CHAPTER 17
Surgical Complications of Typhoid Fever

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Introduction

Typhoid fever is a common infection that has continued to be a public health problem in many developing countries,[1, 2] particularly in areas with poor sanitation and limited availability of clean, potable water. The surgical complications of typhoid fever are a cause of significant morbidity and mortality in children in many parts of Africa, particularly in sub-Saharan Africa. The management of intestinal perforation,[3–6] which is the most common surgical complication, has posed a difficult challenge due to its high morbidity and mortality. A controversy remains regarding what should be the best and most effective surgical option for treating these intestinal perforations.

Demographics

The World Health Organization (WHO) conservatively puts the annual global incidence of typhoid fever at 21 million cases, with 1–4% mortality.[2] The disease predominantly affects school-age children (5–15 years of age), although it does occur in younger children.[2]

Children account for more than 50% of all cases of typhoid intestinal perforation (TIP), which is the commonest severe complication of typhoid,[5] with a peak age incidence of 5–9 years. Unlike typhoid fever in adults, which predominantly affects males,[4,7] boys and girls are equally affected.[5,6]

The overall perforation rate of typhoid in children is about 10%, but the perforation rate appears to increase with age, reaching a high of 30% by age 12 years (Table 17.1).[5]

Typhoid fever, with or without intestinal perforation, appears to occur year round,[5,7] but with a slightly higher incidence in the rainy season (Figure 17.1). This is perhaps an indication of the gross defects in sanitation and lack of safe potable water.

Aetiology/Pathophysiology

Typhoid infection is faeco-oral in nature and is due to faecal contamination of food and water. The infection is caused by the bacteria, *Salmonella typhi* (also known as *Salmonella enterica serotype typhi)*, a gram-negative rod found only in humans, and rarely by *Salmonella paratyphi*. The mechanism of transmission and causation of the common surgical complications is as shown in the flow chart in Figure 17.2.

Surgical Complications

Typhoid fever is a systemic infection involving virtually all organs to varying degrees. The more common surgical complications include intestinal perforation; intestinal bleeding; cholecystitis (perforation, empyema); osteomyelitis; and abscesses. Rare surgical complications include pancreatitis, hepatic and splenic abscesses, pleural effusion, and orchitis.

Therefore, the following procedures are called for (note the mnemonic BSU):

- Week 1: Take **B**lood for culture.
- Week 2: Take **S**tool for culture.
- Week 3: Take **U**rine for culture.

Table 17.1: Age and sex of typhoid perforation and perforation rate in children.

Number of typhoid perforations (1987-1996)				Typhoid perforation rate (over 5 years)		
Age (years)	Sex		Total cases (%)	Number of typhoid cases	Total number of perforations	Perforation rate (%)
	Boys	Girls				
<1	1	—	1 (1.6)	25	1	**4.0**
1–4	1	2	3 (4.7)	120	2	1.7
5–9	25	18	43 (67.2)	194	24	12.4
10–12	7	10	17 (26.6)	41	12	29.3
Total	34	30	64 (100)	380	39	10.3

Source: Adapted with kind permission from Annals of Tropical Paediatrics and International Child Health, Liverpool School of Tropical Medicine.

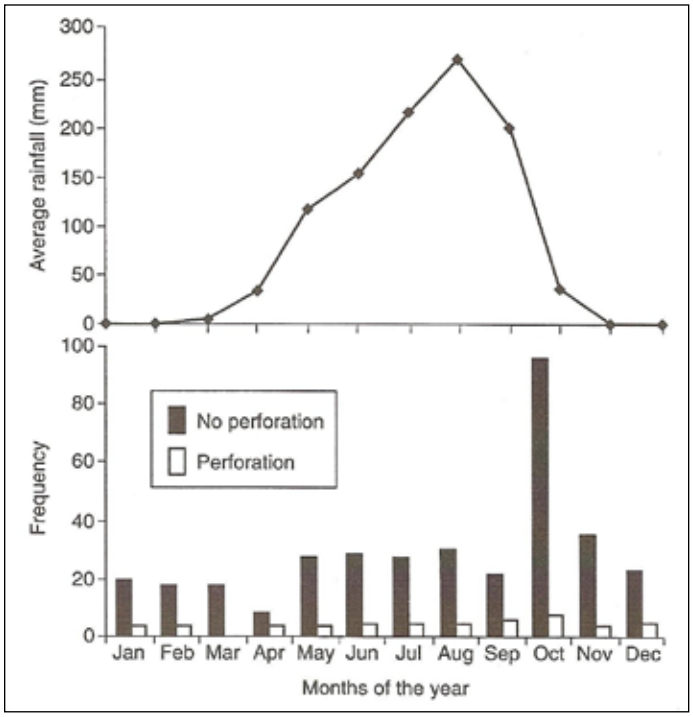

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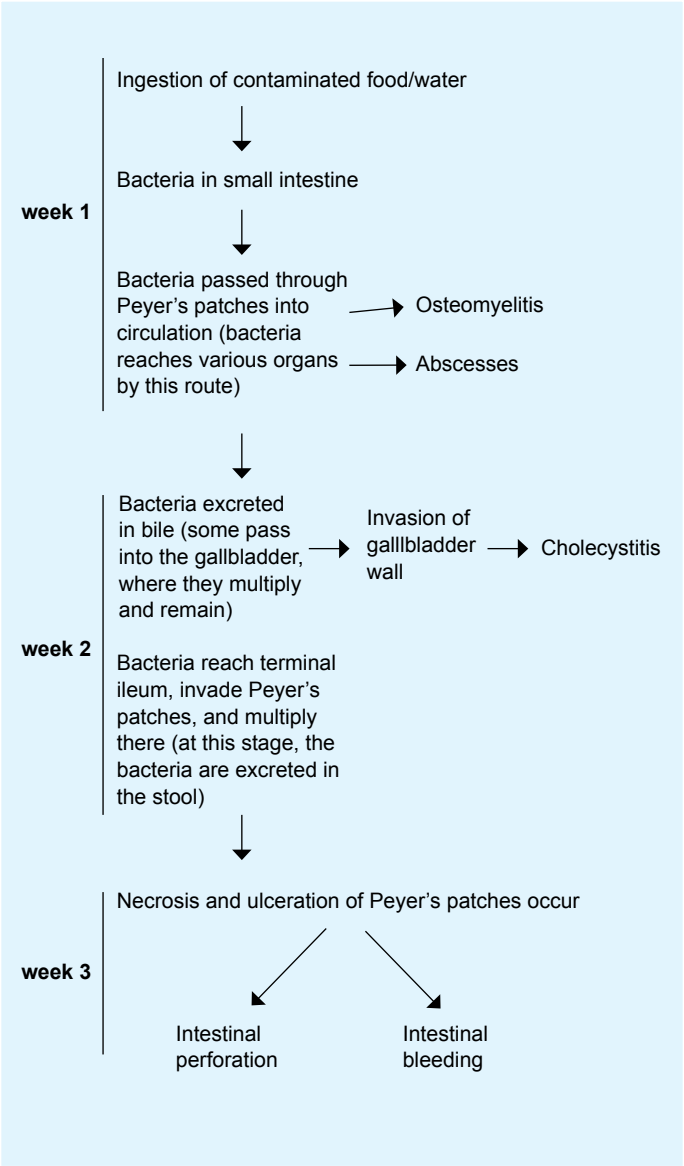
Figure 17.1: Seasonal distribution of rainfall (top) and typhoid fever in children, with and without perforation (bottom).

Table 17.2: Mechanism of surgical complications of typhoid fever.



Clinical Presentation

History

Presentation is commonly late;[5] most patients present several weeks after onset of symptoms, frequently after several attempts at treatment with antibiotics or traditional medications. Symptoms may be atypical in infants and toddlers[3,8] younger than 5 years of age. A little less than 10% develop intestinal perforation under medical treatment,[5] and symptoms may be masked in these patients.

The symptoms include:

- Fever and general body weakness: These are usually the earliest symptoms and always precede abdominal pain (in contrast to appendicitis, for which pain precedes fever). Headache frequently accompanies the fever.
- *Abdominal pain* usually begins 2–30 days (median = 9 days)[5] after the onset of fever. The pain is initially vague but gradually becomes generalised. Although typhoid fever without perforation may be associated with some abdominal pain, this is usually not severe, and the onset of increasing abdominal pain frequently signifies that an intraabdominal complication is setting in.
- *Abdominal distention* can be observed.
- *Diarrhoea or constipation:* Diarrhoea may occur in the early stages, but constipation sets in later in the course of the illness.
- *Passage of blood* in the stool may occur, either as frank or altered blood.
- *Jaundice* may be a complaint.
- *Pain* at the site of the abscess or osteomyelitis.

Physical Examination

These patients are usually very ill; common findings include dehydration, pyrexia, pallor from anaemia (about 50% of children with typhoid perforation have a packed cell volume below 30%[3,5]), and wasting, particularly if the illness has gone on for several weeks.

Jaundice may be present. Shock may also be present, as evidenced by tachycardia and hypotension (blood pressure <80/60 mm Hg); shock is present in about 75–80% of children with typhoid perforation.

Abdominal/rectal examination

There is usually distention, but in a few patients distention may not be remarkable. Patients presenting late may have demonstrable anterior abdominal wall oedema. Bowel sounds are diminished or absent in those presenting late.

Generalised tenderness with guarding is present; this finding, however, may not be remarkable, especially in patients who perforate under medical treatment. Abdominal rigidity is present in only one-third of children with typhoid perforation.[5] A dilated and tender gallbladder may be palpable in the right hypochondrium in patients with cholecystitis.

There may be fullness in the recto-vesical or recto-uterine pouch, suggesting a pelvic collection of pus. Blood may be seen on the examining finger in patients with bleeding.

In osteomyelitis or abscess, the affected site should be thoroughly examined.

Respiratory examination

In very ill patients, respiratory function is compromised by chest infection, which is worsened by the marked abdominal distention. Crepitations may be heard, sometimes bilaterally, indicating that pneumonia has set in and is worsening the child's condition.

Evaluation/Investigations

Because a majority of the patients present with an acute abdomen, intestinal perforation and gallbladder involvement need to be excluded. The latter is most important, as cholecystitis may not require urgent surgical intervention. The diagnosis of TIP is often clinical, based on features of peritonitis,[3,7] and investigations are done to support the diagnosis and identify deficits, as well as to ascertain the fitness of the patient for surgery.

1. *Serum electrolytes, urea, and creatinine:* The levels of sodium, potassium, chloride, and bicarbonate are estimated. They are often deranged, especially in those presenting late. Hypokalaemia is a troublesome problem, and metabolic acidosis may be identified. An elevated urea level is an indication of the severity of dehydration as well as renal compromise; the latter is more likely if hyperkalaemia is also present.
2. *Plain radiography:*

- Chest and upper abdomen (erect film): Some patients with intestinal perforation present evidence of air under the diaphragm. This is present in about 55% of children with TIP,[3] but may be as high as 96% in those with typhoid colonic perforation.[9] The extent of pneumoperitoneum is important as it may be necessary to vent the air to improve respiration and reduce hypoxia. Absence of air under the diaphragm, however, does not exclude perforation. Pulmonary consolidation may be present in those with chest infection.

Figure 17.3: Large pneumoperitoneum from typhoid perforation.

- Full abdomen (erect and supine): The intestines may show dilatation and oedematous walls. Frequently, all that can be seen is a diffuse opacity in most of the abdomen, particularly in those presenting late with intraperitoneal collection. Patients who are too sick for erect film should have a lateral decubitus film to identify pneumoperitoneum (Figure 17.3). The shadow of a distended gallbladder may be obvious, suggesting cholecystitis.

3. *Abdominal ultrasonography:* This is to be done only in patients who do not need urgent surgery and in whom the diagnosis is doubtful; it should identify the following , if present: intraperitoneal abscesses and cholecystitis. The usual evidence of cholecystitis in these patients is mainly dilatation, presence of pericholecystic fluid, and oedematous wall. Other intraabdominal conditions can be excluded.

4. *Microbiological cultures:* Blood and urine, as well as an operative specimen of intraperitoneal fluid/pus, are cultured to identify the *Salmonella* organism and any superimposed infections. In one report of children younger than 5 years of age with TIP,[3] *Salmonella typhi* was cultured from the peritoneal fluid in 46%, urine in 36%, and stool in 32%. In patients in whom intraoperative diagnosis of cholecystitis (and its complication) is made, a sample of gallbladder contents is also cultured.

5. *Complete blood count:* A haemogram is done to identify anaemia. The platelet count is ascertained, particularly in patients with evidence of coagulopathy. Although leucopaenia is a more common finding in patients with uncomplicated typhoid fever, leucocytosis and neutrophilia are more common in those with intestinal perforation or cholecystitis.

6. *Blood grouping and cross matching:* These procedures are necessary in most patients for correction of anaemia or intraoperative use.

7. *Widal's test:* Although found to be positive in one report,[3] this test is rather nonspecific and frequently misinterpreted. It has limited use in the management of these patients.

8. *Further investigations:* These will depend on other complications that are suspected. Note that resuscitation takes precedence over these investigations, which should not delay intervention after resuscitation is complete.

Management

1. *Correction of fluid and electrolyte deficits:* Care needs to be taken to achieve adequate correction. A common cause of death is inadequate replacement of fluid and electrolyte deficits. Four to six hours may be needed to achieve adequate correction.

- Dextrose: Intravenous dextrose in 0.18-0.45% N saline is used in children younger than 5 years of age (the amount of saline used will depend on the serum level of Na^+). In older children, dextrose in 0.9% N saline is used. Large volumes of fluid may be required: 20 ml/kg by bolus infusion is given initially in severely dehydrated patients and those presenting in shock. Ten ml/kg may be repeated after 1 hour if urine output is not satisfactory (never give bolus infusion of any potassium-containing fluid). Thereafter, adjust infusion to maintain a urine output of 1.5–2 ml/kg/hr.
- Potassium (K^+): Once the child is making adequate urine, give at least a daily requirement of K^+ (1–2 mmol/kg/day) until a serum biochemistry result is available. Thereafter, any calculated deficit is added to the daily requirement. The amount of potassium required is added to the intravenous fluid and administered over 18 to 24 hours (do not give more than 10 mmol of K^+ in an hour unless the child is in the intensive care unit (ICU) and is being monitored using an electrocardiogram (ECG)).

2. *Nasogastric decompression:* An appropriate size nasogastric tube is inserted and the stomach decompressed by low pressure suction or intermittent aspiration. This will also help in reducing the pressure on the diaphragm and improve respiration.

3. *Urethral catheter*: An indwelling urethral catheter is left in place to ensure adequate monitoring of urine output.

4. *Reversal of hypoxia:* Hypoxia is a common problem that may affect the integrity of intestinal anastomosis as well as survival. Respiration may be impaired by abdominal distention, peritonitis, and presence of a large pneumoperitoneum. If the pneumoperitoneum is large (see Figure 17.3), insert a size 16G–18G intravenous cannula in the right or left upper quadrant (depending on the site of maximal air collection) to vent the collected gas (avoid the lower border of the liver, if enlarged). The cannula is removed after adequate venting. This manoeuvre often helps to improve respiration and reduce hypoxia. Administer 100% oxygen by nasal catheter until surgery. Oxygen administration may need to be continued for up to 6 hours postoperatively in very ill children.

5. *Blood transfusion:* This is necessary to correct anaemia if the haemogram is <8 gm/dl (packed cell volume of <24%). Anaemia is always corrected before surgery to minimise hypoxia. A rough estimate for blood transfusion is 20 ml/kg body weight to attempt to correct the anaemia before surgery.

6. *Correction of coagulopathy:* A vitamin K injection, 10 mg daily, is given and maintained for at least 5 days.

7. *Antibiotic therapy:* Intravenous, broad-spectrum antibiotics are commenced immediately when the diagnosis of typhoid is suspected. The antibiotics may need to be changed later if there is no improvement and culture results become available. A commonly used effective antibiotic combination is *one* of the following:

- Chloramphenicol (50–75 mg/kg/24 hours in 6-hour dosing) + gentamicin (3–5 mg/kg/24 hours in 8-hour dosing) + metronidazole (7.5 mg/kg/dose given in 8-hour dosing).
- Amoxicillin [50–75 mg/kg/24 hours in 8-hour dosing (or ampicillin, 50–75 mg/kg/24 hours in 6-hour dosing)] + gentamicin (3–5 mg/kg/24 hours in 8-hour dosing) + metronidazole (7.5 mg/kg/dose given in 8-hour dosing).
- Third-generation cephalosporin + metronidazole.
- A quinolone such as ciprofloxacin[10,11] + metronidazole (IV peri-

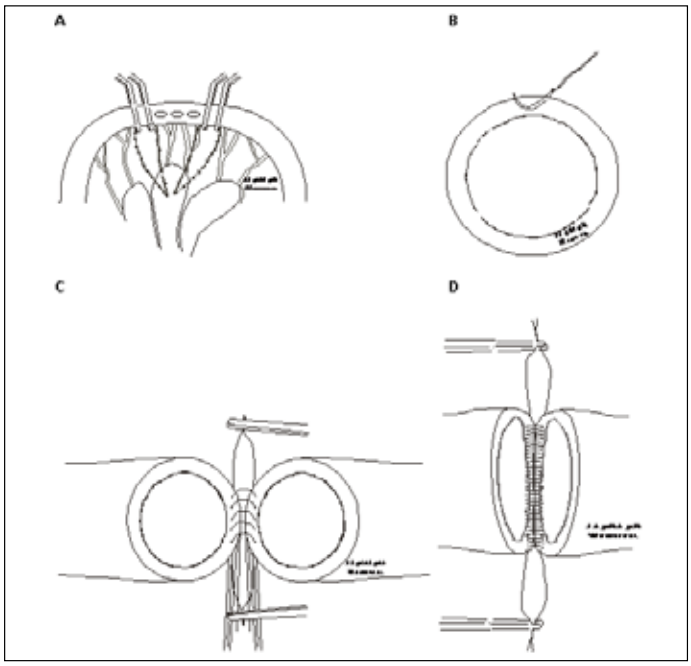


Figure 17.4: Segmental resection of ileum with perforations and end-to-end anastomosis: (A) preparation of bowel with multiple perforations for resection; (B) demonstration of picking only the seromuscular layer; (C) insertion of the posterior seromuscular layer of sutures; (D) posterior seromuscular layer of sutures tied.

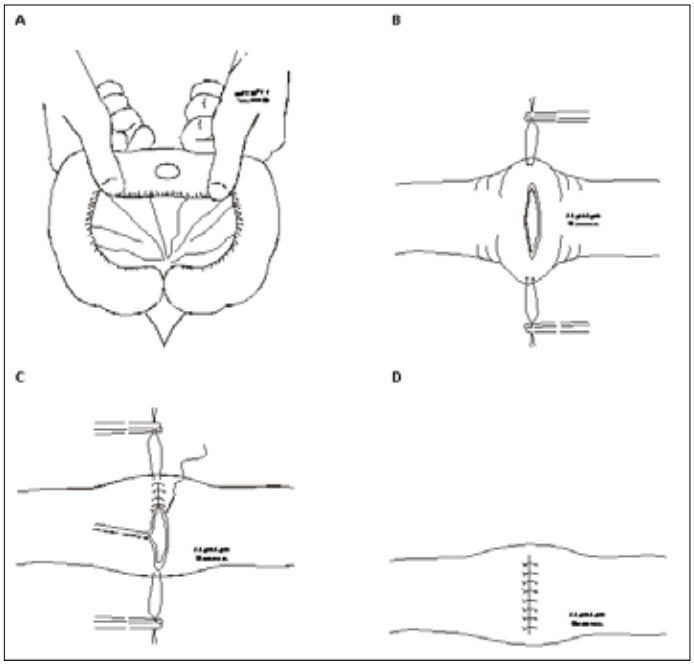


Figure 17.5: Closure of a single ileal perforation in one layer: (A) the perforation on the antimesenteric border of the ileum; (B) after the necrotic edges of the perforation have been excised and stay sutures placed in readiness for a single-layer interrupted seromuscular closure of the perforation; (C) the perforation being closed; (D) the final result of single-layer closure of a typhoid perforation.

operatively). Ciprofloxacin (8–16 mg/kg/24 hours in 2 divided doses IV) and metronidazole as above. Oral ciprofloxacin is given as 10–30 mg/kg in 2 divided doses (this drug combination may be given with or without gentamicin).

The chosen antibiotic regime is continued postoperatively until the temperature returns to normal. Thereafter, the drugs are continued orally (if an oral form is available) for 7–14 days.

Definitive Treatment

Intestinal Perforation

The definitive treatment for intestinal perforation is operative—to evacuate faecal contamination and prevent further contamination. Surgery is done only when the child is adequately resuscitated. Blood transfusions may need to be continued intraoperatively or even postoperatively. If the child is too sick, nonparalysing anaesthesia and hypotension-producing anaesthetic agents (e.g., ketamine hydrochloride) are considered.

For the abdominal incision in small children, a transverse upper or lower abdominal incision is used. If perforated appendicitis is a strong differential diagnosis, a lower transverse incision is more appropriate; if complicated cholecystitis or perforated duodenal ulcer is a strong differential diagnosis, an upper transverse incision is more appropriate. In bigger children (>8 years of age), a long midline incision centred on the umbilicus may provide better exposure.

Once the peritoneal cavity is opened, a specimen of any peritoneal fluid or pus is taken. All peritoneal collections are evacuated. The intestines are thoroughly examined, beginning at the ileocaecal junction until the duodenojejunal junction is reached. The perforation(s) are usually located on the antimesenteric border, and near perforation(s) may also be identified. Leakage from any identified perforation is controlled by a Babcock's forceps clamped lightly over a piece of gauze. Alternatively, the bowel with the piece of gauze over the perforation is handed over to the assistant to put light pressure over it to prevent leakage of intestinal contents while the surgeon continues inspecting the rest of the intestine.

After identifying the perforation(s), the stomach, duodenum, large intestine, liver, and spleen are inspected. Most perforations are located in the last 80 cm of the terminal ileum,[3,5,7] but, rarely, the jejunum and colon (caecum to sigmoid colon)[9] may also be involved. The definitive surgical procedure is decided only after completing the examination of the entire small and large intestines because the sites and number of perforations may dictate the procedure of choice, and there may be areas of impending perforation, which would appear paper-thin on the serosal surface.

Currently, the surgical options are:

1. *Segmental resection of affected intestine* (Figure 17.4): The resected segment should include all perforations and near perforations. The resection margin should be healthy and free of evidence of inflammation such as oedema. Segmental resection is a good choice even for a single perforation. A limited right hemicolectomy may be necessary if the most distal perforation is too close to the ileocaecal junction for safe anastomosis (i.e., <3 cm). The resected length of intestine is always measured and documented. Then intestinal continuity is restored by end-to-end anastomosis. The resected segment is sent to the lab for histopathology.
2. *Simple closure of perforations* (Figures 17.5 and 17.6): This procedure may be used for a single perforation, if perforations are far apart, or if the number of perforations are so numerous that resection may result in a short gut. The edge of the perforation is excised circumferentially (the excised edge is sent to the lab for histopathology). Then simple closure is achieved by a single layer of interrupted, seromuscular stitches.
3. *Enterostomy* (Figure 17.7): An enterostomy is performed if the child is too sick or intestinal oedema is too extensive for safe

anastomosis or simple closure. The perforation (if single) or the proximal and distal ends (following segmental resection) of the intestine are exteriorised as stoma, to be closed at a later date when oedema has subsided and the patient is fit. In very ill patients, a T-tube placed in the lumen after closing all distal perforations has been found to be effective.[12]

Note: Be sure to clean the peritoneal cavity with copious amounts of normal saline.

The fascia and skin are closed; however, if the anterior abdominal wall is oedematous, the skin is left open (delayed primary closure is done after 3 days if there is no wound infection). If the skin is closed in the presence of abdominal wall oedema, surgical site infection frequently occurs.

Where there is severe contamination of the peritoneal cavity with faeculent peritoneal fluid and/or pus, the alternative is to pack the peritoneal cavity with abdominal packs soaked in normal saline and return to close the wound in 48 to 72 hours. This delayed primary wound closure allows a second look to inspect the peritoneal cavity for fluid/pus collection, inspect the suture line or anastomosis for leakage, and repair perforations missed during the first surgery or even reperforations.

Cholecystitis

Cholecystitis and perforation of the gallbladder are important complications[13–15] that occur with increasing frequency. If the diagnosis is certain and no evidence of perforation or gangrene exists, the antibiotics described earlier under "Management" (#7, Antibiotic therapy) are administered and the patient is monitored. If the fever subsides and the child improves, the antibiotics are continued for 7 to 10 days. A cholecystectomy is performed after 6 to 12 weeks.

If the above treatment fails or there is evidence of general peritonitis (perforation or gangrene), treatment is operative. A laparotomy is performed and the specimen of gallbladder contents is sent for culture. A tube cholecystostomy, using a Foley or Malecot catheter, is performed. When all evidence of inflammation has subsided, the tube is removed (note that a tube cholangiogram may be necessary before removal of the tube).

Intestinal Bleeding

After resuscitation, the antibiotics described earlier under "Management" (#7, Antibiotic therapy) are started. The antibiotics are continued for 10 to 14 days after cessation of bleeding. Blood loss may need to be replaced by blood transfusion. The patient is kept in hospital for 5 to 7 days after the bleeding has completely stopped—this is necessary because the bleeding may recur.

Osteomyelitis

Some of the affected patients may have sickle cell disease, which is treated accordingly. Administer chloramphenicol (50–75 mg/kg/24 hr in 6-hour dosing); ampiclox (100 mg/kg/24 hr in 6-hour dosing); or third-generation cephalosporin, initially by intravenous route until temperature returns to normal, then orally for 4–6 weeks. Caution is advised if chloramphenicol is going to be used for a long time.

Any associated abscesses are drained. The affected limb may need to be splinted and elevated until the pain and oedema subside.

Abscesses

Abscesses can occur in any part of the body; they can be superficial or deeply located. The abscess is drained and the patient is given appropriate antibiotics.

Malnutrition

Some of the patients are malnourished or nutritionally depleted. Parenteral nutrition, if available, is given during the acute phase of the illness. When the patient is able to tolerate oral intake, a diet rich in proteins and carbohydrates is given—small, frequent feedings are better tolerated than a large amount at one time.

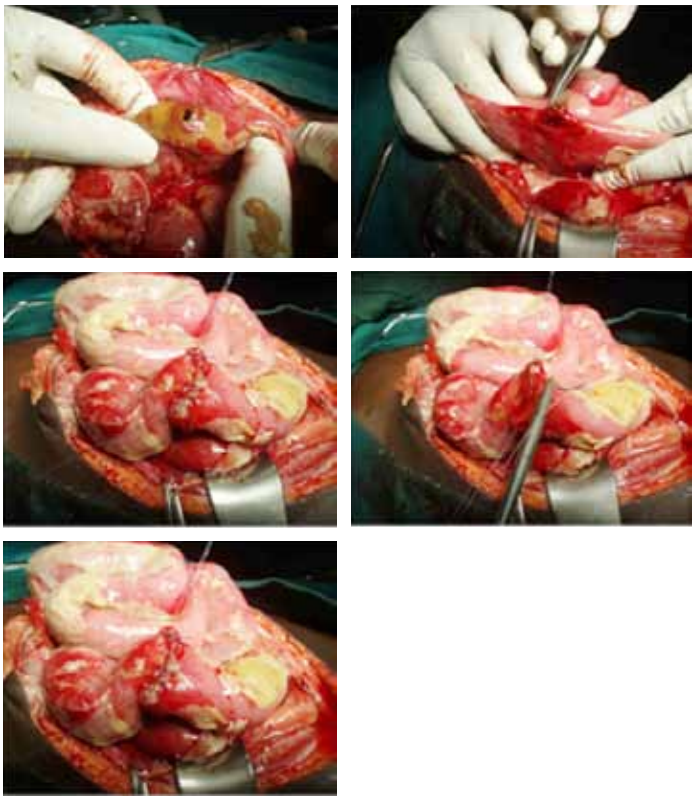


Figure 17.6: Closure of a single ileal perforation after excising the necrotic edges together with the inflamed surrounding area (see Figure 17.5).

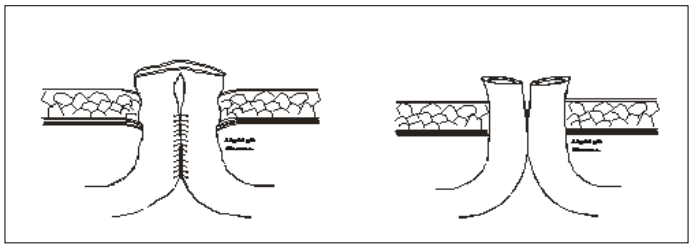


Figure 17.7: Diagrammatic illustration of an enterostomy.

Postoperative Complications

Complications are frequently encountered, particularly in patients who have had intestinal perforation. The more common complications include:

1. *Prolonged ileus* may last for several days and manifest as increasing or persistent nasogastric drainage. Adequate fluid and electrolyte balance, nasogastric drainage, and parenteral nutrition are maintained, and the condition usually resolves on this treatment.

2. *Surgical site infection* is one of the most common complications occurring in 49–59% of patients with TIP.[3–5] Infection is usually superficial in the wound but may be deep. If the infection is deep, anastomotic leakage is suspected. A swab from the wound is cultured to ascertain the microorganisms and their antibiotic sensitivity. Treatment is by local wound care (native honey is quite effective). If the skin was previously sutured, some of the stitches may need to be removed to allow drainage. After the infection is under control, secondary suturing of the wound is performed; if the wound contracts, and the residual wound is small, it is allowed to heal by secondary intention.

3. *Abdominal wound dehiscence* may be partial or complete. This has been reported in 3–14% of children with TIP,[3–5] and is frequently the result of surgical site infection, anastomotic leakage, or intraperitoneal

abscess. These causes are considered and excluded. A reoperation is required: the anastomosis is inspected and handled accordingly if there is leakage; any abscess collection is evacuated and the peritoneal cavity cleaned; the fascia is closed with continuous suturing using appropriate size nonabsorbable suture. Tension-relaxing sutures may need to be applied for 7 to 10 days to take the tension off the fascial closure.

4. *Anastomotic leakage or complete breakdown of the anastomosis* has been reported in about 7% of children with TIP and usually requires relaparotomy. The initial anastomosis is resected and another anastomosis effected. Alternatively, the ends of the intestine are exteriorised as stoma, to be closed at a later date when safe to do so.

5. *Enterocutaneous fistula* will usually close spontaneously with nonoperative management. If there is evidence that it is an end fistula, or if copious intestinal fluid (high output fistula) is discharging through the wound, or if there is peritonitis, relaparotomy is required and the situation is then handled as in the case of anastomotic leakage.

6. *Intraperitoneal abscess* (7–9%)[3,5] usually manifests as a return of fever in a patient who had started to improve. The abscess may be due to a leaking anastomosis or inadequate toileting of the peritoneal cavity with copious amounts of normal saline. Abdominal ultrasonography should confirm the diagnosis. Relaparotomy is required. The anastomosis is inspected to identify any leakage. The abscess is drained and the peritoneal cavity is thoroughly cleaned.

7. *Adhesion intestinal obstruction* may occur several days to years later. It is treated nonoperatively initially (IV fluid resuscitation, analgesics, regular reassessment—preferably by the same surgeon and antibiotics). If evidence of intestinal strangulation or nonoperative treatment fails (intensification of abdominal pain, increased abdominal distention with tenderness and rebound tenderness, and guarding or failure of the general condition of the patient to improve), a relaparotomy is done to release adhesions.

8. *Reperforation* may occur at a new site in 7–9% of children with TIP.[5] It may be the result of an unidentified impending perforation or progression of ongoing infection. A relaparotomy is required and the perforation is handled on its merit.

9. *Hypoproteinaemia* occurs postoperatively in most cases. This manifests in pitting oedema of the feet and ankles. A blood sample is taken for serum proteins, and the condition is treated with fresh blood or fresh frozen plasma (FFP) where available.

10. *Pleural effusion*, although rare, can occur in the postoperative period and is usually unilateral. If the effusion is massive, either it is drained by tapping, or a chest tube is passed immediately for drainage.

Prognosis and Outcomes

Of the children treated for TIP, 53–79%[3,5,6] develop one or more complications. One report suggests that the complication rate may be significantly higher in children younger than 5 years of age.[3] The spectrum of these complications is discussed above.

Mortality from TIP appears to vary widely, ranging from 12% to 41%,[3–5] but a mortality of 0% was reported in children with typhoid colonic perforation.[9] Most mortality is from overwhelming infection, occurring usually after an average of 4–5 days postoperatively. The single most important significant predictor of death in patients with TIP is the duration of abdominal pain after 7 days.[3,5,7] The number of perforations does not appear to significantly affect mortality.

Prevention

Typhoid fever and its complications can be largely prevented by simple public health measures. Current preventive measures include improvements in sanitation and water supply and vaccination.

Improvements in Sanitation and Water Supply

As a faeco-oral infection, typhoid fever is controlled by improvements in sewage and waste disposal, as well as provision of safe potable water. Where piped water is not feasible, provision of bore holes is useful. Community health education regarding waste disposal and discouraging defaecation in the open is relevant.

Vaccination

Although vaccination is not routine at this time, WHO has recommended it as a short-term measure in high-risk areas.[1,2] Two vaccines are considered safe and effective and are presently licenced internationally for those aged >2 years:[2] the injectable Vi polysaccharide and the live attenuated oral Ty21a vaccine (available as a capsule and in suspension). The vaccines are recommended for control of typhoid in high-risk groups and populations as well as for outbreak control. Vaccines may also be offered to travellers to endemic areas. These vaccines are not licensed for use in children aged <2 years. Other improved vaccines are presently being tested, including the Vi-protein conjugate vaccine, which could be useful for children below 2 years of age[1] if eventually licenced.

Evidence-Based Research

The references cited in Tables 17.2 and 17.3 present the effects of operations and surgical management of typhoid perforations in children.

Table 17.2: Evidence-based research.

Title	Comparison of three operations for typhoid perforation
Authors	Ameh EA, Dogo PM, Attah MM, Nmadu PT
Institution	Department of Surgery, Ahmadu Bello University Teaching Hospital, Zaria, Nigeria
Reference	Br J Surg 1997; 84(4):558–559
Problem	Extent of surgery in children with typhoid ileal perforation.
Intervention	Three different operations for typhoid perforation in children.
Comparison/ control (quality of evidence)	Compares three procedures in the operative management of a difficult problem of typhoid ileal perforation in children—simple closure, wedge resection and anastomosis and segmental resection, and anastomosis—by using the same management protocol for all patients.
Outcome/ effect	In all the three operative methods used, the mortality rates were still high, especially so in the wedge resection group. Despite this high mortality, segmental resection with end-to-end anastomosis, where appropriate, gave better results in this study.
Historical significance/ comments	Morbidity and mortality rates in typhoid perforation of the ileum are high irrespective of the surgical procedure used. The need exists to prevent the disease as a whole, but failing that, the management protocol for children with typhoid ileal perforations should include early aggressive resuscitation, antibiotics and analgesics, early limited/minimal surgery, thorough peritoneal toileting (cleaning), blood transfusion and oxygen support (where necessary), and early enteral feeding with supportive care.

Table 17.3: Evidence-based research.

Title	Typhoid colonic perforation in childhood: a ten-year experience
Authors	Chang Y-T, Lin J-Y, Huang Y-S
Institution	Division of Pediatric Surgery, Department of Surgery, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
Reference	World J Surg 2006; 30:242–247
Problem	The ideal treatment of typhoid colonic perforation in children.
Intervention	Three different ways of surgical management of typhoid colonic perforations in children.
Comparison/ control (quality of evidence)	Compares three methods of surgically treating typhoid colonic perforations in children: primary closure of the perforation with ileostomy, wedge resection and simple closure, and partial colectomy with colostomy.
Outcome/ effect	One hundred percent survival rates, mainly attributed to the institution of total parenteral nutrition (TPN) after sufficient hydration. Another outcome measure was length of hospital stay (LOS), which was shorter for the wedge resection and simple closure group than for the others. Complications were similar to those seen in cases of typhoid ileal perforations.
Historical significance/ comments	Typhoid colonic perforation is rare in the authors' subregion, but it does occur. Paediatric surgeons should be suspicious when the ileum is inspected for perforations and none are found, and should inspect the colon. The small size of the sample in the study notwithstanding, useful lessons are to be learned from it, especially the use of TPN to keep the patients nourished until normal bowel movement is fully recovered, which can definitely play a major role in the survival of patients.

Key Summary Points

1. Diagnosis of typhoid intestinal perforation (TIP) is mostly clinical. Plain erect/supine abdominal x-rays and/or chest x-ray may show pneumoperitoneum in about 75% of patients.
2. Most patients are very ill, anaemic, hypoproteinaemic, malnourished, and may have toxic myocarditis. Prepare them well before surgery.
3. Most patients have fluid and electrolyte imbalance. Initial electrolytes may be normal, but repeat check after resuscitation, as they often become deranged by then. Check electrolytes (esp. K^+, Na^+, and Cl^-) in all patients and correct imbalances before surgery.
4. Give appropriate antibiotics that are effective against *Salmonella typhi* and anaerobes (usually, a minimum of two antibiotics) and analgesics.
5. Eliminate continuous peritoneal contamination by surgery. Simple closure or segmental resection and anastomosis are effective. If the child is too ill, exteriorise the segment of bowel with the perforation as an ileostomy. Thorough peritoneal lavage/ toileting with copious amounts of normal saline is mandatory.
6. Strictly monitor input/output for all children with TIP and at least repeat the haemogram and electrolytes 48 hours after surgery and correct any derangements.
7. Use total parenteral nutrition (TPN) where available, but convert to enteral feeding as soon as practicable.
8. Reassess the child daily to identify any postoperative complications and deal with them as soon as feasible.

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