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REVIEW

Management specificities for abdominal, pelvic and vascular penetrating trauma



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Summary Management of patients with penetrating trauma of the abdomen, pelvis and their surrounding compartments as well as vascular injuries depends on the patient's hemodynamic status. Multiple associated lesions are the rule. Their severity is directly correlated with initial bleeding, the risk of secondary sepsis, and lastly to sequelae. In patients who are hemodynamically unstable, the goal of management is to rapidly obtain hemostasis. This mandates initial

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laparotomy for abdominal wounds, extra-peritoneal packing (EPP) and resuscitative endovascular balloon occlusion of the aorta (REBOA) in the emergency room for pelvic wounds, insertion of temporary vascular shunts (TVS) for proximal limb injuries, ligation for distal vascular injuries, and control of exteriorized extremity bleeding with a tourniquet, compressive or hemostatic dressings for bleeding at the junction or borderline between two compartments, as appropriate. Once hemodynamic stability is achieved, preoperative imaging allow more precise diagnosis, particularly for retroperitoneal or thoraco-abdominal injuries that are difficult to explore surgically. The surgical incisions need to be large, in principle, and enlarged as needed, allowing application of damage control principles.

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Introduction

Wartime wounds are typically penetrating injuries caused by bullets or flying debris. Abdominal wounds, generally of hollow organs, are most often multiple (4 to 5 per patient in recent combats) and represent between 10% and 20% of warfare wounds [1,2]. Truncal trauma, representing nearly half of preventable deaths, accounts for 20 to 30% of all deaths in warfare settings. Retroperitoneal organ involvement is more rare but severe. Ballistic injury to central great vessels (aorta, inferior vena cava and mesenteric vessels) is often associated with multiple and/or extensive other abdominal injuries. Pelvic wounds are severe, with mortality exceeding 30% when the rectum is involved [1]. Vascular injuries are prevalent and most concern limb injuries. Borderline compartment injuries are defined as penetrating trauma of frontier zones between two compartments (cervicothoracic, axillary, thoraco-abdominal and inguinal); they are characterized by frequent bleeding, anatomical complexity, difficulty in approach and surgical strategy. Complementary laboratory and imaging investigations are not very sensitive, and most often assessment of lesions is made during surgical exploration in the context of damage control. In the unstable patient, the goal of management is to obtain rapid hemostasis and hemodynamic stability to save the life of the wounded patient. If the patient is hemodynamically stable, the goal of management is first to correctly assess all injuries in order to perform the appropriate treatment urgently. The goal of this chapter is recall the specificities of the diagnostic and therapeutic management of patients sustaining penetrating trauma to the abdomen, pelvis, vessels and bordering compartments in the context of civilian warfare attacks and massive afflux of wounded.

Abdominal wound specificities

Hemodynamically unstable patient

Principles

Bleeding originating from solid organs is treated by resection (splenectomy, nephrectomy) or compression (peri-hepatic or retroperitoneal packing). Hollow organ injury is controlled by temporary measures: linear stapling. There is no place for stoma creation in the unstable patient. The main goal is only to stop peritoneal contamination.

Surgical approaches

Laparotomy is a ‘‘crash-laparotomy’’, the incision is made with a cold blade scalpel. The patient is in shock; because of peripheral vaso-constriction, there is no worrisome bleeding during laparotomy and use of electrocautery is a loss of time. The laparotomy is on the midline.

Treatment of hemorrhage and contamination

Rapid control of major bleeding

In case of massive bleeding, the first gesture is manual compression of the abdominal aorta just below the diaphragm. The anesthesiologist can attest to the efficacy of the procedure when the arterial pressure rises. Manual compression can be replaced by supra-celiac cross clamping, after finger dissection of the muscular fibers of the crura. Simultaneously, the hemoperitoneum is rapidly evacuated with traditional and autologous blood recovery system suction. While in blunt trauma, pads are added in each quadrant to identify the origin of bleeding, the source of bleeding from ballistic wounds is much easier by the more localized nature of bleeding that can most often be controlled manually. A simple measure is to compress the mesenteric root between the thumb and index (Fig. 1). Once this compression is done, the two peritoneal sides can be incised and hemorrhage can be selectively controlled. If this is not possible, and in particular, when the superior mesentery artery is involved, hemorrhage control may require medial rotation of the viscera:

- either from the right: Kocher maneuver followed by mesenteric disinsertion (Cattell and Braasch maneuver) (Fig. 2);
- or from the left: left medial rotation of colon, spleen and pancreatic tail (Mattox maneuver) (Fig. 3).

Analytic treatment of hemorrhagic injuries

Splenic injury should be treated by splenectomy according to the medial rotation technique. To control bleeding from the spleen rapidly, the spleen is pushed up on the spine and the posterior mesogastrium is opened until the spleno-pancreatic block is elevated into the midline, allowing approach to the splenic pedicle to control the bleeding.

Liver hemorrhage is treated essentially by peri-hepatic packing (PHP). This procedure should be performed methodologically according to the instructions in the technical factsheet. If liver bleeding is intra-parenchymal, not rare when projectiles penetrate through the liver, ‘‘internal’’ packing can be achieved with a Penrose drain ligated at one extremity, or a Sengstaken–Blakemore tube, or even

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