Pneumatic Reduction for Intussusception

Muse Freneh, Jason Axt

Introduction:

Ileocolic intussusception is one of the most common causes of intestinal obstruction in infants and toddlers. It occurs when a segment of the bowel (intussusceptum) telescopes into an adjacent distal segment (intussuscipiens), leading to progressive obstruction.

As the intussusceptum advances further into the intussuscipiens through peristalsis, it becomes thickened, edematous, and swollen. This process first obstructs the lumen, then causes venous congestion, followed by arterial compromise, ultimately leading to ischemia and necrosis if untreated.

Primary intussusception—the most common form—occurs in the absence of a pathological "lead point." Cases have a seasonal variation, often correlating with an increase in viral upper respiratory infections and viral gastroenteritis. Some studies suggest that up to 50% of cases are linked to prior Rotavirus infection.

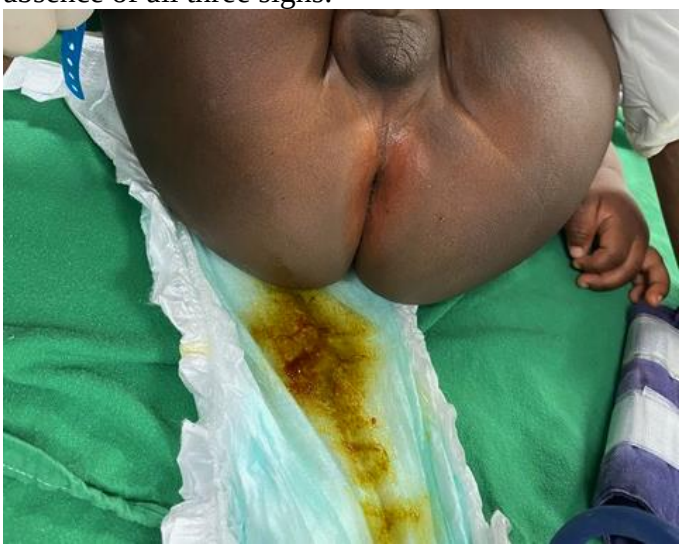
Secondary intussusception, which accounts for 1.5% to 12% of cases, arises due to an underlying pathological lead point. The most common cause is Meckel's diverticulum, though other potential lead points include polyps, hemangiomas, ectopic pancreatic tissue, the appendix, or other lesions. In rare cases, an intestinal tumor serves as a lead point, with incidence increasing with patient age.

Clinical presentation

Intussusception primarily affects children between 3 months and 3 years of age, with peak incidence occurring between 5 and 9 months.

The typical presentation includes sudden onset of intermittent, crampy abdominal pain, often accompanied by leg flexion toward the chest and episodes of vomiting that last for a few minutes. These symptoms alternate with periods where the child appears normal.

If left untreated, progressive obstruction leads to dehydration and lethargy. The classic triad of intermittent abdominal pain, a palpable "sausage-shaped" mass, and "currant jelly" stools is seen in less than 25% of cases, primarily in patients with delayed presentation. Given this, clinicians must maintain a high index of suspicion even in the absence of all three signs.



Stool mixed with blood and mucus gives the appearance of "currant jelly."

A less common presentation involves transanal protrusion of the intussusceptum, which can be mistaken for rectal prolapse. Differentiation is simple: inserting a lubricated tongue depressant or an examining finger next to the prolapsed tissue. If the instrument can be advanced more than 2 cm, transanal protrusion of the intussusceptum should be strongly suspected.

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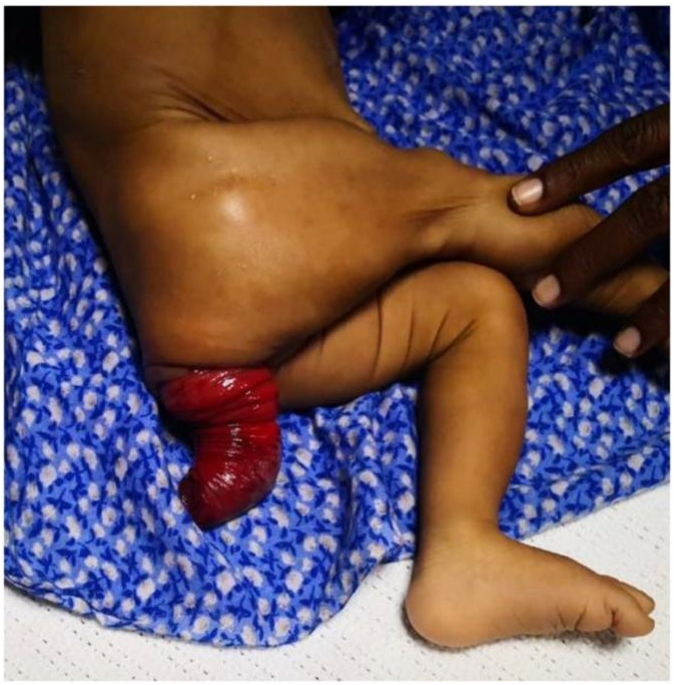
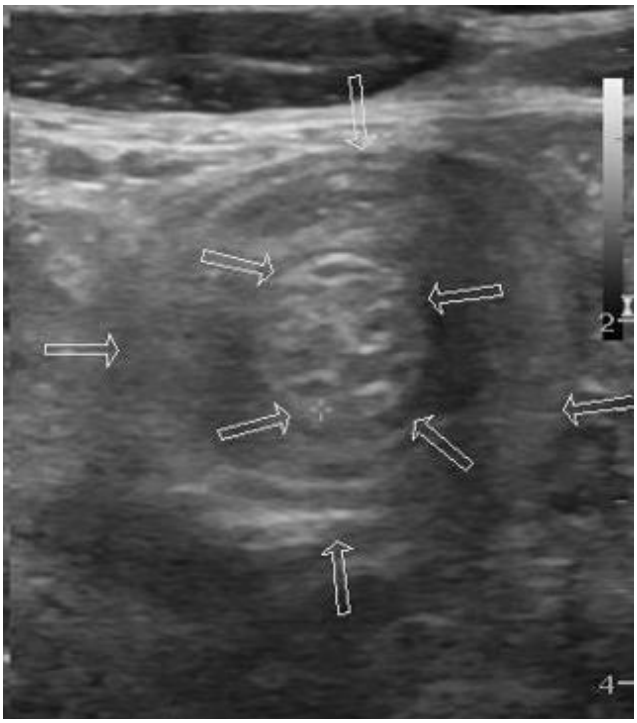


Trans-anal protrusion of the intussusceptum results when the process of intussusception proceeds far enough that the process continues out the anus. Source: https://doi.org/10.1016/j.epsc.2020.101405



Ultrasound image demonstrating target sign. Source: https://radiopaedia.org/articles/target-sign-intussusception

In resource-limited settings, children often present late, frequently with overwhelming sepsis and severe electrolyte imbalances, which require urgent correction before attempting reduction.

Diagnosis

Intussusception is primarily a clinical diagnosis, based on characteristic symptoms and signs. However, imaging is essential for confirmation.

- Abdominal ultrasound is the gold standard for diagnosis, with near 100% sensitivity. The hallmark finding is the "target sign", representing concentric layers of bowel within bowel.
- Additional investigations may be warranted to evaluate for electrolyte imbalances, dehydration, or sepsis, particularly in cases of delayed presentation.

Initial management

Early and aggressive fluid resuscitation is critical in children with intussusception, as dehydration is common due to vomiting and third-spacing of fluids into the edematous bowel.

- Intravenous fluid resuscitation should be initiated immediately.
- Electrolyte imbalances should be corrected, particularly in cases of prolonged illness.
- Urine output must be adequate before proceeding with pneumatic reduction or surgery, as hypovolemia increases the risk of cardiovascular collapse on induction of anesthesia.

In cases where patients present late, with sepsis or shock, stabilization should take priority over any procedural intervention.

Children presenting with peritonitis or septic shock should undergo immediate resuscitation and be taken expeditiously for surgical exploration.

Both pneumatic and hydrostatic reduction are well-documented techniques with comparable success rates. However, pneumatic reduction is

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preferred due to its relative ease of execution and lower risk of contamination if perforation should occur.

While some guidelines suggest that a symptoms exceeding 48 hours make successful non-operative reduction less likely, we advocate for an attempt at reduction regardless of delay, provided there is no septic shock or peritonitis. Even partial reduction may simplify subsequent surgical intervention.

Laparotomy is indicated in cases where:

- Non-operative reduction fails.
- The patient is hemodynamically unstable despite resuscitation.
- There are clear signs of bowel gangrene or perforation.

The procedure is typically performed in the operating room using C-arm fluoroscopy. It is possible to follow the progress of reduction with ultrasound alone, however this can be a difficult technique to master.

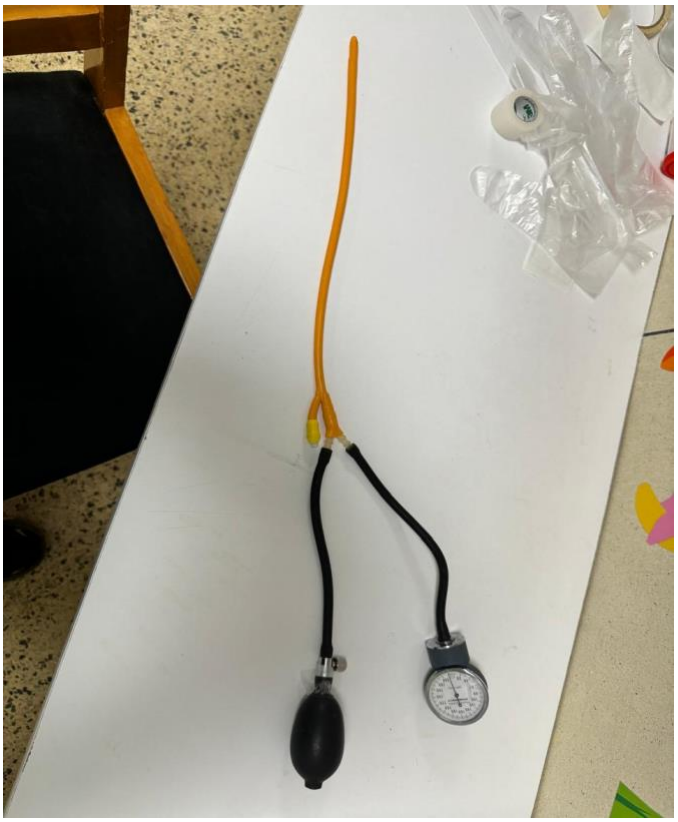
Given the risk of complications, we strongly recommend that pneumatic reduction in low-resource settings be conducted in an environment where immediate surgical backup is available.

Pneumatic reduction is often well-tolerated and can be performed with the child awake or under light sedation. The stepwise approach to the procedure is outlined below.

Materials.

- Manual sphygmomanometer system with a "Y" connector
- Large size foley catheter (E.g. 20 Fr)
- 20 mL Syringe
- Large bore intravenous catheter for decompression in case of perforation with tension pneumoperitoneum
- Lubricant gel
- Fluoroscopy machine

Sphygmomanometer, inflator cuff, and "Y" connector, shown before assembly. A mercury sphygmomanometer, or any other manual device that shows pressure, is also acceptable



The assembled foley catheter, "Y" connector and sphygmomanometer

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Steps:

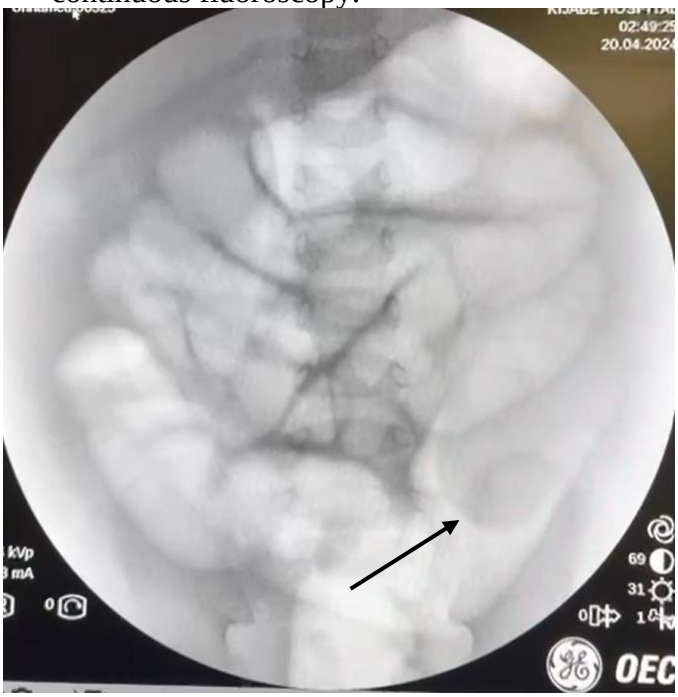
1. The procedure can be done awake or with light sedation.

The patient is positioned at the edge of the operating table in a lithotomy position with the hip and knees flexed at 90 degrees.

2. 20 Fr Foley catheter is placed in the anus and balloon inflated with 20-30cc of air to create an airtight seal. We prefer air over water for inflating the balloon, as it is easier to deflate in case of respiratory compromise due to abdominal distention
3. The catheter is connected to the "Y" connector of the sphygmomanometer system

An assistant will compress the buttocks on either side while pulling lightly on the catheter to create an airtight seal.

4. A single shot x-ray is taken with a fluoroscopy machine viewing from the pelvis to the diaphragm.
5. Air is instilled using the sphygmomanometer device keeping the pressure between 80 and 100mmHg (no more than 120mmHg) while directly observing the meniscus move with continuous fluoroscopy.



Meniscus indicated by the arrow moves with instillation of air.

6. Air can be instilled according to the rule of threes: three minutes at a time, with 3-minute breaks in between and 3 different attempts.

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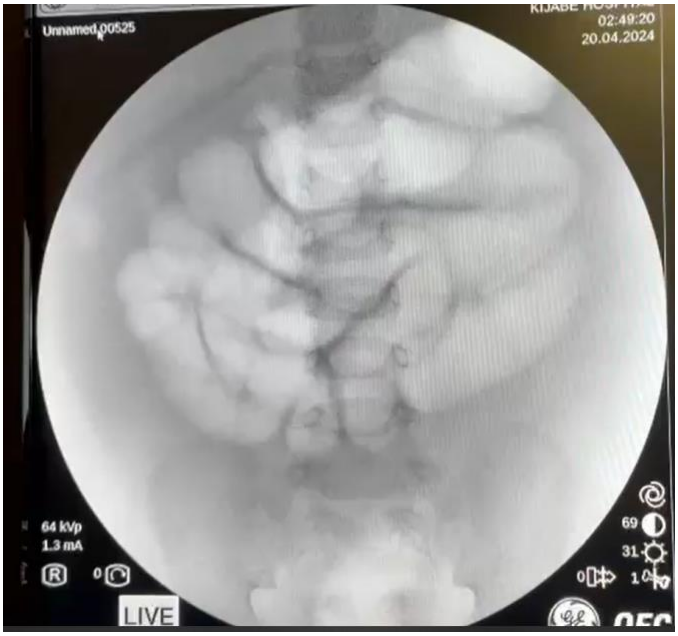
Between reduction attempts, residual air should be evacuated either manually or via the Foley catheter by gently compressing the abdomen while maintaining rectal patency with the other hand.

7. A sudden increase in abdominal distention with failure to evacuate air strongly suggests bowel perforation. If perforation occurs, air can rapidly accumulate in the peritoneal cavity, leading to tension pneumoperitoneum causing severe respiratory compromise and death if not promptly managed. Immediate decompression should be performed by inserting a large-bore intravenous cannula through the abdominal wall. The right upper quadrant is preferred, as it is where free air tends to accumulate and has a lower risk of bowel injury. A rush of escaping air confirms the diagnosis. Once perforation is confirmed, the child should undergo urgent exploratory laparotomy.
8. Reduction is continued until the meniscus moves from the left lower quadrant all the way to ileocecal valve and complete reduction is confirmed with air visibly entering the small bowel.
9. If reduction is successful, the patient can be transferred to the ward and feeding attempted. Patients are typically observed overnight due to challenges accessing healthcare in case of recurrence or incomplete reduction. If the attempt was unsuccessful, reduction can be attempted up to 3 times at 4–6-hour intervals. After three unsuccessful attempts, an exploration should be performed.



Complete reduction of intussusception is confirmed by sudden influx of air into the small bowel in the central portion of the abdomen as shown above.

10. After reduction, patients typically have a dramatic improvement in condition. A patient who continues to vomit, has a distended abdomen, or is unable feed should prompt concern for incomplete reduction or recurrence. Perform a repeat ultrasound. Reduction can be performed up to three times. A fourth intussusception event suggests a pathologic lead point and warrants an abdominal exploration.

Pitfalls

- Failure to form an airtight seal will reduce chances of reduction.
- Failure to recognize and address a perforation and pneumoperitoneum may cause respiratory compromise and even death. As explained above, remove the Foley catheter and perform needle decompression in the right upper quadrant of the abdomen.

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- Failure to have a large bore intravenous cannula nearby at the time of the procedure, leading to "frantically searching" for it when it is needed.
- If a patient does not exhibit rapid reduction of symptoms, suspect incomplete reduction or recurrence.

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