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Characteristics of Thoraco-Abdominal Injuries - A Series of Three Cases

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Rezumat

Particularități ale plăgilor toraco-freno-abdominale - o serie de trei cazuri

Apariția vehiculelor cu motoare tot mai puternice şi în țara noastră a dus la creşterea vitezei de deplasare şi, implicit, a numărului de accidente de circulație, care au consecințe extrem de grave, precum şi a deceselor. Alături de politraumatismele cauzate de accidentele de muncă, acestea necesită o terapie chirurgicală complexă, în timp util, de cele mai multe ori multidisciplinară, şi care pune adeseori chirurgul în fața unor situații cu care nu se întâlneşte în practica de zi cu zi. Traumatismele cu leziuni ale regiunii de graniță toraco-freno-abdominale fac parte din aceasta categorie, pe care am ales să o discutăm cu ocazia acestei lucrări. Vom prezenta trei cazuri clinice ale unor pacienți cu leziuni toraco-freno-abdominale produse prin mecanisme diferite. O plagă prin accident de muncă, secțiune cu flexul, cu leziuni toraco abdominale stângi; un politraumatism prin accident rutier, cu o plagă toraco-freno-abdominală, produsă de o bucată de lemn care a pătruns oblic prin hemitoracele drept anterior, în spațiile intercostale V şi VI, a străbătut lobul pulmonar inferior drept, diafragmul, segmentul VII hepatic, oprindu-se in grilajul costal posterior drept şi un politraumatism prin cădere de la înălțime, cu ruptură de diafragm şi mezenter.

Cuvinte cheie: politraumatism, plagă toraco-freno-abdominală

Abstract

The enlarged number of powerful vehicles in our country led to an increased speed of travel and hence the high number of

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traffic accidents with severe consequences, even death. Along with polytrauma caused by occupational accidents, these types of traumas require complex and often multidisciplinary surgical therapy against the clock, which places the surgeon in front of situations that are not found in the everyday practice. Injuries involving damage to the thoracic-phreno-abdominal region fall into this specific category that we have chosen to discuss in the present work. We will further present three clinical cases of patients with thoraco-phreno-abdominal injuries produced by different mechanisms. A work-accident wound produced by an angle grinder, causing left thoracoabdominal injuries; a polytrauma caused by a road accident, with a thoraco-phreno-abdominal wound produced by a piece of wood that penetrated obliquely through the right thorax, in the 5th and 6th intercostal spaces, crossed the right lower lung lobe, the diaphragm, the 7th liver segment, and stopped in the right posterior costal grid, and a polytrauma following a fall from a height, with a torn diaphragm and mesentery.

Key words: polytrauma, thoraco-phreno-abdominal wound

Introduction

Thoraco-phreno-abdominal wounds are severe injuries due to their pathophysiological impact on the respiratory function, hemodynamics and digestive system. In terms of etiopathology, the first mechanism of production is represented by traffic accidents, followed by assaults and occupational accidents (1).

The enlarged number of powerful vehicles in our country led to an increased speed of travel; hence the high number of traffic accidents with severe consequences, even death. Along with polytrauma caused by occupational accidents, these types of traumas require intricate and often multidisciplinary surgical therapy against the clock, which places the surgeon in front of situations that are not found in the everyday practice. Trauma involving injuries of thoraco-phreno-abdominal region also fall into the category mentioned above.

The gravity of thoraco-phreno-abdominal trauma depends on the thoracic and | abdominal visceral lesions accompanied by haemorrhage and traumatic shock, as well as on the size of the diaphragmatic breach which has as repercussions the mutual contamination of the two cavities and herniation of abdominal viscera in the thorax (2).

The treatment approach of these injuries can be thoracic, abdominal or combined, depending on the type of visceral lesions. Maximum emergency surgery is required in the first hours of hospitalisation. To correctly solve the case, the techniques of digestive, thoracic surgery, as well as those of diaphragmatic defect repair must be perfectly mastered.

Even though nowadays the elapsed time from the occurrence of the accident and the surgical intervention has considerably reduced, and the modern techniques of diagnosis and treatment are superior, still the mortality rate in the case of thoraco-phreno-abdominal injuries is very high, reaching 31% according to several international studies (3,4,5,6).

Case Reports

Thoraco-Phreno-Abdominal Wound by Work Accident

In the first case, a 58-year old patient is being hospitalised in Surgery Clinic I from Sibiu. The patient was a victim of a work accident. While cutting a metal pipe from a difficult position, the angle grinder slipped from his hand causing severe damage to the left hemithorax, diaphragm and abdominal wall (*Fig. 1*).

The patient in traumatic shock, hypotensive, presenting dyspnoea with traumatopnea,

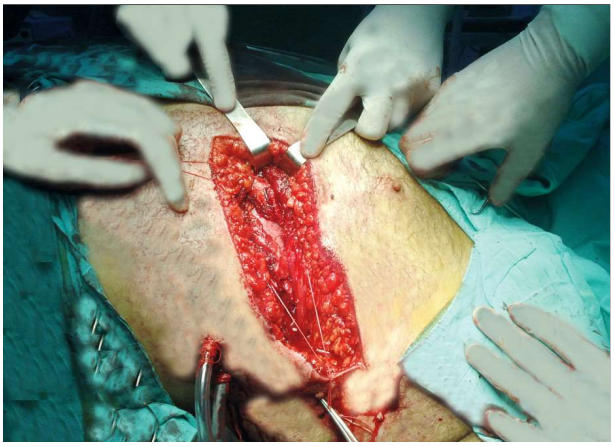

Figure 1. Lacerated wound at the level of the left lower lung lobe

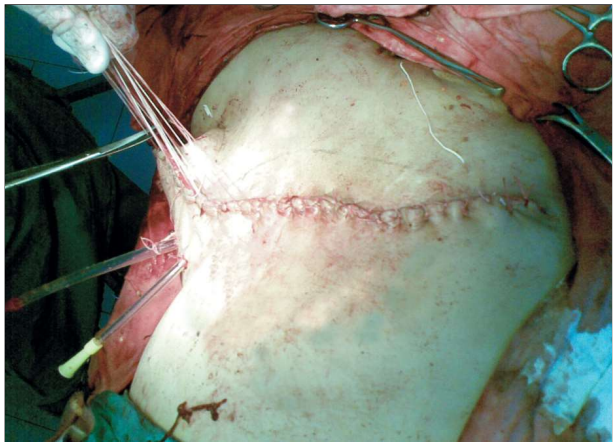

Figure 2. Closure of chest cavity

intense pain and active bleeding at wound level was immediately hospitalised in the Surgical Clinic I and transported directly to the operating room, skipping over other pre-operative investigations.

Intraoperative, upon wound exploration, there was found a left thoraco-phreno-abdominal wound with a section of the costal grid (ribs 5-8), at the same time with skin and subcutaneous tissue, lacerated wound at the level of the left lower lung lobe, diaphragm section with herniation of the transverse colon and omentum in the chest cavity.

In the first stage of the surgery, an atypical resection of the left lung base was performed, including the entire pulmonary dilaceration area with continuous non-absorbable 2 0 suture. Subsequently, omentum and the intestines withdrew into the abdominal cavity, and phrenoraphy was executed with separate Biocryl 0 threads, mounted in "X".

A cavity lavage of left hemithorax with physiological saline solution and a pulmonary suture for permeability control by lung expansion with saline were performed by the anaesthetist, with the help of the balloon; also, a double drainage of chest cavity and its closure with separate "5" nylon threads, observing the rib continuity (*Fig. 2*).

Due to the high amounts of blood in the peritoneal cavity, and to the fact that on the exploration of the trans diaphragmatic abdominal cavity we could not exclude other lesions of intra-abdominal viscera, we were forced to practice left subcostal exploratory laparotomy. Exploratory laparoscopy was excluded due to diaphragmatic injuries. No other intraperitoneal injuries were found. Lavage and drainage of the peritoneal cavity were performed.

The patient's postoperative evolution was favourable. Drainage tubes were suppressed three, respectively six days later, the patient being rehabilitated upon discharge, seven days after surgery.

Thoraco-Phreno-Abdominal Trauma by Chest Penetration – Car Accident

The case no. 2 is that of a 32-year old female patient, admitted to the Surgical Clinic I of Sibiu. She was brought in the Intensive Care Unit, being the victim of a road accident; she occupied the right seat in a car that crashed into a carriage carrying wood. A piece of wood of 8 cm in diameter and 47 cm in length pierced through the windshield, penetrating the anterior right hemithorax obliquely in the intercostal spaces V and VI (*Fig. 3*).

The patient in traumatic and hypovolemic shock, showing tachycardia, hypotension, paleness, intense pain and active bleeding at the wound level was immediately sent to the Surgical Clinic I and transported directly to

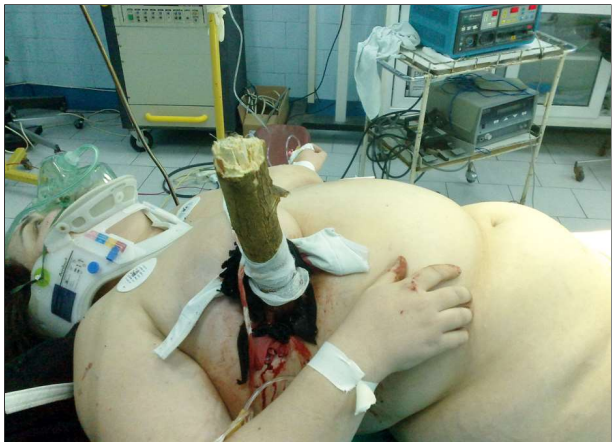

Figure 3. The piece of wood penetrating the anterior right hemithorax

Figure 4. Splinters of wood

the operating theatre, with no other pre-operative investigations; the blood type was tested in the emergency room.

Given the seriousness of the injuries and the thoracoabdominal border area, the first important decision was the type of approach. The surgeons agreed upon a right anterolateral thoracotomy on both sides of the entry orifice in the right hemithorax to have the widest possible access to the area. For the same reason, the resection of rib V, partially destroyed, was performed. On exploration, after lavage and aspiration of blood in the pleural cavity, it was found that the piece of wood penetrated through the right lower lung lobe, the diaphragm, liver VII segment, and stopped in the right posterior costal grid. Also, as a particularity, we found splinters of wood (*Fig. 4*), which on mobilisation led to the tearing effect of "fishing needle".

First, the atypical resection of the right lung base was achieved, including the entire pulmonary dilaceration area with continuous nonabsorbable 2 0 suture. Subsequently, the inlet and output of the wood were joined through a sagittal incision at diaphragm level, along withit. There was found a second-grade hepatic injury (according to the Hepatic Injury Grading of the American Association for the Surgery of Trauma - New Liver Injury Scale), with a dilaceration area of about 8/7 cm entering in-depth in some areas up to 2 cm at liver segment VII level, with minimal bleeding and bile leakage (*Fig. 5*).

It was also found out that the piece of wood was fixed in the posterior costal grid, from which it emerged with difficulty leading to the onset of new bleeding at the level of the supra and subjacent intercostal vascular package (*Fig. 6*).

Haemostasis was performed through ligations at this level, followed by hepatic haemostatic with Biocryl 2 treads mounted in "U", TachoComb application in areas where the bleeding was diffuse and the resection of dilacerations areas. Finally, phrenoraphy was practiced using separate Biocryl 2 wires mounted in "X" (*Fig. 7*).

Subsequently, due to the lack of certainty regarding the effects on abdominal viscera,

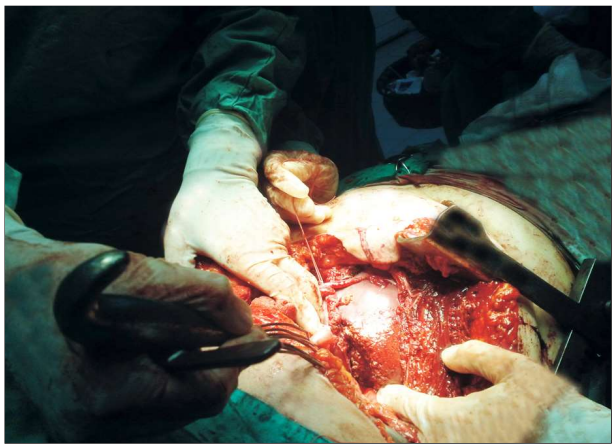

Figure 5. Second grade hepatic injury

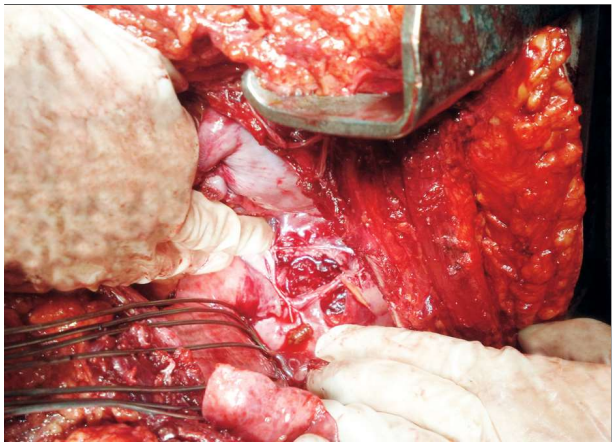

Figure 6. Wound of the the posterior costal grid

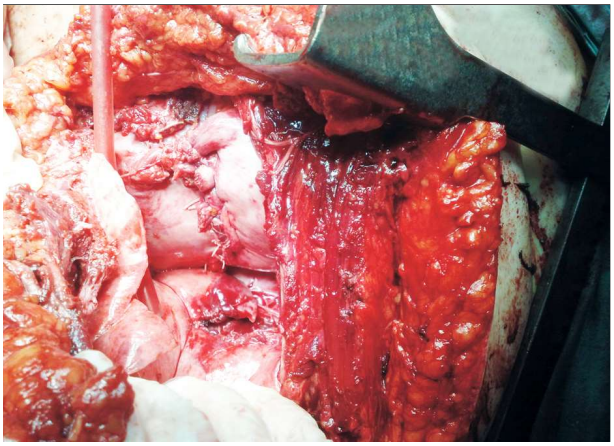

Figure 7. Pulmonary suture line, phrenoraphy, wound posterior costal grid wound

there was performed a minimum right subcostal laparotomy, which revealed no other injuries.

Patient's postoperative evolution was favourable, being hindered only by the appearance of minimum biliary fistulas, initially exteriorised through suction chest drainage tubes. Later on, when passing to Beclaire type drainage, biliary fistula persisted about 72 hours on the inter-hepato-diaphragmatic drainage, then it stopped spontaneously.

The drainage tubes were suppressed seven, respectively 10 days later, and the restored patient was discharged 14 days after surgery (1).

Blunt Thoracoabdominal Trauma

The third case is a 42-year old patient who was brought in the Emergency Room after suffering multiple traumas due to a fall from a height of about 7.5 m. Clinically, a strong thoracoabdominal contusion was found and upper and lower right limb trauma. Abdominal ultrasonography revealed a fine blade of fluid in the bottom of the Douglas' bag (minimum haemoperitoneum). Radiological examinations performed in the emergency room highlighted right humerus fracture in the upper third, right clavicle fracture in the middle third and comminuted fracture of tibia and fibula 1/3 lower right, with no significant changes on chest radiograph (*Fig. 8*).

After the orthopaedic solving of fracture foci, due to the traumatic shock, the patient was monitored in the intensive care unit. The presence of blood in the bottom of the Douglas' bag observed at the ultrasound compelled us to perform a thoracoabdominal scan, which was not relevant. We decided to carry out emergency laparotomy, which highlighted haemoperitoneum through mesentery tear and rupture of the right hemidiaphragm. Mesentery haemostasis and suture were performed; there was no damage to the major vessels. The right diaphragmatic cupola was also sutured with threads mounted in "X" on a distance of about 12 cm. Right abdominal and thoracic drainage through minimum right pleurotomy was carried out. Postoperative

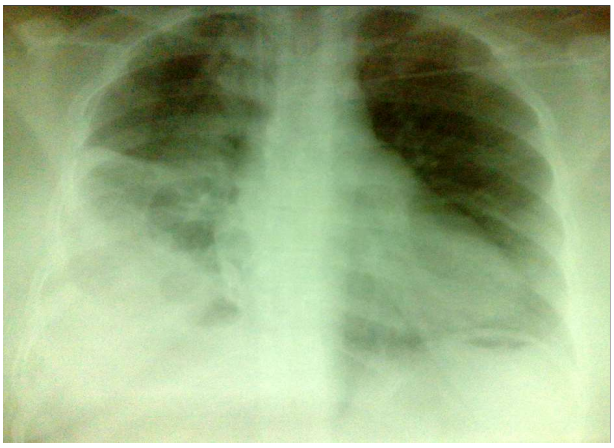

Figure 8. Chest X-ray

evolution was favourable, and the patient was rehabilitated on discharge, five days after surgery.

Discussions

Thoracoabdominal trauma involves both cavities: the chest and the abdomen. These can be open or closed. The thoracoabdominal cavity is a major site of impact in any trauma (7). Thoracoabdominal injuries represent a major risk factor because the bony thoracic cage contains vital organs of circulation and respiration and trauma of these organs challenges the integrity and viability of entire human body; similarly, the abdomen is the third commonest region of body that is injured in civilian trauma, as human abdomen is largely unprotected by bony structure and it contains numerous important vital organs like the liver, spleen, kidney, pancreas and hollow viscus like stomach, intestines and urinary bladder etc (8).

Such trauma can be caused either by a single foreign body that crosses the diaphragm or by more lesions involving the two cavities. When examining a patient with a penetrating injury, one must take into consideration from the very beginning any possible damage to the diaphragm, or the organs inside the two cavities (3) The thoracic, abdominal or mixed approach will be chosen depending on the trajectory of the foreign body and the severity of lesions produced at the intra-thoracic or intra-abdominal level. Generally, in acute diaphragmatic lesions, the trans-abdominal approach is preferred to the thoracic approach, because it enables both the evaluation and the surgery of the associated abdominal injuries. In the case of dormant diaphragmatic injuries, dating for several months or years, the easier thoracic approach is preferred. (9,10,11) It allows much better access to the diaphragm and also the adhesiolysis of any adherences formed between the thoracic and abdominal viscera. In our case, we initially preferred the thoracic approach in the first two cases due to the inlet and the foreign body trajectory which produced the injuries, and also due to the increased possibility of severe intrathoracic visceral injuries. In the second case, the discovery of the diaphragmatic rupture was accidental, while the presence of hemoperitoneum forced us to perform a laparotomy.

In the third case, the situation was reversed; the discovery of the diaphragmatic lesion following the exploratory laparotomy forced us to control the right hemithorax and to achieve minimum right pleurotomy.

The singular occurrence of the diaphragmatic rupture has a risk level of 9 on the ISS scale (Injury Severity Score) (12,13), which correlates with a 0.99 coefficient of survival, but rarely diaphragmatic injuries are singular. They usually accompany other thraco-abdominal visceral lesions which decrease the mortality coefficient and lead to the true mortality of the thoraco-phreno-abdominal lesions. Associated lesions depend much on the type of the mechanism by which they were produced (knife, gun, blunt body, closed trauma).

The treatment of these lesions is but surgical. It is compulsory that the exploratory laparotomy includes a detailed examination of both diaphragmatic domes because lesions at this level can be frequently omitted due to lack of specific clinical and radiological signs. In the third case, even the tomograph computer scan failed to reveal any damage to the diaphragm.

Thoracotomy will highlight whether there are any associated lung injuries. The possibility of performing exploratory laparoscopy can also be taken into consideration (14).

The prolonged hypovolemic shock that leads to the development of multiple systems or organ failure or the association of simultaneous severe injuries in case of a polytrauma are the most common causes of mortality in patients with thoraco-phreno-abdominal trauma (15,16).

Conclusions

Thoraco-phreno-abdominal wounds are severe injuries due to their scale and complexity, often being associated with increased rates of morbidity and mortality. They require urgent

surgical treatment, sometimes skipping over the preparatory stages and diagnosis within the Intensive Care Unit. In the cases of penetrating foreign body, the first-aid performed by the extrication team at the accident site is crucial; by no means must it be mobilised. In the operating room, extracting the foreign body must be attempted only after ensuring a broad approach to the lesion, to master any possible haemorrhage triggered by foreign body mobilisation. In cases of closed trauma with abdominal injuries, diaphragmatic cupolas will compulsorily be examined, even if the clinical and radiological data should exclude this type of injuries.

The thoracic, abdominal or mixed approach will be chosen according to the foreign body trajectory, production mechanism and seriousness of the lesions produced at the intra-thoracic or intra-abdominal level.

Cooperation between the surgeon and the anaesthetist is vital for improving the prognosis of thoracoabdominal trauma.

Conflict of Interest

The authors declare no conflicts of interests.

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