Chapter 76

Thoracic trauma review

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ABSTRACT
The objective of this work is to demonstrate the clinical and epidemiological profile of thoracic trauma, analyzing its possible causes, medical management, patient profile, types of trauma and mortality through a literature review, selecting articles and other bibliographies from 2000 to 2022, using PUBMED and Google Scholar databases. Through the results, it was observed that thoracic injuries are among the main causes of death, violence, reflecting the increase in cases of accidents with a predominance of males. Specific care for thoracic injuries occurs through primary and secondary assessments according to the classification by degree of seriousness. In addition, the types of injuries are characterized by blunt, penetrating, transfixing, the highest risk such as pneumothorax, cardiac tamponade, hemothorax, flail chest and the more specific ones such as pulmonary contusion, costal fractures and heart injury. Thus, it is concluded that there are several types of trauma involving the thorax and that men are the most affected, thus observing the importance of seeking preventive measures for such cases.

Keywords: trauma, thorax

1 INTRODUCTION

According to epidemiological data from 2019, chest trauma (TT) is responsible for 7.3% of all deaths in Brazil and is the third most frequent cause of death in the United States, caused by automobile accidents, physical aggression, violence with perforating weapons, or any type of action that causes injury in the region, such as in surgical cases or emergency procedures. The lesions can be clear or not, and to be seen and to make a diagnosis, complementary exams are needed, such as chest radiography. However, radiography is not as sensitive when there is a more specific clinical case, needing in some cases, CT scan.(ZANETTE, WALTRICK e MONTE, 2019)

About 80% of TT victims are treated by closed pleural drainage thoracostomy (CPD) alone, associated with analgesia and ventilatory therapy. Thoracotomy, on the other hand, is reserved for the

smallest portion of patients, between 10% and 20%. Even so, one third of patients with severe chest injuries die before receiving hospital care and another 20% die later, as a result of pleuropulmonary complications of an infectious nature (FONTENELLES, MANTOVANI, 2000).

In a study carried out in a reference hospital at the mouth of the Itajaí River with 119 patients, it was concluded that most patients were young men affected by motorcycle traffic accidents. Most of the cases were used chest radiography for diagnosis confirmation and different from what is observed in the literature, the mortality was lower than expected due to the high rate of exclusive muscle injury.(ZANETTE, WALTRICK, & MONTE, 2019)

The classification of these injuries differs into open or closed trauma through communication or not between the thoracic cavity and the external environment. Such types can cause hemothorax or pneumothorax and this trauma can cause pulmonary contusion, cardiac or tracheobronchial trauma. The mortality of patients varies according to the severity involved, thus depending on how many and which organs were affected and consequently their system. Thus, informing the population about the injuries involved in a possible chest trauma can help prevent cases, making them aware in order to reduce incidents such as violence with white or firearms and accidents in general (FONTENELLES, MANTOVANI, 2000; SOUZA, SANTOS e PEREIRA, 2013; SCAPOLAN et al. 2010).

2 METHODOLOGY

The work was based on bibliographic research in literature on the subject, as well as in the databases PUBMED and Google Scholar, selecting the main articles from the period between 2000 and 2022.

3 PROFILE OF PATIENTS IN BRAZIL

Chest injuries are among the leading causes of death and the indicator reflects the increase in cases of accidents, as well as violence, both urban and domestic, standing out, therefore, with the growth of the positive deficit of entries in the emergencies of public and private hospitals. Etiologically it is understood that, the predominance of this type of picture, especially when it comes to the various types of violence, is given by the socioeconomic condition of underdeveloped countries, as is the case of Brazil, where the human development index reflects negatively on public safety (SOUZA, SANTOS, and PEREIRA, 2013; ZANETTE, WALTRICK, and MONTE, 2019).

About the profile of patients affected by trauma to the chest, it is feasible to consider that, in view of the analysis through the available research, the predominance of the picture reverberates on the male gender, with emphasis on open trauma. Consequently, when the age of the individuals is observed, adults between 30 and 40 years old have more relevant rates when compared to people between 50 and 60 years old. The margin of women involved in this trauma profile is represented by a higher number of closed than open injuries (WESTPHAL et al., 2009; ZANETTE, WALTRICK, & MONTE, 2019).

Furthermore, the entry of patients to the emergency room and their care, occur too much at night, extending into the early morning hours, with emphasis on cases of blunt trauma. When compared to the daytime period, the victims of open traumas also suffer this type of injury at night and, consequently, at dawn. In relation to open trauma resulting from violence, whether domestic or urban, the white weapon is more frequent than the firearm, given that the possibility of handling and purchase is more accessible (SOUZA, SANTOS, and PEREIRA, 2013; ZANETTE, WALTRICK, and MONTE, 2019).

4 LESIONS

The chest wall, whose function is to protect the internal organs, is composed mainly by bone and muscle structures, mediastinal structures and the great vascularization of the human body. Thus, damage to these components is classified as chest trauma, having a variety of types and injuries, thus requiring a good evaluation (FONTENELLES, MANTOVANI, 2000; SOUZA, SANTOS, and PEREIRA, 2013; SCAPOLAN et al. 2010)

4.1 TYPES OF INJURIES

4.1.1 Blunt trauma

Also called closed trauma, it is characterized by injuries resulting from various mechanisms, the main ones being falls, assaults, and automobile collisions, which give this type of trauma one of the highest mortality rates (AMERICAN COLLEGE OF SURGEONS, 2018). Given this, accidents involving motorcycles are the most common in Brazil (39.6% of cases) (ZANETTE, 2019).

4.1.2 Penetrating trauma

Injuries, also called open injuries, usually caused by stabbing or firearms, are the most minor when compared to blunt trauma. This type of injury, as well as the conduct to be followed, are determined by the characteristics of the penetrating objective, for example the speed and caliber of the projectile, and the region or organs affected (AMERICAN COLLEGE OF SURGEONS, 2018). In most cases, structures in the periphery of the lungs are affected, and can cause complications, such as hemothorax and pneumothorax. (FENILI, ALCACER, AND CARDONA, 2002; VELASCO et al., 2022).

4.1.3 Transfixing trauma

Lesions which affect the structures of the mediastinum, thus can affect large vessels, heart, pericardium, esophagus, among others (AMERICAN COLLEGE OF SURGEONS, 2018).

4.2 HIGHER RISK INJURIES

4.2.1 Pneumothorax

An injury that has several different presentations and can affect structures such as the lung parenchyma, airways and chest wall. The hypertensive type is characterized by the passage of air in a unidirectional way through the pleural cavity, which causes air accumulation, pulmonary compression and displacement of the mediastinum contralaterally, thus having complications such as damage to the venous return and cardiac output. Unlike this presentation, simple pneumothorax does not develop hemodynamic changes, since the amount of air that enters the pleural space is not enough to displace the mediastinum (VELASCO et al., 2022). Finally, in the open there is a passage of air from the pleural space to the external environment, being caused by penetrating injuries to the chest wall (AMERICAN COLLEGE OF SURGEONS, 2018). This open wound, with a diameter of approximately two-thirds of the tracheal diameter, equalizes the pressures of the pleural cavity and the external environment, causing impairment to physiological ventilation (AMERICAN COLLEGE OF SURGEONS, 2018).

The initial treatment for pneumothorax will vary depending on its classification, hypertensive, simple or open, and can be performed 3-point dressing, relief puncture or finger thoracostomy. However, the definitive treatment mandatorily is thoracostomy with chest drainage (AMERICAN COLLEGE OF SURGEONS, 2018).

Decompression in cases of hypertensive pneumothorax can be mediated by relief puncture in the pleural space, in the 4th or 5th intercostal space anterior to the middle axillary line when in adults, and finger thoracostomy as an alternative approach converting to simple pneumothorax. It is also necessary to perform chest drainage at the same puncture site (AMERICAN COLLEGE OF SURGEONS, 2018).

For Pneumothoraces with an open wound, the immediate treatment would be a 3-point dressing, which is only closed in 3 of its extremities, so that during inspiration, the only air entry is the airway, and during expiration, air can exit through the wound, reducing the damage to ventilation. As a definitive treatment, thoracostomy with water-sealed drainage is mandatory (AMERICAN COLLEGE OF SURGEONS, 2018).

4.2.2 Hemothorax

It is an injury that involves the pleural space, characterized by the presence of blood and caused, in general, by penetrating traumas that damage large vessels, but can also originate in blunt trauma. When the volume exceeds 1500mL, and may already present signs of shock, the condition is called massive hemothorax, which will cause lung compression and hinder the respiratory process (VELASCO et al., 2022). In addition, the clinical picture also courses with abolished vesicular murmur, maciceps to percussion, collapsed jugulars and hypotension (AMERICAN COLLEGE OF SURGEONS, 2018).

Due to blood loss it is necessary to simultaneously perform chest drainage with volume replacement using crystalloids and, in some cases, blood transfusion. Thoracotomy is also indicated for cases in which there is injury to important structures, usually by penetrating trauma in the region medial to the scapula or anterior region of the chest (AMERICAN COLLEGE OF SURGEONS, 2018).

4.2.3 Cardiac tamponade

The injury involves the accumulation of fluid within the pericardial sac, which will cause several cascading effects, since the compression of the fluid in the cardiac chambers will restrict its filling and, consequently, decrease the ejection of blood, thus reducing cardiac output (VELASCO et al., 2022). It originates from various trauma mechanisms, such as penetrating injuries, which are the most frequent, blunt trauma, traumatic dissection of the ascending aorta, intrapericardial injuries and injuries to segments of artery and pulmonary veins surrounded by the pericardium. The characteristic clinical picture consists of Beck's triad, composed of jugular turgor, hypotension, and hypophonesis of heart sounds (AMERICAN COLLEGE OF SURGEONS, 2018).

When the diagnosis is confirmed by clinical signs, echocardiogram and pericardial window, the definitive treatment consists of emergency thoracotomy, which should be performed by a surgeon, with fluid infusion prior to surgery in order to increase cardiac output and venous pressure. In the absence of the surgeon, ultrasound-guided pericardiocentesis can be performed, but this does not exclude the need for surgery (AMERICAN COLLEGE OF SURGEONS, 2018).

4.2.4 Unstable thorax

It is the loss of continuity of at least two costal arches with the rest of the rib cage, caused by fractures of these arches at two or more points. In addition, it can also originate from costochondral dislocation of a single rib of the chest (AMERICAN COLLEGE OF SURGEONS, 2018).

In these cases, oxygen therapy with humidified oxygen, ventilation adequacy and volume replacement is indicated, especially when the patient presents signs of hypotension, followed by analgesia (intravenous or by nerve block). Patients in need of ventilation by mechanical support with difficulty in weaning from the respirator, respiratory failure or even significant deformity of the chest wall, may require surgery with fixation of the costal arches (AMERICAN COLLEGE OF SURGEONS, 2018).

4.3 SPECIFIC LESIONS

4.3.1 Pulmonary contusion

Injuries to the lungs generally occur in patients who suffer closed thoracic traumas and have a high mortality rate, being caused by direct impact and being frequently associated with thoracic wall injuries, such as fractures of costal arches. Due to the severity of the cases, a multidisciplinary follow-up for

treatment is extremely important to avoid secondary complications (FENILI, ALCACER E CARDONA, 2002; VELASCO et al., 2022).

Analgesics and oxygen therapy are used for treatment, especially for mild hypoxemia. For more severe cases of hypoxemia and hypercapnia, mechanical ventilation is the recommended approach (AMERICAN COLLEGE OF SURGEONS, 2018; VELASCO et al., 2022).

4.3.2 Costal fractures

These are complex fractures that affect the proper functioning of the pulmonary ventilatory function, since they compromise components of the thoracic cage, causing paradoxical movements, defects in the costal arches and pain. The ventilatory function becomes more compromised in multiple fractures, since it originates the unstable thorax and unregulated breathing that alter the negative intrathoracic pressure, causing a reduction in pulmonary ventilation (FENILI, ALCACER E CARDONA, 2002; VELASCO et al., 2022).

Initially, the use of analgesics is recommended as a way to reduce pain during breathing and in some cases, when oral or intravenous analgesia is not effective, intercostal nerve block or epidural administration is possible. Surgical cases for stabilization of fractures are recommended in unstable thorax accompanied by respiratory failure, deformity and pain without relief even after the options already mentioned (VELASCO et al., 2022).

4.3.3 Aortic Lesion

Traumatic Aortic rupture is a severe contusion, being the most frequent cause of sudden death in automobile collisions or falls from great heights, since it becomes more complicated, requiring immediate intervention, which debilitates the patient until he receives proper care. The typical site of aortic injury is the aortic isthmus, in the descending aorta (FENILI, ALCACER E CARDONA, 2002; VELASCO et al., 2022). The patients with the highest survival rates in cases like this are those with incomplete rupture near the aortic ligamentum arteriosum (AMERICAN COLLEGE OF SURGEONS, 2018).

As a definitive treatment, endovascular stent implantation is used, which has replaced immediate surgical repair. Initial treatment usually occurs through beta-blockers with the goal of reducing blood pressure and heart rate followed by volume resuscitation (AMERICAN COLLEGE OF SURGEONS, 2018).

4.3.4 Heart damage

Also called cardiac rupture or blunt cardiac trauma, it becomes lethal in most cases and patients do not get medical attention in time (FENILI, ALCACER E CARDONA, 2002; VELASCO et al., 2022). It can lead to consequences such as contusion of the heart muscle itself, rupture of chambers, dissection of

coronary arteries, as well as thrombosis, and valvular laceration (AMERICAN COLLEGE OF SURGEONS, 2018). Having as main signs found: cyanosis of the upper extremities, muffled heart sounds, and increased cardiac area, in addition to jugular distension (FENILI, ALCACER, AND CARDONA, 2002; VELASCO et al., 2022).

Cases of closed cardiac injury mainly due to myocardial contusion have a higher risk of sudden arrhythmias, requiring cardiac monitoring for 24 hours with possible supportive treatment. For cases of valve or myocardial rupture, surgical repair is indicated.

5 TRAUMA SCORES

The classification of trauma is performed mainly by means of two scales, the AIS - Abbreviated Injury Scale and the ISS - Injury Severity Score. The AIS measures the severity of injuries according to their anatomical location, such as skull/neck, face, thorax, abdomen/pelvis, extremities/bone and general external. Each lesion is individually classified in an ordinal format representing severity, being numbered from 1 to 6 points (1-mild, 2-moderate, 3-serious, 4-severe, 5-critical, 6-incopatable with life). This score is of fundamental importance, since it is used in other assessment scales, such as the ISS, the Maximum Abbreviated Injury Score, and the NISS - New Injury Severity Score (HSU et al, 2019; PALMER, NIGGEMEYER, & CHARMAN, 2010).

The ISS clinically assesses multiple injuries in the human body and is used to screen patients. This score is based on the numbers from the AIS evaluation, and is calculated from the three most severe injuries in three different anatomical regions, so the numbers are squared (of each injury) and added up, and a result of 0 to 75 can be obtained. Such an evaluation is important to assess the mortality risks due to trauma. When referring specifically to chest trauma, the same type of qualification is performed by means of the AIS and ISS. (DEHOUCHE, 2022; MARASCO et al, 2022).

Another form of evaluation that has been widely discussed is the NISS, which, unlike the ISS, considers the three most severe injuries regardless of the affected region. This new score is considered because it is believed that the old one may underestimate the severity of the trauma by using only one score even for a polytrauma area. However, the ISS is still treated as the "gold standard" trauma score (LI and MA, 2021).

Moreover, chest trauma represents one of the highest mortality rates, and still accounts for 10% of hospital admissions. Furthermore, chest trauma occurs in about 60% of victims with multiple traumas, with a mortality rate of around 25% in these cases. Thus, it should be noted that the main cause of chest trauma is traffic accidents, which account for 56.9% of occurrences, involving various forms of accidents (BOUZAT et al, 2017; DOGRUL et al, 2020; MARASCO et al, 2022).

6 ASSESSMENT AND MANAGEMENT

Thoracic trauma usually consists of several injuries that overlap or overlap injuries from other sites, such as in the abdominal region. Thus, due to its complexity, patient care must be systematic in order to diagnose and treat all injuries for the best outcome and survival (AMERICAN COLLEGE OF SURGEONS, 2018).

In the initial care, it is important to previously prepare all the necessary materials in order to facilitate the advancement of measures to maintain the patient's life, in addition to wearing appropriate clothing in order to avoid contamination. One must also understand what generated the chest trauma, even if superficially, to assimilate and predict all possible injuries, as well as perform the polytrauma care that is contained in the Advanced Trauma Life Support (ATLS) (AMERICAN COLLEGE OF SURGEONS, 2018).

On the other hand, specific care for chest injuries occurs through primary and secondary assessments according to the classification by the degree of seriousness (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1 ADVANCED TRAUMA LIFE SUPPORT (ATLS)

To perform the support to the polytrauma patient, also called primary assessment, the ATLS proposes five steps that must be performed, systematized in ABCDE: airway (A), breathing (B), circulation (C), disability (D) and exposure (E) (AMERICAN COLLEGE OF SURGEONS, 2012). In addition, in out-of-hospital care, systematized by Prehospital Trauma Life Support (PHTLS), the letters X and S are added to the ABCDE system, X being for exsanguination and S for safety (NATIONAL ASSOCIATION OF EMERGENCY MEDICAL TECHNICIANS, 2020; AMERICAN COLLEGE OF SURGEONS, 2018).

In addition, steps should be taken to contribute to the progress of the primary evaluation, such as monitoring carbon dioxide exhalation, observing arterial blood gas and respiratory rate, connecting the electrocardiogram monitor to the patient, and considering chest radiography, which in most cases is sufficient for the diagnosis of injury. (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.1 Airway

The airway permeability must be assessed. If it is obstructed, it is necessary to quickly diagnose the obstruction and remove it. In addition, it is essential to keep the airway clear to allow the patient to breathe, keep the cervical spine in a neutral position, and immobilize it (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.2 Breathing

At this stage, it is necessary to expose the chest and perform chest inspection, palpation, percussion, and auscultation and treat the emergency needs with the goal of maintaining breathing and ventilatory mechanics, for example, by administering oxygen (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.3 Circulation

The pulse, skin coloration, and bleeding points and possible hemorrhage are assessed. If there is time and the necessary material, the patient's pressure should be checked. In addition, it is necessary to compress external bleeding sites, prevent hypothermia, among other types of intervention according to the findings of the assessment (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.4 Disability

The neurological status is assessed by looking at the patient's level of consciousness, the size and response of the pupils to light stimulus, noting if they are equal, and assessing for signs of spinal cord injury (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.5 Exposure

One should undress the patient and control the effects of the environment, for example, by preventing hypothermia (AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.6 Safety

It is necessary to ensure the safety of the location in which first procedures will be performed to ensure patient survival. (NATIONAL ASSOCIATION OF EMERGENCY MEDICAL TECHNICIANS, 2020; AMERICAN COLLEGE OF SURGEONS, 2018).

6.1.7 Exsanguination

At this stage, evaluation and control of severe external bleeding, also called exsanguinant bleeding, is performed, since this is the leading cause of death during trauma. Urgent containment of the bleeding is required, even before assessing and clearing the airway. (NATIONAL ASSOCIATION OF EMERGENCY MEDICAL TECHNICIANS, 2020; AMERICAN COLLEGE OF SURGEONS, 2018).

6.2 PRIMARY AND SECONDARY CARE

Injuries can be classified, according to the ATLS, into imminent life-threatening injuries and potentially life-threatening injuries. In this sense, imminent life-threatening injuries are diagnosed and treated, even partially, as soon as possible during the primary evaluation to maximize the patient's chances

of survival. In contrast, potentially life-threatening injuries may be suspected and investigated more cautiously, and treated in the secondary evaluation.(AMERICAN COLLEGE OF SURGEONS, 2018).

Examples of life-threatening injuries include airway obstruction, open pneumothorax, hypertensive pneumothorax, cardiac tamponade, and others. And, as examples of potentially life-threatening injuries, there is simple pneumothorax, pulmonary contusion, blunt trauma to the heart, traumatic diaphragm rupture, among others (AMERICAN COLLEGE OF SURGEONS, 2018).

Primary care concerns all actions performed, emergently, to ensure the patient's survival, according to the injuries presented and corresponds to the polytrauma care, discussed in the topic above (AMERICAN COLLEGE OF SURGEONS, 2018).

Secondary care, on the other hand, corresponds to an in-depth approach and investigation of all the possible injuries presented. Initially, the history of the trauma and the mechanism by which it occurred is collected, through information that can come from the patient, his family or people who witnessed the event that generated the injuries. After that, the patient is examined thoroughly, in the craniocaudal direction, in order to locate injuries not seen during primary care (AMERICAN COLLEGE OF SURGEONS, 2018).

Thus, as for the chest, its anterior, posterior and lateral walls should be examined for injuries, signs of dyspnea, asymmetries, among other changes. In addition, auscultation should be performed to evaluate cardiac sounds and vesicular murmur, and the thorax should be palpated to look for bruising, bulging, pain, crepitus, and subcutaneous emphysema. Finally, the thorax should be percutated to assess for tympanic or maciceous sites. All lesions found are treated according to their needs (AMERICAN COLLEGE OF SURGEONS, 2018).

In addition, it is necessary to maintain a patent airway and continue ventilation and oxygenation according to the patient's needs, prevent secondary brain injury, remove contact lenses and other accessories, maintain alignment of the cervical, thoracic, and lumbar spine, perform complete neurovascular examination of the limbs, and transfer the patient to the operating room if indicated (AMERICAN COLLEGE OF SURGEONS, 2018).

Among the examples of interventions, we have chest drainage in case of hemothorax, transfusion of crystalloid solutions and hydrocolloids in case of hemorrhage, thoracotomy or video-thoracoscopy according to indications, such as bronchial lesions, open pneumothorax, and rupture of the diaphragm or esophagus, always avoiding unnecessary thoracotomies (FENILI, ALCACER, AND CARDONA, 2002; VELASCO et al., 2022).

Analgesic control is essential, since the patient without pain breathes better, avoiding atelectasis and other complications, as well as prophylaxis of infections secondary to the interventions with a single dose of antibiotics (FENILI, ALCACER, AND CARDONA, 2002; VELASCO et al., 2022).

7 CONCLUSION

From this review, it is possible to observe the variety of injuries that can occur due to thoracic trauma, which can vary from the most specific to those that represent greater risk to the patient due to the organ, region, and functionality involved. Thus, the initial care, evaluation, as well as standardized medical conduct allow for quick and quality care.

Some improvements in the norms of evaluation and conduct have occurred in the last 20 years and are present in reference books on the subject as well as in scientific articles published during this period, allowing a better quality of life for the patient and adequate care.

Therefore, it is essential that the medical team be constantly updated and studied on the subject to adapt the care according to the severity of the patient and the type of injury in order to favor a good recovery for the patient, reducing mortality rates, especially among males.

REFERENCES

AMERICAN COLLEGE OF SURGIONS COMMITTEE ON TRAUMA. **Advanced Trauma Life Suport - ATLS**. 10 ed. Chicago: American College of Surgeons, 2018.

AMERICAN COLLEGE OF SURGIONS COMMITTEE ON TRAUMA. **Advanced Trauma Life Suport - ATLS**. 9 ed. Chicago: American College of Surgeons, 2012.

BOUZAT P.; RAUX, M.; DAVID, J.S.; TAZAROURTE, K.; GALINSKI, M.; DESMETTRE, T.; GARRIGUE, D.; DUCROS, L.; MICHELET, P.. Chest trauma: First 48hours management. **Anaesth Crit Care Pain Med**, v. 36, n. 2, 2017.

DEHOUCHE, N. The injury severity score: an operations perspective. **BMC Med Res Methodol**, v. 22, n. 1, 2022.

DOGRUL, B.N.; KILICCALAN, I.; ASCI, E.S.; PEKER, S.C. Blunt trauma related chest wall and pulmonary injuries: An overview. **Chin J Traumatol**, v. 23, n.3, 2020.

FENILI, R.; ALCACER, J.A.M.; CARDONA, M.C. Traumatismo Torácico – uma breve revisão. **ACM arq. catarin. Med**., Santa Catarina, v. 31, n. 1-2, p. 31-36, jan.-jun. 2002.

FONTENELLES MJP, MANTOVANI M. Trauma torácico: fatores de risco de complicações pleuropulmonares pós-drenagem pleural fechada. **Rev Col Bras Cir**., Campinas, v. 27, n. 6, p. 400-407, 2000.

HSU, S.Y.; WU, S.C.; RAU, C.S.; HSIEH, T.M.; LIU, H.T.; HUANG, C.Y.; CHOU, S.E.; SU, W.T.; HSIEH, C.H.. Impact of Adapting the Abbreviated Injury Scale (AIS)-2005 from AIS-1998 on Injury Severity Scores and Clinical Outcome**. Int J Environ Res Public Health**, v. 16, n. 24, 2019.

LI, H.; MA, Y.F. New injury severity score (NISS) outperforms injury severity score (ISS) in the evaluation of severe blunt trauma patients. **Chin J Traumatol**, v. 24, n. 5, 2021.

MARASCO, S.F.; NGUYEN KHUONG, J.; FITZGERALD, M.; SUMMERHAYES, R.; SEKANDARZAD, M.W.; VARLEY, V.; CAMPBELL, R.J.; BAILEY, M. Flail chest injury-changing management and outcomes. **Eur J Trauma Emerg Surg**, 2022.

NATIONAL ASSOCIATION OF EMERGENCY MEDICAL TECHNICIANS. **Prehospital Trauma Life Support - PHTLS**. 9 ed., 2020.

PALMER, C.S.; NIGGEMEYER, L.E.; CHARMAN, D. Double coding and mapping using Abbreviated Injury Scale 1998 and 2005: identifying issues for trauma data. **Injury,** v. 41, n. 9, 2010.

SCAPOLAN, M.B.; VIEIRA, N.L.P.; NITRINI, S.S.; SAAD JUNIOR, R.; GONÇALVES, R.; PERLINGEIRO, J.A.G.; RIVABEN, J.H.. Trauma torácico: análise de 100 casos consecutivos. **Einstein**, São Paulo, v. 8, n. 3, p. 339-342, jul.-set. 2010.

SOUZA, V. S.; DOS SANTOS, A. C.; PEREIRA, L. V. Perfil clínico-epidemiológico de vítimas de traumatismo torácico submetidas a tratamento cirúrgico em um hospital de referência. **Scientia Medica,** v.23, n.2, p.96- 101. Mar. 2013.

VELASCO, I.T; BRANDÃO NETO, R.A.; SOUZA, H.P.; MARINO, L.O.; MARCHINI, J.F.M.; ALENCAR, J.C.G. **Medicina de emergência:** abordagem prática. 16 ed. São Paulo: Manole, 2022.

WESTPHAL, F.L.; LIMA, L.C.; LIMA NETTO, J.C.; SILVA, J.S.; SANTOS JUNIOR, V.L.; WESTPHAL, D.C. Trauma torácico: análise de 124 pacientes submetidos à toracotomia. **Rev. Col. Bras. Cir.**, v. 36, n. 6, p. 482-486, dez. 2009.

ZANETTE, G.Z.; WALTRICK, R.S.; MONTE, M.B. Perfil epidemiológico do trauma torácico em um hospital referência da Foz do Rio Itajaí. **Rev. Col. Bras. Cir.**, v. 46, n. 2, 2019.