

Backed into a corner: damage control surgery in the rural or austere setting

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SUMMARY

Damage control surgery has evolved during the past 40 years. The initial cases and studies were performed at level 1 trauma centers but has now shifted to damage control at smaller hospitals. This buys time for definitive care at higher-level centers. There is a role for damage control surgery in both general surgery and trauma patients at community trauma centers. The successful implementation and completion of damage control surgery require thorough planning and a full understanding of resource limitation. Additional training or practice for infrequently performed procedures may be necessary. A systems-based approach with postoperative transfer to a higher level of care is acceptable and expected.

INTRODUCTION

Damage control surgery is typically defined as an intervention to correct the ‘lethal triad’ in critically ill patients. The goals are to control bleeding, gain source control and ultimately stop acidosis, coagulopathy, and hypothermia.¹ This strategy is employed across many environments: from level 1 trauma centers to the rural community hospital to the front lines of the battlefield. The focus here is on damage control surgery in a rural community setting (American College of Surgeons (ACS) level 3/4 trauma centers).

Numerous studies in the 1970s and 1980s show benefit in source control of bleeding and infection in an augmented fashion. In the early 1980s, liver packing was found to be successful to control liver hemorrhage in 90% of patients.² Shortly thereafter, the lethal triad was further understood. In 1993, Rotondo *et al* published the first article coining the term ‘damage control surgery’.³

The initial articles, and current perception of damage control surgery, usually imply the open abdomen after abdominal trauma. This concept has been extended to a wide range of other applications, specifically applicable at community hospitals: pelvic hemorrhage, necrotizing soft tissue infections, patients resuscitated by emergency department (ED) thoracotomy, vascular shunts and intrathoracic trauma.

DISCUSSION

Most community and critical access hospitals lack 24/7 vascular surgery, thoracic surgery, dedicated intensivist, dedicated trauma/acute care surgery operating rooms (ORs), interventional radiology (IR), neurosurgery, plastic surgery, or orthopedic trauma. The blood bank is typically limited to four

to six units of packed red blood cell/fresh frozen plasma and one unit of platelets. One of the greatest limitations at a level 3 center is blood availability. Obtaining additional blood from neighboring hospitals takes upwards of 1–2 hours to transport prior to cross-match. OR call teams are expected to respond within 30 min, depending on their ACS trauma designation. Usually, there is a surgeon on call—which is where the predicament starts. The general surgeon is present to intervene, but the ancillary support is absent.

Situations do arise which prevent patient transport to a higher level of care and require surgical intervention at the initial receiving hospital. These situations may compel the surgeon to perform a damage control surgery, or potentially a definitive surgery. In many rural settings, the patient may be clinically appropriate for transfer to a higher level of care, but emergency medical service (EMS) is unavailable. Weather also plays a significant role in the availability of transport options based on patients’ status.

Other cases (for example, necrotizing soft tissue infection) may be discussed with the surgeon on call and recommendations for transfer are made prior to source control or surgical intervention when in fact, a timely local operation is warranted. Transfer may lead to a delay in care and ultimately increase morbidity/mortality depending on the length of transport and delay to OR. In these situations, the initial damage control procedure should be performed, if possible, prior to transport to the accepting facility.

SPECIFIC SITUATIONS

Necrotizing soft tissue infection

In necrotizing soft tissue infections, general surgeons can gain source control in most situations prior to transfer. There is a ninefold increase in mortality if delay is greater than 24 hours.^{4–6} The absence of the following: intensive care unit (ICU) care (or surgical critical care), OR availability for serial debridement, specialized wound care nursing, plastic surgeon for reconstruction or 72-hour bed wait once admitted with no available transport are all reasons for surgeon hesitation in the community setting. However, there is a role for damage control debridement with plans for immediate postoperative transfer to avoid excessive delays in source control. These system issues should not be a reason to delay in early intervention.

Pelvic hemorrhage

Ongoing pelvic bleeding and hemodynamic instability in a hospital setting without IR, ortho trauma,

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Figure 1 Trauma cart.

vascular or adequate blood supply is a nightmare for any general surgeon. Most general surgeons in these settings are not equipped or adequately familiar with resuscitative endovascular balloon occlusion of the aorta (REBOA). Although REBOA is an option, preperitoneal pelvic packing is something with which many general surgeons are familiar. The procedure can be completed in 15 min and may be the bridge needed for expeditious transfer to a level 1 center. Surgeons at level 3 and 4 centers may need to refresh on this technique and as mentioned below, the ACS ASSET (Advanced Surgical Skills for Exposure in Trauma) course is an excellent opportunity for this.

Vascular injury requiring shunt

After reading this, call your OR materials management and ensure appropriate quantity and availability of shunts. Numerous shunts are available, but the important thing is that you are familiar with what is available at your facility. Many facilities stock Argyle and Javid shunts. If you cannot find a true vascular shunt when it is needed, a small-bore chest tube, chest tube, gastric tube or similar single lumen device will suffice. For extremity vascular injuries, obtain proximal and distal control, perform thrombectomy, place a shunt, secure the shunt and splint. Pack the wound and plan for transport. Consider fasciotomies when extended transport is expected. Though prophylactic fasciotomy has fallen out of favor at many centers due to the acuity of intervention, it



Figure 2 Trauma cart supply list.

is important to consider the time to definitive care in these cases. This skill is also covered in the ACS ASSET course.

ED thoracotomy

Most importantly, have an evidence-based algorithm that fits your situation and location based on available resources, injury pattern and patient age. If return of spontaneous circulation is obtained after ED thoracotomy in a community hospital, resource utilization is already at its maximum. In these situations, many factors will play into the definitive plan: blood availability, transport time, helicopter availability, and focused assessment with sonography in trauma examination of abdomen (presence or absence of abdominal hemorrhage). Regardless of the injury, with a 30 min call back for the OR and absence of a dedicated trauma room, the emergency room (ER) becomes the OR. This necessitates having a readily available ‘trauma cart’ as discussed below (figures 1 and 2).

Intra-abdominal bleeding/sepsis

Critically ill patients who cannot be safely transported for definitive surgical intervention may require temporizing surgery for source/bleeding control. This can usually be accomplished by a community surgeon for the index procedure. The postoperative care, surgical intensivist, blood supply and OR/surgeon availability for take-backs become the issue. In these situations, a temporary abdominal closure device can be applied at the index operation prior to transfer to a higher level of care. The options for temporary closure range from commercially available vacuum-assisted devices to make-shift Barker vac or Bogota bag. Collins *et al* describe a simple whip stitch closure with no difference in outcomes versus the AbThera.⁷

The studies on damage control surgery were multicenter trials at level 1 centers. To date, there are no studies comparing outcomes at level 1 versus level 4 centers. However, in post-COVID-19 era of bed unavailability and transport limitations, not all patients will arrive to the desired level of care within the ideal time frame. Smaller level 3 and 4 centers can provide similar temporizing measures with less available resources—IF the above outlined systems and plans are in place for ongoing care after the index procedure.

CONCLUSIONS

Recommendations for the level 3/4 general surgeon for damage control preparedness:

1. Have a working relationship with receiving facility.
 - a. Invite trauma surgeons from your receiving facility to visit your hospital and explain what resources you have available. Make the relationship personal.
 - b. Make arrangements for OR–OR transfer when necessary. If the receiving hospital does not have available beds, direct transfer to the OR is always an option.
 - c. ‘Safe Haven Bed’, West Virginia University’s level 1 trauma center, has three beds that are not counted in the daily house census and are staffed 24/7 for emergent transfers (ICU-level care). These beds are for patients/situations that cannot wait for bed availability.
2. Have a transport plan.
 - a. When commercial transport is not available, have a back-up plan. Make an arrangement with local volunteer/paid fire and EMS personnel to provide an ambulance for transport when the commercial company is not available. A nurse or respiratory therapist from your facility may need to go with the team, if necessary, based on patient condition and personnel training.

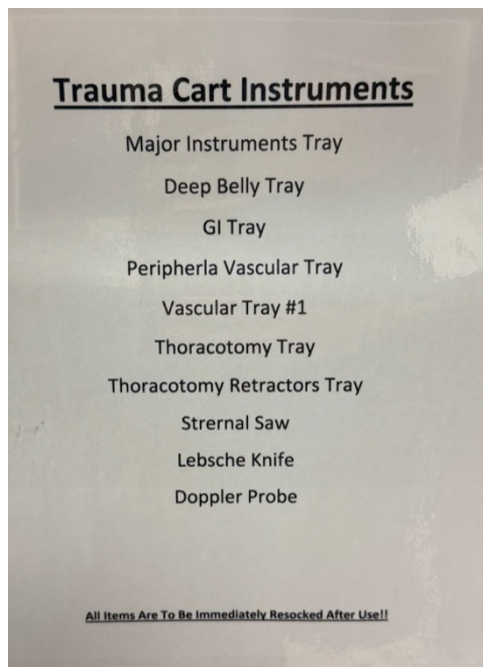


Figure 3 Trauma cart (internal).

- b. Have a flight crew on standby postoperation for immediate transport to the accepting facility to avoid delay in critical care.
3. Have the necessary supplies and instruments on hand.
 - a. Create a ‘trauma cart’ with inventory that you need. The ER staff, OR staff, nursing supervisor and surgeon on call should know where the cart is located.
 - b. The cart should be inventoried and stock rotated on a regular basis.
 - c. Items to consider: vascular suture, vascular shunts, gastrointestinal anastomosis vascular/gastrointestinal staplers, combat gauze, thoracotomy tray, abdominal tray, vascular tray, Fogarty balloons, vessel loops, multiple packs of lap pads, chest tubes, pleura-vac, abdominal vac dressing, vessel sealing energy device of your choice. The inventory list should include any item that you may need

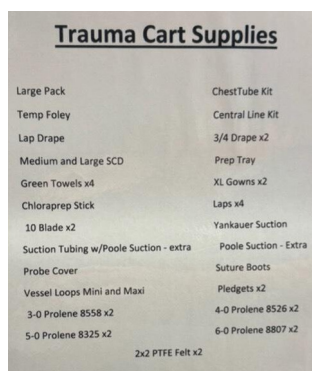


Figure 4 Trauma cart supply list (continuation).

at 03:00 and the traveling nurse will be unable to locate in the OR core (figures 3 and 4).

4. Continuing education
 - Advanced Trauma Life Support
 - ASSET (Advanced Surgical Skills for Exposure in Trauma)
 - Advanced Trauma Operative Management
 - Know the key exposures and review them frequently.
 - Familiarize yourself with the vascular shunts at your facility.
 - Watch videos—if you have not done preperitoneal pelvic packing or a thoracotomy in a while, do not get caught off guard.

SUMMARY

There is a role for damage control surgery in both general surgery and trauma patients at level 3 centers. The successful implementation and completion of damage control surgery require thorough planning and a full understanding of resource limitation. Additional training or practice for infrequently performed procedures may be necessary. A systems-based approach with postoperative transfer to a higher level of care is acceptable and expected.

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REFERENCES

- 1 Stone HH, Strom PR, Mullins RJ. Management of the major coagulopathy with onset during Laparotomy. *Ann Surg* 1983;197:532–5.
- 2 Feliciano DV, Mattox KL, Jordan GL. Intra-abdominal packing for control of hepatic hemorrhage: a reappraisal. *J Trauma* 1981;21:285–90.
- 3 Rotondo MF, Schwab CW, McGonigal MD, Phillips GR, Fruchterman TM, Kauder DR, Latenser BA, Angood PA. Damage control: an approach for improved survival in Exsanguinating penetrating abdominal injury. *J Trauma* 1993;35:375–82.
- 4 Roje Z, Roje Z, Matic D, Librenjak D, Dokuzović S, Varvodić J. Necrotizing Fasciitis: literature review of contemporary strategies for diagnosing and management with three case reports: torso, abdominal wall, upper and lower limbs. *World J Emerg Surg* 2011;6:46.
- 5 Martinschek A, Evers B, Lampl L, Gerngroß H, Schmidt R, Sparwasser C. Prognostic aspects, survival rate, and predisposing risk factors in patients with Fournier’s gangrene and necrotizing soft tissue infections: evaluation of clinical outcome of 55 patients. *Urol Int* 2012;89:173–9.
- 6 Wang KC, Shih CH. Necrotizing Fasciitis of the extremities. *J Trauma* 1992;32:179–82.
- 7 Collins R, Dhanasekara CS, Morris E, Marschke B, Dissanaika S. Simple Suture Whipstitch closure is a reasonable option for many patients requiring temporary abdominal closure for blunt or penetrating trauma. *Trauma Surg Acute Care Open* 2022;7:e000980.