

Acute Intussusception

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Definition

Intussusception is the invagination of proximal bowel into distal bowel, often resulting in bowel obstruction⁽¹⁾. Mesenteric vasculature is pulled into the intussusceptens resulting in blood flow obstruction and bowel wall ischemia. There are multiple types of intussusception including ileocolic, and enteroenteric. For the purpose of this guideline, intussusception will refer to the ileocolic type, which is the most common.

Incidence

Intussusception is the most common cause of acute abdominal pain in young children and has an estimated incidence of 35 per 100,000 children and up to 62 cases per 100,000 in certain age groups (26-29 weeks)⁽²⁾. Intussusception is the most common cause of bowel obstruction in children and one quarter of abdominal surgical emergencies in those less than 5 years old are attributable to intussusception⁽³⁾.

The majority of patients are under 1 year of age with a peak seen between 6-8 months⁽²⁾. Intussusception is extremely uncommon below 3 months of age⁽⁴⁾. There is a male predominance that increases with age⁽²⁾. Although intussusception can quickly progress to disability and death without treatment, with proper resuscitation and management, intussusception has a mortality rate of <1%^(2,5).

Etiology

The majority of cases (approximately 90%) are idiopathic and may result from lymphoid hyperplasia^(1,6,7). Intussusception may be preceded by viral URI or AGE and has been associated with rotavirus and adenovirus infections^(8,9). Pathologic lead points (PLP) are rare but become more common in the older age groups⁽⁶⁾. There is some evidence that beta lactam antibiotics can increase the risk of intussusception⁽¹⁰⁾. Post surgical intussusception usually occurs within 2 weeks of surgery⁽⁶⁾. Although any surgical procedure can result in dysmotility and precede intussusception, it is more commonly seen in intra abdominal surgeries where there is extensive manipulation of the bowel⁽⁶⁾.

Differential Diagnosis

Appendicitis
Anatomic abnormality causing small bowel obstruction
AGE
UTI
Testicular torsion
Sepsis

Guideline Inclusion Criteria

Patients >3 months and <6 years with clinical symptoms suggestive of intussusception.

Guideline Exclusion Criteria

- Patients with comorbid or complex medical conditions.
- Children with signs of sepsis should be initially cared for with the sepsis protocol.
- Children with recent abdominal surgery (within 1 month) should undergo workup for intussusception but the pediatric surgical service should be notified once intussusception is confirmed and prior to air enema.

Diagnostic Evaluation

The classic triad of abdominal pain, hematochezia, and vomiting occur in only one third of patients and is generally associated with a longer duration of symptoms^(9,11).

History of abdominal pain is the most common presenting symptom^(11,12). The addition of one of the following symptoms should prompt a workup for intussusception: bloody stool, vomiting (starts refractory then becomes bilious), or lethargy. A child presenting without abdominal pain but with two of the symptoms above or a history and physical consistent with intussusception should prompt a workup for intussusception.

On physical exam, a sausage shaped mass may be present in up to 30-85% of patients^(9,11). Scaphoid appearance of the right upper quadrant, or Dance sign, is a less common physical exam finding. Abdominal distension may also be noted.

Ultrasound is the diagnostic modality of choice as it has a very high sensitivity and specificity in the diagnosis of intussusception⁽¹⁾.

Determination of Clinical Severity

Assessment guidelines for symptom severity to be performed by attending physician

Low

- Alert, active, good perfusion
- Stable general condition without signs of severe or moderate criteria

Moderate*

Stable appearance with any of the following:

- Duration of symptoms > 48 hours
- Age < 6 months
- Dehydration
- Lethargy
- Concern for small bowel obstruction
- Hematochezia

Severe*

Poor appearance with any of the following:

- Signs of shock
- Signs of peritonitis
- Signs of free air

*Children with moderate and severe severity assessment share features that are associated with increased morbidity and enema failure⁽¹³⁻¹⁷⁾.

Laboratory Tests

Not routinely recommended for uncomplicated intussusception.

Critical Points of Evidence

Evidence Supports

Prompt diagnosis and intervention
The use of fluid resuscitation
The use of ultrasound in the diagnosis of intussusception
Use of abdominal XR to rule out free air or small bowel obstruction
The use of air contrast enema for reduction
The use of delayed repeat enema for well appearing children with partial reduction
Discharge to home after brief observation period

Evidence Lacking/Inconclusive

Use of severity criteria
Abdominal XR for diagnostic purposes
The use of anesthesia or sedation

Evidence Against

Use of antispasmodics (glucagon)
Use of antibiotics
Use of CT for diagnostic purposes

Practice Recommendations and Clinical Management

Laboratory Testing

No routine laboratory testing is recommended for patients with uncomplicated intussusception
(Moderate recommendation; Low quality evidence.)

A BMP should be obtained if the patient appears severely dehydrated to assess for electrolyte abnormalities and kidney function. Acute-phase reactants are not routinely recommended but may be used in conjunction with clinical findings to assess severity. CRP >10 mg/dL is seen more frequently in moderate to severe cases⁽¹⁸⁾. Leukocytosis (WBC >20,000) is seen more frequently in moderate to severe cases and may reflect severity⁽¹⁹⁾. Bacteremia with septicemia is uncommon and blood culture is not routinely recommended⁽²⁰⁾.

Imaging

Ultrasound is the diagnostic modality of choice as it has a very high (100%) sensitivity and specificity in the diagnosis of intussusception^(1,21). For children meeting moderate to severe criteria, ultrasound will be performed in the Emergency Department.
(Strong recommendation; Strong quality evidence.)

Primary or confirmatory imaging with computed tomography should not be conducted for patients with suspected intussusception^(1,6). Ultrasound is preferred over abdominal computed tomography to evaluate for PLPs^(1,6).
(Strong recommendation; Moderate quality evidence.)

Abdominal XR has limited value for intussusception and is not recommended for diagnostic purposes. A soft tissue mass and absence of large bowel gas are suggestive of intussusception but not diagnostic^(1,22). XR is useful in detecting free air or small bowel obstruction, although even with perforation, free air may not be visualized⁽¹⁾. Intussusception is less likely if air is visualized in the cecum but false negatives do occur^(1,17).
(Moderate recommendation; Moderate quality evidence.)

Fluid Resuscitation

IV access should be started and maintained in all children with confirmed intussusception^(23,24).
(Strong recommendation; Low quality evidence.)

All children with suspected intussusception meeting moderate to severe criteria should be immediately fluid resuscitated. In low severity criteria, fluid resuscitation can be held until intussusception confirmed. All children should be reassessed frequently to ensure hemodynamic stability prior to reduction procedure^(13-16, 23,24).
(Strong recommendation; Moderate quality evidence.)

Primary Reduction

Reduction should be attempted by therapeutic air enema⁽²¹⁾. Multiple attempts may be tried at discretion of the Radiologist with up to a 30-minute interlude between attempts. The primary complication of air enema is perforation, which occurs <1% of the time⁽²¹⁾. Contraindications for enema include free air and peritonitis.
(Strong recommendation; Moderate quality evidence.)

The use of smooth muscle relaxants (i.e. Glucagon) has not been found to improve rates of reduction and is not recommended^(25,26).
(Strong recommendation; Moderate quality evidence.)

There is no strong evidence to support anesthesia or sedation during reduction and it is not recommended⁽²⁸⁻³²⁾.
(Weak recommendation; Low quality evidence.)

There is some evidence to suggest steroid administration may decrease recurrence but more studies are needed before this can be recommended.
(Weak recommendation; Low quality evidence.)

Surgical Management

Failure in primary reduction will elicit a surgical services consult. Following surgical services consult, patients will be managed either with delayed repeat enema or surgical intervention off pathway^(13-16,23).
(Strong recommendation; Moderate quality evidence.)

Delayed repeat Enema

Patients with partial reduction on initial enema attempt are candidates for delayed repeat air enema^(23,33). These patients will be admitted under the primary surgical team for evaluation and those deemed appropriate will receive further management per surgery. When initial enema reduction fails, data suggests that delayed repeat enema (DRE) is preferred to immediate surgery because surgical reduction is associated with increased incidence of bowel resection and longer hospital LOS.

(Moderate recommendation; Moderate quality evidence.)

Antibiotics

Antibiotics are not routinely recommended for uncomplicated intussusception and have not been shown to decrease length of stay or improve outcomes^(20,34).

(Moderate recommendation; Moderate quality evidence.)

Antibiotic Management for Peritonitis/Perforation

Antibiotics are recommended for diagnosis of peritonitis or perforation⁽³⁵⁻³⁷⁾.

(Strong recommendation; Moderate quality evidence.)

First line therapy:

Cefazolin (33mg/kg/dose IV q8 hours | Max 2000mg/dose) or ceftriaxone (75mg/kg/dose IV q24 | Max 2000mg/dose) and metronidazole (10mg/kg/dose IV q8 hours | Max 500mg/dose)

Time to Early Feeding

No difference has been demonstrated in intestinal perforation, shock, sepsis, LOS, pain, fever, or recurrence in patients who had early PO (<2hours after procedure) vs delayed PO⁽³⁸⁾. We recommend starting PO as soon as desired.

(Moderate recommendation; Low quality evidence.)

Early Discharge

Children may be safely discharged after a short observation period (4-6 hours) after air enema, and more recent data suggests that they may be discharged from the ED after only 4 hours of observation. This is a change from previously admitting this group for 24 hours. Shortened period allows observation for complications of reduction and for tolerance of PO. Most recurrences occur after 48 hours and the vast majority would not be captured in a 24 hour hospitalization⁽³⁹⁾. Recurrences may be safely reduced via repeat air enema and readmitted under the pathway⁽⁴⁰⁾.

(Strong recommendation; Moderate quality evidence.)

Consults/Referrals:

- Stat consult pediatric surgical service on patients with clinical signs of peritonitis or free air visualized on XR
- Consult pediatric surgical service for patients who fail primary reduction with air enema
- Stat consult pediatric surgical service for patients with perforation during air enema

The pediatric surgical service should be notified once intussusception is confirmed and prior to air enema in post-operative patients

Patient Disposition

Admission Criteria

Following successful non-surgical reduction of uncomplicated intussusception, children should be admitted for a short 4-6 hour observation period to evaluate for complications of enema reduction and ensure adequate PO and hydration prior to discharge.

Discharge Criteria

- Tolerating PO with adequate urine output
- No vital sign instability
- No persistent abdominal pain or emesis
- Barriers to care, including distance of home to hospital and parent comfort level with discharge are assessed
- Low urine output

Caregiver Education

(See Addendum 2)

Caregivers should be informed that intussusception carries a 10-12% recurrence rate. The majority of recurrences occur after 48 hours. Recurrences may be safely reduced via air contrast enema. Children should immediately be brought to the Emergency department if they display:

- Colicky or constant abdominal pain
- Persistent emesis
- Lethargy

Follow-Up Care

F/U with a primary care provider in 1-2 days.

intussusception
Emergency Department Revisit rate within 72 hours for
non-surgically reduced intussusception

Outcome Measures

Time to initiate diagnostic ultrasound
Time to initiate air enema
Emergency Department and Hospital Length of Stay
Readmission rate within 72 hours for non-surgically reduced

Addendums

Patient flow and Review of key evidence

Rotavirus Vaccine and Intussusception:

The Rotavirus vaccine is associated with the development of intussusception. The minimum age for rotavirus vaccine is 6 weeks and the maximum age for the 1st dose is 14 weeks, 6 days. There are two Rotavirus vaccines: The monovalent rotavirus vaccine (RV1, marketed as Rotarix)- a 2-dose series at 2 and 4 months and the pentavalent rotavirus vaccine (FV5, marketed as RotaTeq)- a 3-dose series at 2, 4 and 6 months. If any dose in the series is either RotaTeq or unknown, providers should default to the three-dose series^(54,55,56).

Most infants who receive the rotavirus vaccine have no problems. Of note, infants are more likely to be irritable and have mild temporary diarrhea or vomiting after a dose of the rotavirus vaccine. There is a small risk of intussusception from the rotavirus vaccine which usually occurs within a week after the first or second dose. According to the CDC, this additional risk is estimated to range from about 1 in 20,000 to 1 in 100,000 US infants who get the rotavirus vaccine. It is important to address the risk of intussusception with caregivers in addition to benefits of the rotavirus vaccination. Discussing the numerous hospitalizations each year the rotavirus vaccine prevents (>50,000) can give caregivers perspective on the importance of this vaccine^(54,55,56).

The contraindications for this vaccine include: infants with a history of intussusception, infants with a history of severe allergic reaction (e.g., anaphylaxis) after a previous dose of rotavirus vaccine or exposure to a vaccine component, 2) infants diagnosed with severe combined immunodeficiency (SCID), and 3) infants with an uncorrected congenital malformation of the gastrointestinal tract⁽⁵⁶⁾. There is no contraindication for a sibling of a patient who has been diagnosed with intussusception to receive the rotavirus vaccine and the sibling should be vaccinated against rotavirus according to CDC guidelines^(54,55,56).

ADDENDUM 1

Patient Management Flow

- For all patients in the moderate and severe categories, abdominal ultrasound should occur in the Emergency Department.
- For patients in the low severity category, ultrasound may be performed in the radiology suite; however, if positive, patient should return to the emergency room for monitoring until able to complete air enema.
- For those patients in the low severity category for whom there is a low clinical suspicion for intussusception, PIV placement and bolus administration may be held until after ultrasound confirmation. Once confirmed, if outside of weekday standard working hours, patients should return to the emergency department for PIV placement and bolus administration. During weekday working hours PIV will be placed by the radiology RN.
- In severe patient cases, where there is a clinical concern for peritonitis or free air visualized on 2 view abdominal XR, a stat surgical services consult should be made to the attending surgeon on call.
- If perforation occurs during enema reduction, a stat surgical services consult should be made to the attending surgeon on call.

Early Discharge Following Enema Reduction

Historically, many hospitals have observed patients presenting with uncomplicated intussusception in the inpatient setting for 24-48 hours to monitor for recurrence with a medium length of stay of 2 days following enema reduction². A recent Meta-analysis by Gray et al examined 69 studies of intussusception recurrence in patients aged 0-18³⁹. Studies were divided by enema modality and controlled for quality. Overall recurrence rate for contrast enema (CE) was 11.6 (CI 10%-13.3%), 6.9% (CI 5.1%-9%) for ultrasound guided air enema (UGAE), and 7.7% (CI 5.6%-10%) for fluoroscopy guided air enema (FGAE). Recurrence rate in the first 24 hours following reduction was 2.7% (CI 1.2%-4.8%), 0.9% (CI 0.1%-4.8%), and 1.5% (0-6.2%) respectively, suggesting that the majority of recurrences would not be captured in a 24-hour hospitalization. Furthermore, multiple studies support the safety of outpatient management and repeat enema for recurrence⁴⁰⁻⁴³. It is therefore reasonable to admit for a short 4-6 hour observation period following reduction and then discharge to home if meeting discharge criteria.

Pathologic lead points

The majority of intussusceptions are caused by hyperplasia of the lymphoid aggregates in the terminal ileum¹. In approximately 6% of patients, a pathologic lead point may be present⁴⁴. The presence of PLP increases with age with 5% occurring in ages 0-11 months and 60% occurring in children aged 5-14 years⁴⁴. Children with >1 recurrence or >1 discrete episodes of intussusception have a higher incidence of PLP⁴³. The most common PLP is a Meckel's diverticulum. Other common causes include duplication cysts, intestinal polyp, lymphoma, and Henoch-Schönlein purpura^{6,43}. Ultrasonography is a useful modality to identify PLPs and may detect up to 64% of PLPs⁶. Due to the high prevalence of Meckel's diverticulum acting as a PLP, a Meckel's scan is a reasonable imaging modality if PLP is suspected but not confirmed on ultrasound. CT can be a useful imaging study; however, in a study conducted by Daneman et al, CT failed to detect PLPs that had been missed by ultrasound⁴⁵. Further imaging and testing should be tailored to the individual cases.

Delayed Repeat Enema

Historically, children without complete reduction of intussusception following enema have undergone surgical reduction. Although there has been a significant trend away from surgical reduction for intussusception, the rate of operative intervention has been reported to be as high as 51% in some areas of the United States². There is an increasing body of evidence that supports the use of a delayed repeat enema (DRE-a repeat enema several or more hours after initial reduction attempt) to reduce well appearing children who have had a partial reduction with enema^{21,33}. It is felt that the interval time relieves venous congestion and edema thus facilitating the subsequent reduction attempt³³. In a retrospective cohort study of 4,980 children with intussusception, 502 underwent a DRE while 1,407 children underwent operative reduction. 26.7% of children in the operative group had bowel resections while 11.8% required bowel resection in the DRE group (AOR 2.50, 95% CI 1.83-3.41, $p < 0.001$)³³. The time interval between initial reduction attempt and DRE has not been rigorously studied. Patient instability, perforation, peritonitis, and failure to move the intussusception are contraindications for DRE³³. DRE may be attempted for well appearing children with partial reduction of intussusception with coordination between radiology and primary surgical service.

Evidence Based Outcome Center

EXCLUSION CRITERIA

- Age < 3 months **OR** > 6 years
- Children with signs of sepsis
- Underlying medical condition
- Comorbidities
- Recent surgery

Inclusion Criteria

Patient 3 months to 6 years of age presenting with abdominal pain and at least one following:

- (1) Bloody Stool, (2) Lethargy, (3) Vomiting, **OR** (4) History & examination suggestive of intussusception

Determination of Clinical Severity by Attending Physician

Low

Criteria:
Stable general condition
Without signs of severe or moderate criteria

Consider PIV placement

Manage OFF-Pathway

Moderate

Stable appearance with any of the following criteria:

- Duration of symptoms > 48 hours
- Age 3 to 6 months
- Dehydration
- Lethargy
- Concern for small bowel obstruction
- Hematochezia

- Place IV
- Order NS bolus
- Consider ordering analgesia

Order STAT Ultrasound

Consider 2 View Abdominal X-ray if concern for small bowel obstruction

Ultrasound consistent with intussusception?

YES

IV placed?

YES

Order air enema

Pulse Oximeter & nurse monitoring during transport and procedure

Ensure patient is stable and has adequate hemodynamic stability

Perforation?

NO

Intussusception reduced?

YES

Admit for 4-6 hours observation

DISCHARGE CRITERIA

- Tolerating PO
- Adequate urine output
- No persistent abdominal pain
- No persistent emesis
- No vital sign instability

Discharge

Severe

Poor appearance with any of the following:

- Signs of shock
- Signs of peritonitis
- Signs of free air

Order STAT:

- 2 View Abdominal X-ray
- Ultrasound
- AND -
- Place IV
- Order NS bolus

Peritonitis or free air?

NO

YES

Emergency Department Antibiotic Management: Combination Therapy:

Cefazolin:

33 mg/kg/dose IV q8 hours | Max 2000 mg/dose

Metronidazole:

10 mg/kg/dose IV Q8 hours | Max 500 mg/dose

OR

Ceftriaxone:

75mg/kg/dose IV Q24 hours | Max 2000 mg/dose

Metronidazole:

10 mg/kg/dose IV Q8 hours | Max 500 mg/dose

Manage OFF-Pathway
STAT Surgical Consult

Surgical Consult

Patients with partial reduction are candidates for repeat air contrast enema.

Admit to Surgical Service
Manage OFF-Pathway

ADDENDUM 2

Discharge Instructions for Intussusception

Your child was diagnosed with intussusception. This is a condition where a portion of intestine slides inside another portion. This happens in the same way that parts of a telescope slide inside each other when you close it. Blood supply to part of the intestine could then become blocked. This can cause severe damage if not treated. Intussusception can happen anywhere in the bowel. It is most common where the large intestine and small intestine meet. The cause of intussusception is often unknown.

A fluid or air enema is often used to both diagnose and treat the problem. A flexible tube is used to put fluid or air into the intestine. Then, special X-rays are taken. The force of the fluid or air entering the intestine often straightens it.

Home care

- Allow your child to return to normal activity as soon as he or she feels up to it.
- Watch your child for signs that the condition has returned. Intussusception can sometimes come back. If your child shows signs of symptoms returning, bring him/her immediately back to the Emergency Department for evaluation.
- Feed your child a normal diet.
- If your child is less than 4-6 months old, discuss the rotavirus vaccine schedule with your pediatrician. Your child **should not** get further doses of this vaccine if he/she has not completed the vaccine series.

Follow-up care

Make a follow-up appointment as directed by our staff.

When to call your child's doctor

Call the doctor right away if your child has any of the following:

- Pain in the abdomen that comes and goes
- Constant pain in the abdomen that does not improve or seems to be worsening
- Vomiting
- Extreme sluggishness, tiredness, or fatigue
- Dark, mucus-like, bloody stools
- Pale skin color
- A rectal temperature of 100.4°F (38.0°C) or higher
- A fever that lasts more than 24 hours in a child younger than 2 years or for 3 days in a child 2 years or older
- A seizure caused by the fever

Instrucciones para cuando el paciente es dado de alta por una invaginación intestinal

A su hijo le diagnosticaron una intususcepción. Este es un trastorno en el cual una porción del intestino se introduce dentro de otra (se invagina) como las partes de un telescopio cuando se cierra. En consecuencia, el flujo de sangre en esa parte del intestino puede quedar bloqueado. Si se deja sin tratar, podría causar daños graves. Una intususcepción puede ocurrir en cualquier parte del intestino, pero suele ocurrir con mayor frecuencia cerca a donde el intestino grueso se une al intestino delgado. Su causa por lo general se desconoce.

Tanto para tratar como para diagnosticar el problema, suele usarse un enema de líquido o de aire. Se utiliza un tubo flexible para introducir líquido o aire en el intestino. Luego, se toman radiografías especiales. Por lo general la fuerza del líquido o del aire al entrar al intestino lo enderezan.

Cuidados en la casa

- Permita que su niño vuelva a su actividad normal tan pronto se sienta listo.
- Observe a su niño en caso de que haya señales de que su problema ha regresado, ya que la intususcepción a veces puede volver a presentarse. Si su hijo muestra señales de que los síntomas han regresado, llévelo inmediatamente al Departamento de Emergencias para una nueva evaluación.
- Dele a su niño una dieta normal.
- Si su hijo tiene menos de 4 a 6 meses, hable con su pediatra sobre el calendario de vacunación contra el rotavirus. Su hijo **no debe recibir** más dosis de esta vacuna si no ha completado la serie de vacunas.

Visitas de control

Programe una visita de control según le indique nuestro personal.

Cuándo debe llamar al médico

Llame al médico inmediatamente si su niño presenta cualquiera de los siguientes síntomas:

- Dolor abdominal que aparece y desaparece
- Dolor constante en el abdomen que no se alivia o parece empeorar
- Vómitos
- Lentitud, cansancio o fatiga extrema
- Deposiciones (heces) con sangre, oscuras o con mucosidad
- Palidez de la piel
- Una temperatura rectal de 100.4 °F (38.0 °C) o más
- Fiebre que dura más de 24 horas en un niño menor de 2 años o durante 3 días en un niño de 2 años o más
- Una convulsión causada por la fiebre

References

1. Daneman A, Navarro O. Intussusception: Part 1: A review of diagnostic approaches. *Pediatr Radiol.* 2003;33:79-85.
2. Tate JE, Simonsen L, Viboud C, et al. Trends in Intussusception Hospitalizations Among US Infants, 1993-2004: Implications for Monitoring the Safety of the New Rotavirus Vaccination Program. *Pediatrics.* 2008;121:e1125-e1132.
3. DiFiore JW. Intussusception. *Semin Pediatr Surg.* 1999;8:214.
4. Buettcher M, Baer G, Bonhoeffer J, Schaad UB, Heininger U. Three-Year Surveillance of Intussusception in Children in Switzerland. *Pediatrics.* 2007;120:473-480.
5. Jiang J, Jiang B, Parashar U, Nguyen T, Bines J, Patel MM. Childhood intussusception: a literature review. *PLoS one.* 2013;8:e68482.
6. Navarro O, Daneman A. Intussusception: Part 3: Diagnosis and management of those with an identifiable or predisposing cause and those that reduce spontaneously. *Pediatr Radiol.* 2004;34:305-312.
7. Lehnert T, Sorge I, Till H, Rolle U. Intussusception in children—clinical presentation, diagnosis and management. *Int J Colorectal Dis.* 2009;24:1187-1192.
8. Bhisitkul DM, Todd KM, Listerick R. Adenovirus infection and childhood intussusception. *Am J Dis Child.* 1992;146:1331.
9. Ito Y, Kusakawa I, Murata Y, et al. Japanese guidelines for the management of intussusception in children, 2011. *Pediatrics International.* 2012;54:948-958.
10. Spiro DM, Arnold DH, Barbone F. Association Between Antibiotic Use and Primary Idiopathic Intussusception. *Arch Pediatr Adolesc Med.* 2003;157:54-59.
11. Bruce J, Huh YS, Cooney DR, Karp MP, Allen JE, Jewett J, T C. Intussusception: evolution of current management. *J Pediatr Gastroenterol Nutr.* 1987;6:663.
12. Champoux AN. Recurrent intussusception: risks and features. (*Arch Pediatr Adolesc Med*, 1994;148:474-478). *JAMA, The Journal of the American Medical Association.* 1994;272:574F.
13. Liu KW, MacCarthy J, Guiney EJ, Fitzgerald RJ. Intussusception—current trends in management. *Arch Dis Child.* 1986;61:75-77.
14. McDermott VG, Taylor T, Mackenzie S, Hendry GMA. Pneumatic reduction of intussusception: Clinical experience and factors affecting outcome. *Clin Radiol.* 1994;49:30-34.
15. Stein M, Alton DJ, Daneman A. Pneumatic reduction of intussusception: 5-year experience. *Radiology.* 1992;183:681
16. Burge DM. Intussusception: Factors related to treatment. *J Pediatr Surg.* 1991;26:1251-1251
17. Wehmler SN, Buonomo C, Bachur R. Risk stratification of children being evaluated for intussusception. *Pediatrics.* 2011;127:e296.
18. Willetts IE, Kite P, Barclay GR et al. Endotoxin, cytokines and lipid peroxides in children with intussusception. *Br. J. Surg.* 2001; 88: 878–83.
19. Reijnen JA,
19. Festen C, van 19. Roosmalen RP. Intussusception: factors related to treatment. *Arch. Dis. Child.* 1990; 65: 871–3.
20. Somekh, E., Serour, F., Goncalves, D., & Gorenstein, A. (1996). Air enema for reduction of intussusception in children: Risk of bacteremia. *Radiology*, 200(1), 217.
21. Daneman A, Navarro O. Intussusception: Part 2: An update on the evolution of management. *Pediatr Radiol.* 2004;34:97-108.
22. Sargent MA, Babyn P, Alton DJ (1994) Plain abdominal radiography in suspected intussusception: A reassessment. *Pediatr Radiol* 24:17–20
23. Stein-Wexler R, O'Connor R, Daldrup-Link H, Wootton-Gorges SL. Current methods for reducing intussusception: survey results. *Pediatr Radiol.* 2015;45:667-674.
24. ACR–SPR Practice Parameter for the Performance of Pediatric Fluoroscopic Contrast Enema Examinations. *American College of Radiologists.* (2014).
25. Franken J, E A., Smith WL, Chernish SM, Campbell JB, Fletcher BD, Goldman HS. The use of glucagon in hydrostatic reduction of intussusception: a double-blind study of 30 patients. *Radiology.* 1983;146:687.
26. Hoy GR, Dunbar D, Boles ET. The use of glucagon in the diagnosis and management of ileocolic intussusception. *J Pediatr Surg.* 1977;12:939-944.
27. Essa, A. E., Eltayeb, A. A., & Mansour, E. (2011). Evaluation of the role of dexamethasone in decreasing early recurrence of intussusception: Using ultrasound-guided saline enema for reduction. *Surgical Practice*, 15(4), 114-119.
28. Meyer JS. The current radiologic management of intussusception: a survey and review. *Pediatr Radiol.* 1992;22:323-325.
29. Rosenfeld K, McHugh K. Survey of intussusception reduction in England, Scotland and Wales: How and why we could do better. *Clin Radiol.* 1999;54:452-458.
30. Touloukian RJ, O'Connell JB, Markowitz RI, Rosenfield N, Seashore JH, Ablow RC. Analgesic premedication in the management of ileocolic intussusception. *Pediatrics.* 1987;79:432.
31. Shiels 2, W E., Kirks DR, Keller GL, et al. John Caffey Award. Colonic perforation by air and liquid enemas: comparison study in young pigs. *AJR. American journal of roentgenology.* 1993;160:931.
32. Ilivitzki A, Shtark LG, Arish K, Engel A. Deep sedation during pneumatic reduction of intussusception. *Pediatr Radiol.* 2012;42:562-565.
33. Lautz TB, Thurm CW, Rothstein DH. Delayed repeat enemas are safe and cost-effective in the management of pediatric intussusception. *J Pediatr Surg.* 2015;50:423-427.
34. Al-Tokhais, T., Hsieh, H., Pemberton, J., Elnahas, A., Puligandla, P., & Flageole, H. (2012). Antibiotics administration before enema reduction of intussusception: Is it necessary? *Journal of Pediatric Surgery*, 47(5), 928.
35. Levison ME and Bush LM. Peritonitis and Intraabdominal Abscesses. In GM Mandell, JE Bennett, and D Raphael. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases.* 2010 Philadelphia: Churchill Livingstone: 1011-1034.
36. Solomkin JS, Mazuski JE, Baron EG, et al.: Guidelines for the selection of anti-infective agents for complicated intra-abdominal infections. *Clin Infect Dis.* 2003;37:997-1005.
37. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guideline for antimicrobial prophylaxis in surgery. *Surg Infect (Larchmt).* 2013 Feb;14(1):73-156.

38. Adekunle-Ojo AO, Craig AM, Ma L, Caviness AC. Intussusception: Postreduction Fasting Is Not Necessary to Prevent Complications and Recurrences in the Emergency Department Observation Unit. *Pediatr Emerg Care*. 2011;27:897-899.
39. Gray et al. Recurrence Rates After Intussusception Enema Reduction: A Meta-analysis. *Pediatrics*. 2014;133(7):110-119. *Pediatrics*. 2014;134:827.
40. Beres AL, Baird R, Fung E, Hsieh H, Abou-Khalil M, Ted Gerstle J. Comparative outcome analysis of the management of pediatric intussusception with or without surgical admission. *J Pediatr Surg*. 2014;49:750-752.
41. Bajaj L, Roback MG. Postreduction Management of Intussusception in a Children's Hospital Emergency Department. *Pediatrics*. 2003;112:1302-1307.
42. Whitehouse JS, Gourlay DM, Winthrop AL, Cassidy LD, Arca MJ. Is it safe to discharge intussusception patients after successful hydrostatic reduction? *J Pediatr Surg*. 2010;45:1182-1186.
43. Daneman A, Alton DJ, Lobo E, Gravett J, Kim P, Ein SH. Patterns of recurrence of intussusception in children: a 17-year review. *Pediatr Radiol*. 1998;28:913-919.
44. Blakelock RT, Beasley SW. The clinical implications of non-idiopathic intussusception. *Pediatr Surg Int*. 1998;14:163-167.
45. Navarro O, Dugougeat F, Kornecki A, et al (2000) The impact of imaging in the management of intussusception owing to pathologic lead points in children. A review of 43 cases. *Pediatr Radiol* 30:594-603

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46. Kwon, H., Lee, J. H., Jeong, J. H., Yang, H. R., Kwak, Y. H., Kim, D. K., & Kim, K. (2019). A Practice Guideline for Postreduction Management of Intussusception of Children in the Emergency Department. *Pediatric Emergency Care*, 35(8), 533-538.
47. Forati, S., Yaghmaï, B., & Allah-Verdi, B. (2017). The effect of early feeding after enema reduction of intussusception in order to investigate the rate of recurrence and side effects of reduction. *Biomedical Research*, 28(13)
48. Xie, X., Wu, Y., Wang, Q., Zhao, Y., Chen, G., & Xiang, B. (2018). A randomized trial of pneumatic reduction versus hydrostatic reduction for intussusception in pediatric patients. *Journal of Pediatric Surgery*, 53(8), 1464-1468. <https://doi.org/10.1016/j.jpedsurg.2017.08.005>
49. Flaum, V., Schneider, A., Ferreira, C. G., Philippe, P., Sancho, C. S., Lacreuse, I., Moog, R., Kauffmann, I., Koob, M., Christmann, D., Douzal, V., Lefebvre, F., & Becmeur, F. (2016). Twenty years' experience for reduction of ileocolic intussusceptions by saline enema under sonography control. *Journal of Pediatric Surgery*, 51(1), 179-182.
50. Ahmad, M. M., Wani, M. D., Dar, H. M., Mir, I. N., Wani, H. A., & Raja, A. N. (2016). An experience of ultrasound-guided hydrostatic reduction of intussusception at a tertiary care centre. *South African Journal of Surgery. Suid-Afrikaanse Tydskrif Vir Chirurgie*, 54(1), 10-13.
51. Forati, S., Yaghmaï, B., & Allah-Verdi, B. (2017). The effect of early feeding after enema reduction of intussusception in order to investigate the rate of recurrence and side effects of reduction. *Biomedical Research*, 28(13).
52. Liu, X., Xia, B., Yu, H., Hu, L., Fan, S., Xiao, D., Gu, L., Chen, J., Wen, Z., & Ma, X. (2019). Atropine Premedication Facilitates Ultrasound-Guided Reduction by Saline Enema in Children With Intussusception. *Frontiers in Pharmacology*, 10. <https://doi.org/10.3389/fphar.2019.00043>
53. Gluckman, S., Karpelowsky, J., Webster, A. C., & McGee, R. G. (2017). Management for intussusception in children. *Cochrane Database of Systematic Reviews*, 6. <https://doi.org/10.1002/14651858.CD006476.pub3>
54. Addition of History of Intussusception as a Contraindication for Rotavirus Vaccination. (n.d.). Retrieved September 8, 2020, from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6041a5.htm>
55. Rotavirus | Vaccination | CDC. (2019, December 9). <https://www.cdc.gov/rotavirus/vaccination.html>
56. Intussusception: A Very Rare Risk After Rotavirus Vaccination. (n.d.). Retrieved September 8, 2020, from <https://www.medsafe.govt.nz/profs/PUArticles/September%202018/IntussusceptionRotavirusVaccination.htm>

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Approved by the Acute Intussusception Evidence-Based Outcomes Center Team

Revision History

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Updated: *Early Discharge, Discharge Recommendations - Rotavirus increased risk of Intussusception, Delayed Repeat Enema section, Shortened observation 4-6 hours prior to discharge.*

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