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SHORT REPORT

How we do it Emergency Department Thoracotomy for Penetrating Pulmonary Trauma: A Practical, Heuristic Approach for the Inexperienced in Thoracic Surgery

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Abstract

The manuscript specifically concentrates on patients with penetrating thoracic trauma, who having undergone Emergency Department Thoracotomy (EDT) have been diagnosed with injury to the lung. Its purpose is to describe a practical / heuristic approach, enabling the inexperienced in thoracic surgery doctor, to perform a successful EDT and if need arises, a definitive operation in the absence of a Cardiothoracic or appropriately trained Trauma Surgeon.

Keywords: Penetrating trauma, pulmonary trauma, Emergency Department Thoracotomy

Introduction

In the last few decades, penetrating trauma has gradually increased in Europe. As a result, it is nowadays not uncommon for hospital Emergency Departments (ED) to be confronted with patients, who have sustained penetrating trauma to the thorax, some of whom, being in moribund condition, require an Emergency Department Thoracotomy (EDT). Depending on the viscera injured, the aim of this potentially lifesaving procedure, is to release cardiac tamponade and control cardiac bleeding, perform internal cardiac massage, clamp the pulmonary hilum to control torrential haemorrhage from the lung, and to cross-clamp the descending aorta improving cerebral and coronary perfusion.

If the patient's physiological condition improves, he is transferred from ED to operating theatre – if one is available – for the definitive repair of the injuries encountered. Transfer to operating theatre is advantageous compared to operating in the *"austere"*, for surgery, ED. Ideally the definitive repair should be taken over by a Cardiothoracic or appropriately trained Trauma Surgeon, if they are not involved in another theatre case. On stating the *"ideal"*, it is worth considering, that there are many hospitals, where these two specialties are not part of the staff establishment. It is therefore obvious, that in many instances the EDT, as well as the definitive operative repair of the injuries encountered, will have to be taken over by doctors of the ED or surgical specialties, that do not have adequate cardiothoracic experience.

This manuscript specifically concentrates on patients with penetrating thoracic trauma, who having undergone EDT have been diagnosed with injury to the lung. Its purpose is to describe a practical / heuristic approach, enabling the inexperienced in thoracic surgery doctor, to perform a successful EDT and if need arises, a definitive operation in the absence of a Cardiothoracic or appropriately trained Trauma Surgeon.

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Operative Steps

If upon opening the thoracic cavity, a mediastinal injury is excluded, proceed to evacuation of blood and clots, expose the injured lung, and evaluate the site of the haemorrhage or the presence of a hilar or central lung haematoma. If the bleeding is torrential and is expected to take a long time to control, thus, destabilising the patient's physiological condition, proceed to cross clamping the pulmonary hilum and reassess [1].

In order to perform that, temporarily stop ventilation, allowing adequate visualisation of the operative field. Then grasp the hilum of the lung, approaching in a cephalic to caudal direction (using the left hand for the right thoracotomy and the right hand for the left thoracotomy), and apply pressure for haemostasis. Then insert a vascular clamp in the same direction and clamp the entire pulmonary hilum (pulmonary arteries, pulmonary veins, and main stem bronchus) between your grasping hand and the pericardium. Keep in mind, that if confronted with extra-pericardial pulmonary artery bleeding presenting with a massive haemothorax, you can open the pericardium and get control of the appropriate intra-pericardial pulmonary artery branch before attempting to manage the distal injury. It has been advocated by some authors to divide the inferior pulmonary ligament to mobilise the lung and clamp the hilum. This is time consuming and potentially risky as on division with your scissors of the proximal part of the ligament, it is possible to damage the inferior pulmonary vein. Other authors have advised to control the hilum by performing the *"hilar twist"* – rotating the lung around the hilum through 180 degrees, after diving the inferior pulmonary ligament, to occlude the main hilar vessels and bronchus. We feel that this is simply a technical exercise as in every EDT tray a large vascular clamp should always be basic armamentarium, rendering the twist pointless [2].

Control of haemorrhage

Control haemorrhage from superficial pulmonary penetrating wounds by placing a Duval clamp and then over-sowing with a 2.0 or 1.0 absorbable suture utilising a haemostatic (locking) stitch. Any resection of the lung parenchyma can nowadays easily be performed by using staplers as part of a damage control or even a definitive procedure. Therefore, you can perform otherwise technically and timewise taxing procedures efficiently and fast. It is surprising how difficult it is to close the stapler when the lung is fully inflated. Therefore, stop ventilation by temporarily disconnecting the ventilatory circuit, and ask your assistant to squash the lung between his hands, whilst having an abdominal swab between the lung and hand. This way, the lung will be sufficiently deflated as air will escape through the disconnected circuit and lung laceration, and at the same time avoiding the assistant's fingers perforating the lung parenchyma. In haemorrhage from a through and through injury of the peripheral portion of the lung, proceed to a wedge resection by using a TA or GIA stapler (Figure 1).

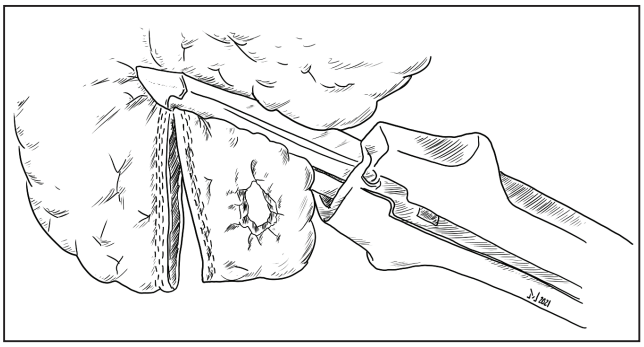

Figure 1: Wedge Resection

In a peripheral injury excision use a 3.5mm GIA stapler. If the portion of the lung to be resected is thicker or more central, use a 4.8mm GIA stapler [3]. In the presence of haemorrhage originating from inside a pulmonary tract caused by a bullet or a stab wound, perform a tractotomy by laying open the tract using a GIA stapler. One arm of the stapler is placed through the entrance and exit wound of the lung (Figure 2).

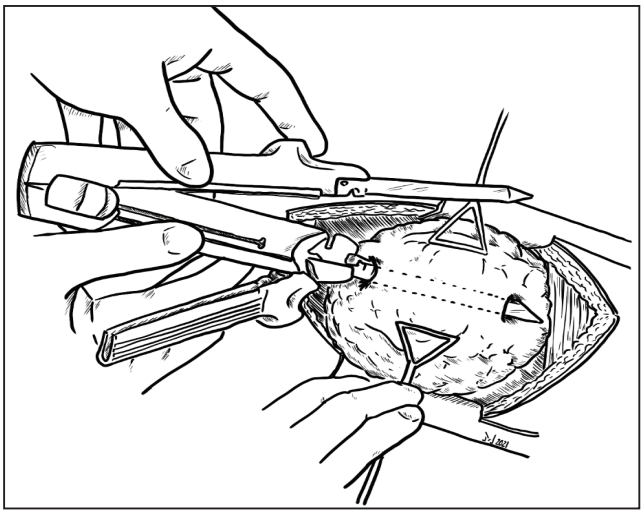

Figure 2: Tractotomy in lung tissue

The other arm of the stapler is placed over the top of the lung parenchyma and the stapler is fired (Figure 3).

This will effectively expose the tract, allowing the surgeon to suture bleeding vessels and transected bronchi under direct vision. The injured vessels will be ligated by using Figure-of-eight 3.0 absorbable sutures (Figure 4).

If this does not result in effective haemostasis, resect the laid-open tract by performing a limited non-anatomical wedge resection, that includes the tract [4]. Overall, the use of staplers to perform a tractotomy has greatly reduced the necessity for segmental resection or pneumonectomy in the management of penetrating pulmonary trauma [5]. Dissection and repair of the hilar structures is greatly taxing in a non-emergency environment, therefore practically

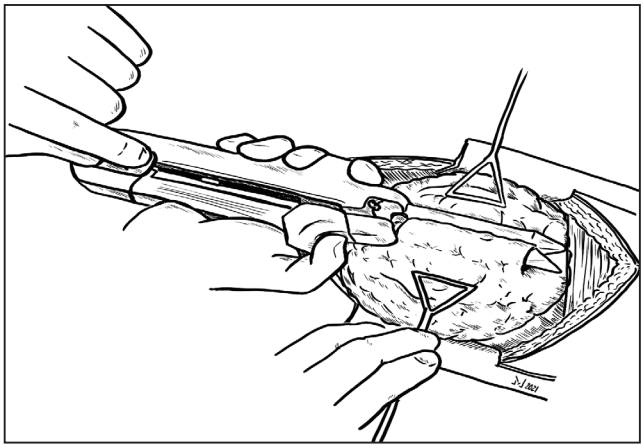

Figure 3: Closing and firing the linear stapler

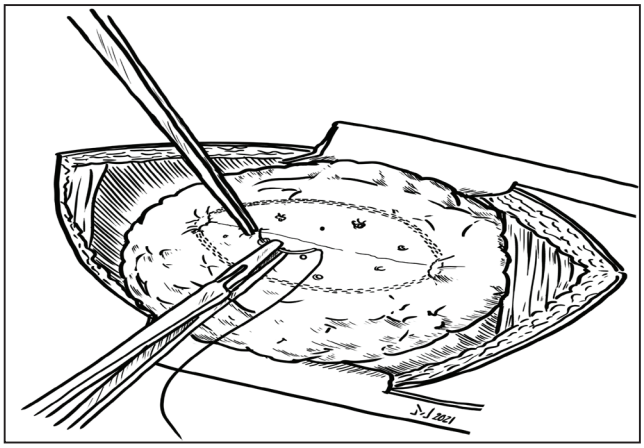

Figure 4: The bleeding vessels can be identified and oversewn

impossible in the EDT scenario. If saving the patient's life requires lobar resection, consider a stapled closure of both pulmonary vessels and bronchi, which is faster than suturing and requires less proximal and distal vascular mobilisation [6]. So, while controlling the hilum, proceed to a very basic dissection and apply vascular staplers (TA 30V) to the pulmonary arteries and veins, and standard TA 30 4.8mm staplers to the bronchial stump.

Conclusion

Patients arriving in hospital with penetrating trauma to the lung in certain cases require an EDT to survive. In the absence of a Cardiovascular or appropriately trained Trauma Surgeon, "the most experienced surgeon on site" will have to take over the operative management of these patients. This has been simplified with the addition of staplers. It is recommended to all doctors, who perform EDTs to attend a number of thoracic operations to familiarise themselves with the anatomy of the gross anatomy of the lungs.

Declarations

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Ethics: Manuscript is a "How we do it"; therefore, ethics approval has been waived.

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