Pneumatic reduction of pediatric intussusception: Experience at Queen Rania Al-Abdullah Hospital for Children

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ABSTRACT

Objective: To report our experience in the management of pediatric intussusception using Pneumatic reduction regarding the outcome, complications, success and failure rates.

Method: A retrospective study was done at Queen Rania Al-Abdullah Hospital for Children in the period from September 2012 to December 2014, total number of cases were forty five, thirty two were males (71.1%) and thirteen were females (28.9%), male to female ratio was 2.5:1, The ages of patients ranged from two months to three years with a mean age of 9 months.

Results: Pneumatic reduction under fluoroscopic guidance was done for forty five patients who presented with intussusception for the first time and for four recurrent intussusceptions that had occurred in four patients. In forty cases (88.9%) Pneumatic reduction was successful while unfortunately it failed in five cases (11.1%). No intestinal perforations occurred using this technique.

Conclusion: Pneumatic reduction under fluoroscopic guidance is a safe, simple, cost effective technique with a high success rate; it is a quick procedure, easy to perform with a low radiation exposure.

Key words: intussusception, Pneumatic reduction, perforation.

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Introduction

Intussusception is an acquired invagination and telescoping of a portion of proximal bowel (Intussusceptum) into a distal bowel (intussuscipien) with further antegrade propagation of intussusception into the intussuscipien by ongoing bowel peristalsis. [1-4] It is probably the most frequent cause of acute abdomen and intestinal obstruction in infants and toddlers. [4-6] Intussusception occurs in nearly one case per 2000 infants and children, [1] it predominates in males with male to female ratio 3:1 which increases with age to become 8:1 in children 4years old or more. [1,5,7] Intussusception affects primarily infants and toddlers age groups with a peak occurrence between 3-10 months, [1,2,5,8] despite of that intussusception can occur in all other pediatric age groups and even in adults but in these age groups there is a great possibility to have a pathological lead point as a cause of intussusception. [3,9] Intussusception displays a seasonal variation that correlates with times of increased viral infections(upper respiratory tract infections, gastroenteritis or both). [3, 10] Intussusception can be classified according to etiology into primary (idiopathic) and secondary to a pathological lead point, and according to anatomical location into ileocolic which is the most

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common type of intussusception accounts about 90%, ileoileocolic, colocolic, ileoileal and jejunojejunal. [1,2]

The clinical presentation of intussusception is variable and non-specific; the most common signs and symptoms are irritability, abdominal pain, vomiting, lethargy, currant jelly stool and sausage-shaped abdominal mass, whereas sepsis, perforation and peritonitis are less common symptoms which usually present later. The classic triad of symptoms (vomiting, abdominal pain and currant jelly stool) is present in one fourth –one third of cases; that is why the accuracy of clinical diagnosis is not significant and we have to rely on radiological imaging to confirm or disprove the diagnosis of intussusception. [1, 5, 11, 12]

Ultrasonography (USS) is the gold standard radiographic imaging for the diagnosis of intussusception; It is a simple, cheap, quick technique with no radiation exposure; the accuracy rate is 100% with sensitivity and specificity nearly 100% in experienced hands. The typical ultrasonographic signs are target or doughnut sign in transverse view and pseudo kidney sign in longitudinal view.

Diminished blood flown color Doppler suggests high incidence of irreducibility. UUS also has a role in the diagnosis of a pathological lead point if present.[2,5,6,7,11]

The accuracy of the characteristic plain radiographic findings (meniscus and target signs) is low (25-50%), therefore abdominal X-ray is requested to exclude complications as bowel perforation. [5]Barium or contrast enema was the gold standard method for the diagnosis and management of intussusception in the past, but after the evolution of the U/S its role became more limited in the diagnosis of intussusception. [5]

The management of intussusception starts by resuscitation and preparation of the patient for reduction with non-operative radiological techniques or operative reduction by laparotomy or laparoscopy. The major improvement in the treatment of intussusception is the general acceptance and the increment use of the non-operative radiological reduction techniques as the first line of choice in management of patients with intussusception especially pneumatic reduction.[1,5,11]Recurrence of intussusception is defined as a new episode of intussusception that occurs after at least 12 hours or more post reduction of the initial episode whereas its occurrence within less than 12 hours is attributed to incomplete reduction rather than recurrence , its incidence is 1-4% after surgery and 5-15% after radiological reduction, it occurs most commonly within the first 6 months, it has a high reducibility rate reaches up to 95-100% due to the awareness of the parents to the symptoms and signs, early presentation and prompt diagnosis.[9,13].

Delay in the diagnosis of intussusception leads to lower success rate of non operative radiological reduction techniques, higher rate of operative reduction and more complications as bowel perforation, peritonitis and sepsis. [1, 5].

The aim of our study is to report our experience in the management of pediatric intussusception using Pneumatic reduction regarding the outcome, complications, success and failure rate.

Methods

A retrospective study was done at Queen Rania Al Abdullah Hospital for children (QRHC) in the period from September 2012 to December 2014; it included forty five patients who were managed for intussusception with pneumatic reduction. There were 32 males (71.1 %) and 13 Females (28.9%) with male to female ratio 2.5:1, the ages ranged from 2 months to 36 months with mean age 9 months. The peak incidences was between 3-9 months (66.7%).

The management procedure and complications were explained in details to the parents and a signed consent form was obtained.

Equipment

The equipment used for pneumatic reduction is a simple device locally prepared, composed of hand held pump to insufflate air which is connected to a small sphygmomanometer to which a three ways Foley's catheter (18-24 fr) is attached at its inlet. The Foley's catheter outlet is closed by a spigot and it is opened intermittently as needed for deflation and

decompression of colonic air while clamping the inlet to prevent soiling of stool to the sphygmomanometer. A large gauge cannula is needed to be ready on the fluoroscopy table to decompress the abdomen if accidental bowel perforation and tension pneumoperitonium developed. (Fig. 1)

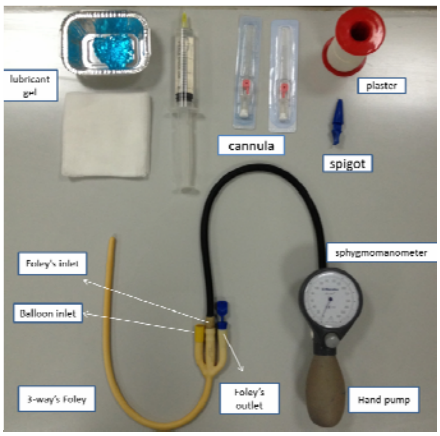

Fig. 1: The equipment needed for pneumatic reduction

Technique

Preparation of patients for pneumatic reduction is done by the following steps:

1-Exclusion of sepsis, peritonitis and bowel perforation by clinical examination and abdominal x-ray if needed.

2- Laboratory tests of CBC, KFT, cross match and blood group are requested.

3-Insertion of NG tube size 8-10 French to decompress stomach and bowel.

4-Adequate hydration and resuscitation of patients with 20 ml normal saline per 1 kg as bolus.

5- Administration of prophylactic antibiotics with gram negative and anaerobic coverage to prevent bacterial translocation.

6- Obtaining signed informed consent from the parents after explaining the procedure of pneumatic reduction in details, its complications and possibility of laparotomy if perforation occurred or failure of pneumatic reduction.

7- Preparing theatre, anesthesia and scrub team if laparotomy is needed.

After preparation, patient is sent to the fluoroscopy room in the radiology department where a team consists of a pediatric surgical specialist a surgical resident, a radiologist doctor, a radiological technician and a nurse is present and ready for the procedure. The child is placed on the fluoroscopy table in the supine position.

The Foley's catheter is lubricated and inserted into the rectum of the child and its balloon is inflated with 20ml normal saline, then the buttocks of the child are strapped together using a tape to secure tight closure of anus to prevent air leak.

Control film is taken initially to assess bowel gas distribution before starting pneumatic reduction, the pediatric surgical specialist starts insufflating air into the colon by manually squeezing of the hand pump slowly and intermittently not to exceed pressure of 80-120 mmHg, the assistant (surgical resident) clears the abdomen by holding the arms of the baby upward, observes the respiration of the baby and his abdomen for any signs of perforation and also monitors the pressure.

No medications are given during pneumatic reduction as sedative drugs which will obscure any complications like bowel perforation, tension pneumoperitonium and shock, also muscle relaxants that inhibits the child's crying and straining which plays an important role in pneumatic reduction by increasing the intra-abdominal pressure leading to faster reduction.

Under the guidance of fluoroscopy, the intussusception is followed till complete disappearance of the mass and reflux of the gas freely into the small bowel at the center of the abdomen which means a successful and complete pneumatic reduction .In each pneumatic reduction session a total of three trials with three minutes of each is allowed. (Fig. 2).

After successful reduction, the child becomes comfortable and relaxed. He is then sent back to the surgical ward for observation. The nasogastric tube is kept for 6 to 12 hours especially in patients presented with repeated vomiting and abdominal distension. After removal of the nasogastric tube the child is permitted to start oral clear fluids one to two hours later and if it is tolerated then regular diet is resumed. The child is discharged from the hospital 24 hours post successful reduction after educating and informing the parents about the possibility of recurrence of

the intussusception in 5-15% of cases and the importance of being aware to return back to the emergency department early if similar picture recurred to avoid the complications of delayed diagnosis. If pneumatic reduction failed a delayed repeated pneumatic reduction is done after 1-2 hours as long as the mass has moved, i.e partial reduction has occurred, symptoms are relived and there are no contraindications such as sepsis or peritonitis.

If delayed repeated pneumatic reduction failed, the patient is sent for exploratory laparotomy. Antibiotics are continued post reduction in patients with fever, difficult pneumatic reduction and after laparotomy.

Fig. 2a

Fig. 2b

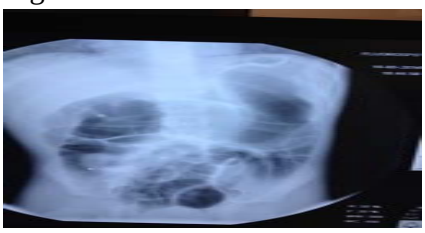

Fig. 2c

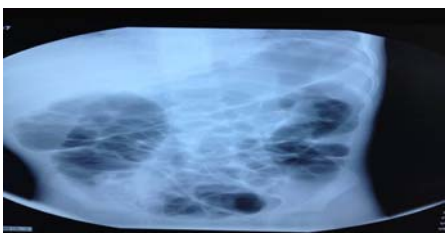

Fig. 2d

Fig. 2: Pneumatic reduction with fluoroscopic guidance.

The intussusception mass is at left colon(white arrow)(a) , The intussusception mass moves with air insufflations to the hepatic colonic flexure seen at right upper quadrant (b), The intussusception mass moves to the ileocecal junction (white arrow) (c), successful pneumatic reduction with gas filling the whole small bowel and disappearance of the intussusception mass completely.

Results

The clinical presentation was variable, most common signs and symptoms were abdominal colic and irritability in45 patients (100%) , vomiting in 34 patients (75.6 %) ,rectal bleeding in 32 patients (71.1%), fever in 5 patients (11.1%) The duration of symptoms and signs ranged from 3 hours to 144 hours, 26 patients were presented less than 24 hours (57.8%).Viral infections either upper respiratory tract infection or gastroenteritis preceded clinical presentation in 12 patients (26.7%), the seasonal distribution was documented : fourteen cases (31.1%) in autumn, thirteen cases (28.9%) in winter, ten cases (22.2%) in spring and eight cases (17.9%) in summer showing a high incidence of intussusception during cold months. Pneumatic reduction was done for 45 patients who presented with intussusception for the first time and for four recurrent intussusceptions which had occurred in four patients. It was successful in forty cases (88.9%), while unfortunately exploratory laparotomy was done in five patients (11.1%) after failure of pneumatic reduction. Of those who underwent exploratory laparotomy, manual reduction of ileocolic intussusception was done for two patients and on the other three patients resection of gangrenous bowel and primary anastomosis was done, the type of intussusception encountered in patients who underwent resection and anastomosis was ileoileocolic. No pathological lead point was identified. No perioperative bowel perforation was encountered. The post-operative course passed smoothly with no surgical complications such as wound infection, intestinal obstruction and recurrent

intussusception. Four episodes of recurrences had occurred in four patients, with a recurrence rate of 8.9%. The earliest recurrence occurred after 20 hours from the initial episode while the latest recurrence occurred after 13 months. All of the recurrent cases were reduced successfully by air enema under fluoroscopy with a reducibility rate of 100%.

Discussion

Intussusception is the commonest cause of abdominal surgical emergency in infants and toddlers. [14] when intussusception occurs in the proximal invaginated bowel (intussusceptum) carries its mesentry into the recipient bowel (intussuscipien) leading to compression of mesenteric vessels between the layers of the intussusceptum and this results in lymphatic and venous obstruction and stasis with bowel wall edema formation. If intussusception persists, arterial blood flow will be compromised leading to bowel ischemia and necrosis with outpouring of mucus and sloughs of ischemic mucosa producing stool with the typical appearance of red currant jelly and eventually if intussusception doesn't reduce. Complications as bowel gangrene, peritonitis, sepsis and intestinal perforation will occur.[5,7] Therefore early diagnosis and prompt treatment of intussusception is very important to reduce its morbidities and mortalities.

Non operative radiological reduction of intussusception is the management of choice, it includes pneumatic reduction with fluoroscopic guidance, pneumatic reduction with ultrasonographic guidance, hydrostatic reduction with fluoroscopic guidance and hydrostatic reduction with ultrasonographic guidance.[5,14-16] These techniques are associated with rapid recovery, less hospitalization and less surgical complications in contrast to operative reduction.[1]Operative management is indicated in patients who present with sepsis, peritonitis and bowel perforation, evidence of pathological lead point and failure of non-operative radiological reduction .[9,10]

Pneumatic reduction of intussusception is the non-operative radiological reduction of choice in our center and many other countries like USA, China, India and United Kingdom,[14] It has been exercised since 1950's.It has many advantages include: A high success rate (90% or more) and low perforation rate(less than 1%). [4,15] It is a safe, simple technique and is easy to perform. [16]It is a rapid technique that results in short time of radiation exposure, with a radiation dose half that of the hydrostatic reduction .[4,16]It is cheap because the device is simple, locally assembled, can be cleaned and reused; the only part to be changed is the Foley's catheter. Barium is not used in this technique.[17] It has a low recurrence rate in contrast to hydrostatic reduction under fluoroscopy. [13,18] It is less messy and results in lower incidence of bowel perforation and less peritoneal contamination if perforation occurred.[4,16] The reported success rate of pneumatic reduction is 90% or more which is higher than the hydrostatic reduction under fluoroscopy ,this is due to the fact that air has inherent compressibility that enables it to sweep and dissect between the intussusceptum and the intussuscipien leading to rapid reduction .[4,15]

The only contraindications for pneumatic reduction are sepsis, peritonitis, shock, and bowel perforation, otherwise it can be applied to all cases even with trans anal protrusion of intussusception.

Farhan Tareen [6] reported a success rate of pneumatic reduction about 91.5%, while it was 88.9% in our study at Queen Rania Al Abdullah Hospital For Children despite the fact that all of our cases were having idiopathic intussusception. This is most probably due to delay in diagnosis which occurred in four of the five patients with failed pneumatic reduction, where the duration of symptoms was three days or more in these patients (80%).

The causes of the delay in diagnosis were the lack of awareness and underestimation of the parents to the complaints of their child until an alarming signs as rectal bleeding or shock occur which are late signs, and also the delay in referral of the child from peripheral hospital to our specialized center after being admitted there.

Edward Hannon [14] reported in his study in UK a higher success rate (77.5-84%) and lower perforation rate (0.9%) when pneumatic reduction was done by pediatric surgeon and

radiologist, whereas the success rate was lower (61%) and the perforation rate was higher (1.4%) when pneumatic reduction was done by a radiologist alone. At our center pneumatic reduction is done by pediatric surgeon in the presence of a radiologist doctor and we didn't report any bowel perforation in our study so we recommend that a pediatric surgeon is the leader of the pneumatic reduction team.

Supika [19] reported a perforation rate of 4% and FarhanTareen [6] reported a lower perforation rate (1.5%) , while Zulfiqar's[4] reported no perforations, and as we mentioned previously in our study there was no perforations, so this technique has a very low perforation rate.

Rangsan Niramis [18] documented a recurrence rate of (15.8%) after management of intussusception with barium hydrostatic reduction under fluoroscopy and a lower recurrence rate (11.4%) using pneumatic reduction and also in our study we reported a low recurrence rate of (8.9%).Although Pneumatic reduction under U/S guidance has many advantages as being done without radiation exposure, delivers more information about reduction process, post reduction ileocecal valve edema and recognizes the presence of a pathological lead point, it's not used popularly because of the less experience and familiarity of radiologists to use this technique and to identify perforation.

ServetOcal [11] reported a success rate of 72.3% using hydrostatic reduction under U/S guidancein Turkey and Vijay Pujar[15] reported a success rate of 73.5% using the same technique in India. These results are low in comparison to our result (88.9%) using pneumatic reduction, in addition to the fact that pneumatic reduction doesn't have the disadvantages of hydrostatic reduction as being messy to use, takes more time, has a higher recurrence rate and if perforation occurs usually its associated with large bowel wall tears and significant peritoneal contamination especially with barium that can be permanent .Surgical reduction of intussusception is still used as the main stay and the first line of choice in the management of intussusception at some centers despite the high risk of morbidities and mortalities, the cause of that is the limited resources and specialized facilities, and the lack of experience using non operative radiological reduction.

In Bode's [3] study which was carried out at the Lagos University Teaching Hospital in west Africa where surgical reduction was the mainstay for the management of intussusception , the mortality rate was 12.1% which was attributed mainly to perioperative complications as overwhelming sepsis, wound infections, fecal fistula and burst abdomen, while in our study the mortality rate was 0% and there was no post-operative complications , this is because surgical reduction was done only for the five patients with failed pneumatic reduction as a last choice for reduction and not as the mainstay for reduction.

Phillipo Chalya[1] reported in his study at a tertiary care hospital in northwestern Tanzania using surgical reduction as the mainstay for management of intussusception that the mean hospital stay was 7-14 days whereas in our study where pneumatic reduction was the mainstay for treatment ,it was 12-24 hours .The lower hospital stay results in decreased hospital acquired diseases, less cost and lower morbidities.

The major limitation of pneumatic reduction is bowel perforation, which may result in tension pneumoperitonium and respiratory compromise. This can be managed easily by inserting a large gauge cannula to decompress the abdomen. Bowel perforation can be decreased by starting pneumatic reduction with a low pressure and increasing it slowly as necessary not exceeding 120 mmHg, specially in patients who are more susceptible to perforation (age younger than 4-6 months, duration of symptoms and signs more than 2-3 days and the presence of complete intestinal obstruction.[16,4])

Conclusion

Pneumatic reduction is safe, simple, rapid technique with low radiation exposure, it is cheap, easy to perform with a high success rate and low perforation rate.

We recommend pneumatic reduction to be the first line of treatment for intussusception if there is no contraindications for it.

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