

Damage Control in Emergency General Surgery

Indications and Outcomes

Adam Nelson, MD, FACS

Collin Stewart, MD, FACS

Background

- The principles of damage control surgery (DCS) originated in severe trauma and hemorrhagic shock.
- DCS is applicable to emergency general surgery (EGS) however the indications and outcomes are different from trauma.
- The most common EGS diagnoses requiring DCS are viscus perforation, mesenteric ischemia, postoperative peritonitis, non-traumatic hemorrhage, abdominal compartment syndrome, and pancreatitis.
- Understanding the indications and outcomes for DCS in EGS patients is key for appropriate patient selection and is the focus of this module.

Indications

- DCS is indicated in the following cases:
 - Profound physiologic derangement.
 - Select cases of intra-abdominal sepsis (IAS).
 - Intestinal ischemia requiring a planned second-look.
 - Fascia cannot be closed due to severe bowel distension.

Physiologic Derangement

- The “lethal triad” (acidosis, hypothermia, and coagulopathy) was initially coined for trauma-related hemorrhagic shock however, these are markers of decompensated shock regardless of etiology.
- Patients in decompensated shock are less likely to tolerate a definitive operation and have an indication to undergo DCS.
- Additional physiologic indications for DCS include low systolic blood pressure, increasing vasopressor requirements, high-volume blood loss or transfusion needs, and high-volume crystalloid resuscitation.

- Decision-making regarding use of DCS should center around intraoperative physiologic trends as patients in preoperative shock may improve with source control and resuscitation to the point that DCS is unnecessary.

Intra-Abdominal Sepsis (IAS)

- The use of DCS in cases of IAS is controversial and is the subject of debate.
- The approach to severe IAS has historically consisted of three approaches: on-demand relaparotomy, planned relaparotomy, open abdomen with planned reexploration.
 - On-demand relaparotomy – definitive index surgery where source control is achieved and the abdomen is closed. A relaparotomy occurs only if clinically needed.
 - Planned relaparotomy - definitive index surgery where source control is achieved and the abdomen is closed. A planned second laparotomy is performed in 24-72 hours. The rationale is that even with adequate source control at the index case, patients with diffuse contamination often have persistent disease which can be addressed at subsequent operations. However, additional laparotomies are morbid and up to 66% of planned relaparotomies have no additional septic findings.
 - On-demand vs planned relaparotomy – multiple studies have shown improved outcomes with decreased cost and fewer negative reexplorations using an on-demand approach. Furthermore, many septic complications such as abscess formation develop later than 72 hours and can be managed with percutaneous drainage. Therefore, the planned relaparotomy approach has been largely abandoned.
 - Open abdomen with planned reexploration (OA) – abdominal wall is not closed during the index case and a temporary closure device is applied with planned reexploration.
 - OA is identical to techniques used for patients in decompensated shock however it is unclear when to apply this approach in the setting of IAS without decompensated shock.
 - OA in the setting of IAS results in worse outcomes such as reduced rates of primary fascial closure, increased intra-abdominal complications, and higher 90-day mortality compared to its use in trauma.
 - However, in cases of Hinchey III/IV perforated diverticulitis, OA has been shown to have a reduced risk of anastomotic leak and lower rates of stoma formation.
 - Currently, the role for OA in the setting of IAS is still unclear. The Closed or Open after Source Control Laparotomy for Severe Complicated Intra-Abdominal Sepsis (COOL trial) is underway which compares OA to on-demand laparotomy in patient with IAS.

- On-demand laparotomy is the approach that is most consistent with current evidence and should be used for most cases of IAS.
- Additional IAS-based considerations/indications for use of OA with exploration are:
 - Cannot safely perform definitive reconstruction.
 - Need to reevaluate intestinal viability .
 - Inability to achieve definitive source control (e.g. necrotizing infections).

Intestinal Ischemia

- Acute mesenteric ischemia is an indication for a planned second-look laparotomy to reevaluate bowel for ongoing ischemic changes.
- Allows for questionably viable bowel to either improve or demarcate and therefore can optimize the amount of bowel that is ultimately resected.

Fascia Cannot Be Closed Due to Bowel Distension

- Severe bowel distension may prevent primary fascial closure either due to inability to reapproximate fascia or concern for development of abdominal compartment syndrome after closure.

Damage Control Surgery and Transfer in Emergency General Surgery

- EGS patients may require transfer to a higher level of care for definitive management however the transfer process may take significant time and resources.
- DCS can facilitate rapid source control and stabilization at the referring hospital prior to transfer.

TABLE 1. Indications for DCS in Nontraumatic Abdominal Pathology

(1) Physiologic Derangement	Evidence of Persistent Acidosis, Hypothermia, or Coagulopathy Despite Adequate Resuscitation and Source Control (Lethal Triad): <ul style="list-style-type: none"> • pH < 7.2, Base Deficit >15, Lactic Acid >5 • TEG, PT/INR > 2, Intraoperative Visualization of Nonsurgical Bleeding • Temperature < 34° C Evidence of Persistent Hemodynamic Instability Despite Adequate Resuscitation and Source Control: <ul style="list-style-type: none"> • Systolic Pressure <90 mm hg • Operational Blood Loss >4 L • Utilization of >10 Units of Blood Product OR > 12 L of Crystalloid • Increasing Vasopressor or Inotropic Requirements
(2) Intra-Abdominal Sepsis	The routine use of an OA for IAS should be avoided. Specific indications in which DCS should be considered: <ul style="list-style-type: none"> • Inability to obtain complete source control or high suspicion for recurrent/persistent intra-abdominal infection despite presumed source control • Inability to safely perform GI tract reconstruction • Significant uncertainty regarding intestinal viability
(3) Intestinal Ischemia	The routine use of a “second look” laparotomy in the management of intestinal ischemia is generally recommended, particularly in the following situations: <ul style="list-style-type: none"> • Physiologic derangement • Findings of IAS from perforated viscous or necrotic intestine • Significant uncertainty regarding intestinal viability
(4) Profound Bowel Distention & Abdominal Compartment Syndrome (ACS)	Regardless of etiology, diffuse bowel distention may require an OA approach due to: <ul style="list-style-type: none"> • Physical inability to reapproximate the midline fascia • Development of ACS symptoms (ex. new or worsening hypotension, increased peak airway pressures) • Significant concern for eventual ACS development in the postoperative setting if primary fascial closure performed

TABLE 2. Comparison of an OA Versus on-Demand Relaparotomy Approach for Severe Intra-Abdominal Sepsis

OA vs. on-Demand Relaparotomy for Severe Intra-Abdominal Sepsis

	OA	On-Demand Relaparotomy
Description	<ul style="list-style-type: none"> • OA approach with negative pressure temporary abdominal closure during index operation • Planned reexploration in 24–48 hours regardless of clinical condition 	<ul style="list-style-type: none"> • Definitive surgical repair/reconstruction with abdominal closure during index operation • Additional relaparotomy only if clinically indicated
Benefits	<ul style="list-style-type: none"> • Allows for early detection of persistent or recurrent intra-abdominal infection • Removal of peritoneal fluid containing inflammatory mediators; may reduce local and systemic inflammatory burden and reduce risk of multi-organ failure • Potential decreased need for intestinal diversion and decreased risk of anastomotic leak 	<ul style="list-style-type: none"> • Improved or equivalent survival benefit • Avoids unnecessary surgical interventions • Avoids morbidity of the OA, the key source of complications in DCS • Reduced hospital length of stay • Reduced cost
Negatives	<ul style="list-style-type: none"> • Increased mortality • Risk of unnecessary interventions • Complications arising from an OA (ex. enterocutaneous fistula, fluid/heat loss, catabolic state, fascial retraction, and loss of domain) 	<ul style="list-style-type: none"> • No reevaluation of the abdominal cavity to assess for additional infectious foci • Requires consistent observation for clinical deterioration and a high clinical suspicion to identify patients who require additional surgical infection control • Increased need for intestinal diversion and increased risk of anastomotic leak
Indications	<ul style="list-style-type: none"> • Severe physiologic derangement • Inability to safely perform GI tract reconstruction (deferred anastomosis) • Need to reassess questionably viable intestine • Inability to obtain complete source control or high suspicion for persistent infection 	<ul style="list-style-type: none"> • Should be utilized in all situations of severe IAS unless specific clinical indications for an OA are present

References:

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2. Fernández C. Damage control surgery and transfer in emergency general surgery. *Surgical Clinics of North America*. 2023;103(6):1269-1281. doi:10.1016/j.suc.2023.06.004