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Adding a custom made pressure release valve during air enema for intussusception: A new technique

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ABSTRACT

Background: Non-surgical reduction remains the first line treatment of choice for intussusception. The major complication of air enema reduction is bowel perforation. The authors developed a custom made pressure release valve to be added to portable insufflation devices, delivering air at pressures accepted as safe for effective reduction of intussusception in children under fluoroscopic guidance. The aim of this study was to develop a custom made pressure release valve that is suitable for the insufflation devices used for air enema reduction of intussusception and to put this valve into regular clinical practice. **Materials and Methods:** An adjustable, custom made pressure release valve was assembled by the authors using readily available components. The valve was coupled to a simple air enema insufflation device. The device was used for the trial of reduction of intussusception in a prospective study that included 132 patients. **Results:** The success rate for air enema reduction with the new device was 88.2%. The mean pressure required to achieve complete reduction was 100 mmHg. The insufflation pressure never exceeded the preset value (120 mmHg). Of the successful cases, 58.3% were reduced from the first attempt while 36.1% required a second insufflation. Only 5.55% required a third insufflation to complete the reduction. In cases with unsuccessful pneumatic reduction attempt (18.1%), surgical treatment was required. Surgery ranged from simple reduction to resection with a primary end to end anastomosis. No complications from air enema were recorded. **Conclusions:** The authors recommend adding pressure release valves to ensure safety by avoiding pressure overshoot during the procedure.

Key words: Air enema, intussusception, pneumatic, pressure release, reduction, safety, valve

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INTRODUCTION

Pneumatic reduction of intussusception with fluoroscopic guidance is quick, safe, cheap and clean and has high success rates. One major concern is to avoid the danger of pressure overshoot that occasionally happens when the child contracts his abdominal wall against the inflated colon. Careful monitoring of the pressure during the procedure is essential. Further modifications to the insufflation devices can be done to keep the pressure within a safe range. Adding a custom made, spring-loaded pressure release valve to the air circuit makes it impossible for the pressure to overshoot beyond the preset limit, increasing the safety of the procedure.

MATERIALS AND METHODS

Patients

This is a prospective study conducted in the Paediatric Surgery Unit from April 2014 to March 2015. One hundred and thirty-two patients aged between 3 months up to 3 years old were included. The 94 males and 38 females were symptomatic from few hours to 3 days with symptoms including vomiting, pain, diarrhea and blood-stained mucous stools. Indications for laparotomy included toxemia, suspected perforation or peritonitis, age range outside of 3 months to 3 years and suspected secondary intussusception associated with a primary pathology. In all other cases, the non-operative

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reduction was attempted with air enema using the modified insufflation device with the custom made pressure release valve.

Equipment

An insufflation device [Figure 1] was assembled using a Y-shaped rubber tubing, a hand-held pump that is used to pump atmospheric air, a digital pressure gauge and the pressure release valve. The custom made pressure release valve can be assembled using easy to source components that are readily available even in resource scarce areas. It is simply a spring-loaded ball check valve with a vent. Adjusting the tension of the spring determines the threshold for pressure release [Figure 2]. Components of the valve are: Two empty eye drop containers, a pen spring and a metal or glass ball [Figure 3]. A two-way Foley's balloon catheter was used to insufflate the air through the rectum, the caliber of the catheter ranged from 18F to 22F depending on the patient's age.

This device was combined with the pressure release valve to vent air when the pressure exceeds the preset value. Calibration of the device was done prior to use. To calibrate, close the circuit and use the pump to raise the pressure within the circuit. Notice the maximum pressure where the valve will release. To set at a higher pressure, tighten the eye drop container cap. To set at a lower pressure, loosen the cap. The device was then put into regular clinical practice.

Technique

After the catheter was introduced through the rectum, the balloon was inflated with 10 cc saline via the balloon inlet. The patient's gluteal folds were strapped together to reduce air leakage during the procedure.

With intermittent fluoroscopy monitoring, the air was insufflated using the hand-held pump to a pressure range from 80 to a maximum of 120 mmHg which was not exceeded thanks to the pressure release valve. The pressure was maintained for a maximum of 3 min/session. The air was then released. A total of three insufflations were performed for the duration of 3 min each.

Intussusception was considered reduced when air entered loops of small bowel within the central window framed by the peripheral large bowel.

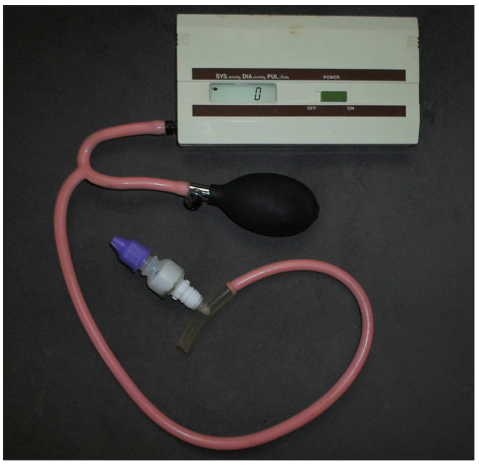

Figure 1: Air enema insufflation device

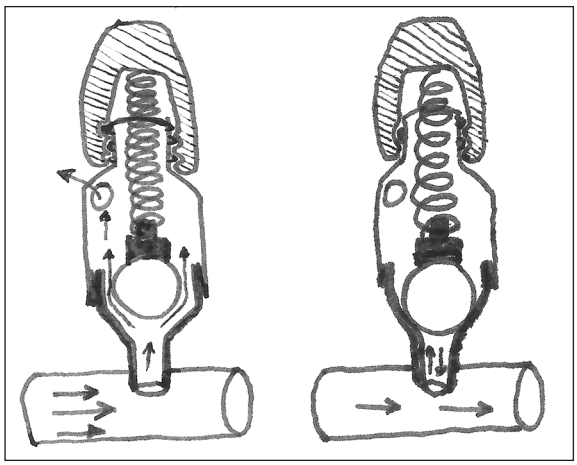

Figure 2: Mechanism of action of the spring-loaded pressure release ball valve

Figure 3: Assembly of the pressure release valve

RESULTS

In an audit for the Paediatric Surgery Unit for the year 2015, the success rate for air enema reduction with the new device was 81.8% (108 out of 132 cases). The mean age at admission was 8.5 months.

The mean pressure required to achieve complete reduction was 100 mmHg. Of the 108 successful cases,

63 cases (58.3%) were reduced from the first insufflation while 39 cases (36.1%) required a second insufflation. Only 6 cases (5.55%) required a third insufflation to complete the reduction.

In 24 cases with unsuccessful pneumatic reduction trial (18.1%), surgical treatment was required. Simple reduction (milking) was done in 17 patients; 4 of them had serosal tears which were repaired. There were three cases with a suspicious loop, but the vascularity improved with hot fomentation, so no resection was needed. Resection with a primary end to end anastomosis because of a gangrenous loop was required in 4 patients.

No complications were recorded during attempts of pneumatic reduction. After confirming the successful reduction of intussusception, patients were kept for periods ranging from 12 to 24 h to exclude early recurrence of intussusception and until they passed normal motions and tolerated oral feeding. All patients had an uneventful post-reduction recovery, and they were discharged to follow-up in an outpatient clinic.

DISCUSSION

Intussusception is a common paediatric surgical emergency. The incidence of infantile intussusception ranges from 0.3 to 4 cases per 1000 live births in Europe, North America and Australia, but in some developing countries a higher incidence and a high rate of complications have been described.[1]

Following the use of air enema, the need for operative intervention has been reduced to <20% of presenting patients.[2]

Air enema reduction proved to be a cheap, safe and effective option for the treatment of intussusception.[3] When compared with barium, the fluoroscopy screening times for air enema are shorter.[4] Also, recurrences are less with air than barium, and the morbidity is less should a perforation occur.

The air enema reduction device used in this study was developed to meet the needs of an air enema. Its unique features are: It is portable, with a manual pump under the control of the operator. The custom made pressure release valve effectively blows off the excess pressure that develops during the procedure due to bowel contractions or straining. This increases the safety of the procedure whilst decreases the need for continuously keeping an eye on the pressure reading. The device does not contain mercury or glass that can spill or shatter to cause injury to personnel.

With this portable device, a Foley's catheter, a 20 ml syringe and adhesive tape are the only materials that are necessary to initiate an air enema. This reduces the set-up time.

A successful air enema typically takes 1-3 min of the fluoroscopy time.[5] This reduces the procedure time during which the child is distressed. These, along with the absence of spillage, provide for a rapid turnaround time for the operating theatre. From a subjective point of view, operators feel safer and more comfortable using an air enema device with a pressure release valve.

In the present study, pneumatic reduction attempts were done for all patients with intussusception unless it was absolutely contraindicated. This approach is consistent with the recently published papers that mentioned that air enema reduction should be attempted in all cases except in those with established perforation and peritonitis.[6]

The pressure which was used to complete the reduction process was kept below 120 mmHg to avoid the possibility of perforation. The mean pressure required to achieve complete reduction was 100 mmHg which is in agreement with all the recently published literature.[7-10]

The success rate of pneumatic reduction varied widely in literature from 50% to 94%, with most investigators reporting rates >80%.[11] The success rate of pneumatic reduction in the present study was 81.8% which is in agreement with most of the published literature.[8,9,11-14]

No mentionable complications were recorded during the trial of pneumatic reduction in all of the 132 cases included in the study. Perforation as a possible complication did not occur in any case (0%). The overall mortality in the present study was (0%). This low mortality rate can be attributed to the good resuscitation prior to the trial of pneumatic reduction. Another factor to be mentioned is the use of a non-operative technique which avoids critical side effects of anaesthesia and post-operative complication which play an important role in the morbidity and mortality related to intussusception.

CONCLUSION

Adding pressure release valves to air insufflation devices is recommended by the authors. This addition ensures

the safety of the procedure by avoiding the pressure overshoot during the trial of pneumatic reduction of intussusception. The authors' custom made pressure release valve is easy to build, efficient and safe to use in clinical practice.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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