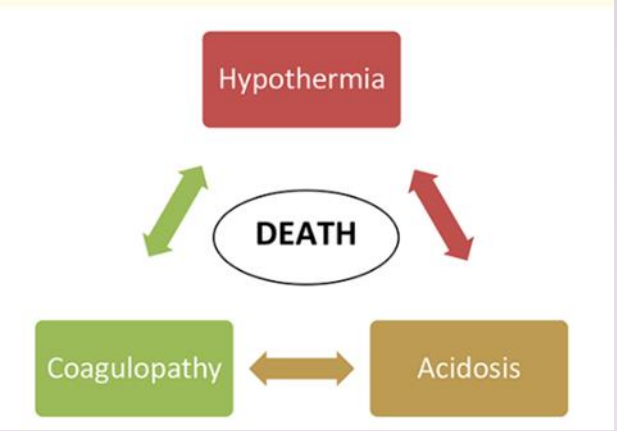
DAMAGE CONTROL SURGERY

Definition

A staged approach to managing patients with traumatic or nontraumatic injuries who require immediate surgical intervention, but need further resuscitation prior to definitive surgical treatment.

The initial phase of damage control surgery is aimed at controlling bleeding, contamination, and necrosis. After postoperative patient stabilization, definitive surgical repair can be carried out.

- First described in 1993
- Has seven fold improvement (from 11% to 77%) in mortality in patient of combined visceral and major vascular injuries
- have improved the survival of critically injured patients.
- Conceptually, the bloody vicious cycle, first described in 1981, is the lethal combination of coagulopathy, hypothermia, and metabolic acidosis



Bloody vicious cycle(lethal triad of death)

Profound shock and/or massive injuries responsible for large blood losses quickly initiate the cycle of hypothermia, acidosis, and coagulopathy.

- Hypothermia from evaporative and conductive heat loss and diminished heat production occurs despite the use of warming blankets and blood warmers.
- The metabolic acidosis of shock is exacerbated by aortic clamping, administration of vasopressors, massive RBC transfusions, and impaired myocardial performance.
- The acute coagulopathy of trauma, described previously, is compounded by hemodilution, hypothermia, and acidosis.

Once the cycle starts, each component magnifies the other, which leads to a downward spiral and ultimately a fatal arrhythmia.

Hypothermia is an inevitable pathophysiological consequence of severe injury and subsequent resuscitation.

- Implicated factors are:

1. Heat loss in the field

2.resuscitation maneuvers

3.Injury severity

4.Ag

5.Exposure of body cavities during surgery

6.Impaired thermogenesis, and Degree of transfusion have all been

- If sufficient resuscitation is ensured and the patient is exposed to heat and oxygenation is ensured, then oxidative respiration increases and the acidosis is corrected by itself.

- **The purpose of DCS** is to limit operative time so that the patient can be returned to the SICU(surgical ICU) for physiologic restoration and the cycle thereby broken.

Indications to limit the initial operation and institute DCS techniques include a combination of :

1. refractory hypothermia (temperature <35°C)
2. profound acidosis, (arterial pH <7.2, base deficit <15 mmol/L)
3. refractory coagulopathy
4. Prolonged PT
5. Thrombocytopenia

6. The need for massive transfusion (the need for more than >10 units of red blood or the need for body fluid replacement)
7. High-energy blunt trauma
8. Multiple penetrant injuries
9. Visceral injury combined with major vascular trauma
10. Variations in physiological reserve (the elderly, those with a large number of comorbidities, and athletes)

The core strategy of DCS:

Phase 1 : **abbreviated initial laparotomy**

Phase 2 **: resuscitation**

Phase 3 : **delayed definitive surgery**

PHASE 1: An abbreviated laparotomy

- An abbreviated laparotomy is directed at rapidly controlling haemorrhage and minimizing contamination.
- A vertical, midline incision is made from xiphisternum to the pubic symphysis. Once the abdominal cavity is entered, immediate control of haemorrhage and haemostasis is the main priority. This can be achieved by four quadrant abdominal packing, ligation, cross-clamping, shunting or balloon catheter tamponade.

➢ **Controlling surgical bleeding while preventing ischemia is of utmost importance during DCS**

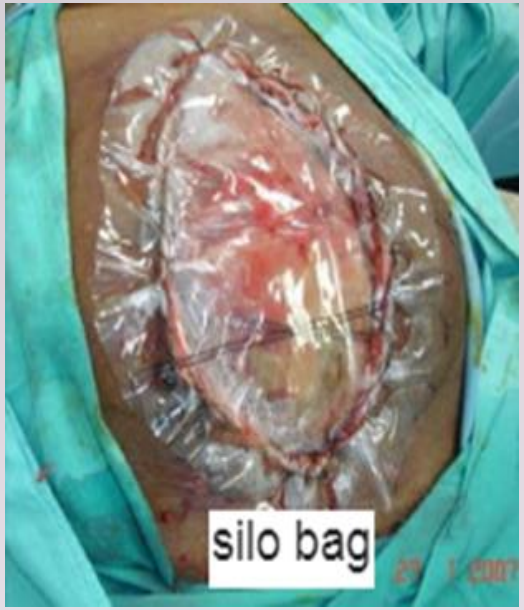
Once the bleeding is controlled, the next step is the **control of contamination** (The second key component of DCS is limiting enteric content spillage.) . The entire length of the bowel wall is inspected; prevention of further contamination is achieved by rapid closure of the perforated Viscus by simple suturing, ligation or stapling.

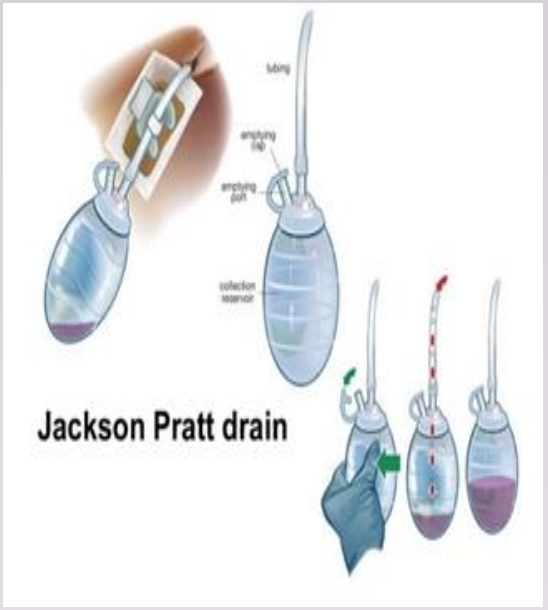
With multiple enterotomies, if the area of injury represents less than 50% of the length of the small bowel, a single resection can be undertaken.

- No reconstructive surgery is undertaken at this first laparotomy.

- Thorough irrigation of the abdominal and pelvic cavities with warm solution should be performed prior to closure**. A plastic-covered sterile operating room towel** is placed circumferentially under the fascia to cover and protect the underlying viscera, and the wound is packed. **A small number of central perforations** are made in the covering to enable the fluid to egress to the drains.

- **Closed-suction drains** are placed above the plastic at the level of the subcutaneous tissue brought out through separate stab wounds or the inferior part of the wound and secured to the skin. The abdominal fascial layer **is left open**, and temporary abdominal closure is undertaken with towel clips, silo bag closure or vacuum pack. Skin closure is not recommended.

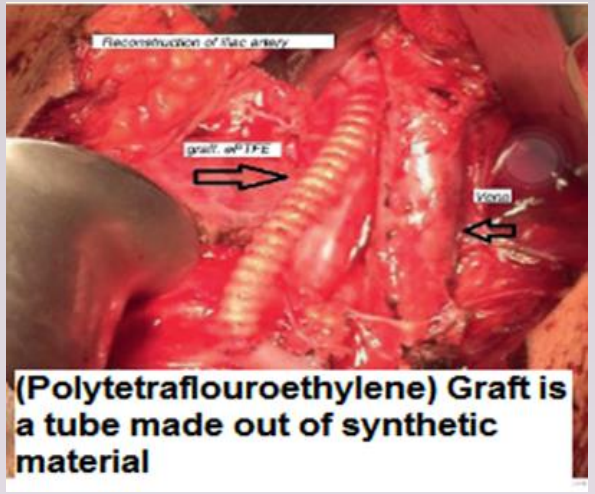

silo bag


Jackson Pratt drain

- In this technique, the bowel is covered with a fenestrated subfascial sterile drape, and two Jackson-Pratt drains are placed along the fascial edges; this is then covered using an Ioban drape, which allows closed suction to control reperfusion-related ascitic fluid egress while providing adequate space for bowel expansion to prevent abdominal compartment syndrome.

- During the initial DCS stage, the subfascial sterile drape is not covered by a blue towel so that the status of the bowel and hemorrhage control can be assessed.

✓**Aortic injuries** must be repaired using an interposition PTFE graft.



✓**Venous injuries** are preferentially treated with ligation in damage control situations, except for the suprarenal, inferior vena cava and popliteal vein, those are usually repaired by grafting .

Specific situations in controlling bleeding:

- **For extensive solid organ injuries** to the spleen or one kidney, excision is indicated rather than an attempt at operative repair.
- **For hepatic injuries**, perihepatic packing of the liver will usually tamponade bleeding. Translobar gunshot wounds of the liver are best controlled with balloon catheter tamponade, whereas deep lacerations can be controlled with Foley catheter inflation deep within the injury track.
- **For thoracic injuries** requiring DCS several options exist. For bleeding peripheral pulmonary injuries, wedge resection using a stapler is performed. In penetrating injuries, pulmonary tractotomy is used to divide the parenchyma ; individual vessels and bronchi are then ligated using a 3-0 polydioxanone suture (PDS) and the track left open. Patients who sustain more proximal injuries may require formal pulmonary resection but pneumonectomy is poorly tolerated.

- **Cardiac injuries** may be temporarily controlled using a running non absorbable polypropylene suture or skin staples. Pledgeted repair should be performed for the relatively thin right ventricle.

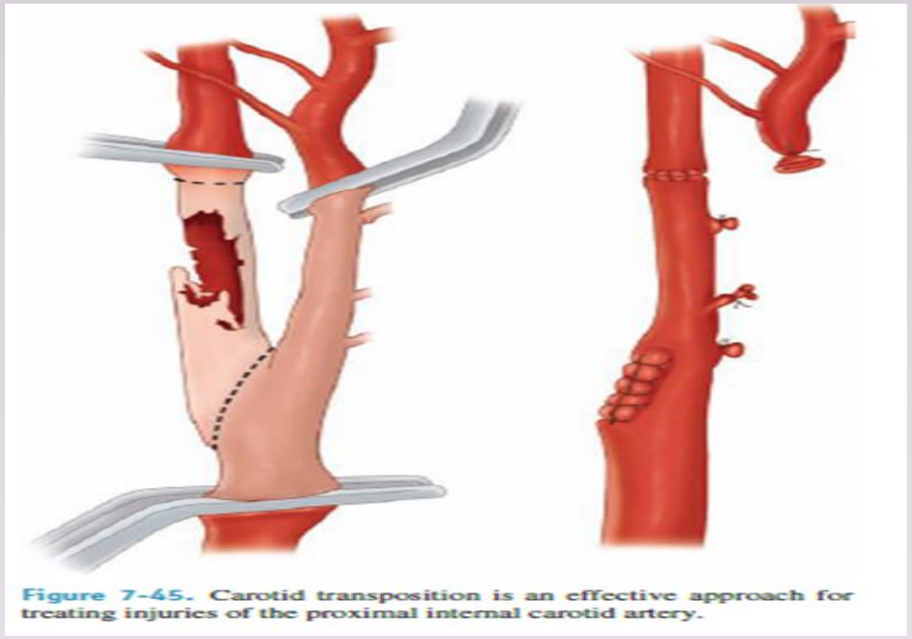


Figure 7-45. Carotid transposition is an effective approach for treating injuries of the proximal internal carotid artery.

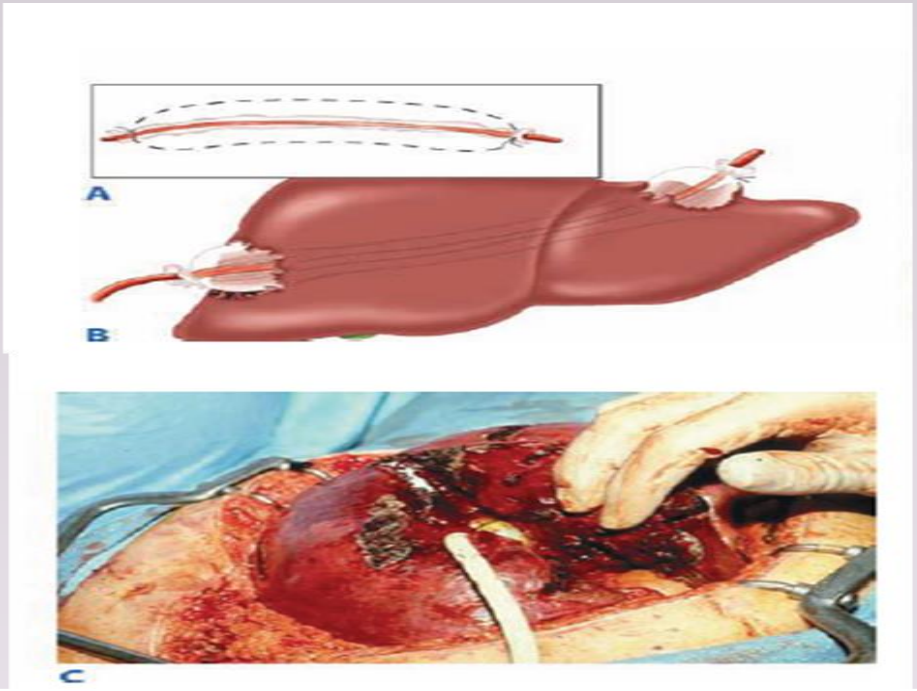
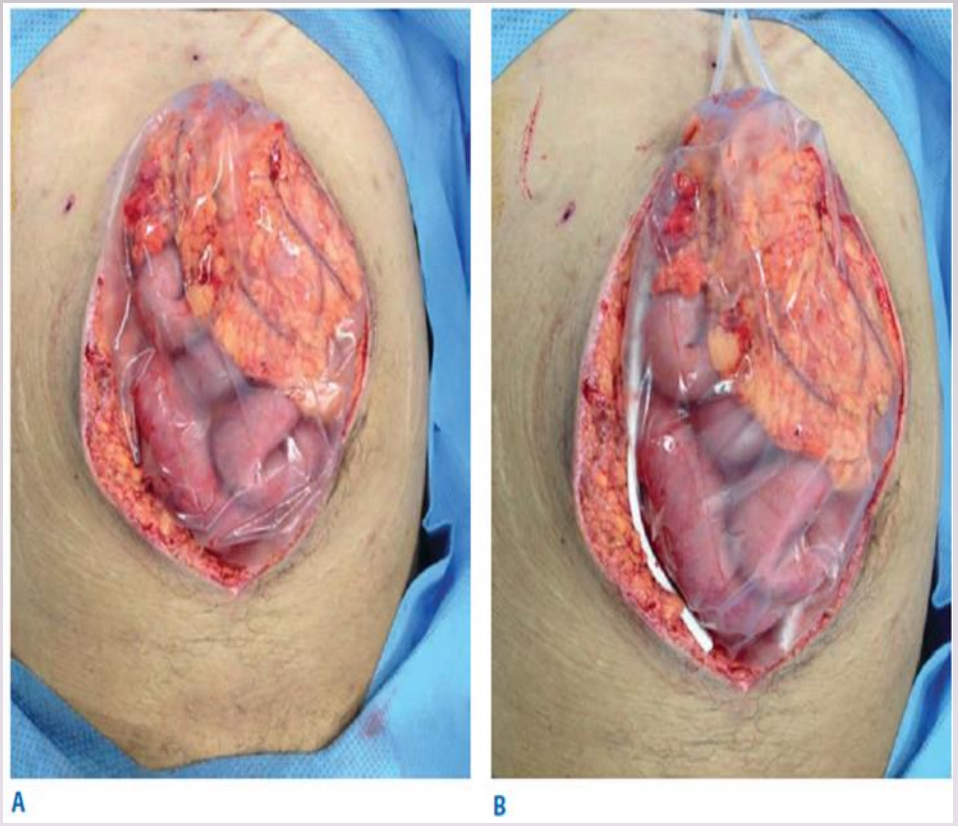
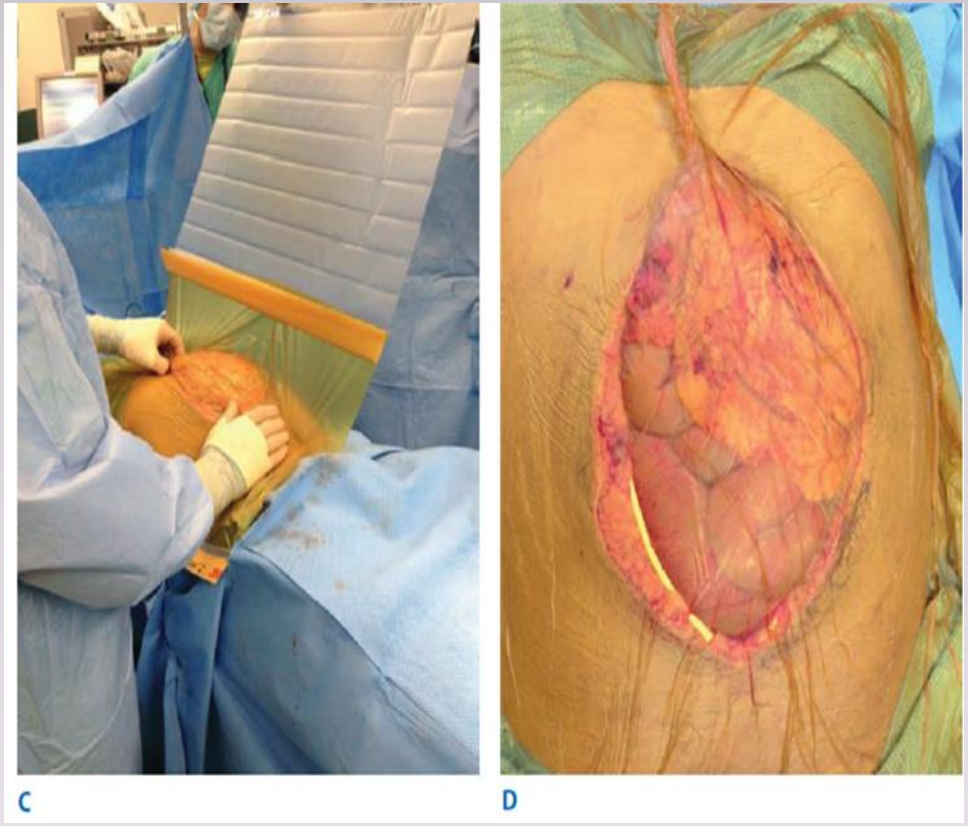


Figure 7-48. A. An intrahepatic balloon used to tamponade hemorrhage from transhepatic penetrating injuries is made by placing a red rubber catheter inside a 1-inch Penrose drain, with both ends of the Penrose drain ligated. B. Once placed inside the injury tract, the balloon is inflated with saline until hemorrhage stops. C. A Foley catheter with a 30-mL balloon can be used to halt hemorrhage from deep lacerations to the liver.


A
B


C
D

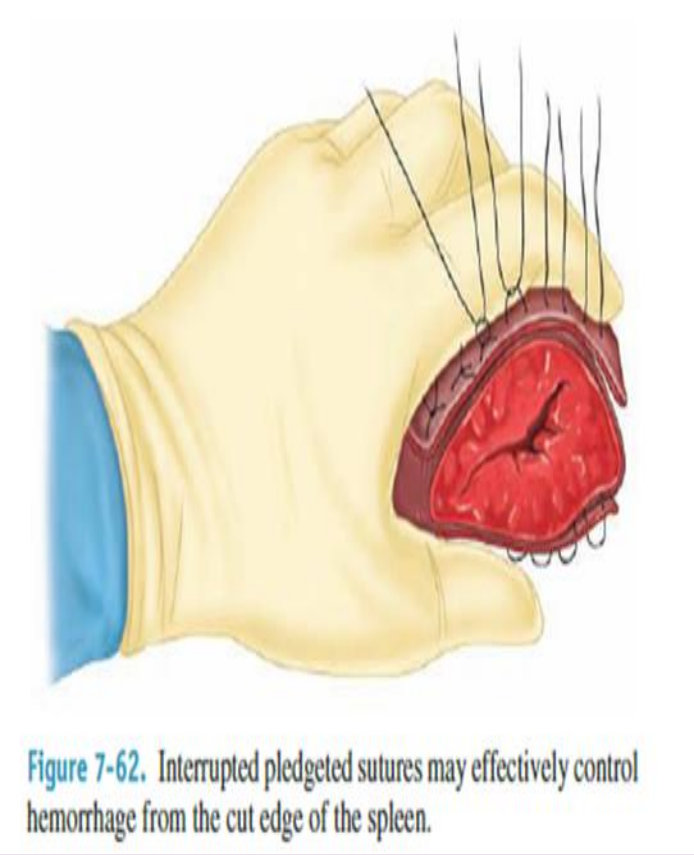


Figure 7-62. Interrupted pledgeted sutures may effectively control hemorrhage from the cut edge of the spleen.

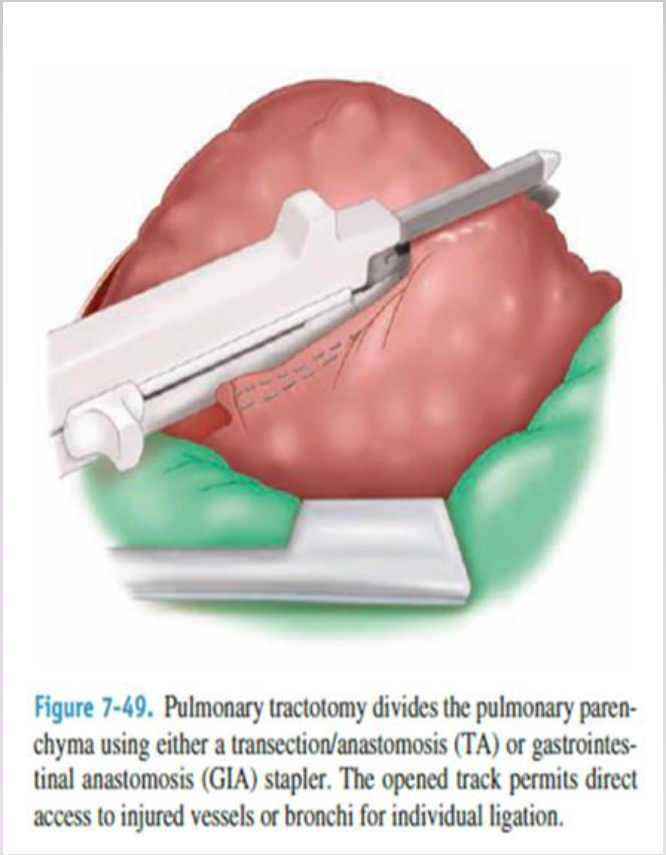
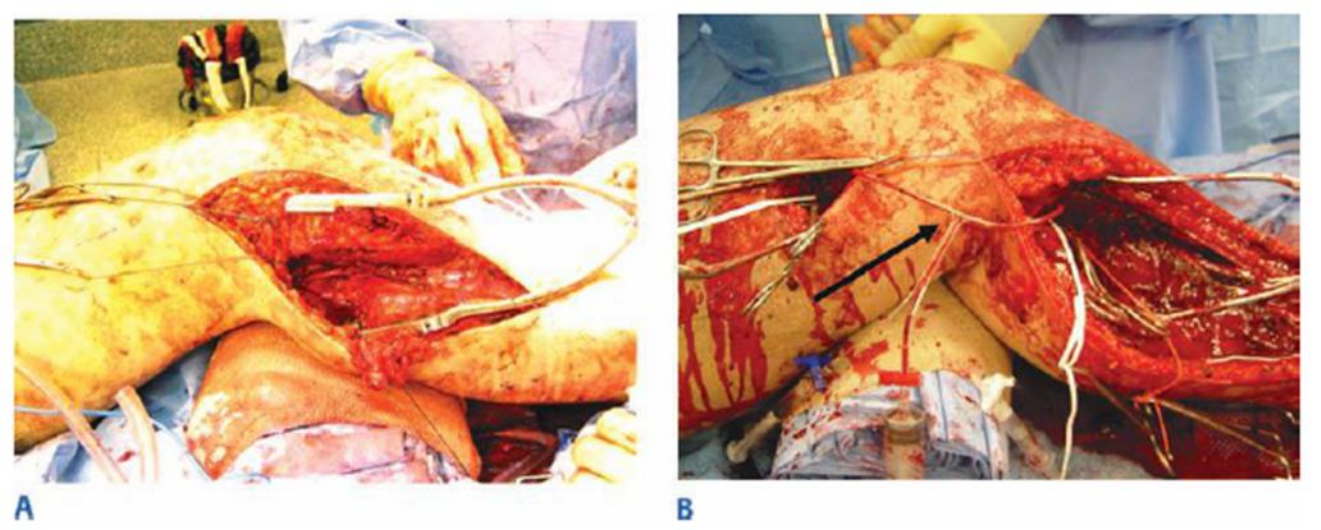


Figure 7-49. Pulmonary tractotomy divides the pulmonary parenchyma using either a transection/anastomosis (TA) or gastrointestinal anastomosis (GIA) stapler. The opened track permits direct access to injured vessels or bronchi for individual ligation.

A. The popliteal space is commonly accessed using a single medial incision (the detached semitendinosus, semimembranosus,and gracilis muscles are identified by different suture types).

B. Alternatively, a medial approach with two incisions may be used. Insertion of a Pruitt-Inahara shunt (arrow) provides temporary restoration of blood flow, which prevents ischemia during fracture treatment.



- **Small GI injuries** (stomach, duodenum, small intestine, and colon) may be controlled using a rapid whipstitch .Complete transection of the bowel or segmental damage is controlled using a GIA stapler, often with resection of the injured segment. Alternatively, open ends of the bowel may be ligated using umbilical tapes to limit spillage.
- **Pancreatic injuries**, regardless of location, are packed and the evaluation of ductal integrity postponed.
- **Urologic injuries** may require catheter diversion. Before the patient is returned to the SICU, the abdomen must be temporarily closed.

PHASE 2: RESUSCITATION

- Damage control resuscitation has **three** basic components: permissive hypotension, minimizing crystalloid-based resuscitation, and the administration of predefined blood products in ratios similar to those of whole blood.

- Because of the known early coagulopathy of trauma, the current approach to managing the exsanguinating patient involves early implementation of damage control resuscitation (DCR). Although most of the attention to hemorrhagic shock resuscitation has centered on higher ratios of plasma and platelets, Regardless of the optimal ratio, it is essential that the trauma center has an established mechanism to deliver these products quickly and in the correct amounts to these critically injured patients. In fact, several authors have shown that a well-developed massive transfusion protocol is associated with improved outcomes independent of the ratios chosen. This aggressive delivery of predefined blood products should begin **prior** to any laboratory-defined anemia or coagulopathy.

- **Optimal early resuscitation** is mandatory and determines when the patient can undergo definitive diagnosis as well as when the patient can be returned to the OR after initial damage control surgery.

- **Specific goals** of resuscitation before repeated “semielective” transport include a core temperature of >35°C (95°F), base deficit of <6 mmol/L, and normal coagulation indices.

- Replacement is continued **until PT period is 15s** and **the platelet number is 100,000/mm3**.* If fibrinogen levels are low, cryoprecipitate can be applied every 4 h. *In life-threatening nonsurgical hemorrhages, recombinant factor VIIa can be applied .

- Although correction of metabolic acidosis is desirable, how quickly this should be accomplished requires careful consideration.

- **Coagulopathy is the goal as a secondary objective.** For this purpose, blood products and resuscitation are planned for the patient. **In the first 24 h.**

- **Adverse sequelae of excessive crystalloid resuscitation include :**

1. increased intracranial pressure

2. worsening pulmonary edema

3. worsening intra-abdominal visceral

4. retroperitoneal edema resulting in secondary abdominal compartment syndrome.

Therefore, it should be the overall trend of the resuscitation rather than a rapid reduction of the base deficit that is the goal **. The goal is to normalize lactate within 24 hours.**

❑CONCLUSION:

General steps : stop bleeding then stop contamination then SICU 24 to 48h for stabilization then go again to theater.

❑Unfortunately, 

The patient died of the multiorgan failure, hypothermia, coagulopathy, or "failure to thrive." Even with aggressive attempts at "triple" antibiotics; steroid, superfluid, and vasopressor administration, nutritional supplimentation, neutralization of gastric, pancreatic, and intestinal secretions; and even complex ventilators and extracorporeal support, undesirable outcomes in terms of cost, length of ICU/ hospital stay, cerebral insufficiency, respiratory cripples, and death were encountered.

Critical Factors (bad scenarios):

1. Severe metabolic acidosis (pH < 7.30).

2. Hypothermia (temperature <35°C).

3. Resuscitation and operative time > 90 minutes.

4. Coagulopathy as evidenced by development of nonmechanical bleeding.

5. Massive transfusion (> 10 units packed red blood cells).

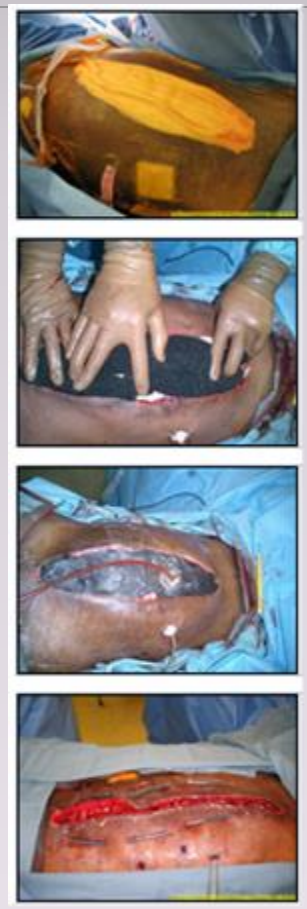
PHASE 3: DELAYED DEFINITIVE SURGERY

- Return to the OR within 24-48 hours is planned once the patient clinically improves, as evidenced by normothermia, normalization of coagulation test results, and correction of acidosis.
- Ideally performed at 24 to 36 hours, later if indications of physiologic derangement persist.
- Removal of packs, with replacement if necessary.
- Secondary survey of the abdomen: missed injuries at the time of damage control surgery are not uncommon.
- Restoration of gastrointestinal and vascular continuity if necessary.
- Performance of other definitive procedures, such as ostomy placement.

- Abdominal closure if possible,..

If bowel edema prevents this, several techniques (e.g., Wittman patch) can be employed to help reapproximate fascial edges in stages.

- Multiple “second-looks” may be needed.



Wittman patch