Management of the Contaminated Operation

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Infectious complications after surgery remain a major cause of morbidity and mortality in surgical patients. Bacteria are commonly present during surgical procedures, and the balance between bacterial presence and host defense is critically important in determining whether or not clinically significant infection will result. The degree of bacterial inoculum is thought to correlate with the risk of developing postoperative infection. Management of the contaminated operation presents the greatest clinical challenge.

Contaminated operations include intrinsically dirty procedures such as surgery for perforated ulcer, perforated diverticulitis, appendicitis, and dead bowel. They also include procedures in which unanticipated spillage occurs, for example, when bowel contents are spilled during lysis of adhesions or when the gallbladder is perforated during laparoscopic cholecystectomy (with resulting spillage of bile and stones).

Postoperative complications may include subcutaneous wound infection, fasciitis, abscess formation, enterocutaneous fistula, and systemic sepsis. Management should be directed toward minimizing the bacterial inoculum, addressing the patient's additional risk factors for infection and augmenting the patient's host defenses. This chapter reviews specific surgical strategies to address and potentially mitigate these risks.

Preoperative Considerations

Timing of Surgery

One of the most fundamental strategies is to consider whether the emergency contaminated operation can be converted into an elective operation performed later under more controlled circumstances. This has been extremely successful in the treatment of diverticular abscesses. The standard management of open surgical resection with drainage of the abscess, resection of the involved bowel, and Hartmann's procedure has largely been supplanted by percutaneous drainage of the abscess, treatment with antibiotics, and judicious assessment for possible delayed single-stage resection. Another example would be the management of perforated appendicitis with abscess – again often successfully managed with percutaneous drainage of the abscess and antibiotics. In both instances, the initial management has shifted from a primary surgical approach in a dirty field to judicious use of antibiotics and percutaneous drainage of the abscess.

Adequate Resuscitation of the Patient

Maximizing tissue perfusion and oxygen delivery forms the cornerstone of successful perioperative resuscitation. Two important principles are (1) restitution of adequate circulatory volume and (2) avoidance of peripheral vasoconstriction. Successful cardiopulmonary resuscitation ultimately results in higher PO_2 in injured tissue, which in turn results in increased bacterial resistance, collagen synthesis, and epithelialization.

Peripheral vasoconstriction is a clinically important contributor to poor oxygen supply in wounded tissue. Mediators of vasoconstriction include blood volume deficits, cold temperature, smoking (nicotine), and certain medications.

Perioperative hypothermia delays healing and predisposes patients to wound infections. Maintenance of perioperative normothermia is important for all surgical patients,

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C.E.H. Scott-Conner (ed.), *Chassin's Operative Strategy in General Surgery*,
DOI 10.1007/978-1-4614-1393-6_7, © Springer Science+Business Media New York 2014

but particularly so for patients undergoing emergency surgery for intra-abdominal sepsis.

Resuscitation should be determined not by fixed formulas but by specific goals (targets) for mixed venous oxygen saturation, central venous pressure, mean arterial pressure, and urine output.

Perioperative Parenteral Antibiotics

The use of perioperative parenteral antibiotics in contaminated operations is considered therapeutic rather than prophylactic. Start antibiotics as soon as a diagnosis of sepsis or a potentially septic focus is made. If spillage of enteric contents has caused unanticipated contamination during a routine operative procedure, adjust antibiotics accordingly.

Adjust these antibiotics in the operating room as dictated by the findings. In the postoperative period, assess the need for and appropriateness of antibiotic coverage every day as results of blood cultures, cultures of purulent material obtained at surgery, and the patient's clinical course dictate. Generally antibiotics are continued for 7–10 days after abdominal surgery for perforation or dead bowel.

Consider using prophylactic antifungal therapy when a gastrointestinal perforation is found.

Preoperative Imaging

CT scan with judicious use of contrast is the single most useful modality for evaluating patients before emergency abdominal surgery. If a discrete, contained abscess is found, consider parental antibiotics and percutaneous drainage rather than surgery.

Intraoperative Considerations

Supporting the Patient/Continuous Resuscitation

Continue goal-directed resuscitation in the operating room. Hypothermia during abdominal surgery has been associated with an increase in surgical wound infections. In animals, it has been shown to cause intraoperative and postoperative vasoconstriction with a resulting decrease in subcutaneous tissue oxygen tension. Decreased oxygen tension, in turn, results in decreased microbial defense and impaired immune function. Thus, attention has been directed to the effect of perioperative normothermia versus hypothermia and the incidence of surgical wound infection. Kutz et al. conducted a prospective double-blind randomized study in humans undergoing elective colorectal surgery and showed that patients who were normothermic during surgery experienced wound infections one-third as often as patients who were hypothermic during surgery.

Normothermia may be difficult to achieve in septic patients and patients with major trauma. Warming the operating room, warming all fluids, and using warming circuits in the anesthesia machine may all be required.

Finding and Isolating the Source

It is crucial to identify and eliminate the source of contamination. This may require closing a perforation, resecting a segment of bowel, or draining abscesses.

Sometimes the source is obvious from the history, physical examination, and preoperative imaging studies. Ruptured appendicitis with generalized peritonitis or a perforated duodenal ulcer would be examples of such situations. In other cases the source will be obvious only at surgery. In very rare and frustrating cases, free intra-abdominal air may prompt laparotomy, and no definite source is found (see the end of this section).

A long midline incision provides the best exposure to all quadrants of the abdomen. Carefully separate fibrinous adhesions between loops of bowel. The color, texture, content, and odor of peritoneal fluid will often give a definite clue as to the level of the perforation. Adhesions are often densest near the site of perforation. Copious irrigation with warm saline, removal of fibrin, and packing the abdomen in quadrants will allow identification of the source.

When, despite diligent search, no source is found, carefully evaluate the upper digestive tract by opening the lesser sac (to allow inspection of the back of the stomach). Fill the abdomen with warm saline and have the anesthesiologist inject air into the stomach via the gastric tube. Bubbles will be evident if there is a hole in the distal esophagus or stomach. Some surgeons use methylene blue dye for a similar purpose. Similarly carefully mobilize the sigmoid colon and look for a tiny diverticular perforation. When nothing is found, close the abdomen and continue antibiotics while awaiting results of cultures. Some surgeons will place closed suction drains near the most likely source, for example, near the sigmoid colon if occult diverticular perforation is suspected.

Surgical Technique: Does the Surgeon Make a Difference?

Studies have shown that when infection rates of individual surgeons are followed and the surgeons are provided with feedback regarding these data, their postoperative infection rates are reduced. Unfortunately, most such studies concern clean elective surgery where the anticipated wound infection rate is extremely low.

Meticulous surgical technique is an important principle that affects postoperative results, including the incidence of postoperative infections. Sharp dissection, gentle tissue manipulation, and adequate hemostasis have often been cited as important factors that constitute proper surgical technique. Although there are historical data that attempt to compare resistance of surgical wounds to infection based on the use of a steel knife versus electrocautery, few data support one technique or the other. Some attention has been also given to proper suture usage. The guiding message in this regard should be to limit suture use to a necessary minimum, avoiding undue tissue tension and strangulation.

Localizing Contamination

Adequate exposure with proper retraction is essential for conducting appropriate exploration of the contaminated field. Many surgeons drape off (isolate) the surgical incision by applying wet towels or gauze to the subcutaneous tissue, which minimizes contact with gross contamination but does not prevent bacterial strike-through. Use of a wound protector drape, such as the Alexis O Wound Protector/Retractor (Applied Medical, Rancho Santa Margarita, CA), may help keep tissues moist and isolate the subcutaneous fat from gross contamination. Such a drape is slipped into the open incision (Fig. 7.1) and then opened and spread out to cover the subcutaneous fat and musculoaponeurotic layers of the abdominal wall (Fig. 7.2).

Subtle behaviors in the operating room may also play a role in minimizing postoperative complications. Upon conclusion of the contaminated segment of the operation, change gown, gloves, and instruments prior to abdominal wall closure.

Wound Irrigation

Adequate intraoperative irrigation of the wound minimizes the bacterial inoculum and has been shown to decrease postoperative infection. It has long been customary to pour several liters of saline into the contaminated cavity during the contaminated portion of an operation and just prior to closing, although specific practices vary widely among surgeons. Frequent irrigation with 200 ml of saline followed by aspiration is a rational approach to washing out bacteria spilled into the field. Take care not to let the irrigation fluid spill over onto subcutaneous tissues. Experimental models have shown that the most important factor that determines wound infection during contaminated surgery is the number of bacteria present at the wound margins at the end of the operation. The effect of operative field irrigation on the incidence of deep wound/abscess formation is less clear.

The use of antibiotic agents in the irrigating solution is more controversial, although many surgeons routinely irrigate with antibiotic saline solutions. Irrigants have contained such antibiotics as a cephalosporin, an aminoglycoside, neomycin, and metronidazole. In addition to decreasing the

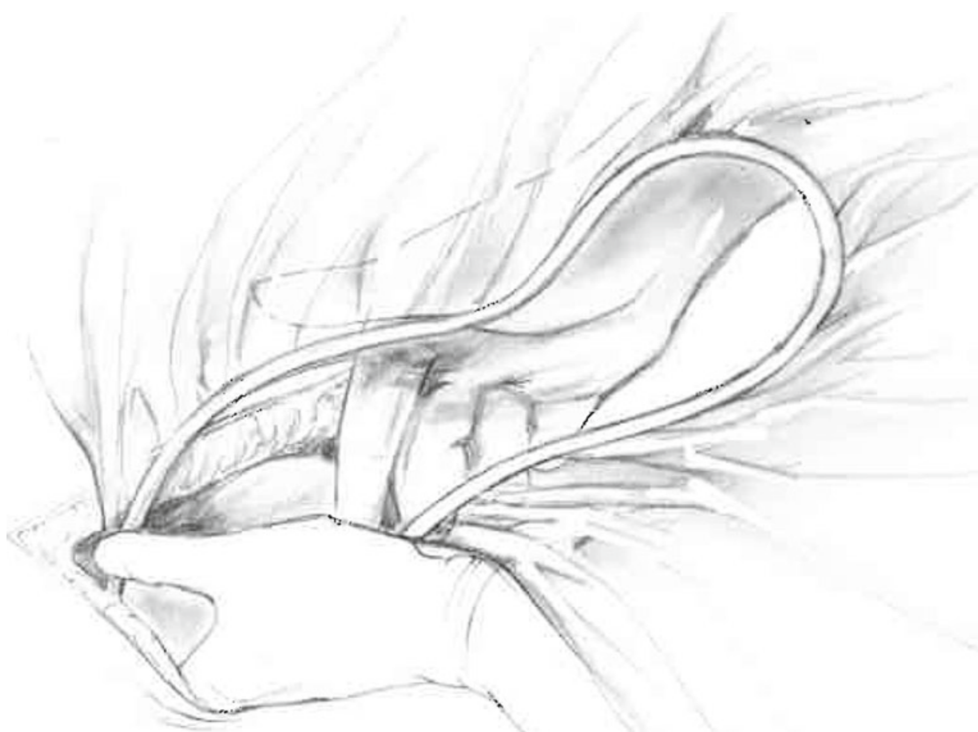

Fig. 7.1

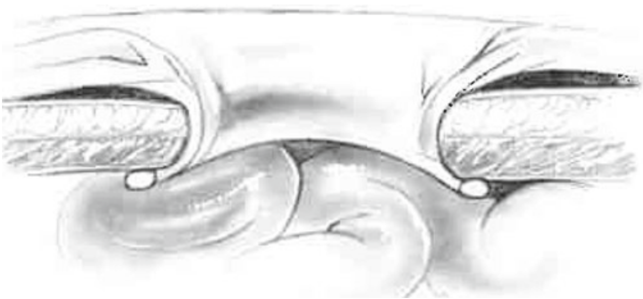

Fig. 7.2

bacterial inoculum, wound irrigation rinses the operative field of tissue debris and blood clots, which may be relevant to prevention of postoperative infection.

Other Considerations

Drains are used when a localized collection of pus (a well-formed abscess) is found or when there is concern over continuing contamination. See Chap. 10.

When the patient is unstable or reoperation is planned within a short period of time, consider damage control laparotomy (Chap. 8). Limit the initial operation to control of contamination and reserve any gastrointestinal reconstruction to a second procedure.

Local antibiotic therapy has received relatively little attention in the United States, with most of the available literature arising from European study groups. The application of local antibiotic therapy has the advantage of providing high concentrations of antibiotic to a well-defined area. On the other hand, once the wound is closed, it is not simple to reduce or remove the source of antibiotic.

Local antibiotic therapy has been supplied in the form of undiluted parenteral antibiotic powder, antibiotic beads, and antibiotic collagen sponges. The latter two methods are most popular. Antibiotic-containing collagen sponges appear to be most practical, as the collagen dissolves and does not require removal. The sponges are usually in the form of sheets and therefore can be used to cover large areas more accurately than the beads. Local antibiotic therapy has been utilized for orthopedic procedures, pilonidal surgery, colorectal procedures, and cardiovascular and vascular surgery.

Postoperative Considerations

Wound Closure

Primary wound closure during contaminated operations has been associated with a nearly 40 % wound sepsis rate. Thus, healing by secondary intention has been the tradition when dealing with wounds of highly contaminated operations. It is a well-accepted practice to leave the skin and subcutaneous tissue open after such operations to allow drainage. The main goal of such management is to prevent potentially devastating complications, such as fasciitis.

Delayed primary closure, within 4–6 postoperative days, results in fewer wound infections than primary closure after contaminated operations. Many surgeons believe that attempted delayed primary closure is a reasonable "compromise" between healing by secondary intention and primary closure. When successful, delayed primary closure avoids large wounds that require labor-intensive, potentially expensive care.

Wound Dressings

Wound dressings are a means to protect the wound and a mechanism for absorbing wound drainage. Wounds that are to heal by secondary intention or delayed primary closure require a wound dressing. Wet gauze should be applied to the subcutaneous tissue, covered with a dry pad, and then covered with occlusive tape. These dressings must be changed at least twice a day. To create a wet-to-dry dressing, the gauze is removed from the wound without soaking the gauze prior to removal. The wet-to-dry dressing mechanically helps debride the subcutaneous tissue of any debris that collects between dressing changes. On occasion, contaminated and infected abdominal operations require marsupialization, leaving the abdominal cavity open. In these cases dressing changes using sterile technique and optimal exposure must often take place in the operating room. They can also take place, with care, in the intensive care setting.

Acknowledgment This chapter was contributed by Claudia L. Corwin, MD, in the previous edition.

Further Reading

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