CHAPTER 68
INTUSSUSCEPTION

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Introduction

Intussusception is the most common type of intestinal obstruction seen in the paediatric age group, especially in infants and toddlers. It is an occlusive-strangulation type of intestinal obstruction, and all necessary measures should be taken early to ensure prompt diagnosis and treatment in order to prevent ischaemia and necrosis of bowel. Intussusception occurs when a portion of the proximal bowel (usually referred to as the intussusceptum) telescopes into a segment of the adjoining distal bowel (known as the intussuscepiens). The intussusceptum is propelled further into the intussuscepiens by peristalsis and eventually becomes thickened, oedematous, and swollen, leading to blockage of its lumen (occlusion) and subsequent pinching off of its mesentery (strangulation).

Children with intussusception in the African subregion, as a rule, present late to hospital for management[1,2,3] as a result of lack of knowledge on the part of parents, who try assorted local remedies before bringing the child to hospital.

Diagnosis of the condition can be difficult and tricky,[4] sometimes causing diagnostic confusion with other conditions, such as enterocolitis, dysentery, and gastroenteritis, further delaying the diagnosis. When the diagnosis is made late (meaning more than 48 to 72 hours after symptoms develop), surgery is usually the only option left to most surgeons. About 90–95% of intussusceptions occur in children between the ages of 3 months and 3 years,[5,6] and usually do not have a pathological lead point (i.e., they are idiopathic in nature).[6]

Demographics

Intussusception is known to occur among children in Africa, but unfortunately its true incidence is not known. It is seen with striking variation in frequency in various parts of the world. Worldwide, the incidence is estimated to be approximately 2–4 cases per 1,000 children, with a male-to-female ratio ranging from 1.4:1 to 3:2.[1-4,7-9] The male preponderance is more remarkable in the latter months of infancy. Intussusception tends to occur in well-nourished infants, around the time of weaning of the infant; its incidence in malnourished children is less than 30%, as quoted in the literature from Africa.[10] No paediatric age group is exempt from having intussusception, but it is more common in infants and toddlers. After 3 years of age, anatomically identifiable pathological lead points (PLPs) may be the cause of an intussusception in about 1.5% to 12% of children.[9,11]

Aetiology

In most childhood intussusceptions, the cause is usually unknown; this type of intussusception is referred to as idiopathic. This is the case in 90–95% of intussusceptions found in infants and toddlers. In this group of children, there may be hypertrophy of the mural lymphoid tissues, known as Peyer's patches, in the terminal ileum as a result of a viral illness (caused by adenovirus or rotavirus) with a history of acute gastroenteritis and/or respiratory tract symptoms. Operative findings in these children often include enlarged mesenteric lymph nodes and Peyer's patches.[11,12] In others, a mobile caecum is found. In most hospital-based studies in the subregion, in children younger than 3 years of age with intussusception, 10–30% were found to have had gastroenteritis.[1,10]

The most common PLP in the causation of nonidiopathic intussusception, especially in older children, is Meckel's diverticulum,[4,13–15] followed by polyps of the small intestine and colon.[11,12,14,15] Other PLPs include intestinal duplications, lymphomas, haemangiomas, lymphosarcomas, enteric cysts, Henoch-Schönlein purpura with submucosal haematomas, cystic fibrosis with inspissated meconium, benign intestinal neoplasms, Peutz-Jeghers familial polyposis, ectopic gastric mucosa, ectopic pancreatic mucosa, and worm infestations (especially *Ascaris lumbricoides*). The proportion of intussusceptions with a PLP increases with age.[13] Intussusception may also occur in children as a result of trauma, such as a postoperative complication after abdominal surgery,[3,12,13] especially retroperitoneal surgery, and after immunization with rotavirus vaccine.[10]

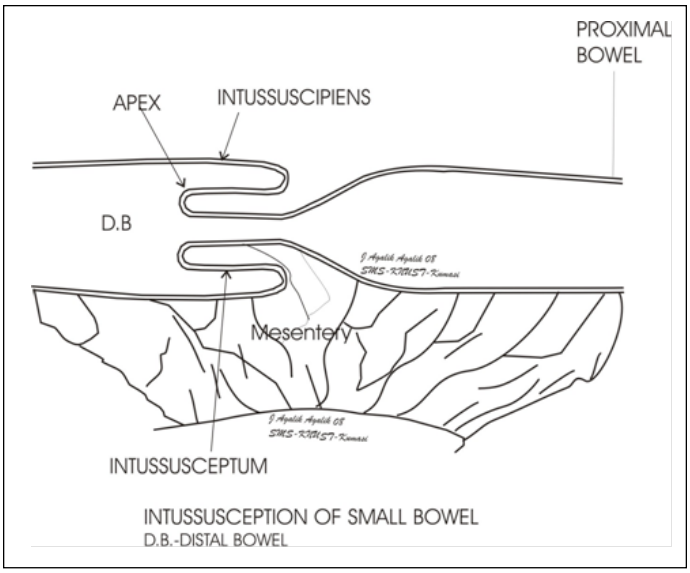
Pathophysiology

An imbalance of the longitudinal forces along the intestinal wall is believed to be the cause of intussusception.[9,11] This lack of homogeneity of longitudinal forces along the intestinal wall can be caused by a mass acting as a lead point or may result from a disorganized pattern of peristalsis. Because of the imbalance between the contractions of the circular muscles perpendicular to the axis of the longitudinal forces, a kink develops in the abnormal portion of the intestine, thus creating a fulcrum for infolding of this area, resulting in its invagination into the adjacent distal bowel (Figure 68.1). The telescoped intestine then acts as the apex of the intussusception (known as the intussusceptum) and completely invaginates into the distal portion of the bowel that receives it (the intussuscipiens) (Figure 68.2). The process of invagination continues, the mesentery is pulled along with the intussusceptum and can travel all the way to the rectum, and as the intussusceptum progresses, the lymphatic return is first impeded and eventually venous drainage is impaired as a result of increased pressure in the wall of the intestine, leading to congestion and oedema of the intussusceptum.

Eventually, the arterial blood supply to this segment of bowel is obstructed. The mucous membrane, which is very sensitive to ischaemia, sloughs off first and is passed out as mucous stools initially; the ischaemic mucosa bleeds when it sloughs off in the end, and this

(A) **(B)**

Figure 68.1: Two infants with manually reduced intussusception: (A) infolding or indentation of the terminal ileum where the intussusceptum started; (B) infolding of the caecum, resulting in a caeco-colic intussusception.



Source: Courtesy of Francis A. Abantanga.

Figure 68.2: Diagrammatic representation of an idiopathic intussusception. The apex is the lead point of the intussusception

blood mixes with the mucosa and mucus to give the classic "red currant jelly stools".

If the swelling, oedema, and ischaemia are not relieved, the lumen of the bowel will become completely occluded, and transmural necrosis of the intussusceptum will set in, leading to fluid sequestration, translocation of intestinal bacteria into the peritoneal cavity, perforation of the bowel, and possibly peritonitis.

Clinical Presentation

The usual presentation is of a healthy, well-fed infant aged between 6 and 9 months on average.

History

There may or may not be an antecedent infection (e.g., a viral infection). A good history eliciting the following findings will most often suggest the diagnosis.

1. There is a sudden onset of uncontrollable/inconsolable crying, which occurs intermittently every 10 to 30 minutes and lasts for a few seconds or so. This coincides with the sudden onset of colicky abdominal pains, when the intussusceptum together with the mesentery and nerves are drawn into the intussuscipiens. The screaming is high-pitched in nature and is unexpected.

2. The child stops screaming and plays normally in between attacks until the next occurrence of colicky abdominal pain sets in. This type of abdominal pain is pathognomonic of intussusception in infants because the pattern in which that the child cries for some time, stops and plays, and starts crying again, is rarely seen in other conditions.

3. During the periods when the child screams, he or she frequently draws up the lower limbs to the abdomen as if to reduce the pain. Between the colicky episodes, the child may appear listless and frequently pale.

4. Vomiting sets in. Vomiting tends to begin earlier in infants and is reflex in nature. Vomiting due to intestinal obstruction is a late sign, and the vomitus may be bilious.

5. Stools may at first be mucoid (the sloughed-off mucosa). Blood in stools may appear as early as within the first 6 hours, but it may also be absent until a day later. Blood mixed with mucus, giving the characteristic appearance of red currant jelly stools of intussusception, is present in only about 30% of cases (Figure 68.3(A)). There are occasions when the bloody mucoid stools are first noticed only after a digital rectal examination (DRE) of the child.

(A) (B)

Figure 68.3: (A) Red current jelly stool 8 hours post presentation. (B) A prolapsed necrotic intussusception, which was found to be ileo-ileocolic intraoperatively. A right hemicolectomy was carried out, and the child survived.

6. The triad of intermittent abdominal pain, vomiting, and bloody stools is encountered in about 30% of infants with intussusception.[10,11]

7. A history of diarrhoea or constipation may be given. However, the parents may give a history of diarrhoea only just before the onset of the bloody mucoid stools. This may lead to confusion in the diagnosis because medical conditions such as dysentery will usually be the first thing to come to mind. As a result, there is a delay in diagnosis, especially if the first-line medical caregiver has a low index of suspicion for intussusception.

8. There may be a history of a recent immunisation using rotavirus vaccine[5,10] or of a viral illness.[3]

9. In older children, the major symptom is abdominal pain, which is present in almost all cases. Bloody stools and vomiting are reported in about 25%. The triad of abdominal pain, bloody stools, and vomiting is a rare combination in this age group, and these are nonspecific symptoms.[14]

Physical Examination

Physical examination will reveal a healthy-looking child, especially if the patient is brought for consultation within the first few hours of the occurrence of the intussusception. In the presence of the typical triad of intermittent abdominal pains, vomiting, and bloody mucoid stools, there is the need to examine the child thoroughly in order to make the right diagnosis.

Infants and toddlers who present late (i.e., after 24 hours), which is the rule and not the exception in the African subregion) will be irritable, weak, and lethargic. To avoid delays in making a clinical diagnosis, the presence of pallor and lethargy in a child who has cried for several hours to days should alert the clinician to these subtle features of intussusception in addition to the presence of any one or two symptoms of the classical triad mentioned above.

The late-presenting child also will be dehydrated, or frankly in shock with cold clammy extremities (typical of late presentation and/or late diagnosis). The degree must be assessed rapidly and corrected appropriately. In addition, the child will be febrile or anaemic.

In those who present early, an abdominal mass may be palpable, if present. In late presenters, the abdomen is distended (sometimes grossly) and tender, and it is difficult to palpate any intraabdominal masses. If the abdomen is tender, with rebound tenderness and guarding, one should suspect the presence of peritonitis and therefore treat it appropriately (see the section "Treatment" later in this chapter).

If the abdomen is not distended (i.e., it is flat or scaphoid), the right iliac fossa feels empty—this is the Dance's sign.

On digital rectal examination, the rectum may be empty or one may palpate the intussusceptum or the lead point of the intussusception in the rectum, and on withdrawal of the examining finger, there may be passage of only mucus or bloody mucoid stools; the finger may or may not be stained with blood. In the late presentations, the chances of passage of blood per rectum are high due to possible necrosis of the bowel. There may be prolapse of the intussusceptum through the anal orifice in those who present very late (Figure 68.3(B)).

Investigations

In resource-poor settings, the physician may not have access to the investigations described here, in which case a high clinical acumen and index of suspicion is the next best alternative. Our management algorithm for the child with intussusception is illustrated in Figure 68.4.

Characteristically, diagnostic investigations include abdominal ultrasound (US) scans in axial and longitudinal views. This is accurate in detecting intussusception with a certainty of up to 100% and can also show additional pathologies such as the presence of a PLP.[6,15,16] It also allows the operator to be able to say whether the intussusception is in the small intestine or the large bowel.

In the axial/transverse view, the intussusception is seen as a target lesion or has a doughnut sign (Figure 68.5). In the longitudinal view, there is a pseudokidney or sandwich appearance. When the radiologist or ultrasonographer sees these two signs, the abdominal mass is likely an intussusception. In most cases, the radiologist is able to tell whether there is a PLP or not.

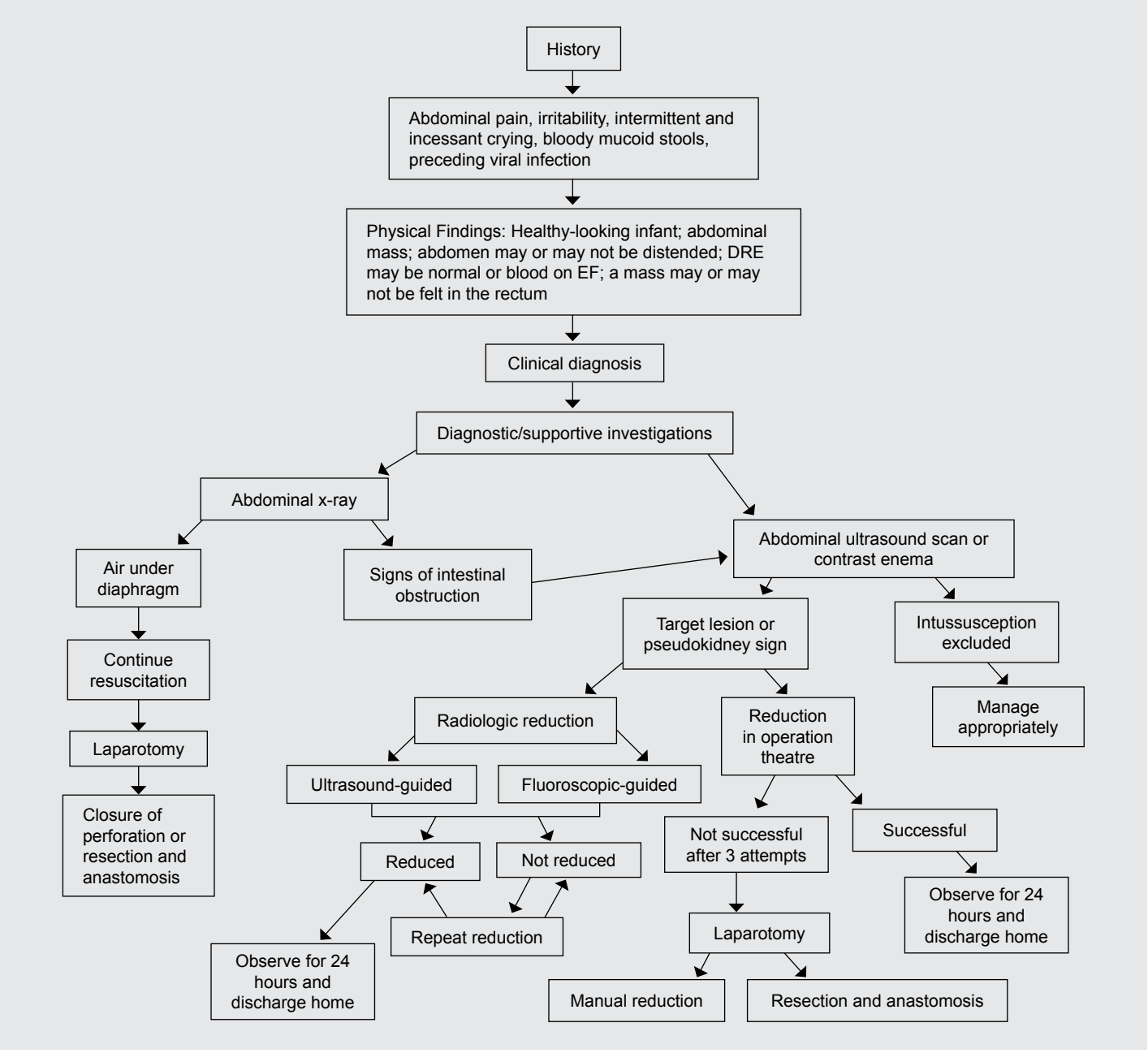
There are definite signs on US that will influence nonoperative management (i.e., hydrostatic or pneumatic reduction); the details of these are beyond the scope of this book but can be obtained from the literature.[17–23] Ultrasound may pick up a PLP (Figure 68.6).

Generally, trapped fluid[17,18] on US scan and the absence of blood flow at Doppler imaging,[6,17,24,25] where available, are indicators of ischaemia, and irreducibility of the intussusception and should be carefully considered in any further management of the lesion.

In the absence of ultrasound, other investigations can be used.

Contrast Enema Examination

The contrast most frequently used is barium solution, but an air enema can also be used. The two main classic signs of intussusception at enema examination are the meniscus sign produced by the rounded apex of the intussusceptum protruding into the column of contrast material and the coiled spring sign formed when the oedematous mucosal folds of the returning limb of the intussusceptum are outlined by contrast material in the lumen of the colon.[6]



(DRE = digital rectal examination; EF = examining finger)

Figure 68.4: Algorithm for the management of a child with intussusception

Figure 68.5: Ultrasound scan showing the doughnut appearance (target lesion) of an intussusception.

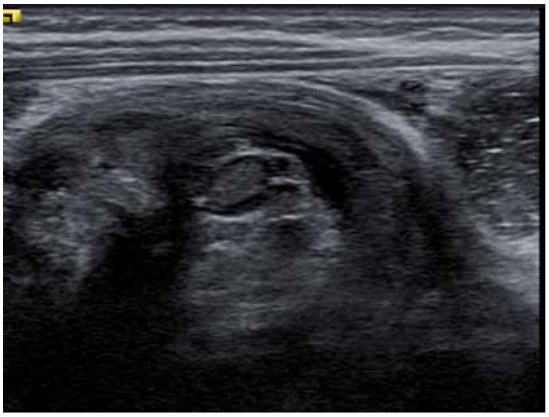
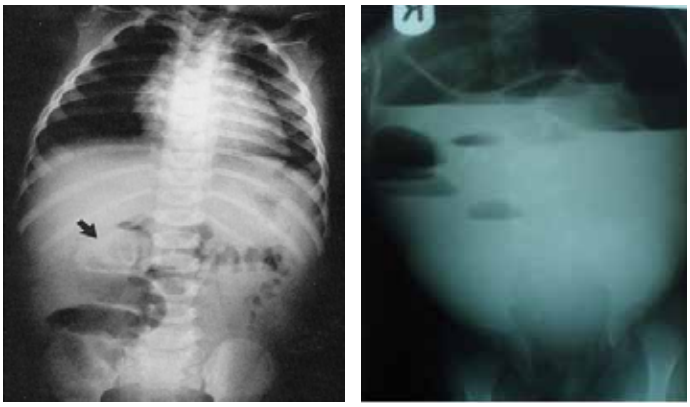


Figure 68.6: Intussusception with lead point.



(A) **(B)**

Figure 68.7: (A) Intussusception on plain abdominal x-ray showing the target sign. (B) Plain erect abdominal radiograph of a 6-month-old child with intussusception, showing multiple air-fluid levels consistent with intestinal obstruction.

Plain Abdominal Radiographs

Plain abdominal radiographs can also be used to diagnose intussusception because there are a number of radiographic signs of intussusception, but they have a poor sensitivity of about 45%. These signs include a soft tissue mass seen at the right upper quadrant, reduced air in the small intestine or a gasless abdomen, and air in a displaced appendix.[6] The two more specific radiographic findings of intussusception are (1) the target sign, seen in Figure 68.7(a) at the right upper quadrant over the kidney, which consists of a soft tissue mass with concentric circular areas of lucency due to mesenteric fat of the intussusceptum; and (2) the meniscus sign (a crescent of gas in the colonic lumen outlining the intussusceptum).

Plain radiographs most often display multiple air-fluid levels indicating intestinal obstruction (Figure 68.7(b)). These are usually late signs. Sometimes, a plain abdominal radiograph in the presence of intussusception may be unremarkable, however.[26]

If the caecum is found to be filled with gas or faeces in its normal position on a plain abdominal radiograph, then intussusception can often be excluded. Plain abdominal radiographs are done to exclude pneumoperitoneum, especially in children who present late with intussusception. Once one or two of the cardinal signs of intussusception are present, however, the radiograph can be used, if available, to help confirm the diagnosis.

Computed Tomography

Computed tomography (CT) scan and magnetic resonance imaging (MRI) very rarely are used for the diagnosis of intussusception, especially in poorly resourced countries. They are of use when the diagnosis of intussusception is in doubt, or the presentation is atypical of intussusception, or when the child has vague abdominal complaints of unknown cause. Also, in a few cases where the US scan is inconclusive or atypical, then either a CT scan or an MRI can be used to make the diagnosis. The presence of a bowel-within-bowel configuration with inclusion of mesenteric fat and/or mesenteric vessels is pathognomonic for intussusception on MRI or CT scan.

Other Investigations

Other supportive investigations include a full blood count (FBC), and blood urea, creatinine, and electrolytes to assess the extent of dehydration.

By using the various investigations (e.g., plain radiography, abdominal ultrasonography, barium enema, CT scan, and MRI), and finally after laparotomy, intussusception can be classified as:[1,25]

- *Enterocolic:* ileocolic (the most predominant type of intussusception seen in infants and toddlers); ileo-ileocolic; ileocaecal;
- *Enteroenteric:* jejunojejunal, jejunoileal, ileo-ileal; or
- *Colocolic:* caecocolic, colocolic.
- Special forms of intussusception include the following:
- *Retrograde intussusception:*[14,16] Invagination of the distal bowel (intussusceptum) into the proximal bowel (intussuscipiens).
- *Postoperative intussusception*: Complicates the postoperative period in about 0.5–16% of laparotomies.[11,12] A majority of cases occur after retroperitoneal dissection or extensive bowel manipulation.
- *Spontaneous reduction of intussusception:* More than half of intussusceptions are asymptomatic and are frequently diagnosed during ultrasonography, barium enema examinations, or CT scan for one reason or another.
- *Other:* Intussusceptions can occur around different catheters (e.g., various feeding tubes such as gastrojejunostomy tubes, nasojejunal tubes,[14] etc.).

Treatment

The treatment of intussusception in children is an emergency, by either nonoperative or operative methods. Delay in treatment will lead to ischaemia and necrosis of the intestine, bowel perforation, peritonitis, shock, and possibly death. Nonoperative reduction (NOR) is the first line of approach where facilities are available; if that fails, the next logical step is operative management.

Contraindications to the use of NOR in the treatment of a child with intussusception are obvious peritonitis,[16,26] pneumoperitoneum secondary to bowel perforation,[16] shock,[16] a grossly distended abdomen (relative contraindication), small-bowel intussusception such as ileo-

ileal or ileo-ileocolic, and a long duration of symptoms before admission to hospital (>24 hours).

Before any mode of treatment is decided upon, the child must be vigorously resuscitated with fluids, including blood if the need arises. A nasogastric tube (NGT) is used to decompress the stomach, an intravenous (IV) line with a large-bore paediatric cannula appropriate for the age is set up, and a urethral catheter is passed into the bladder to monitor the effectiveness of the resuscitative measures by aiming at obtaining 0.5–2 ml of urine per kilogram body weight per hour. Broad-spectrum antibiotics must be started.

Give 20 ml/kg body weight of IV fluids (normal saline (NS) or Ringer's lactate (RL)) in a minimum of 30–45 minutes to a maximum of 1 hour. Repeat this until the child is well hydrated, then put on maintenance fluids using 4.3% or 10% dextrose in one-fifth NS (see Chapter 5, Fluid and Electrolyte Management). The maintenance fluid (NS or RL) is given as 4 ml/kg/hr for the first 10 kg, then 2 ml/kg/hr for the next 10 kg, up to 20 kg and 1 ml/kg/hr for anything more than 20 kg, all in 24 hours. Thus, a 25-kg child will receive: $(4 \times 10 \times 24) + (2 \times 10 \times 24) + (1 \times 5 \times 24) = 960 + 480 + 120 = 1{,}560$ ml of fluid in 24 hours as maintenance fluid.

As stated above, childhood intussusceptions can be managed nonoperatively or surgically. Nonoperative reduction of intussusception is now considered by most paediatric surgeons as the method of choice for its treatment and involves the use of various agents, gaseous or fluid. NOR can be carried out by using fluids such as barium,[6,17,27] normal saline,[6,24] and water-soluble contrast media.[6] This method is referred to as hydrostatic, as opposed to pneumatic or air enema reduction (AER), in which only air[4,18] is used. These agents may be used under either fluoroscopic or ultrasound guidance. Note, however, that barium can induce chemical peritonitis when it leaks through a bowel perforation into the peritoneal cavity. Water is not suitable because it will be absorbed should the procedure be prolonged and cause water intoxication.

The Procedure for NOR

Nonoperative reduction is usually performed in the radiology unit by (paediatric) radiologists with a paediatric surgeon in attendance. The procedure can also be performed by a paediatric surgeon trained in ultrasonography. The procedure involves allowing the fluid (barium solution, water-soluble contrast medium, or NS) to flow at a height of about 100 cm above the level of the buttocks into the rectum and further up the colon to meet the intussusceptum and, under sustained pressure, to reduce it. This is all done under fluoroscopy or US guidance, and the process of reduction is followed carefully. The reduction is considered successfully if there is reflux of fluid back into the terminal ileum through the ileocaecal valve (Figure 68.8(a)).

Air can also be used for reduction of the intussusception. Fluoroscopy-guided or US-guided pneumatic reduction of the intussusception is considered superior to hydrostatic reduction because it is safer, faster, and cleaner, and it requires less radiation. Also, pneumatic reduction has a higher success rate than hydrostatic reduction. It is advisable to use pressures not exceeding 120 mm Hg for the pneumatic reduction of intussusceptions in children. Pressures less than 80 mm Hg are noneffective.

After a successful enema reduction (hydrostatic or pneumatic), the child should be kept in hospital for a period of 24 hours for observation and then can be discharged home. Feeding can also be resumed immediately after the procedure.

The recurrence rate of NOR is less than 10%. Recurrence may be due to incomplete reduction (but under fluoroscopy- or US-guided reduction, that is less likely) or due to the presence of a PLP. A recurrent intussusception should be treated by first trying NOR again; if that fails or a PLP is observed, then surgery is advised.

It is recommended that if the first attempt at enema reduction of the intussusception fails, two or three more attempts can be made, and if these fail to reduce the intussusception, the child should undergo surgical reduction. Surgery is also advised if there is leakage of fluid into the peritoneal cavity as a result of perforation of the bowel. Leakage of air can cause gross abdominal distention, splinting of the diaphragm resulting in acute respiratory distress, and a life-threatening abdominal compartment syndrome.[28] The pneumoperitoneum thus caused is readily recognizable, and immediate intervention in the form of abdominal paracentesis using a large-bore needle (gauge 14 or 16) in the radiology unit before transporting the patient to the operation theatre can be life saving.

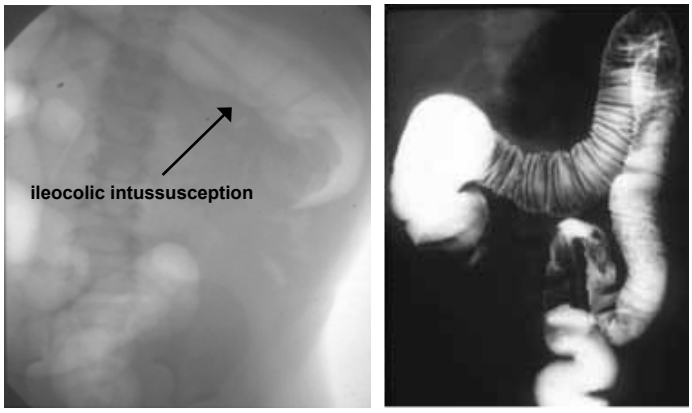


Figure 68.8: (A) Air reduction of an ileocolic intussusception. (B) Barium enema showing intussusceptum in the distal ascending colon.

We believe that the best results are obtained following NOR of intussusception.

Alternative Methodology

In the absence of a fluoroscope and/or US facilities in an institution, air enema reduction of intussusception can be done in the operating room with the child under anaesthesia.[29] This method has been developed locally, and we attest to its safety and suitability for poorly resourced regional or district hospitals in West Africa, where children with intussusception are brought very late to hospital.[30]

The AER method involves submerging the free end of the NGT in a kidney dish filled with water and inserting a 20 or 22 Fr Foley catheter into the rectum (fully blowing up the balloon). An aneroid sphygmomanometer is attached to the Foley catheter (Figure 68.9(A–D)), and air is then insufflated into the rectum between pressures of 80 to 140 mm Hg. Before insufflating air into the rectum, the surgeon first palpates the abdomen under anaesthesia, since the child is now completely relaxed, and determines the position of the mass in the peritoneal cavity. As the air is insufflated, the surgeon continuously palpates and follows the progress of the mass from wherever it was proximally. When the intussusception is completely reduced, air flows proximally into the small intestines and into the stomach. The air passes through the NGT and is noticed as a continuous flow of bubbles in the kidney bowl filled with water. What is important here is that the air flow into the kidney dish must be continuous, which confirms that the intussusceptum has reduced. The balloon of the Foley catheter is deflated and the catheter removed; some of the air will escape through the anal orifice, resulting in the abdomen becoming soft again and less tense.

Then, the abdomen is again examined to feel for the mass. Normally, one cannot palpate the intussusception after a successful reduction (except for the palpation of the reduced oedematous bowel, which requires some experience for one to accept that it is oedematous bowel and not the intussusception that one is feeling beneath the fingers).

The patient is sent to the recovery ward to recover from anaesthesia and can be fed 3 hours after the procedure. The patient is observed for 24 hours, within which period a repeat ultrasound scan is done to confirm the successful reduction of the intussusception or, in the absence of an ultrasound machine, about 10 to 20 ml of barium solution

is given orally (through the NGT, if still in place). This is usually observed in the stools within 24 hours, when the patient can then be discharged home.

If reduction fails after two to three attempts (i.e., the mass is still palpable and its reduction is not progressing), or if there is a suspicion of a perforation of the bowel (air escapes freely and easily into the peritoneal cavity, the abdomen becomes grossly distended, and after removing the Foley catheter no air escapes from the anal orifice), the NOR procedure is immediately suspended and a laparotomy is performed. As a precaution, the instruments for a laparotomy are always set on a tray, and the theatre nurse is scrubbed and gowned, ready and waiting. By using this method in our institution, we have had 59.1% successful reduction rates.[30]

Surgical management is reserved for children with failed hydrostatic or pneumatic reduction of the intussusception; those who develop leakage of fluid into the peritoneal cavity during enema reduction; those in whom free air, peritonitis, or shock was present on admission; or those in whom PLP (e.g., a polyp, enterogenic cyst, etc.) was detected during investigations or after NOR.

(A)

(B)

(C)

(D)

Source: Courtesy of Francis A. Abantanga.

Figure 68.9: Theatre setup for pneumatic or air enema reduction of an intussusception in a 7-month-old child. (A) The child is anaesthetized and ready for AER; (B) close-up view of the setup; (C) the continuous bubbling of air into the kidney dish with water, indicating that the intussusception has been reduced; (D) the complete set of requirements.

Surgical Management

Access into the peritoneal cavity is usually through an above or below transverse umbilical incision. The intussusception (Figure 68.10) is delivered into the wound, and an attempt is made to reduce it manually by a combination of milking and squeezing of the intussusceptum by the surgeon and gentle tugging on the free limb of the intussusceptum by the assistant. If the manual reduction is successful, the operation ends there. Some surgeons will fix the caecum if it is found to be very mobile, and others will perform an appendectomy, depending on which incision was used, to prevent any future confusion should the patient present again later with suspected appendicitis.

If an attempt at manual reduction fails as a result of tears or a perforation in the bowel, or if the intussusception is deemed to be gangrenous from inspection at the beginning of the surgery, or if a PLP is found, then segmental resection is performed with re-establishment of bowel continuity by an end-to-end anastomosis.

Another operative method for reduction of intussusception is by laparoscopic surgery,[31] during which the intussusceptum is pulled out of the intussuscipiens. All the manoeuvres carried out by the open method can be done laparoscopically, including resection and anastomosis.

Postoperative Complications

Postoperative complications include recurrence of the intussusception, perforation of the bowel during NOR of the intussusception, surgical site infection, anastomotic leak, anastomotic breakdown, enterocutaneous fistula (especially if the patient is poorly nourished), postoperative adhesive intestinal obstruction, and incisional hernias.

Prognosis and Outcome

Prognosis is usually excellent if diagnosis is early, resuscitation is carried out thoroughly, and treatment is started early, especially with successful nonoperative reduction of the intussusception. Worldwide, the overall mortality of intussusception is about 1%, and near zero with NOR of the intussusception.

On the African continent, however, mortality is very high, ranging from 12.1% to 35.1%.[2,3,7,9] Recurrence rates following NOR range from 5% to 20%[15,16] with a mean of about 10%.[16] After surgical reduction, recurrence rates range from 1% to 4%.[32]

Figure 68.10: An intraoperative picture of an ileo-ileal intussusception in a child. Note the oedematous and inflamed intussuscepiens and the enlarged mesenteric lymph nodes.

Prevention

In the main, the majority of intussusceptions in children, especially infants and toddlers, are idiopathic and difficult to prevent. Hence, prevention is aimed at educating parents or caregivers about the disease and its potential hazard so that children will be brought early to hospital. Primary medical caregivers also need to be educated to increase their index of suspicion for earlier diagnosis and intervention.

Table 68.1: Evidence-based research.

Title	Sonographic features indicative of hydrostatic reducibility of intestinal intussusception in infancy and early childhood
Authors	Mirilas P, Koumanidou C, Vakaki M, Skandalakis P, Antypas S, Kakavakis K
Institution	Agia Sophia Children's Hospital, Goudi, Athens, Greece
Reference	Eur Radiol 2001; 11: 2576–2580
Problem	To find out which sonographic patterns of intussusception are indicative of reducibility by hydrostatic reduction in children.
Intervention	All children with intussusception underwent sonographic examination of the abdomen using transverse and longitudinal scans. The sonograms were evaluated for (a) a target lesion with multiple concentric rings surrounding an echogenic centre, (b) a doughnut-like mass in the transverse plane in which the thickness of the hypoechoic external ring was measured, (c) appearance of trapped fluid in the doughnut-like or target-like mass, and (d) coexistence of free fluid in the peritoneal cavity.
Comparison/ control (quality of evidence)	The hydrostatic reduction rate was 100% when the head of intussusception appeared as a target lesion; with a thickness of the hypoechoic external ring of the doughnut ≤ 7.2 mm, the reduction rate was 100%; if the thickness was between 7.5 and 11.2 mm, the reduction rate was only 68.9%; if the thickness of the hypoechoic external ring of the doughnut-like mass was more than 14.0 mm, surgical reduction was required.
Outcome/ effect	Wall thickness was found not to be a significant prognostic factor in the reducibility of intussusception, trapped fluid was found to be consistently a poor prognostic feature of reducibility of an intussusception, and free fluid in the peritoneal cavity did not have any adverse effect on air-reduction prognosis.
Historical significance/ comments	This paper is significant in the sense that if one can get a report of the ultrasonographic patterns of the intussusception, it is possible to decide beforehand which intussusceptions will easily reduce without much effort and which ones will need more effort to reduce them or even which ones should not undergo hydrostatic or pneumatic reduction for fear of causing a perforation or reducing a gangrenous bowel.

Evidence-Based Research

Table 68.1 presents a study to find out which sonographic patterns of intussusception are indicative of reducibility by hydrostatic reduction in children. Table 68.2 presents a 10-year-study to determine whether nonoperative management of intussusception is effective and safe in children age 3 years or older.

Table 68.2: Evidence-based research.

Title	Is non-operative intussusception reduction effective in older children? Ten-year experience in a university affiliated medical center
Authors	Simanovsky N, Hiller N, Koplewitz BZ, Eliahou R, Udassin R
Institution	Hadassah Medical Center, Jerusalem, Israel
Reference	Pediatr Surg Int 2007; 23:261–264
Problem	Nonoperative management of intussusception in children aged 3 years or more in order to determine its efficacy and safety in this age group.
Intervention	Clinical features of intussusception were collected from this group of children, recording the age, predisposing factors, symptoms, and signs, with a review of the sonographic and fluoroscopic images to assess the degree of intussusception and possible underlying PLP.
Comparison/ control (quality of evidence)	An abdominal ultrasound scan was done in all 24 children with 26 intussusceptions revealing a pseudokidney sign of intussusception in all and mesenteric lymphadenopathy in 10. Image-guided reduction was attempted in all except one with a small bowel obstruction; in two, barium enema reduction was attempted; and in 23, air enema reduction was performed.
Outcome/ effect	In four children, a PLP was the cause of the intussusception: one Meckel's diverticulum and three Burkitt's lymphoma. Air enema reduction in two of the last three and barium enema reduction in the last one failed to reduce the intussusceptions. Four children failed nonoperative management of their intussusceptions: three by pneumatic reduction and one by barium enema reduction, but when surgery was performed, no PLP was found in any of them. Finally, 18 patients with intussusception confirmed by ultrasound scan, who did not have PLP, were successfully reduced by using air enema.
Historical significance/ comments	This paper confirms the notion that all intussusceptions in children, regardless of age, should be managed by using nonoperative methods (pneumatic or hydrostatic) first. It is only when this fails that surgery should be considered.

Key Summary Points

1. Intussusception is an occlusive-strangulation type of intestinal obstruction that requires early diagnosis and treatment.
2. more than 90% of intussusception cases occur in the age range from 3 months to 3 years, and they are usually idiopathic in nature.
3. Intussusception with a pathological lead point occurs more in the older age group, but can be seen in infants and toddlers.
4. Intussusception is rare but possible in neonates, so clinicians should have a high index of suspicion if there is a prolapsed rectal mass in such children.
5. Diagnosis is clinical and confirmed by ultrasound scan of the abdomen looking for a target lesion/doughnut sign in the axial view and the pseudokidney/sandwich appearance in the longitudinal view.
6. An erect plain abdominal radiograph may be requested for exclusion of pneumoperitoneum, but it is not a routine investigation for diagnosing intussusception. The radiograph will, however, inform one about the presence of intestinal obstruction.
7. Once the diagnosis is confirmed, it is necessary to resuscitate the child for an attempt at hydrostatic or pneumatic reduction under either fluoroscopy or ultrasound guidance first. A maximum of three attempts should be made to reduce the intussusception.
8. All nonoperatively reduced intussusceptions should be observed for a minimum of 24 hours in hospital before being discharged.
9. All patients who are haemodynamically unstable, are in shock, have peritonitis, have bowel perforation either on admission or during nonoperative reduction of the intussusception, are suspected of having a gangrenous bowel (see Figure 68.3) and those who have failed pneumatic reduction should undergo open surgery and an attempt at manual reduction or segmental resection and end-to-end anastomosis.

References

1. Abantanga FA, nii-Amon-Kotei D, Ayesu-Offei H. Intussusception in Kumasi, Ghana: analysis of 84 cases. JUST 1996; 16:95–98.
2. Abdul-Rahman LO, Yusuf AS, Adeniran JO, Taiwo JO. Childhood intussusception in Ilorin: a revisit. Afr J Paediatr Surg 2005; 2:4–7.
3. Bode CO. Presentation and management outcome of childhood intussusception in Lagos: a prospective study. Afr J Paediatr Surg 2008; 5:24–28.
4. Blanch AJM, Perel SB, Acworth JP. Paediatric intussusception: epidemiology and outcome. Emergency Med Australasia 2007; 19:45–50.
5. Kombo LA, Gerbers MA, Pickering LK, et al. Intussusception, infection, and immunization: summary of a workshop on rotavirus. Pediatr 2001; 108:e37.
6. del-Pozo G, Albillos JC, Tejedor D, et al. Intussusception in children: current concepts in diagnosis and enema reduction. Radiographics 1999; 19:299–319.
7. Keita M, Barry OT, Doumbouya N, et al. Acute intussusception in childhood. Aspects of epidemiologic, clinical features and management at Children's Hospital, Donka, Guinea, Conakry. Afr J Paediatr Surg 2006; 3:1–3.
8. Ravitch MM. Intussusception. In: Ravitch MM, Welch KJ, Benson CD, Aberdeen E, Randolph JG, eds. Pediatric Surgery. Year Book Medical Publishers, Inc., 1984, vol. 2, Pp 989–1003.
9. Carneiro PMR, Kisusi DM. Intussusception in children seen at Muhimbili National Hospital, Dar-es-Salam. EAMJ 2004; 81:439–442.
10. Bines JE, Ivanoff B. Acute intussusception in infants and children. Incidence, clinical presentation and management: a global perspective. A report prepared for the steering committee on diarrhoeal diseases, vaccines and vaccine development. In: Vaccines and Biologicals. World Health Organization, 2002.
11. Doody DP, Foglia RP. Intussusception. In: Oldham KT, Colombani PM, Foglia RP, Skinner MA, eds. Principles and practice of pediatric surgery. Lippincott Williams & Wilkins, 2005; Vol. 2, Pp 1297–1305.
12. Ein SH, Daneman A. Intussusception. In: Ziegler MM, Azizkhan RG, Weber TR, eds. Operative Pediatric Surgery. McGraw Hill Professional, 2003, Pp 647–655.
13. Blakelock RT, Beasley SW. The clinical implications of non-idiopathic intussusception. Pediatr Surg Int 1998; 14:163–167.
14. 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.
15. Chahine AA. Intussusception. Available at: http://emedicine.medscape.com/article/930708 (accessed 25 December 2008).
16. Ko HS, Schenk JP, Troger J, Rohrscheider WK. Current radiological management of intussusception in children. Eur Radiol 2007; 17:2411–2421.
17. Mirilas P, Koumanidou C, Vakaki M, et al. Sonographic features indicative of hydrostatic reducibility of intestinal intussusception in infancy and early childhood. Eur Radiol 2001; 11:2576–2580.
18. Britton I, Wilkinson AG. Ultrasound features of intussusception predicting outcome of air enema. Pediatr Radiol 1999; 29:705–710.
19. del Pozo G, Gonzalez-Spinola J, Gomez-Anson B, et al. Intussusception: trapped peritoneal fluid detected with US—relationship to reducibility and ischemia. Radiology 1996; 201:379–383.
20. Reijnen JAM, Festen C, van Roosmalen RP. Intussusception factors related to treatment. Arch Dis Child 1990; 65:871–873.
21. Lee HC, Yeh HJ, Leu YJ. Intussusception: the sonographic diagnosis and its clinical value. J Pediatr Gastroenterol Nutr 1989; 8:343–347.
22. McDermott VC, Taylor T, Mackenzie S, et al. Pneumatic reduction of intussusception: clinical experience and factors affecting outcome. Clin Radiol 1994; 49:30–34.
23. Stephenson CA, Seibert JJ, Strain JD, et al. Intussusception: clinical and radiographic factors influencing reducibility. Pediatr Radiol 1989; 20:57–60.
24. Krishnakumar, Hameed S, Umamaheshwari. Ultrasound guided hydrostatic reduction in the management of intussusception. Indian J Pediatr 2006; 73:217–220.
25. Saxena AK, Seebacher U, Bernhardt C, Höllwarth ME. Small bowel intussusception: issues and controversies related to pneumatic reduction and surgical approach. Acta Paediatrica 2007; 96:1651–1654.
26. Simanovsky N, Hiller N, Koplewitz BZ, Eliahou R, Udassin R. Is non-operative intussusception reduction effective in older children? Ten-year experience in a university affiliated medical center. Pediatr Surg Int 2007; 23:261–264.
27. Atalabi OM, Ogundoyin OO, Ogunlana DI, et al. Hydrostatic reduction of intussusception under ultrasound guidance: an initial experience in a developing country. Afr J Paediatr Surg 2007; 4:68–71.
28. Ng E, Kim HB, Lillehet CW, Seefelder C. Life threatening tension pneumoperitoneum from intestinal perforation during air reduction of intussusception. Pediatr Anaesthesia 2002; 12:798–800.
29. Cheung ST, Lee KH, Yeung TH, et al. Minimally invasive approach in the management of childhood intussusception. ANZ J Surg 2007; 77:778–781.
30. Abantanga FA, Amoah M, Adeyinka AO, Nimako B, Yankey KP. Pneumatic reduction of intussusception in children at the Komfo Anokye Teaching Hospital, Kumasi, Ghana; East Afr Med J 2008; 85:550–555.
31. Wiersma R, Hadley GP. Minimizing surgery in complicated intussusception in the Third World. Pediatr Surg Int 2004; 20:215–217.
32. Irish MS. Intussusception: surgical perspective. Available at: http://emedicine.medscape.com/article/937730 (accessed 25 December 2008).