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SURGICAL TECHNIQUE

Damage control laparotomy

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The essence of damage-control laparotomy is to perform the most rapid intervention possible in order to permit ongoing resuscitation without delay. The gesture is limited to a rapid exploration with inventory of sites of active hemorrhage or intestinal leakage and summary control followed by simple closure or even incomplete closure of the laparotomy.

Early recourse to damage-control laparotomy has resulted in an indisputable improvement in the management of major abdominal trauma, as well as severe non-traumatic intra-abdominal emergencies. But even if the patient leaves the operating suite alive to be transferred to the arteriography suite or intensive care unit, he is, by no means cured, and the subsequent management must be scrupulously managed.

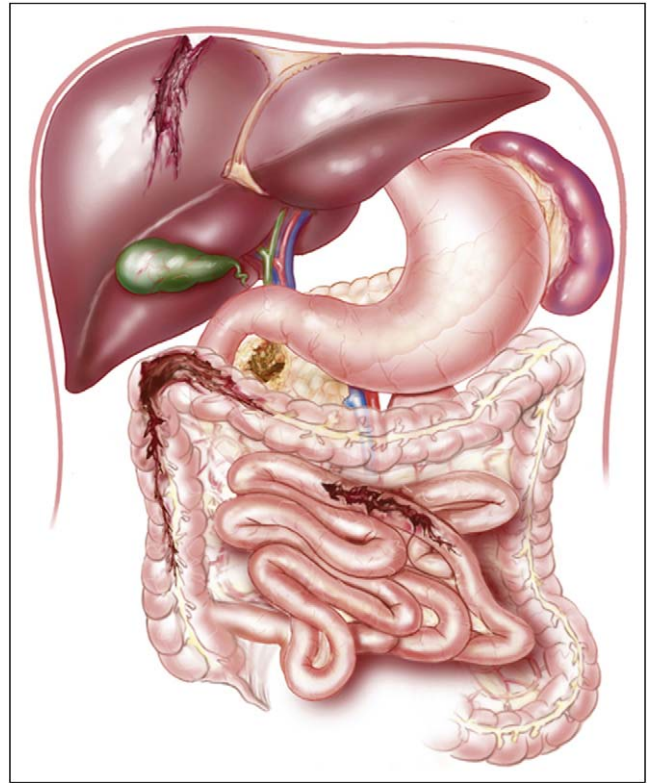
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1 Indications for damage control laparotomy (DCL)

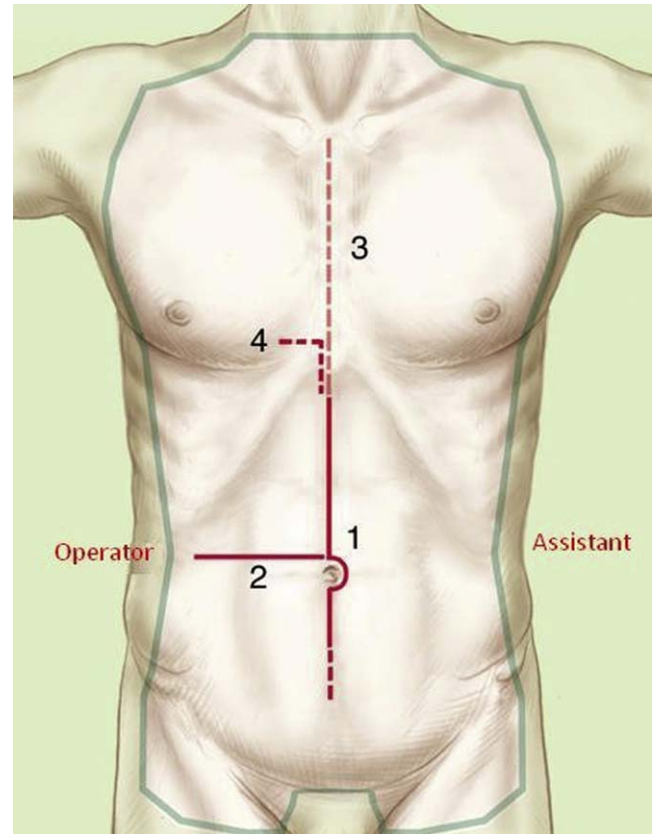
The concept of damage control surgery was developed in the setting of abdominal traumatology where the combined nocive effects of hypothermia, acidosis, and multiple transfusions result in a hemorrhagic diathesis that renders classical surgical maneuvers futile; temporary measures that can be rapidly and simply performed will allow the patient to undergo rapid fluid resuscitation on the operative table and in the intensive care setting while attending to the specific biologic disorders that provoke disordered coagulation. Some patients, having undergone DCL, are transferred straight from the operating room (OR) to the angiography suite for urgent computed tomography (CT) angiogram and/or visceral arterial embolization. The decision to resort to DCL is made in the OR when confronted with the findings at laparotomy, but the need for DCL can often be foreseen: if the patient has already received five units of blood transfusion, the temperature is below 34°, the pH is less than 7.25, or the systolic blood pressure is less than 70 mmHg.

Non-traumatic abdominal emergencies may also be an indication for DCL; this may be the case when the patients overall condition is so severe that the benefit of a well-conducted resuscitation in an intensive care setting outweighs the benefits of an immediate surgical repair of lesions. For example, in a patient undergoing intestinal resection for ischemic necrosis with concomitant profound shock, the choice of leaving the viable ends of bowel stapled or simply ligated within the abdomen and limiting the parietal closure to skin-level suture (without fascial closure) may offer the patient the best chance of immediate survival. A re-intervention after 2 or 3 days of resuscitation will allow definitive repair of the remaining lesions under improved conditions (in those patients who survive). The actual technique of DCL naturally depends on the specific organs involved, particularly in traumatology. Here, for example, we illustrate a case of major liver trauma, with incidental involvement of other organs.



2 Incision

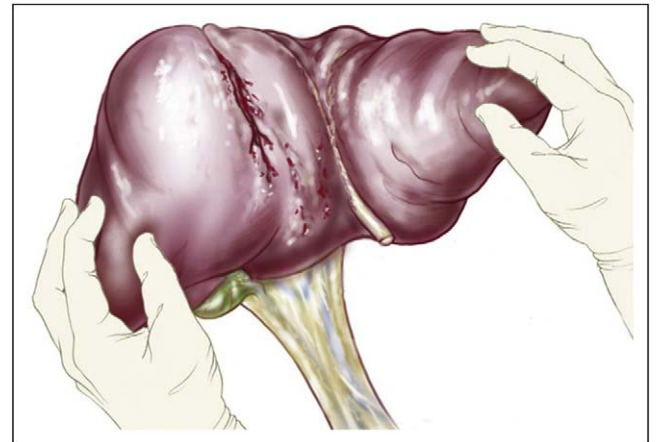
The field should be draped widely from above the sternal notch to below the inguinal crease. The initial mid-line incision should extend from the xiphoid to the pubis. Then, while continuing to aspirate spilled blood (with two suction devices if the bleeding is active), bimanual compression of the liver accompanied by pressure tamponade with lap pads packed into the other quadrants will allow a rapid inventory of the other lesions and assessment of the principal sources of bleeding.



3 Hepatic and splenic trauma

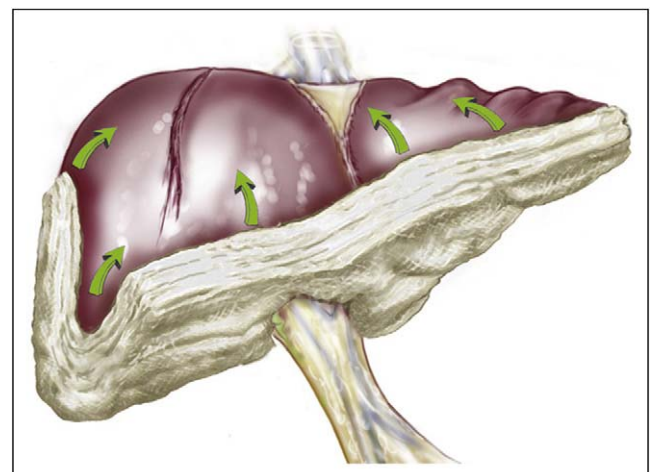
In the context of DCL, there is no role for splenic repair; these circumstances call for an expeditious splenectomy.

For severe liver injuries in a setting of massive blood loss, prompt bimanual hepatic compression is essential to close the liver parenchyma on itself while applying pressure superiorly and anteriorly.



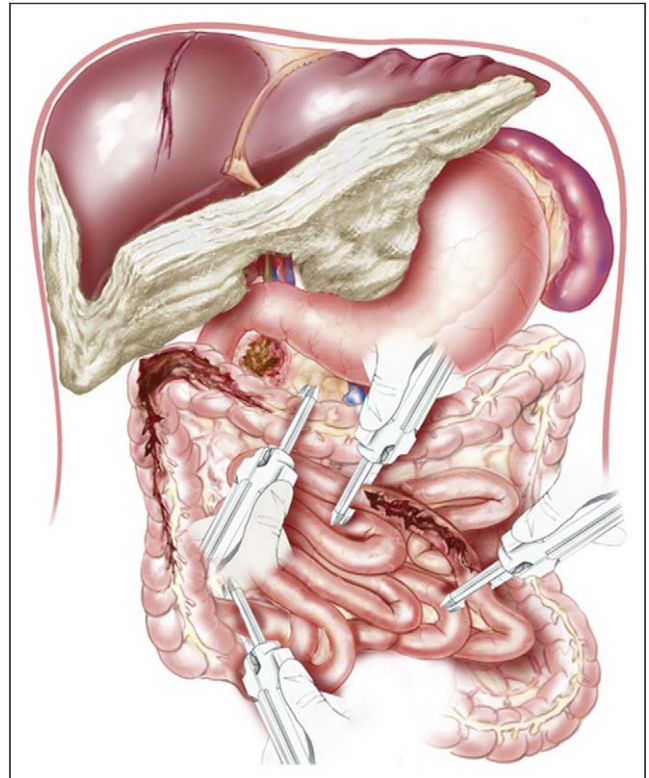
4 Perihepatic tamponade

Initial bimanual compression supplemented by perihepatic tamponade (PHT) by packing with lap pads will control almost all hepatic hemorrhage due to venous bleeding, whether from portal or supra-hepatic origin. If hemorrhage persists despite reinforcement of hepatic packing, there is usually an arterial source of bleeding; if clamping of the hepatic pedicle slows the blood loss, this confirms the arterial injury. The surgeon must then choose between urgent hepatic arterial embolization, or exceptionally, ligation of the hepatic artery or its right branch.



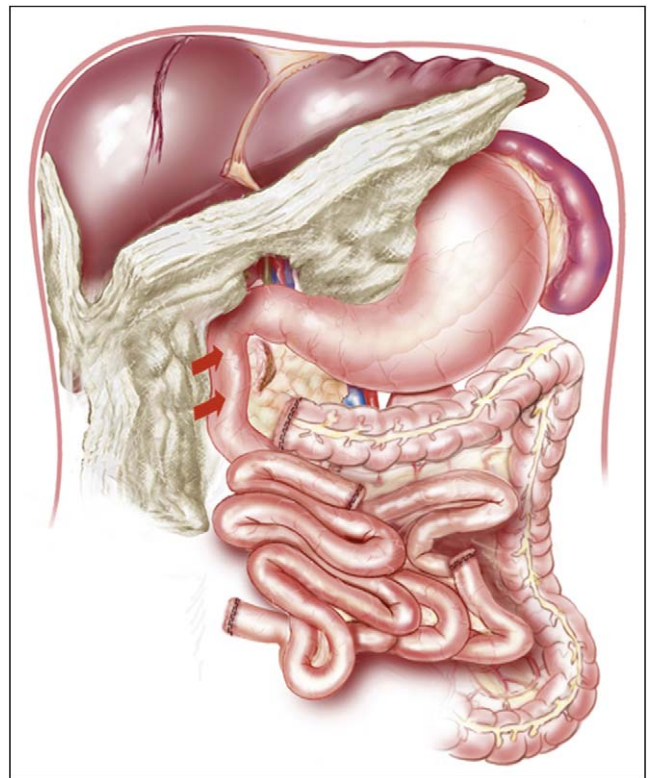
5 Intestinal and mesenteric injuries

Intestinal lacerations or loss of substance, should be treated by rapid resection of any intestine that is damaged beyond repair, followed by suture repair, luminal ligation, or staple closure of viable bowel. Mesenteric or mesocolic hemorrhage should be treated by summary ligation without concern for any eventual ischemia which might result. This will be dealt with at interval reintervention when the patient is stabilized.



6 Duodenopancreatic injury

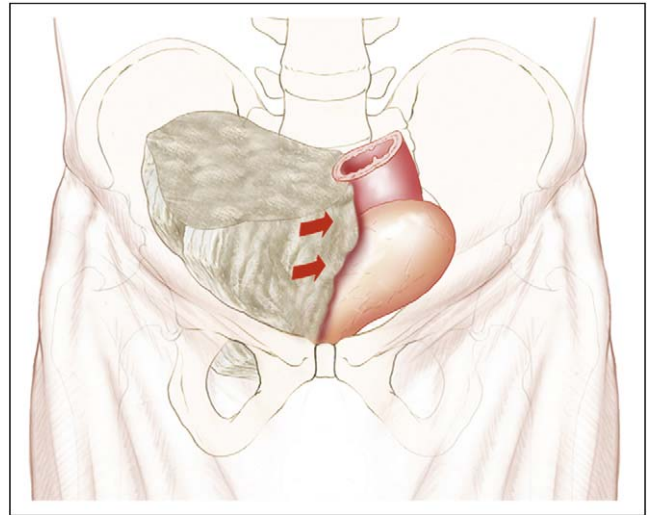
Rapid hemostasis of major bleeding vessels and insertion of packs usually suffices to achieve hemostasis. In the rare cases where heavy bleeding persists, a hemostatic duodenopancreatectomy with no attempt to re-establish intestinal continuity (staple closure of transected organs) along with packing may be necessary.



7 Retroperitoneal hemorrhage

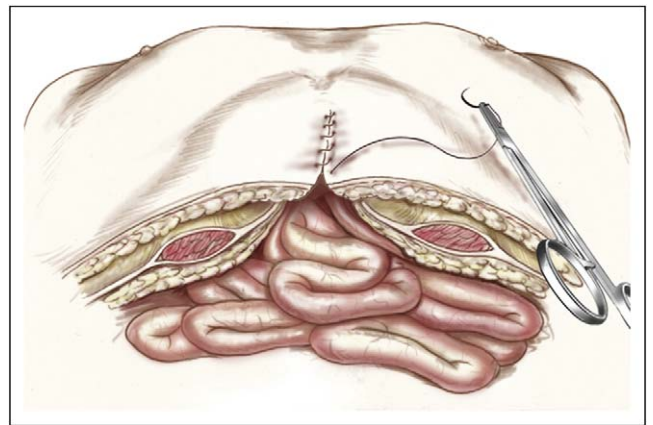
In most cases of retroperitoneal hematoma due to blunt trauma, it is best to avoid opening the hematoma; however, rapid enlargement of the hematoma indicative of arterial bleeding imposes exploration. Whether the retroperitoneum was opened by the trauma itself or by the surgeon, a rapid and summary control of arterial bleeding by vessel ligation or clamping should be followed by tamponade with packs to control any remaining diffuse venous bleeding. In the specific instance of pelvic hematoma (usually with concomitant pelvic fractures), packing should be applied to the hemorrhagic side or in front of and behind the bladder. Pelvic packing is usually a life-saving maneuver which must usually be followed by prompt arteriography and arterial embolization.

A similar attitude of life-saving urgency dictates summary nephrectomy when faced with open active renal hemorrhage.



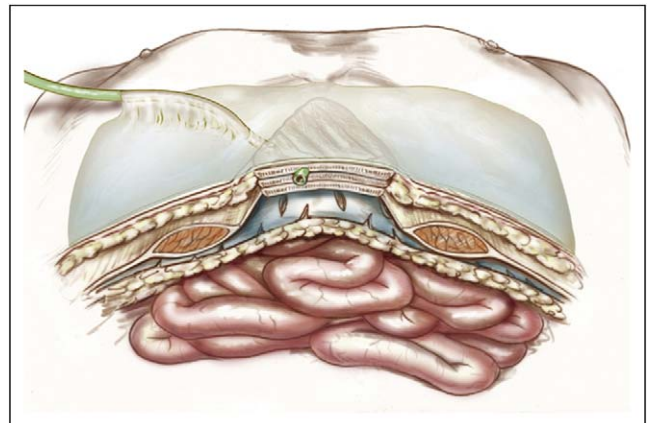
8 Skin closure

The parietal closure should be rapid and tension-free. The simplest approach when there is adequate slack is a running closure of the skin layer alone.



9 Laparostomy closure

If the abdominal wall seems tight, a skin closure should not be performed. In such cases, parietal closure can be achieved by leaving the abdomen open (laparostomy) covered with a negative-pressure dressing. It is essential to avoid closure under tension which results in abdominal hypertension and may lead to development of an abdominal compartment syndrome in the immediate post-operative period.



Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.