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Thoracic Damage Control: Let's Think About Intrathoracic Packing

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Maud Prezman-Pietri**
B 2 **Pierre Rabinel**
B 2 **Grégoire Périé**
ABDE 1 **Bernard Georges**
ABEF 2 **Laurent Brouchet**
ABCDEF 1 **Fanny Vardon Bounes**

1 Anesthesiology and Critical Care Unit, University Teaching Hospital of Toulouse, Toulouse, France
2 Department of Thoracic Surgery, University Teaching Hospital of Toulouse, Toulouse, France

Corresponding Author: Fanny Vardon Bounes, e-mail: bounes.f@chu-toulouse.fr
Conflict of interest: None declared

Patient: **Male, 48**
Final Diagnosis: **Hemothorax**
Symptoms: **Dyspnea**
Medication: —
Clinical Procedure: —
Specialty: **Critical Care Medicine**

Objective: **Management of emergency care**

Background: In cases of hemorrhagic shock following thoracic trauma, thoracotomy is indicated as primary surgical management, as a chest tube might lead to exsanguination. Thoracic packing is an alternative, particularly in severe injury trauma.

Case Report: A 48-year-old male was involved in an accident in which 2 cars collided. The patient suffered from right-sided hemothorax due to diaphragm rupture and stripping of the diaphragmatic pillar. A right anterolateral thoracotomy revealed an active bleed due to diaphragmatic pillar stripping and laceration with liver herniation. Right thoracic packing was established to stop the bleeding.

Conclusions: The primary objectives of thoracic damage control are to prevent cardiac tamponade, to control intrathoracic bleeding and massive air embolism or bronchopleural fistula, and to allow open cardiac massage. These patients represent challenging cases of both rapid therapeutic decision-making and operative intervention. Thoracic packing is a part of damage control in cases of hemorrhagic shock after thoracic trauma.

MeSH Keywords: **Hemothorax • Shock, Hemorrhagic • Thoracic Injuries**

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Background

Thoracic trauma injury is a frequent lesion found in severely traumatized patients, with a fatality rate of 25%. Even minor traumatic hemothorax can be self-renewed by pleural clotting, which can worsen a patient's condition. In cases of hemodynamic instability, diagnostic and hemostatic thoracotomy are indicated as primary surgical management, as a chest tube might lead to exsanguination. Scientific literature describes goals of damage control for thoracic injury [1–3].

Here, we report the case of a severe thoracic trauma complicated by hemorrhagic shock, successfully treated with thoracic packing.

Case Report

We report the case of a 48-year-old male who was involved in an accident in which 2 cars collided at high speed on a race circuit. Upon arrival of the French Emergency Medical Service, physical examination of the patient revealed 96% oxygen saturation, while the patient was receiving 5 L/minute via an oxygen mask, and the patient was found to be hemodynamic instability. The first micro method-determined hemoglobin was 110 g/L, which decreased to 89 g/L. Ultrasound revealed bilateral pleural effusion. Prehospital care consisted of vascular filling, intravenous norepinephrine infusion, and 2 packed red blood cell transfusions. The patient was intubated before being transferred to a Level 1 Trauma Center.

Upon arrival at the trauma center, blood tests revealed hemostasis disorders, combined respiratory and metabolic acidosis, and traumatic coagulopathy. Computed tomography scan showed a massive right-sided hemothorax due to diaphragm rupture (Figures 1, 2) and multiple costal fractures. Mediastinal mass effect also occurred as a complication, with stripping of the diaphragmatic pillar and pulmonary collapse. There was no cerebral or abdominal injury.

Right anterolateral thoracotomy was emergently performed to control stripping diaphragmatic pillar. After hemothorax evacuation, active bleeding due to traumatic diaphragmatic pillar stripping was found. Moreover, a traumatic section of triangular ligament led to active pre-vertebral bleeding. Diaphragmatic laceration with herniation of the liver was found, but no laparotomy was performed. Diaphragmatic crura suturing was not sufficient to stop the bleeding or to correct hemodynamic instability. As damage control treatment, right thoracic packing was performed (Figures 3, 4) with mesh insertion, associated with 2 chest tubes. The patient was stabilized after surgery. The thoracic packing was removed 48 hours later, without bleeding relapse. Chest tubes were removed 3 days later. The patient



Figure 1. Thoracic packing to treat severe bleeding in thoracic compartment. Computed tomography angiography with massive right-sided hemothorax.

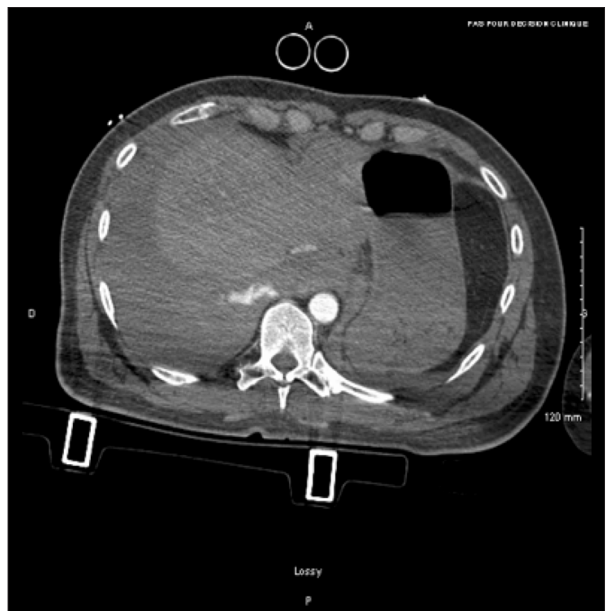


Figure 2. Thoracic packing to treat severe bleeding in thoracic compartment. Sectioning of the right diaphragmatic spearhead of the hemothorax.

was finally extubated at day 5. He left the intensive care unit at day 12, and went back home 18 days after the accident.

Discussion

Despite a high mortality rate, about 90% of patients with life-threatening thoracic injuries are managed with a simple procedure such as pleural drainage using a chest tube [1].

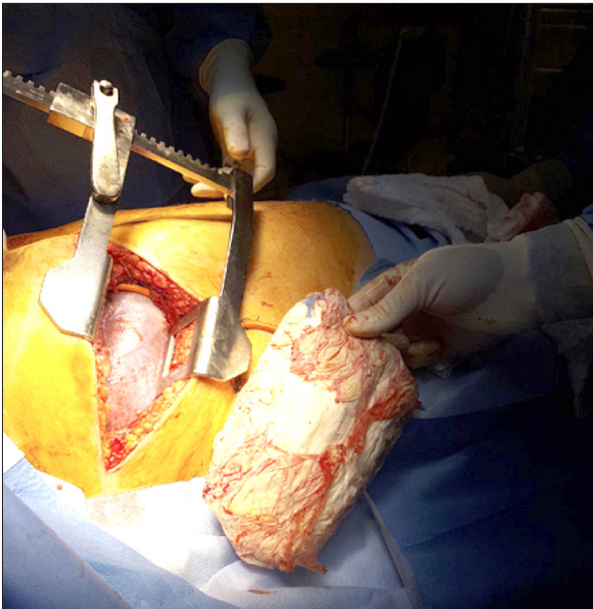


Figure 3. Thoracic packing to treat severe bleeding in thoracic compartment. Introduction of thoracic packing.



Figure 4. Thoracic packing to treat severe bleeding in thoracic compartment. Computed tomography scan control of thoracic packing.

In 1970, McNamara and colleagues described a reduction in mortality rates when thoracotomy was performed “early” after penetrating trauma [4]. This report defines criteria for surgical exploration: initial chest tube output exceeding 1500 milliliters or continuous hourly output of more than 200 mL per hour [5–8]. Recently, new recommendations regarding the management of severe trauma injury have been proposed [9].

Thoracic damage control should be used whenever the magnitude of the visceral damage is such that definitive repair is likely to exceed the patient’s physiologic limits [1,10]. The concept is to focus on stopping the hemorrhage alone and not to address definitive repair or closure. Resuscitative thoracotomy is restricted to patients with specific indications as determined by the patient’s clinical status immediately upon arrival to the emergency department, the mechanism of injury, or the need to perform therapeutic maneuvers to manage correctable causes of shock, including decompressing cardiac tamponade, cross-clamping the aorta, managing exsanguinating cardiac or vascular injuries, and evacuating air embolisms.

The primary objectives of thoracic damage control are to prevent cardiac tamponade, to control intrathoracic bleeding, to control massive air embolism or bronchopleural fistula, and to allow open cardiac massage [3,4,6]. Although only 10% of blunt chest trauma requires an operation, these patients typically present a challenging treatment dilemma, including rapid but thoughtful decision-making, comprehensive anatomic understanding, and often prompt operative intervention [6].

Many thoracic surgeons avoid damage-control techniques such as intrathoracic packing and temporary chest wall closure after thoracotomy for trauma because of the potential effect of packing on intrathoracic pressure and infection risks [11]. Patients can develop a thoracic compartment syndrome, which is physiopathology similar to cardiac tamponade. Venous return can be decreased by high intrathoracic pressure, and hypovolemia patients exacerbate this mechanism leading to decreased cardiac output. In a retrospective trauma registry study of 42 patients with thoracic packing, only 1 develop thoracic compartment syndrome [12]. There was no difference in mean airway pressure before or after chest closure. Thus, thoracic compartment with ventilation and cardiac impairment can stay thoracic complications. However, to not compromise cardiac function, it has to be integrated inside the lateral, posterior, and apical thoracic recess without disturbing heart function or inferior vena cava [13,14]. In our case report, cardiac and ventilator functions were not compromised by thoracic packing, and bleeding control improve hemodynamics.

A retrospective study of 12 traumatized patients identified hemostasis control in 7 patients treated by pleural packing [15]. Complications included acute renal failure, bacteremia, pneumonia, and adult respiratory distress syndrome. However, it is worth noting that no study has shown an increase in mortality, or an increase in infections associated with pleural packing.

A “second-look” surgery is generally recommended within 48 hours, but timing for return to the operating room for definitive chest closure is determined by adequacy of resuscitation.

Conclusions

Thoracic packing can be an alternative to manage uncontrollable chest wall bleeding post-trauma, permitting successful hemostasis and cardio-respiratory stability. This technique should be developed as damage-control surgery practice.

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Conflict of interests

None.