General Surgery Essentials

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Introduction

General surgical conditions span a wide variety of disease states. This chapter will focus on emergent or urgent general surgical conditions and their management in low- and middle-income countries (LMICs). In resource-limited settings, barriers to care are significant and include acceptability, accessibility, availability, and affordability. Patients often present in late stages of their disease states, which impacts perioperative considerations and management. Providers are often required to diagnose surgical conditions without the laboratory and imaging studies that are typically used in high-resource settings. It is prudent to understand available resources, drugs, personnel, instruments, supplies, blood, and postoperative care setting, and factor these into decision-making. It is also vital to understand the local context and culture. Situational ethics often come into play for procedures that carry possible reproductive consequences, amputations, and informed consent. The primary decision-maker must be identified and may include a male spouse (especially for procedure with reproductive consequences), family elder, or village leader. Additional factors such as the financial obligations of the

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patients for the care must be taken into consideration. Often, patients will be asked to purchase and obtain supplies for a procedure including drugs, IVs, sutures, and dressings as well as pay a fee upfront for any care. Patients and their families' decision-making can include declining lifesaving procedures due to financial constraints. Practicing general surgery in the global setting requires full consideration of all elements to successfully treat each patient; contextual understanding is vital in this process.

Initial Assessment of the Surgical Patient

The history and physical exam is of primary importance in the global setting as laboratory and imaging resources may not be available to aid in the diagnosis. Key portions of the history for all general surgery patients include, but are not limited to, nutritional status, HIV status, diabetic history, and social considerations such as ability to adhere to treatment or follow-up. It is also common that patients present with anemia due to chronic conditions making a preoperative hemoglobin of 7–8 gm/dl not uncommon. This must be factored into operative decision-making. These and other conditions/factors may impact the surgical care and outcomes of each patient.

Differential Diagnosis

An expanded differential is important to consider in these settings, as conditions are often encountered in limited resource settings that are not commonplace in Western practice. Differential diagnoses must include consideration of surgical manifestations of infectious diseases and presentations of diseases in a younger age group than commonly seen in the developed world. These conditions may be far along in their disease state, and more urgent surgical intervention may be required.

Procedures

For all invasive procedures, it is imperative to keep in mind that patients may have diseases that can be transmitted through needlestick or other bodily fluid exposure. Patients in some LMICs may have a much higher incidence of diseases such as TB and HIV; therefore, it is the surgeon's responsibility to make sure that they and their team are as prepared as possible. Personal protective equipment is not as readily available in many settings, so consideration should be given to bringing eye protection, N-95 masks, and needlestick prophylaxis kits for HIV.

Skin and Soft Tissue

The Essentials

- Subcutaneous abscesses, pyomyositis, and intramuscular abscesses are common.
- Many patients are malnourished and may be immunocompromised.
- Use of ultrasound is valuable to differentiate cellulitis, abscess, and pyomyositis.

Infectious soft tissue conditions comprise a larger surgical burden in LMICs compared to high-income settings where antibiotics and primary care are more readily available. In LMICs, patients have frequent injuries from walking without shoes and farming activities. In LMICs, deeper infections and multifocal locations are more commonly seen. A common pitfall is incomplete drainage and irrigation of abscess cavities.

Abscess

Compared to high-income settings, there is a larger etiology of soft tissue abscesses in LMICs, and many organisms can be involved. Patients often present with pain, tenderness, warmth, and swelling at the site of infection. Laboratory studies are often not required for diagnosis; though the use of ultrasound (US) can help distinguish between a superficial abscess and pyomyositis. It is also more common to see abscesses in young children, often in the neck or head area (Fig. 13.1). Adequate incision and drainage with copious irrigation is the mainstay of treatment. Decisions about use of local anesthetics, conscious sedation, or general anesthesia need to be made on a case-by-case basis. Often the site of the incision can be determined by palpation of fluctuance or the point of maximal tenderness, but US can assist in locating the cavity as can needle aspiration. If possible, send the fluid for culture.

Fig. 13.1. (**a**, **b**) Show an abscess of the right neck of two children. (**c**) Shows an abscess of the posterior scalp of a child

The most common organisms are *Streptococcus* and *Staphylococcus*, and starting antibiotics before or after drainage can assist in resolution. Though wound care is difficult in LMICs, a common pitfall is making the incision too small and not adequately breaking up and draining the cavity. To ensure continued drainage, placement of a drain and use of a cruciate incision can be useful. Close follow-up exams and wound care are needed initially to ensure resolution. If the abscess cavity is completely drained and surrounding cellulitis resolved, continued antibiotics are not warranted. If a patient does not improve, re-exploration of the wound is required [1].

Pyomyositis

The Essentials
- Pyomyositis is an infection of the skeletal muscle.
- Other considerations: infected hematoma post trauma.
- Diagnosis: tense painful muscle – aspiration and/or US can be helpful.
- Treatment: systemic antibiotics and drainage of the muscular abscess.

Definition

Pyomyositis, also known as tropical pyomyositis or myositis tropicans, is a bacterial infection of the skeletal muscles that eventually results in a pus-filled abscess. It can account for approximately 5% of hospital admissions in tropical areas, and in patients with HIV, the incidence can be as high as 31% [2]. *S. aureus* is the most common organism cultured, but other organisms including streptococci and gram negatives can also be responsible. It is also not uncommon to have "sterile pus" and no organisms identified [2]. The etiology is not well characterized and is thought to be possibly due to hematogenous spread of bacteria to a muscle area that may have been damaged by previous trauma, parasite infection, or malnutrition that allows for bacterial growth in skeletal muscle which is typically infection resistant.

Signs and Symptoms

The muscles most commonly affected are the quadriceps, glutei, pectoralis major, serratus anterior, biceps, iliopsoas, gastrocnemius, abdominal, and spinal muscles [3]. Typically a single muscle group is infected, but patients can present with infection in more than one site up to 20% of the time [4]. The disease presents in three stages depending on the time to presentation to the clinic or hospital [5].

Stage 1: This is characterized by systemic complaints of fever, malaise, and muscle pain and swelling. The muscle group may feel woody and indurated. There is no overlying cellulitis and no abscess can be palpated or seen on ultrasound. If recognized at this stage, oral antibiotics with good staph coverage may treat the infection, but patients should be monitored because abscess formation is still possible. Approximately 2% present at this stage.

Stage 2: Almost 90% of patients present in this, the suppurative phase. It is typically 1–3 weeks after the initial presentation of muscle pain and is characterized by fever, exquisite muscle tenderness, and edema. The muscle over the abscess is tense and painful. But there is often no erythema visible and no skin signs of the deep-seated infection making the diagnosis of deep abscesses challenging. Aspiration with or without ultrasound typically demonstrates pus and confirms the diagnosis. If left untreated, the infection can progress to sepsis and bacteremia.

Stage 3: This is the least common presentation and is characterized by systemic toxicity from untreated worsening muscle infection, bacteremia, and septic shock and its attendant complications.

Diagnostic Tests

Needle aspirate the muscle group at the site of maximal firmness. Since the abscess is usually quite deep, a longer needle may be necessary to reach the cavity. Ultrasound can be helpful to identify if a deep abscess is present and assist during aspiration.

Special Considerations

Have a high index of suspicion in HIV-positive patients; if no abscess is present on presentation, patients should be observed on antibiotics for a few days to make sure that an abscess does not form.

Treatment

Administer systemic antibiotics with excellent staph/strep coverage combined with incision and drainage of the abscess. Traditionally, surgical incisions were done to allow packing of the cavity, but now with the experience of successful percutaneous drain placement via radiographic guidance in high-resource settings, it is time to consider the use of smaller incisions to allow for drain placement and removal of all pus in the low-resource setting. If the abscess responds to drain placement via an incision, this would save the difficulty of handling an open wound in the low-resource environment. If the patient did not improve, then more extensive incision and drainage could be done.

Necrotizing Soft Tissue Infections

Necrotizing soft tissue infections are most often caused by mixed gram-negative and gram-positive organisms, often gas producing, which are rapidly evolving and can quickly track either in the subcutaneous space or along fascial planes (fasciitis) and even involve the muscle. On physical exam, the characteristic finding is pain out of proportion to what would be expected, especially when not directly over the obvious site of infection. Crepitus over the involved tissue, and gas on plain x-ray imaging, is diagnostic of a necrotizing soft tissue infection that requires prompt attention. Other skin changes such as necrotic areas and bullae can also be present. Necrotizing infections often require extensive tissue debridement to healthy tissue, though even

with these measures, septic shock is the most common cause of death. In LMICs, full laboratory services are likely not readily available so reliance on history and physical exam will guide diagnosis and management. When in doubt, an operative exploration is indicated to distinguish between cellulitis and a necrotizing soft tissue infection. Care for these patients can be very challenging in resource-limited environments due to the lack of critical care and ventilation capabilities. Such resource limitations may factor into survivability of the patient and should be discussed with the family.

Treatment should commence with immediate broad-spectrum systemic antibiotics to cover both gram-positive and gram-negative organisms. Older medications such as penicillin G, clindamycin, and gentamycin are effective agents and should be administered if the more modern antibiotic regimens with extended spectrum penicillins and vancomycin are not available. Simultaneous fluid resuscitation with isotonic crystalloids should be administered while setting up the operating room for an emergent debridement. It is imperative to remove all involved skin, soft tissue, and when involved the fascial layer and involved muscle. Tissue usually has a grayish discoloration and does not bleed. "Dishwater"-appearing fluid leaks out from the affected tissues. Debridement should occur until bleeding and live tissue is reached (Fig. 13.2). Patients may require additional operative debridements to fully control the infection. Initially patients should be placed in the highest monitored setting available due to risk of ongoing septic shock. Repeat examinations of margins of the debrided wound to ensure no progression should occur often in the first 24–48 h until the extent has been fully declared. Decisions to return to the OR for additional debridements should be based on clinical parameters of improvement or the lack thereof.

Gangrene (Amputations)

Patients with peripheral arterial disease and/or uncontrolled diabetes can develop serious sequela that span the spectrum from severe soft tissue infection to gangrene (tissue necrosis). This commonly impacts the distal extremities, mostly the

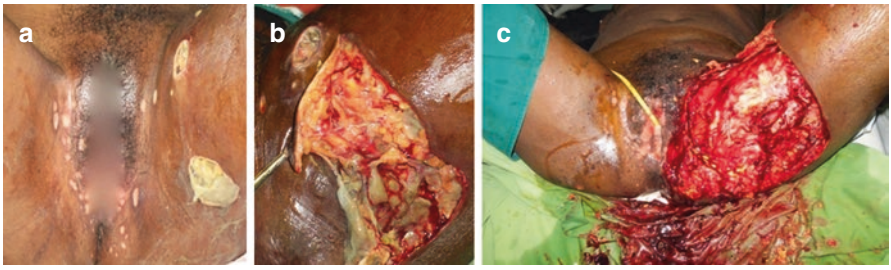

Fig. 13.2. This figure shows a necrotizing soft tissue infection of the left medial thigh. (**a**) Depicts the patient at presentation; (**b**) shows first stage of debridement; (**c**) shows the complete initial debridement

feet, toes, and calf, and sometimes the hands, as they are farthest from the heart. In addition, gangrene can be seen due to untreated traumatic fractures of the extremities. There are two main types of gangrene: dry and wet gangrene. In any patient with gangrene, a thorough exam of all upper and lower extremity pulses is absolutely necessary. In addition, an ankle-brachial systolic pressure index (ABI – the ratio of the ankle systolic blood pressure divided by the brachial systolic blood pressure) should also be performed at the bedside when possible. The ABI can assist in better understanding the severity of a patient's peripheral arterial disease and how they may recover from surgical intervention [6]. If patients have pulses that are too weak to calculate an ABI, they likely have severe peripheral arterial disease. Patients should also have a blood glucose obtained to determine if they have hyperglycemia since they may not know they have the disease, or even when they are known to have it may be untreated due to lack of access to diabetic medications.

Dry gangrene tissue is hard, shrunken, with a dry texture, and a clear demarcation between live tissue and necrotic tissue (black) (Fig. 13.3). Eventually, the line of separation from necrotic tissue and viable tissue will be complete, and the gangrenous tissue will eventually slough off. Acute surgical intervention for dry gangrene is not warranted.

Wet gangrene has a moist appearance with swelling, and the demarcation between viable and necrotic tissue can have an area of pink, soft, and wet tissue in between. This is a sign of an active infection and is a surgical emergency. Wet gangrene has a much worse prognosis and can quickly lead to sepsis. Due to high

Fig. 13.3. Both are examples of dry gangrene from trauma, as shown by the black necrotic tissue. (**a**) Is the scalp of a child and (**b**) is the left arm of a teenager

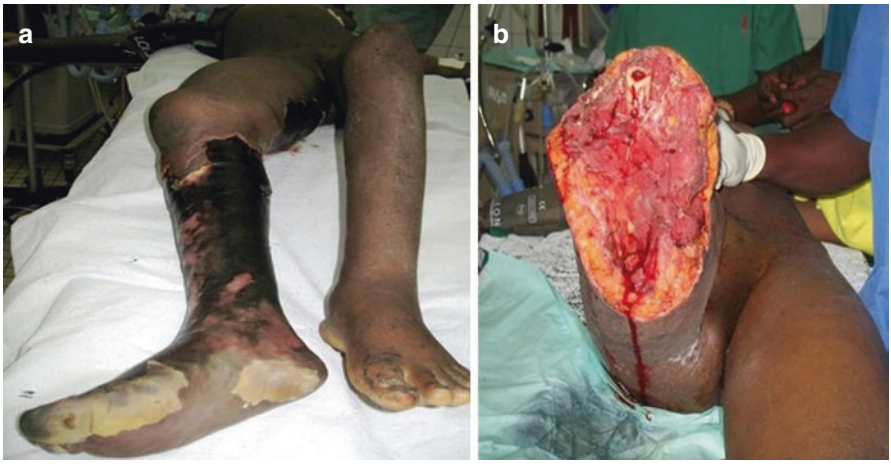

Fig. 13.4. (**a**) Shows wet gangrene of the right lower extremity; (**b**) shows treatment by guillotine amputation to healthy noninfected tissue

mortality of wet gangrene, an emergent salvage (or guillotine) amputation of the affected limb is often necessary (Fig. 13.4) [6].

This will help limit the systemic impact of the infection and allow time for the infection to be treated with antibiotics. In general, the safest course for acute infection is to leave the amputation site open to allow for control of infection with subsequent stump revision and closure. The site for a guillotine amputation should be at the most distal site not involved in severe infection that allows for removal of the infected area. Preservation of uninfected tissue is necessary for the future revision to optimize stump creation for the remote chance of a future prosthesis.

For gangrene secondary to peripheral vascular disease, patients should be counseled to stop smoking to try to prevent future problems. If they have any access to a higher level of care, discussion about a complete vascular workup should be done and a referral instituted. Diabetic foot education can also be considered as a preventative service. Nightly foot inspection can help prevent some of the infections from punctures that result in severe foot infections.

Tetanus

Tetanus is caused by the exotoxin elaborated by *Clostridium tetani* that affects the nervous system causing patients to develop reflex muscle spasms and rigidity. Tetanus infections are more common in LMICs as tetanus vaccines are not readily available. In LMICs, it is important to give tetanus toxoid when able to all those who present with an open wound or infection. Tetanus should be suspected in any patient complaining of spasm of the muscles of the jaw or "lockjaw." In addition, there can be painful spasms in other muscle groups in the neck, trunk, and extremities and by generalized, seizure-like activity in severe cases (Fig. 13.5).

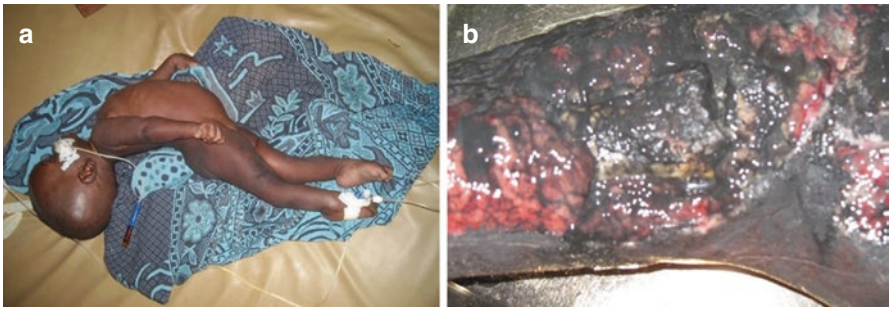

Fig. 13.5. (**a**) Depicts a small child with opisthotonus caused by tetanus; (**b**) shows an extensive wound in the lower extremity of an adult tetanus patient

The clinical course is variable and dependent on whether the patient has any prior immunity, the amount of toxin present, and the age and general health of the patient. The majority of neonatal tetanus cases are due to contamination of the umbilical stump and unfortunately are often fatal. Child and adult tetanus should be treated when possible with wound cleansing, removal of any necrotic tissue, administration of tetanus toxoid, and administration of human tetanus immune globulin (TIG) both for passive immunization and for therapy. When available, TIG (500 units as a single IM dose) should be administered as well as antibiotic treatment with metronidazole. Patients should be kept in quiet rooms with minimal stimulation; spasms can be controlled with benzodiazepines and intravenous magnesium sulfate. Patients can have respiratory issues and if possible should be transferred to a tertiary care center for mechanical ventilation; this is often not possible. Supportive care with IV fluids, nutrition, and observation for the time of significant spasm (1–2 weeks) can result in complete recovery [7]. Postoperative tetanus, though uncommon, may result from both exogenous and endogenous sources and can develop within 24 h after an operation [8].

Perirectal Abscesses

Perianal and ischiorectal abscesses often present with pain, an indurated perianal mass, discomfort with defecation, and possibly fever. Infection is thought to be due to obstructed cryptoglandular anal glands that then become infected. The infection then travels the path of least resistance into perirectal spaces and then abscess formation occurs. The main types of perirectal abscesses include perianal, ischiorectal, intersphincteric, and supralevator (Fig. 13.6). If the abscess is supralevator in location, it can be difficult to diagnose since it cannot be palpated on rectal exam and may not have as clear cut symptoms as the other abscess locations. Diagnosis is made by history and then perineal examination. The area should be inspected for redness, tenderness, and fluctuance; a digital rectal exam must be performed to assess for tenderness and abscess palpation. Needle aspiration can be helpful to try and identify pus if there is some question on exam. The primary treatment is

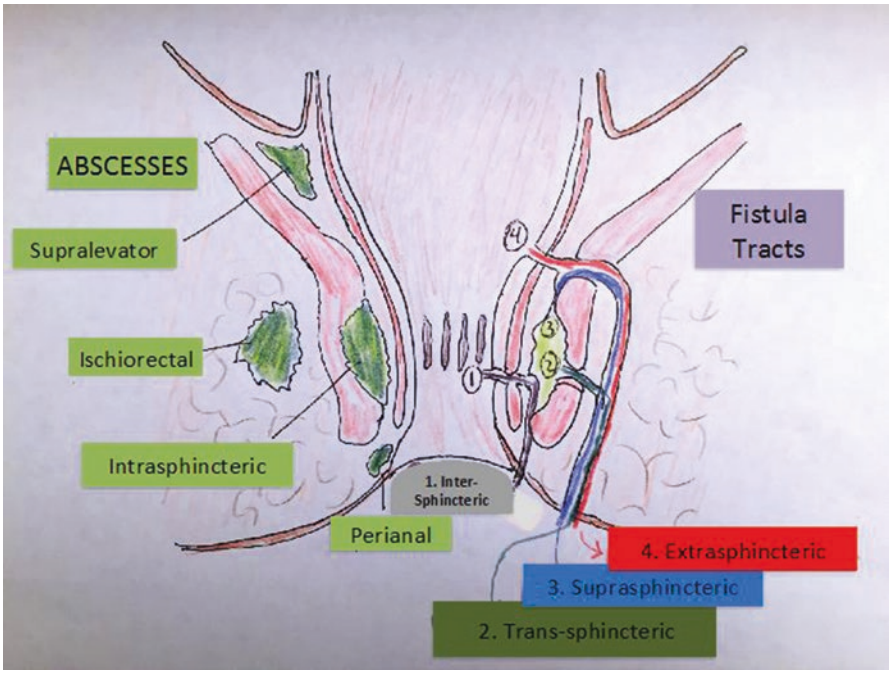

Fig. 13.6. Image depicting location and types of perirectal abscesses and fistula tracts

incision and drainage of the entire abscess cavity. Antibiotics are adjunctive and should be used until the cellulitis has resolved. Daily sitz baths, as well as after defecation, is an excellent way to manage the wound and avoid daily packing. Undrained collections should be considered if the patient does not improve markedly and still complains of pain.

It is imperative to maintain continence during incision and drainage, and multiple procedures may be necessary to allow drainage of the pus or to better identify a possible anal fistula. Anesthesia beyond local anesthesia is sometimes necessary to completely drain and treat perianal infectious diseases.

Perirectal Fistulas

Due to the pathology of disease of perianal abscesses, fistula tracts are common and about one-third of patients with an abscess requiring drainage suffer the end result of an anal fistula. These fistulas can be identified in the majority of patients at the time of abscess drainage. There is no clear consensus on whether or not to treat the fistula at time of abscess drainage. Long fistula tracts should have a seton placed, which will allow better identification of tract trajectory and sphincter involvement. Once these details are known, a more definitive plan for treatment can be determined with the key objective of maintaining continence. When forming a treatment

plan, one must consider the location of internal opening, the course of the fistula tract, and therefore the amount of sphincter involved.

The classification of anal fistula guides choice of the most appropriate fistula treatment options (Fig. 13.6). Typical treatment of intersphincteric and low transsphincteric fistulas is a simple fistulotomy to unroof the tract and allow it to heal. Care should be taken to preserve as much of the sphincter complex as possible to diminish the risk of postoperative incontinence. Suprasphincteric and transsphincteric fistulas involve much more of the anal sphincter, carry a higher risk of incontinence, and are a real challenge in the low-resource environment. If the surgeon has knowledge and experience in rectal advancement flaps or the LIFT procedure (ligation of intersphincteric fistula tract), these approaches can be considered. Both techniques have been shown to be successful in complex fistula disease but require specific procedural training and experience for success and to avoid risks of incontinence or recurrence. Cutting and non-cutting setons are commonly used in low-resource settings. Setons can be made of many materials including umbilical tape, silk, rubber bands, and even cable ties [9]. The seton is placed through the fistula and cinched down over time to slowly divide the subcutaneous tissue and sphincter. This approach requires multiple visits and has a risk of incontinence.

Breast

The Essentials

- Lack of screening and access to care cause patients to present late in their disease stage.
- Pathologic evaluation of biopsies is not always available, causing many to be lost to follow-up while awaiting diagnosis or treating patients with a presumptive diagnosis..
- Adjuvant treatments such as chemotherapy, hormonal therapies, and radiation therapy may be nonexistent in LMICs and may not be used as part of treatment plans.

Breast Cancer

Breast cancer is not as prevalent in LMICs as in high-income settings, but mortality rates for breast cancer may be higher in the former. In addition, with Westernization of these regions, breast cancer rates are increasing. Due to numerous barriers to screening and diagnosis, only 20–50% of women in LMICs are diagnosed in early stages (I and II), compared to over 70% diagnosed in these early stages in high-income settings. There are additional delays after diagnosis to treatment, called "provider interval," with LMICs having an interval from diagnosis to treatment over four times longer than high-income countries [10].

LMICs have minimal access to chemotherapies, hormonal therapies, and radiotherapies for the treatment of breast cancer. Even without these therapies, early

identification and timely surgical intervention can save lives. The Breast Health Global Initiative (BHGI) has led in the development of "Guidelines for International Breast Health and Cancer Control" for LMICs. If adjunctive therapies are not available for patients, breast-conserving surgical interventions are not recommended, and modified radical mastectomy is indicated, even for early stages [11]. Unfortunately, breast cancer often presents as a fungating obvious cancer with palpable nodes either from metastatic spread or from associated infection. If cellulitis is present, the infection should be treated with antibiotics and wound care prior to undertaking resection. As outlined above, modified radical mastectomy is the recommended treatment with excision of breast tissue and involved axillary nodes. In the setting of a large fungating cancer, resection leaving an open wound may be necessary followed by reconstruction after the wound bed has granulated with a split thickness skin graft. If at all possible, the tissue should be sent for pathology, and estrogen/progesterone status should be determined. This is often impossible either due to the lack of money to pay for the tests or the lack of a pathologist. Tamoxifen, if available, could be empirically considered for adjuvant treatment.

Breast Abscess and Mastitis

Breast infections are common in LMICs and management is similar to high-income settings. Infections can be both lactation and non-lactation associated. Non-lactation mastitis can occur in multiple age groups including infants (<2 months), children, adolescents, and adults. Lactation mastitis is very common because of high-multiparous mothers and prolonged breastfeeding. Mastitis can lead to abscess formation if left untreated, or the primary presentation may be abscess with overlying cellulitis.

Mastitis typically presents with swelling, erythematous skin, tenderness, induration, and warmth. Pus may or may not be expressed through the nipple but if present can be cultured or examined if resources allow. Antibiotic treatment initially targeted at staph and strep should be initiated and broadened to cover gram negatives if there is no response to the cellulitis in 24–48 h. Analgesics with nonsteroidal anti-inflammatory agents (e.g., ibuprofen) can be helpful and used in lactating and non-lactating patients. Breastfeeding can continue even with the infected breast, and women should be encouraged to make sure the breast empties as much as possible with each feeding. A breast abscess presents as a fluctuant mass and is a common sequela of mastitis; however, it can also present without any previous history of mastitis. Abscesses can occur in any age or gender but are more common in women. Palpable fluctuant masses are often noted on exam, and if ultrasound is available, the breast can be imaged to better identify size and depth. Initial management includes antibiotics and percutaneous abscess aspiration as long as the skin is intact over the abscess and the abscess is <6 cm. Up to three aspirations are often required for complete resolution. Surgical incision and drainage treatment is used for abscess with overlying skin compromise or frank necrosis, large abscesses, abscesses just beneath the skin, or in failed aspiration patients. Local anesthesia can be used and excision of any necrotic skin as well as drainage of the cavity should be done. The wound can be left covered and not packed and irrigation done until the wound closes [12]. If an infection is not resolving with

antibiotics and drainage, the diagnosis of inflammatory breast cancer needs to be considered and investigated via a biopsy if possible.

Hernia Disease

The Essentials

- The burden of hernia disease is high in LMICs.
- Inguinal hernias are more common in men, while femoral hernias are more common in women.
- Incarcerated hernias are the leading cause of bowel obstruction in LMICs.
- Type of repair depends on resources available – it is imperative to be prepared to perform primary tissue repairs as well as the use of mesh herniorrhaphy.

The high burden of hernia disease in LMICs was highlighted in the Disease Control Priorities the Third Edition of Disease Control Priorities (DCP3); Volume on Essential Surgery concluded that over 14,000 deaths due to hernias could be averted each year if basic surgical care could be provided in LMICs [13]. Several studies have shown that the burden of hernias and the associated morbidity and mortality is higher in sub-Saharan countries than in higher-income countries [14, 15]. Due to delay in definitive surgical care of symptomatic hernias in resource-limited countries, patients often have larger hernias and a higher severity of symptoms.

Of all hernias, groin hernias have the highest rate of incarceration and strangulation [16]. Though inguinal hernias account for over 95% of all groin hernias, femoral hernias are more likely to present strangulated (Fig. 13.7). It is important to complete a hernia exam on all patients, particularly those presenting with obstructive symptoms, as hernia is the leading cause of bowel obstruction in LMICs.

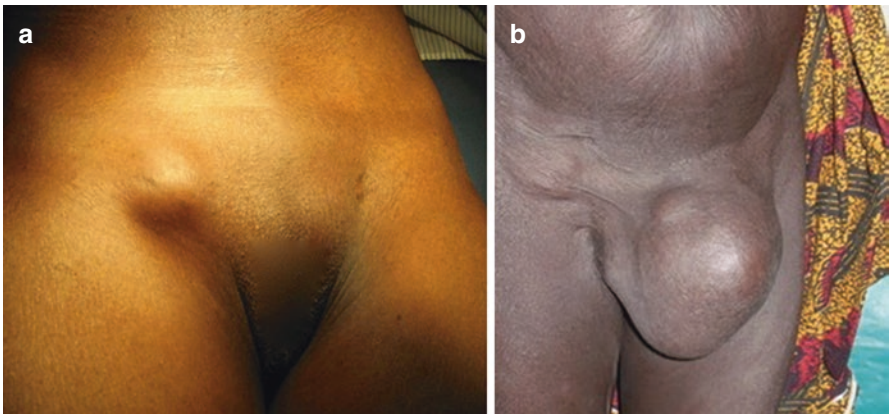

Fig. 13.7. (**a**) Depicts an incarcerated femoral hernia in a female. (**b**) Shows a female with bilateral hernias, the left incarcerated and the right reducible

Groin Hernias

All symptomatic inguinal hernias should be repaired due to risk of incarceration/strangulation. Notable increase in size over time is common, as heavy labor is common for people in LMIC. Mesh repair is preferred due to the lowest risk of recurrence. If commercial mesh is not available, the use of sterilized polyester or nylon (100%) mosquito net can be used as the hernia mesh [17]. When hernia mesh is not available, procedures such as the McVay (Cooper's ligament) repair with relaxing incision can be performed for femoral hernias and Shouldice or Bassini repairs for indirect and direct hernias. Each of these repairs share the following common operative steps [18]:

1. Skin incision superior to the pubic tubercle and inguinal ligament.
2. Division of soft tissue to the external oblique aponeurosis.
3. Opening of the external oblique aponeurosis from the external inguinal ring extending laterally past the internal ring.
4. Mobilization of the cord structures from inguinal canal.
5. Division of the cremaster muscle to identify an indirect hernia sac and examination of the floor for evaluation of a direct hernia sac.
6. Mobilization and reduction of hernia sac(s) – ligation not usually necessary. For large scrotal hernias, an indirect sac can be transected in the inguinal canal, and the anterior wall opened as far as possible distally to prevent hydrocele.
7. Open the transversalis fascia from the internal ring to the pubic tubercle.
8. In the McVay and Bassini repair, the transversalis fascia combined with the transversus abdominus fascia, the aponeurosis, and the internal oblique muscle is sewn either to Copper's ligament (McVay) or the shelving edge of the inguinal ligament (Bassini). In the McVay repair after the initial closure to Cooper's ligament, the repair transitions to the shelving edge at the level of the femoral vein.
9. The repair is continued just past the internal ring.
10. A vertical or hockey stick relaxing incision through the anterior rectus sheath starting just above the pubic tubercle and superiorly – the distance necessary is based on the degree of tension in the repair.

Ventral Hernias

Anterior abdominal wall hernias can be epigastric, umbilical, periumbilical, or incisional. Epigastric hernias often only require surgical intervention if symptomatic, while we recommend surgical repair of all periumbilical hernias due to higher rates of incarceration. Umbilical hernias are quite common in children and should not be repaired until the child is >2 years old because the vast majority will close on their own. Since the incidence of complicated umbilical hernias in children in LMICs is not known, there are some recommendations that defects >1–1.5 cm in children age 3 and above are closed when possible [19]. Incisional and ventral

Fig. 13.8. (**a**) Umbilical hernia in a child with bowel fistula formation due to untreated incarceration and bowel obstruction; (**b**) show exam findings on presentation; (**c**) shows intraoperative findings of small bowel fistula

hernias are common in LMICs and can be challenging to repair when >4 cm because of the relative lack of prosthetic meshes. Hernias can be closed with primary fascial closure but may have significant chances of recurrence if large. An excellent alternative technique is a component separation to allow for a tension-free primary tissue repair. Briefly, skin flaps are raised exposing the anterior rectus and external oblique fascia. The external oblique fascia is incised 2 cm lateral to its border with the rectus and the external oblique muscle mobilized bluntly upward off of the internal oblique muscle. This allows for midline movement of the rectus and laxity to primarily close the defect. Drains are recommended where the skin flaps were mobilized to diminish the chance of seromas. This is an excellent alternative when prosthetic mesh is not available. Patients will need to be observed for development of seromas, skin flap compromise, and wound infections. Abdominal binders, if they can be found, can be used to help support the abdominal wall during recovery. Patients should be counseled to not resume heavy work after hernia repairs, but this may not be possible; therefore, recurrence is not unusual after repairs in this setting (Fig. 13.8).

Incarcerated/Strangulated Hernias

One of the most common emergencies seen is an incarcerated/strangulated hernias of any anatomic location. Patients present with a tender painful mass, possibly with bowel obstruction, or even peritonitis depending on how long it took to reach the hospital. Reduction should only be attempted if there are no signs of bowel compromise such as fever, overlying skin changes, or peritonitis. If the hernia is reduced, admission for observation followed by elective repair should be done if at all possible to prevent future bouts of incarceration. If signs of strangulation are present, immediate surgery through an incision directly over the hernia is warranted. It is important to inspect the involved bowel, which may require enlargement of the hernia defect of laparotomy. Bowel resection with primary anastomosis may be necessary if there has been vascular compromise (Fig. 13.9). Primary tissue repair can then be completed and the patient observed postoperatively.

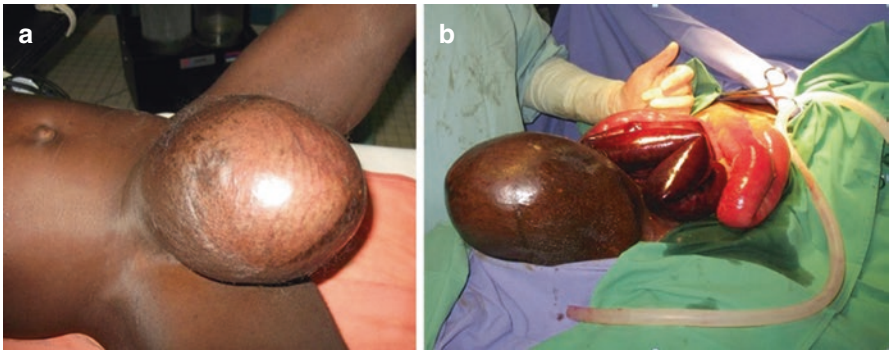

Fig. 13.9. (**a**) Strangulated right inguinal; (**b**) intraoperative findings of ischemic small bowel requiring bowel resection

Gastrointestinal (GI) Emergencies

The Essentials

- The differential diagnosis is broad; one must be familiar with the epidemiology of the region they will be serving.
- Imaging and lab studies are limited – rely heavily on thorough history and physical exam to guide care.
- Patients present late in their disease process and, therefore, assume dehydration, malnutrition, anemia, and electrolyte abnormalities on arrival and resuscitate and optimize the patient prior to the operation as able.

Patients in LMICs often present later in the disease process, thus making the history and physical exam even more crucial for prompt determination of management. A recent study showed that 72,000 people in India died from acute abdominal conditions in 2010, most in their home and most in rural areas [20]. Due to late presentation, many patients with GI emergencies are in poor clinical condition, with severe anemia, dehydration, poor nutrition, and possible electrolyte abnormalities. It is imperative to attempt to correct severe anemia (Hgb <6) and dehydration prior to any operation. In addition, in many of these settings, laboratory facilities are not readily available, and determination of electrolyte abnormalities is not possible. Recall, patients with persistent emesis often have metabolic alkalosis and hypokalemia. Though less likely in patients with an acute surgical abdomen, patients with profound diarrhea may have hyperchloremic metabolic acidosis, also often with hypokalemia.

Due to cultural and language differences, obtaining an accurate history may be difficult. Open-ended questions are preferred when initially obtaining a history, though ensuring specific information is obtained may require directed and pointed questions. For example, some patients may describe the pain as “recently” coming on, though when asked specifically, the pain started “two weeks ago.” In every

setting, a thorough review of systems is important, with particular focus on gastrointestinal and genitourinary systems. Standard history questions about quantity, frequency, character of emesis, or bowel movements must also be expanded to include questions about the presence of blood or worms. It is important to include a detailed history of urinary and vaginal symptoms, as a common cause of abdominal pain in women can be due to severe urinary tract infections or pelvic inflammatory disease. For all patients, always specifically ask if they have had any previous abdominal surgery.

The physical exam is of critical importance as a thorough history may be difficult to elicit. Much information can be gained from examining the eyes and mouth. Sunken eyes may be a sign of dehydration, icteric sclera may be a sign of liver disease, and pale conjunctiva may be a sign of anemia. The tongue will also be dry when patients are dehydrated. The abdominal exam must be thorough and must include evaluation for distention, guarding, fluid, rigidity, rebound, and masses. Additionally, even if not included in the history, always examine for umbilical, inguinal, and femoral hernias. Rectal exam is also almost always indicated. Female patients may require a pelvic exam to rule out gynecologic causes of pain such as uterine rupture or pelvic inflammatory disease, which is noted with cervical motion tenderness on exam.

Appendicitis

The Essentials

- Appendicitis is one of the most common causes of an acute abdomen across the globe.
- Imaging and laboratory studies are limited, rely on clinical diagnosis, and do not delay operation if suspicion is high.
- Prepare for open appendectomy, as laparoscopic availability is limited.

Appendicitis is one of the most common indications for urgent/emergency surgery across the globe [21]. Often, due to lack of resources, the diagnosis of appendicitis is clinical, without supporting imaging or laboratory studies. The negative appendectomy rate may be higher in low-income settings, which, due to high morbidity and mortality of delayed diagnosis in these settings, is acceptable. Early surgical intervention is recommended in the presence of high clinical suspicion.

The natural history is unclear, and there appears to be a subset of patients who are more at risk for perforation and that this is not a time-dependent phenomenon. Children are at higher risk of perforation than adults. Recent data exists that demonstrate early uncomplicated appendicitis (non-perforated or gangrenous) can be successfully managed in most cases with antibiotics, but this may not be a good strategy in LMICs since there is a significant risk of recurrent appendicitis in the next year; thus, definitive management at presentation is recommended.

Table 13.1. The elements and scoring of the Alvarado score for diagnosis of acute appendicitis [22]

	Features	Score
Symptoms	Migration of pain	1
	Anorexia	1
	Nausea/vomiting	1
Signs	Tenderness in right lower abdomen	2
	Rebound tenderness	1
	Elevated temperature (≥37.3 °C)	1
Laboratory test	Leukocytosis	
	Neutrophilic left shift	
Total score		10

Clinical Findings

Abdominal pain is the most common symptom and is often the first symptom. The pain usually starts in the periumbilical region then migrates to the right lower quadrant. The often described "four symptoms of acute appendicitis" includes right lower quadrant pain, anorexia, nausea, and vomiting. The Alvarado score can assist in determining the likelihood of acute appendicitis (Table 13.1) [22]. A score of 5 or 6 is compatible with acute appendicitis; 7 or 8 is probable appendicitis, while 9 or 10 is extremely probable appendicitis.

Special Considerations

Diagnostic tests, such as US, CT, and MRI scans, or laboratory studies are limited and should not be required to make a clinical diagnosis. The physical exam findings are more classic with pain at McBurney's point (in the right lower quadrant) with an anterior appendix; retrocecal appendicitis tends to present later. Physical exam maneuvers such as psoas and obturator signs and a digital rectal exam can all be helpful in aiding the diagnosis. Appendicitis is generally more difficult to diagnose in females, due to ovarian pathology, pelvic inflammatory disease, or ectopic pregnancy.

Treatment

If the appendicitis is complicated, meaning that the base of the appendix is perforated (or highly inflamed) or the appendix is gangrenous or grossly perforated, a partial or full cecectomy is often warranted. This is still possible through a standard right lower quadrant appendectomy incision, though enlarging the incision will likely be necessary and thorough irrigation is imperative. In this instances and when possible, a partial cecectomy should be done since this will only require suture closure of the cecum and not an ileocolic anastomosis.

Antibiotics should be initiated once the diagnosis of appendicitis has been made and should be continued on all patients through the operation. Postoperative antibiotic recommendations vary for complicated versus uncomplicated appendicitis and rely on intraoperative findings to guide timing. With complicated (gangrenous or perforated) appendicitis, patients are at higher risk for abscess and continued

infectious complications, and antibiotics are warranted for 3–5 days postoperatively [23]. For uncomplicated appendicitis, in patients with mild or moderate inflammation, antibiotics can be stopped postoperatively. If the patient is highly febrile or has signs of sepsis preoperatively, even with technically uncomplicated appendicitis noted intraoperatively, antibiotics should be continued for at least 1–3 days [24].

Cholecystitis

The Essentials

- The burden of gallbladder disease varies dramatically across regions – be familiar with the epidemiology of your local setting.
- Patients often present late and may have acute on chronic cholecystitis and scarred gallbladders.
- Abdominal ultrasound is the most useful imaging modality; suggestive findings of acute cholecystitis include positive sonographic murphy's sign, thickened gallbladder wall >4 mm, pericholecystic fluid, and visualization of impacted stones.
- Open cholecystectomy is the mainstay of treatment in LMICs.

The burden of gallbladder disease, gallstones, and subsequent cholecystitis varies dramatically across regions and across different ethnic groups. Regardless of region or race, women are impacted by gallbladder disease more frequently than men worldwide. Unexpected pathologies such as ascaris or salmonella typhi causing cholecystitis also occur in LMICs.

Signs and Symptoms

Patients with acute cholecystitis often have pain in the right upper quadrant, epigastric pain, nausea, fever, and emesis. Additionally, these patients frequently have a history of similar episodes in the past where their symptoms were less severe and resolved on their own, indicative of biliary colic. Patients will frequently be tachycardic and may have a fever. A positive Murphy's sign (arrest of inspiration upon deep palpation of the right upper quadrant) is often present with definite acute cholecystitis, though not necessary for the diagnosis. These symptoms can also occur with amoebic and bacterial hepatic abscesses and without preoperative US; definitive diagnosis can occur in the operating room.

Diagnostic Tests

If laboratory studies are available, a complete blood count (CBC) is useful to identify those with leukocytosis (as well as anemia). Patients who present severely jaundiced usually do not just have cholecystitis. Other diagnoses such as common bile

duct obstruction (stone, worm, tumor), primary liver disease, and hemolytic anemias must be considered and caution used before proceeding with operative treatment; surgery may not be indicated. Liver function tests (LFTs) can assist in establishing these diagnoses but are often not available.

Abdominal US is often the most accessible and useful imaging modality to assess gallbladder disease, particularly in resource-limited countries. An abdominal US can evaluate gallbladder size, wall thickness, presence and size of gallstones, pericholecystic fluid, and the size of common bile duct. Though abdominal US has high sensitivity and specificity for stones in the gallbladder, it can miss smaller stones in the common bile duct. The majority of LMICs will not have the availability of CT, magnetic resonance cholangiopancreatography (MRCP), nor hepatobiliary iminodiacetic acid (HIDA) scans. Additionally, utilization of endoscopic retrograde cholangiopancreatography (ERCP), which can be both diagnostic and therapeutic, requires specialized training and facilities, and therefore access is limited.

Treatment

The Essentials

- Open cholecystectomy: recommended treatment option in most settings. When laparoscopic equipment and supplies are present, this would be the preferred procedure.
- Open subtotal cholecystectomy: many patients will present late in their disease progression and anterior wall inflammation may be too great to complete a full cholecystectomy. Drain placement is critical due to chance of postoperative bile fistula.
- Open common bile duct exploration: to relieve blocked common bile duct.
- Cholecystostomy tube: will ultimately require subsequent cholecystectomy. Should rarely be considered unless there are no other treatment options.

For definitive treatment of acute cholecystitis, we recommend open cholecystectomy. This open approach allows for common bile duct exploration as needed and remains the most commonly used method for gallbladder removal in low-resource countries. In the highly unusual scenario of a critically ill patient too unstable to undergo a general anesthetic, a cholecystostomy tube insertion under local +/− sedation may be performed for gallbladder drainage. For severe ascending cholangitis, t-tube drainage of the CBD can be considered to temporize the patient prior to definitive treatment. Though nonoperative management and treatment with fluid resuscitation and antibiotics is a temporizing option, in resource-limited countries, patients are often far along in their disease process and are frequently lost to follow-up; therefore, definitive treatment is recommended.

Small Bowel Obstruction

The Essentials
- Etiology: hernias, adhesions, Ascaris, volvulus, intussusception, strictures, cancers, and foreign bodies.
- Patients will present late and will be dehydrated – attempt to resuscitate prior to surgery.
- Always complete a rectal exam and palpate for hernias (including groin).

As mentioned in detail in the introduction of this section, patients are more likely to present late in the disease process, and attempts at resuscitation and correction of anemia and electrolyte abnormalities should be attempted prior to surgical intervention. The differential diagnosis for small bowel obstruction is broad, but the same principles apply to all patients and include a thorough history and physical exam. Always complete a rectal exam and palpate for hernias (even if no history of hernias), especially groin hernias.

Hernia

Many patients will present with a tender or tense mass at a known hernia site. This may be less reliable in elderly patients, particularly elderly females with femoral hernias. If the patient presents 6 h or less from the initiation of symptoms, then attempts at external reduction may be attempted. If the patient presents over 6 h since the initiation of symptoms, they have an increased risk for compromised or ischemic bowel that requires resection. When attempting reduction, ensure the patient is supine (can place cushions under the legs for reducing abdominal hernias to further relax the abdomen), position in slight Trendelenburg, and administer IV pain medications if available to treat the patient's pain. A general principal of reducing hernias is to not attempt to "push" the mass in; rather slowly "squeeze" the herniated mass, which will push out edema and with slight pressure will often result in successful reduction. If reduction is not successful or the patient has additional symptoms of diffuse abdominal pain or peritonitis, urgent operation is warranted for examination of bowel and repair of hernia defect.

Ascaris

Ascaris lumbricoides is a giant roundworm that infects humans who ingest fertilized eggs. The larva can penetrate the wall of the duodenum and enter the blood stream to then reach other organs, such as the liver, heart, and lung. The larva can then be coughed up and swallowed by which means the adult worms return to the small intestine where they grow and can obstruct the small intestine. *A. lumbricoides* is a large public health concern, and it is estimated that 62 million people suffer from this roundworm infection worldwide [25]. In addition, *Ascaris*-related bowel obstruction is seen in 730,000 people worldwide each year and

accounts for 11,000 deaths each year [25]. The adult roundworms can be found as high as the duodenum but generally live in the jejunum and ileum [26]. Patients can present with acute or subacute symptoms [27], and many have a history of worms in their feces or emesis. An abdominal x-ray will not only show signs of obstruction but can reveal worms. For further detail, please refer to Chap. 15.

Small Intestine Volvulus

Patients with volvulus of the small intestine generally present with acute onset abdominal pain and emesis. Abdominal x-rays can assist with the diagnosis and differentiate from other obstructive pathology, such as *Ascaris* obstruction. This requires urgent surgical intervention and attempts to release adhesions, bands, or an internal hernia. Bowel resection may be required.

Intussusception

Young children often present with the history of intermittent abdominal pain, distension, and "currant jelly" stools, and those under 2 may pull their knees to their chest with the pain episodes (Fig. 13.10). In addition, intussusception can be seen in adults due to abdominal tuberculosis, tumors, and *Ascaris* infections. The use of ultrasound is particularly useful for diagnosis and can see a "target" sign. LMICs do not have ready access for enema reduction and radiology confirmation; thus, minilaparotomy is often necessary. In children, the intussusception can be reduced by milking the bowel, not pulling the bowel due to risk of tear. Tumors are a possible cause in adults, and if found intraoperatively, the involved bowel should be resected.

Cancers and Strictures

Cancers are not a common cause of small bowel obstruction in LMICs. In addition, inflammatory bowel disease is also rare, though strictures could be due to abdominal tuberculosis. These should both be considered on the differential diagnosis, and regional variation should be taken into consideration.

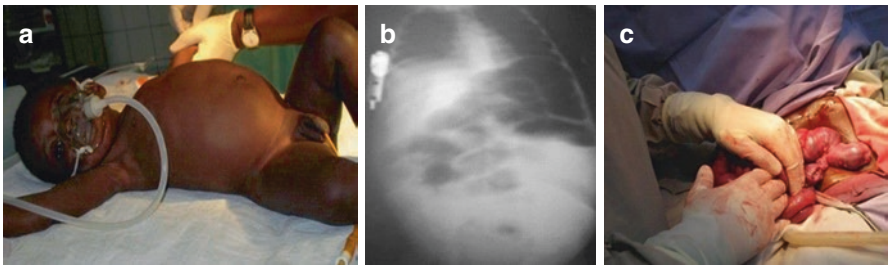

Fig. 13.10. Ileocolic intussusception. (**a**) Depicts a young child at presentation with abdominal distension; (**b**) x-ray findings at presentation; (**c**) the intraoperative findings of the ileocolic intussusception

Perforated Ulcer Disease

The Essentials
- Ulcer disease is an extremely common cause of peritonitis.
- Should be suspected with history of dyspepsia, often due to Helicobacter pylori.
- Treatment: omental patch repair for perforation and postoperative treatment with therapy for H. pylori.

Perforated ulcers are a common cause of peritonitis and acute GI emergencies in LMICs. The incidence has been shown to be as high as four out of five patients with peritonitis [20]. The patients often have a long history of dyspepsia. Unlike typhoid perforations, patients do not have several weeks of fever, headache, or fatigue. Patients will often present with acute onset abdominal pain, and by the time they seek medical attention, they may have a rigid abdomen with rebound tenderness and guarding. Undiagnosed and untreated *Helicobacter pylori* infections are often the cause. As with all patients with perforation, resuscitation prior to surgical intervention is imperative. Treatment includes exploratory laparotomy, identification of the perforation, and omental patch repair. Often, definitive diagnosis of *H. pylori* may not be possible, though postoperative therapy for eradication is indicated. Omental patch seems to have displaced the older treatments that included a truncal vagotomy and a drainage procedure, but there have been no comparative trials in LMICs especially in the context of inability to often treat the *H. pylori* infection. Control of the infection through laparotomy and washout and coverage of the leak site appears to constitute adequate treatment though higher perioperative mortalities are present than in Western series [28, 29].

Colonic Volvulus

The Essentials
- Sigmoid volvulus in young men is prevalent in Africa unlike typical age groups in HICs.
- Early presentation of sigmoid volvulus may be amenable to sigmoidoscopy for reduction of sigmoid volvulus, though sigmoidectomy is warranted for prevention of recurrence.

The most common sites for colonic volvulus are the cecum and the sigmoid. Colonic volvulus is a common cause of large bowel obstruction globally and particularly in LMICs [30–32]. It occurs when a segment of large bowel twists about its mesentery, creating a closed-loop obstruction. Volvuli are at high risk to cause ischemic bowel due to the twisting of the mesentery and subsequent vascular compromise.

Sigmoid Volvulus

This occurs due to an air/stool filled loop of sigmoid that twists around the mesentery. Sigmoid volvulus is the most common colonic volvuli and most often occurs in the Western setting in the elderly or patients over 70 years of age. In Africa, the disease epidemiology is very different than in Western countries and is predominately a disease seen in young males (25–40 years old) [33]. The exact pathogenesis is unknown but may be due to redundant sigmoid colon, very high-fiber diet, or chronic constipation. A recent examination of deceased fetuses in KwaZulu-Natal suggested that there was a possible congenital elongated narrow sigmoid colon which predisposes to volvulus [34]. Those with sigmoid volvulus may have a more insidious onset of abdominal pain and distension, with emesis being a late symptom. Some do present with acute symptoms of obstruction. On physical exam, abdominal distension and tympany are common, with signs of peritonitis raising concern for perforation or ischemic bowel. An abdominal x-ray will often show a U-shape of the distended sigmoid colon, from the pelvis to the right upper quadrant; and air will be absent in the rectum. Though sigmoidoscopy is likely not available in many settings in LMICs, it can be used to reduce the volvulus followed by an elective sigmoidectomy to prevent recurrence. For emergent treatment, both single stage resections with re-anastomosis or classic two stage procedures with colostomy and Hartmann's procedure have been reported. There are also substantial differences in operative treatment reported in African countries for emergent treatment of volvulus even when gangrenous intestine is found. Mixed results with the single stage approach have been found, but it can be safely performed in selected candidates [35, 36]. Creation of a stoma in a low-resource setting has substantial consequences since stoma appliances and bags are almost impossible to find in many areas. If a colostomy is done, reversal at the earliest time should be considered to lessen the impact of the stoma [33].

Cecal Volvulus

In cecal volvulus, the cecum and ascending colon rotate around the mesentery. The pathogenesis is due to a redundant and mobile cecum and ascending colon, which maybe be a congenital development. Cecal volvulus in general occurs in younger patients. There are three types of cecal volvuli; these include type 1 (clockwise axial torsion), type 2 (counterclockwise axial torsion), and type 3 (folding upward of the cecum (bascule)). Type 1 and 2 are the most common. The presentation is also variable, as some patients have more insidious onset of symptoms, while others have acute onset of obstructive symptoms. An abdominal x-ray with cecal volvulus may show an air-filled "coffee bean" cecum that is usually displaced medially and superiorly [35]. Open right colectomy or ileocecal resection is recommended as the definitive treatment for cecal volvulus [35]. Though cecopexy or colpopexy has been described [37], there may be a higher risk of recurrence, and those in LMICs already have decreased access to surgical care.

Due to lack of imaging studies (particularly CT), definitive diagnosis of either type of colonic volvulus may not be possible, and diagnosis will often be confirmed at exploratory laparotomy.

Obstructing Colon Cancer

The Essentials
- Colon cancer is much less common in LMICs, though is increasing due to globalization.
- Due to lack of screening in LMICs, patients often present with obstruction, perforation, or anemia secondary to bleeding.

Colorectal cancers in LMICs is much less common than high-income settings (five to ten times less common), though this is changing fairly rapidly due to globalization and changes in diet [38]. Most cancers are adenocarcinomas, and due to lack of colonoscopies and screening, patients present much later in the disease process, often with obstruction, perforation, or anemia from chronic blood loss. It is rare to have a patient with an asymptomatic colon cancer. Due to lack of pathology and CT imaging, diagnosis of colorectal cancer may be made during exploratory laparotomy. Adjuvant therapies are also limited as is monitoring for recurrence. Colon resection elective or emergent colon resection follows the same principles as in the Western setting except the anastomosis is typically sutured since there are usually no staplers available in the OR.

Liver and Splenic Abscess

The Essentials
- Symptoms for both hepatic and splenic abscesses are often nonspecific.
- Abdominal US is effective for diagnosis and follow-up.
- Antibiotics can be used successfully for small bacterial abscesses of <3 cm.
- Amebic abscess most often respond to medical treatment and do not require drainage until they are >10 cm.

Hepatic Abscess

Bacterial

Symptoms of a bacterial liver abscess are often vague, with right upper or epigastric pain, and can be insidious and nonspecific. Causes of these abscesses can range from biliary obstruction, prior bacteremia episodes, or preceding intra-abdominal infection. Abscesses are very common in Asia but can be found worldwide. Laboratory findings may show a leukocytosis, though liver enzymes may be within reference ranges. Though abdominal CT with contrast has the highest sensitivity, abdominal US is effective in making the diagnosis. Initial

management includes IV antibiotics alone for small abscesses (<3 cm) and percutaneous drainage under ultrasound guidance if available. Percutaneous aspiration can also be considered for abscesses 3–5 cm in size. There are no uniform recommended antibiotic regimens. In general coverage against broad spectrum, organisms (gram negatives/positive and anaerobes) include 2 weeks of IV antibiotics followed by 1–1.5 months of oral antibiotics [39]. Patients who do not improve on treatment should be re-imaged if possible for multiple or loculated abscesses that require drainage or aspiration. It may be difficult to obtain these resources and ensure patient compliance. If percutaneous drainage is not available, and repeat US shows continued abscess, surgical intervention with open abscess drainage is warranted.

Amebic

Amebic liver abscesses are most commonly seen in endemic areas such as Mexico, Africa, India, and Central and South America and are due to an *Entamoeba histolytica* infection. *E. histolytica* is a protozoan that enters the liver via the intestines and portal system. It most commonly affects young men, and symptoms of abdominal/epigastric pain and fever usually occur several months after infection [40]. If laboratory services are available, eosinophilia and a leukocytosis may be seen. Abdominal ultrasound is often required for a diagnosis, and a hepatic lesion consistent with an abscess is seen. Diagnosis is based on clinical and US exam with clinical suspicion based on endemic geographic location and, if available, serology. Empiric treatment with metronidazole to see if the patient improves could be tried in endemic areas, or small needle aspiration to distinguish frank pus from a pyogenic abscess versus the typical "anchovy paste" aspirate of the amebic abscess can be completed. The mainstay of treatment is oral metronidazole for 7–10 days, though if this fails, percutaneous aspiration/drainage is recommended and has been found to mostly be necessary in larger abscess >10 cm in size [39, 41]. Open surgical drainage of amebic liver abscesses is not generally warranted.

Splenic Abscess

Splenic abscesses are generally due to hematogenous spread of bacteria and, as expected, are more commonly seen in immunocompromised patients. Similar to liver abscesses, symptoms of splenic abscess can also be vague and often include fever and abdominal pain. Though patients may not complain of left upper quadrant pain, splenomegaly can sometimes be noted on physical exam or abdominal US. Patients also often have a leukocytosis. Splenectomy is the mainstay of treatment for splenic abscesses. Access to image-guided percutaneous drainage of the splenic abscess is limited in LMICs, though studies have found this is a viable option if done with IV antibiotics [42]. Though difficult in LMICs, it is important to try to ensure patients receive post-splenectomy vaccine prophylaxis, including polyvalent pneumococcal, meningococcal, and *Haemophilus* b vaccines.

Tuberculosis Peritonitis

The Essentials
- Tuberculosis peritonitis is uncommon though increased in patients with HIV, diabetes, and malignancy.
- Ascites is seen in vast majority of patients at presentation.
- Symptoms are insidious and often include abdominal pain, weight loss, and fever.
- Minilaparotomy may be required for diagnosis, though medical treatment with an antituberculosis regimen is the mainstay of management.

Tuberculosis peritonitis is caused by *Mycobacterium tuberculosis* (TB) via hematogenous spread from the lung to the peritoneum. Infection generally occurs due to reactivation of latent TB, though it can also occur in active pulmonary TB. At the time of diagnosis, over 90% of these patients present with ascites. If ascites is not present, it is a sign of more advanced disease [43]. The symptoms are insidious and include weeks to months of abdominal pain, weight loss, and fever. This is a difficult diagnosis as patients often do not know of a diagnosis of TB, and signs of TB are often not present on chest x-ray. The gold standard of diagnosis is culture of *Mycobacterium* from the ascitic fluid or peritoneal biopsy. TB peritonitis should be on the differential in all patients with unexplained ascites. Diagnosis can be made visually with a minilaparotomy as one can see the peritoneum studded with white nodules. Biopsies of these nodules will show caseating granulomas and be positive for acid fast bacilli. Treatment is nonsurgical and requires initiating a full anti-TB treatment regimen (discussed in Chap. 15). Fever, ascites, and abdominal pain all generally improve after several weeks of medical treatment. Those with delayed treatment can develop abdominal adhesions due to the TB peritonitis and are at risk for obstruction in the future – this risk, as well as signs and symptoms of obstruction, should be communicated with patients.

Abdominal Masses

The Essentials
- Pediatric:
  - Abdominal masses are most common in children under 5 years old.
  - The older the child, the more likely the mass is to be malignant.
- Adult:
  - Abdominal masses and cancers are commonly infection related in LMICs (e.g., hepatocellular carcinoma related to chronic hepatitis B and/or C).
- Surgical resection of abdominal masses in children and adults is the mainstay of management.

GI Masses by Age

Abdominal masses vary by age, though the majority of masses in both the pediatric and adult populations ultimately need to be surgical removed. The work up may be more limited in LMICs as the use of CT, MRI, bone scans, laboratory tests, and pathology may not be readily available these settings. This makes history and physical exam even more important in aiding in the diagnosis. It is critical to obtain information on rate of growth, location in abdomen, and mobile versus fixed mass. An abdominal US is useful in determining the site of the mass and can help determine cystic versus solid masses. The most common abdominal masses by age groups and general management considerations are reviewed below.

Pediatric

Abdominal masses in the pediatric population are most common in children under 5 years of age, with most masses in neonates occurring in the retroperitoneum (renal origin). Older children are more likely to have masses that are malignant. The most common diagnoses are Wilms tumor, neuroblastoma, ovarian and liver tumors, and involvement of nodes or organs with lymphoma or leukemia. Please refer to Chap. 20 Essential Pediatric Surgery for more details.

Adult

Abdominal masses in adults may not be symptomatic or palpable, though patients may experience symptoms that narrow the differential diagnosis. Hepatic and splenic abscesses can cause an abdominal mass and must be considered along with malignant etiologies. While obtaining the patient's history, it is also important to seek information on family history of cancer and social history including alcohol and tobacco use. Colorectal cancer, though less common in LMICs compared to high-income countries, is increasing in incidence due to changes in diet and is also diagnosed in very late stages due to lack of screening [38]. Many abdominal masses and cancers in LMICs are related to infectious causes and can be seen in the liver, stomach, and cervix [44, 45]. Liver cancer has a high incidence in developing countries due to chronic hepatitis B and C virus infection and lack of hepatitis B vaccination in childhood [4]. Gynecological cancers can also present as abdominal masses (Fig. 13.11). US is an excellent tool to try to rule out infectious causes of abdominal masses such as liver abscess, echinococcus, kala-azar, or tropical splenomegaly (covered in Chap. 15). If a mass lesion is discovered, primary treatment for most abdominal masses in this setting is surgical resection, with stage of disease determining need for additional therapies such as chemotherapy and radiation therapy. The diagnosis is commonly made at the time of the operation, and resection is completed to remove the mass when technically feasible. Lack of pathology is common, and concrete diagnosis and stage is often unable to be determined (Fig. 13.11). Benign etiologies such as mesenteric cysts can occasionally be found and easily treated by surgical resection (Fig. 13.12). It is not unusual to identify patients with widely metastatic cancer to the liver and/or peritoneum; unfortunately, there are often no good options for treatment or palliation, and long-term survival is uncommon (Fig. 13.13).

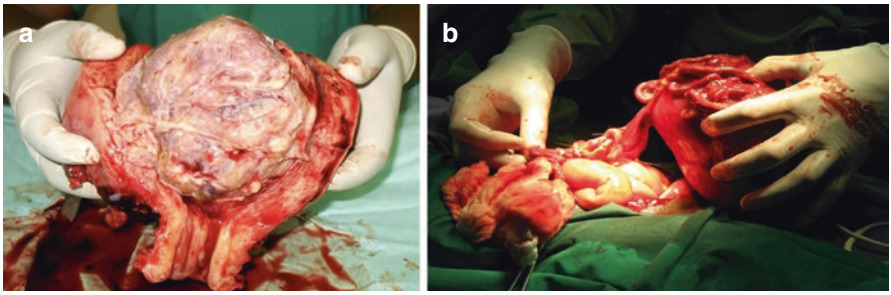

Fig. 13.11. Lower abdominal masses: (**a**) uterine mass; (**b**) ovarian mass

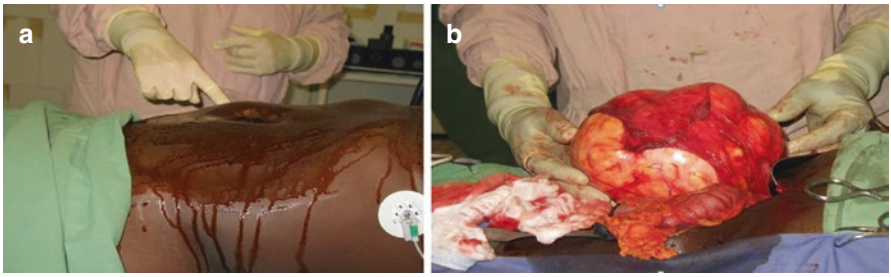

Fig. 13.12. 42-year-old female presenting with right mid-abdominal mass. (**a**) Visible and palpable large abdominal mass; (**b**) operative finding of large mesenteric cyst found at the root of the mesentery

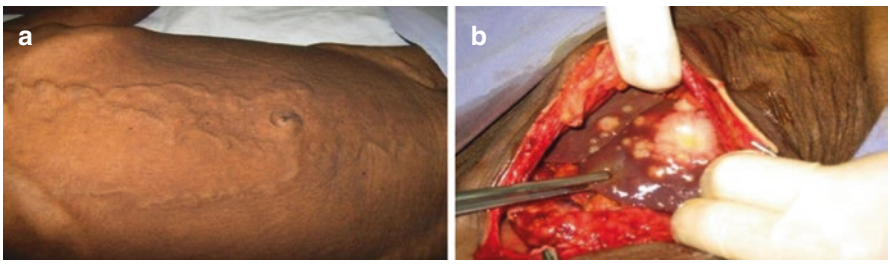

Fig. 13.13 A 47-year-old man presenting with upper abdominal mass. (**a**) Distended abdomen with collateral veins at presentation; (**b**) mini-diagnostic laparotomy revealed probable metastatic cancer throughout the liver

Proper selection of patients should be performed; preoperative hemoglobin, nutritional state, and HIV state need to be carefully considered. In general, operations should be avoided in end-stage HIV cases since the recovery and survival potential is very low. Palliative procedures can also be considered, such as intestinal bypass when extensive tumor is found that cannot be safely resected.

Summary

In summary, general surgical conditions seen in LMIC can be similar to conditions seen in high-resource countries but tend to present later in the disease course. In this setting, it is also necessary to consider that conditions may represent surgical presentations of infectious diseases not commonly seen in high-income countries except in immigrants. Evaluation of the patient with special attention to nutritional status, anemia, and HIV status must be done as well as a consideration of the resources on hand and the patient's ability to afford and participate in the care being proposed. Surgical treatment may be lifesaving and often requires innovative solutions to some of the practice challenges found in these environments.

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