Intraoperative Strategy: Open Surgical Approach

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Objectives

- Outline the key intraoperative decisions in non-trauma emergency surgery.
- Identify factors that favor choosing a definitive management strategy.
- Describe conditions that favor damage control strategy.
- Briefly outline the main damage control strategy components and techniques.
- Describe the management principles following damage control laparotomy.

1.1 Introduction

- The vast majority of emergent surgery, despite the urgent nature of the problems, deals with patients that possess normal hemodynamic parameters and normal physiology:
  - These patients can be approached in a methodical fashion employing a thorough physical examination, appropriate laboratory studies, radiographic studies, and additional adjuncts to establish a specific diagnosis prior to the operative procedure.
  - Once obtained, the diagnosis guides decisions in relation to need for resuscitation and antibiotics, patient positioning, laparoscopic versus open surgical approach, type

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of incision, need for assistance, and postoperative care planning.
  - Most patients in this category require a single operation for resolution of their pathologic state.
- Other patients may present with signs of an acute abdomen with diffuse peritonitis:
  - These patients must be approached in a more expedited fashion. Resuscitation must commence immediately, and the history and physical examination is sometimes abbreviated. Diagnostic studies may be limited secondary to the patients underlying hemodynamic instability, and the diagnosis may not be secured in the preoperative phase of patient management.
- Lastly, in a very small subset of patients, extreme alterations in physiology and hemodynamic parameters exist:
  - This patient population presents shocked and septic. Hypotension, acidosis, hypothermia, and coagulopathy necessitate a unique intraoperative approach. Normal physiology cannot be fully restored preoperatively or during the operation; therefore, abbreviated operations with control of contamination, and occasionally hemorrhage, are used to temporize and subsequently are followed by additional operations – "damage control surgery."
- Irrespective of patient condition, the following precautions are common to most procedures envisioned in this course:
  - *Patient positioning and adjunctive procedures:*

    Critical aspect of any operation, the goal being to avoid interruptions to reposition, re-prepare the patient with antiseptic, and redrape the patient multiple times.

    Great care must be taken in securing the patient should extreme table tilt or rotation be needed, and in applying proper padding to pressure points and areas where nerves run superficially.

    A surgical "time out" observed before the beginning of the procedure to guarantee that the correct patient is receiving the correct operation on the correct area of the body and to ensure that all equipment and necessary blood products are available. Anesthesiology and surgical teams should agree on timely prophylactic antibiotic administration, the need for urinary catheter, and nasogastric tube insertion before starting the procedure.

In the severely ill patient, the following additional precautions and procedures must be considered:

1. Optimization of physiology: volume expansion, blood component therapy, antibiotics and vasoactive agents as needed, and correction of hypoxemia, anemia, and cardiac failure.
2. Mandatory placement of a urinary catheter for close observation of urine output (goal: 0.5 ml/kg/h).
3. Placement of a nasogastric tube preoperatively.
4. Central venous lines, and arterial lines.
5. And, although debated, in some cases, a pulmonary artery catheter can be helpful, especially in the elderly cardiac patient.
6. Early goal-directed therapy, including early infusion of crystalloid and blood products (goal: central venous pressure of 8–12 mm Hg, mean arterial pressure above 65 mm Hg, and mixed venous oxygenation at least 70 %).
7. Early initiation of broad-spectrum antibiotics at the onset of hypotension.
8. In certain patients with abdominal compartment syndrome in the ICU, deemed unsuitable for transportation to the operating room, a bedside laparotomy in an expeditious fashion to decompress the ACS.

- Most intraperitoneal processes are easily accessed with the patient in the supine position on the operating room table.
- Need for access to the perineum (placement of transrectal stapling devices, access for

endoscopic procedures, and the ability to lavage the rectum and distal sigmoid colon) or to the thorax should be anticipated.
  - Patient positioning and draping should allow for proper retraction, easy and quick extensions of incisions and timely conversion from laparoscopy to laparotomy, and performance of stoma and insertion of drains, as needed.

- *Incision:*
  - Both open and laparoscopic approaches are possible in many, if not most stable patients.
  - Trocar positions and skin incision should take into account previous incisions and operations, the possibility of full exploration of the peritoneal cavity, the need for adequate and proper retraction, as well as ample exposure adapted to the disease and procedure to be accomplished.
    In many cases, it is helpful to begin exposure in an area away from previous incisions in the hopes of avoiding troublesome scar and underlying visceral adhesions.
  - The very obese patient poses a unique challenge secondary to excess subcutaneous adiposity and intraperitoneal mesenteric fat. Larger patients typically require larger incisions for adequate exposure of the involved organ or organs.
    Laparoscopy, although often more difficult and requiring conversion, is particularly well suited to the obese, providing that surgeon expertise is available.
- *Exposure:*
  - Proper positioning of operating room lights, the need for a headlamp (best secured comfortably on the head prior to beginning the operation), and ample and adapted retraction are pivotal to safe and adequate exposure.
  - Retraction:
    In laparoscopy depends essentially on gravity, aided by table tilt and side rotation.
    In laparotomy depends on judicious use of self-retaining or handheld devices, as needed.
    A few examples include the Balfour™-type retractor, the Bookwalter™ retractor, or the Omni™ retractor.
- *Presence of additional operating room personnel:*
  - The operating surgeon may desire the assistance of a colleague or choose to operate with another surgeon or surgical team.
    Useful in long, difficult operations.
- *Staging:*
  - The key intraoperative decision: can the patient tolerate definitive control and complete repair of the principal disease process causing the emergency, be it hemorrhage, contamination, obstruction, or ischemia?
    If physiological stage of the patient is stable (not in hypovolemic or septic shock, no acidosis, hypothermia, or coagulopathy), and the appropriate resources (personnel, skills, equipment, time) are available, removal of the underlying cause and definitive repair and restoration of function can be performed.
    Occasionally, the patient's physiology changes during the conduct of the operation, and the successful performance of an operation is no longer feasible:
    - The surgeon and anesthetist must perform an expedited search for the etiology of the altered physiology and in the instance that normal physiology can be quickly restored; the operation can, most likely, continue; and a definitive procedure can be performed.
    - If the patient remains unstable, the operative plan should be changed and a staged operation may become necessary:
      - The surgeon's mindset must not be fixed; surgeon's ego must be set aside: Detect a change and react appropriately is imperative for the safety of the patient.

– Staged procedures are prudent decisions in the case of gross contamination, visceral necrosis, and infection:
  The initial operation may serve to control the source of infection and evacuate whatever contaminated products may be present. In this situation, return trips to the operating room will allow the surgeon to ensure adequate contamination control and do any additional debridement, drainage of purulence, resection of nonviable organs, or evacuation of infected material.
  Tissue beds are inspected for viability and if found to be compromised may be debrided to healthy tissue.

In some instances, the initial operation may leave some uncertainty as to the exact extent of the insult:

- For examples, when operating for mesenteric ischemia, one strategy frequently employed is the "second look" at 24–48 h after the initial operation to assess the viability of the bowel.
- Besides mesenteric ischemia, the concept of the "second look" can be applied to any questionable organ viability within the abdomen, skin and soft tissue, or chest.

Transfer to another facility may be appropriate should expert consultation or specific postoperative care be needed, but is not immediately available.

- *The Stable Emergency Surgery Patient*
- The stable patient usually allows adequate workup and often the diagnosis is known or highly suspected. Planned trocar or skin incision placement, adapted to patient bodybuild, the disease and involved organ(s) are straightforward. Unforeseen adhesions and disease can usually be dealt with accordingly.

– *The acute abdomen (etiology unknown):*
Classically, patients with peritonitis are taken directly to the operating room after a short period of fluid resuscitation, antibiotics and analgesia for a full abdominal exploration in an attempt to localize the causative agent and manage the pathology:

- Considerable debate exists as to whether these patients should undergo laparoscopic exploration or laparotomy:
  – With adequate expertise, many patients can be treated through the laparoscopic approach.
  – Otherwise, these patients are best evaluated utilizing a long midline incision from the xiphoid to the symphysis pubis through the linea alba.
- Upon entry into the peritoneal cavity, any blood, succus entericus, feculent material, or purulence is evacuated from the cavity and sent for culture analysis:
  – A full and systematic exploration of all the abdominal viscera is essential to avoid missing pathologies:
    Once the pathology is recognized and contamination controlled.
    Inspection should be routine.
    Small bowel from the ligament of Treitz to the ileocecal valve:
    - Taking care to examine the entire circumference and its mesentery
      Colon from the cecum to the peritoneal reflection of the rectum:
      - If retroperitoneal colonic abnormality is noted, the lateral peritoneal reflections can be incised and the posterior portion of the colon examined with medial visceral rotation.

    Foregut from the diaphragmatic crura to the ligament of Treitz:
    - Stomach:
      – Anterior stomach perforations can be clearly seen with simple inspection.
      – However, to avoid missed gastric perfora-

tions, the gastrocolic ligament should be divided and the stomach reflected superiorly.
  - Superior retraction of the stomach allows visualization of the posterior gastric wall up to the esophageal entry point near the fundus.

Pancreas:
- Entry into the lesser sac also allows inspection of the anterior portion of the pancreas.

Duodenum:
- Can be mobilized from its retroperitoneal attachments by performing a Kocher maneuver and inspecting the posterior surface

Gallbladder: easily inspected in the liver bed

Genitourinary system:
- Incise lateral attachments of either the right or left colon to rotate the colon medially:
  - Reveals Gerota's fascia, which can be incised, thus facilitating an anterior view of the kidney.
  - The ureter is easily identified as it crosses the iliac bifurcation into the internal and external branches.
  - Can be examined as necessary by carefully incising the retroperitoneal tissue overlying or adjacent to it:
    Great care should be taken in the inflamed retroperitoneum to avoid injury to the ureters.

  Finally, the solid organs of the abdomen:
  - Most instances allow inspection of the organs in their native beds.
  - However, mobilization may be required:
    - Liver: the hepatic ligaments can be incised.
    - Spleen: the lateral attachments can be easily cut.

- *The Acute Abdomen and Septic Shock*
  Patients in septic shock complicated by acidosis, coagulopathy, and hypothermia mandate a different resuscitative and operative approach from that of the typical patient: abbreviated operations and transport to an intensive care unit for restoration of normal physiology prior to definitive operative repair or damage control surgery, applied as early as possible.
  - *Intraoperative evaluation:*
    - Preoperative history, physical examination, and diagnostic adjuncts may be minimal.
    - Intraoperative decisions are guided by vigilant monitoring of the patient's physiologic status.
    - Patient physiology guides the extent of the operation:
      Operating times should be minimized.
      Abbreviated procedures performed.

  If physiology allows, definitive operation can be performed:
  - However, this can be safely delayed to a second look laparotomy after physiology is restored. In the face of hemodynamic instability, a planned return to the operating room in 24–48 h for definitive operation and second look is the most prudent and safest for the patient:
    - Control of bleeding:
      Packing of raw, bleeding surfaces or solid organs.
      Ligation of visible bleeding vessels (unless end arteries).
      Balloon tamponade techniques for inaccessible bleeding sites.
      Flow in an occluded end artery can be restored with a temporary vascular shunt.

- Hollow organ obstruction:
  Proximal diversion using tubes or ostomies
- Control of infection:
  The source of contamination (infection or necrosis) must be efficiency removed, either with drainage, resection, diversion, or closure of perforations.
  - Holes can be stapled or sutured.
  - In destructive injuries requiring resection, the ends can simply be tied off without attempting anastomosis or diversion at the first operation.
  - When resection is inappropriate (common bile duct, duodenum), controlling contamination with diverting tubes inserted into the hollow organ and external drainage might be the only options available.
    Copious irrigation of the abdomen with warmed crystalloid solution then helps remove particulate matter and dilute bacteria and debris.
  - Fashion a temporary abdominal dressing:
    Temporary abdominal closure:
    - Slows excessive heat and fluid loss and aids in the restoration of normal physiology
    - Can be attained using disposable plastic sheeting and vacuum devices that are available either commercially or fashioned in the operating room

    Additionally, skin and soft tissue infections may require repeat trips to the operating room for debridement and inspection of areas of questionable viability.

1.2 Postoperative Management

- The stable patient can return to the ward if post-inventional surveillance is satisfactory.
- The unstable patient requires appropriate postoperative monitoring in an intensive care unit setting:
  - Invasive hemodynamic monitoring
  - Early detection of complications of care
  - Restoration of normal physiology:
    Restoration of body temperature (rewarming with warmed intravenous fluids, increased ambient temperature of the room and warming blanket)
    Correction of coagulopathy (aside from restoring body temperature back to normal): infusion of crystalloid, blood, plasma, and cryoprecipitate as directed by laboratory parameters and signs of overt bleeding
    Correction of acidosis: infusion of volume and correction of body temperature

Diagnosis	*Hemodynamically Normal*	*Hemodynamically Unstable*
Appendicitis	Laparoscopic/open appendectomy	Open appendectomy versus drainage and antibiotics
Cholecystitis	Laparoscopic/open cholecystectomy	Cholecystostomy tube versus antibiotics
Diverticular disease	Resection, +/− ostomy or primary anastomosis	+/− resection, drainage of phlegmon
Abdominal wall hernia	Reduction and repair	Reduction, +/− resection, +/− second look
Ischemic bowel	Resection and primary anastomosis	Resection, +/− second look
Perforated viscus	Repair, +/− resection	Resection, +/− second look
Obstruction, adhesive	Adhesiolysis	Adhesiolysis, +/− second look
Obstruction, hernia	Reduction, +/− resection	Reduction, +/− resection, +/− second look
Obstruction, malignant	Resection, +/− anastomosis, +/− ostomy	+/− resection, fecal diversion, +/− second look
Skin and soft tissue infection	Drainage or debridement	Drainage or debridement, +/− second look