 16.7% compared to other studies[2-5] with one study reporting 2.4%.[5] This may be attributed to the delay in reporting to our facility mentioned earlier which is also supported by the fact that two out of the three cases that had perforation had gangrenous bowel which needed resection at surgery. Another reason for the high percentage of perforation is the small sample size and therefore the percentage is likely to go down as the number of cases and the experience of the team increase.

In one 5 year review of pneumatic reduction of intussusceptions,[5] the researchers found two main predictors of perforation. These were young age (less than 4 months) and long duration of presentation (more than 2.6 days). The ages of our patients (i.e. 5, 9 and 13 months) eliminates age as a predictor thus making duration of symptoms the other predictor in our case. In our study two out of the three cases that had perforations had the symptoms for 2 days and one for a day, thus not fully supporting duration as a predictor. However it is also possible that the parents only came 2 days after the illness became severe e.g. blood in the stool, indicating the disease might have gone on a little longer, thus explaining the bowel gangrene seen at surgery. We did not find any link between the sex of the child and an increased tendency to perforate.

Studies have shown that even though perforation is a major drawback to this procedure and can rapidly lead to tension pneumoperitoneum which can easily lead to serious outcomes including death, it can easily be managed by using a canula or hypodermic needle before the child is sent to theatre for the definitive management.[2,5] In our study we used hypodermic needle (G21) to satisfactorily decompress the abdomen in the cases that were complicated by perforation before sending them to theatre. Other centres used a G18 cannula.[5]

Another point about pneumatic reduction worth mentioning is that, even in the event of perforation, there is minimal or no peritoneal soiling as compared fluoroscopic-guided hydrostatic reduction with barium or ultrasound-guided hydrostatic reduction with normal saline. It is therefore associated with less morbidity or mortality should there be a perforation.[5,7,8]

The 5 year review mentioned earlier also mentioned rectal bleeding (haematochezia) at presentation as a major predictor of non-reduction.[5] Most of our patients (89%) presented with rectal bleeding, thus comparing this figure to our success rate it was unlikely that rectal bleeding is a predictor of non-reduction in our environment.

That notwithstanding, we noted that in some cases where there was fluid in the lumen of the intussuscepiens, it either did not reduce or we had difficulty in the reduction process. This was however not a consistent finding. The significance of this finding will become clearer as the numbers increase.

In our study sex did not appear to be factor in the reducibility of an intussusception because the male to female ratio of the cases that did not reduce, four males and two females (M:F=2:1), seemed to correlate with the male to female ratio of the total study population.

A limitation of pneumatic reduction is its limited ability to identify the lead points which cause intussusception during the pneumatic reduction process. One study indicated the ability to identify only 2 out of 12 lead points identified at surgery.[4]

Another limitation worth noting is pseudoreduction, where gas enters small bowel even though the intussusception has not reduced.[2,5] We did not see pseudoreduction in our initial study. This may show up as the numbers increase.

Despite these challenges pneumatic reduction of intussusception is cheap, safe, easy and quick to perform and has an impressive success rate. It is associated with far less morbidity and mortality than surgical management which comes with a double risk, that due to surgery and that due anaesthesia. It is therefore worth considering it as a primary means of intussusception reduction at Korle Bu Teaching Hospital and other hospitals that have the needed expertise and equipment i.e. radiologist, paediatric surgeon (or a general surgeon who can handle paediatric cases), a fluoroscopy machine, and an ultrasound machine.

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