

International Journal of Health Science

EMERGENCY EVALUATION AND MANAGEMENT FOR TRAUMATIC PULMONARY ARTERY INJURIES

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Abstract: The aim of this study was to identify the evaluation and emergency management options available for traumatic pulmonary artery injuries, considering the most effective diagnostic and therapeutic approaches to minimize damage and improve prognosis. Methodology: A literature review was carried out through searches in the Scientific Electronic Library Online (Scielo) and PubMed databases. 159 articles were found, of which 7 studies were selected after applying the inclusion criteria. Result: The initial evaluation of traumatic pulmonary artery injuries involves a multidisciplinary approach that includes clinical evaluation, hemodynamic stabilization and use of imaging tests, such as computed tomography (CT) of the chest. Computed tomography angiography (CT angiography) and conventional angiography are useful modalities to assess the extent of the lesion and determine the treatment plan. Emergency management of traumatic pulmonary artery injuries depends on the severity of the injury and the clinical condition of the patient. For hemodynamically stable patients, the initial evaluation after the ATLS protocol involves performing a CT scan to assess the extent of the injury. For hemodynamically unstable patients, however, more invasive interventions are required, such as the insertion of a Resuscitative Endovascular Aortic Balloon Occlusion (REBOA) device and referral to the operating room for damage control and repair of the pulmonary artery. Conclusion: Appropriate management of patients with traumatic pulmonary artery injuries is essential due to the high mortality rate. Management varies according to hemodynamic stability, with stable patients undergoing computed tomography to assess the extent of the lesion, while unstable patients undergo insertion of REBOA and are referred for surgery.

Keywords: Pulmonary artery; Chest injuries;

Complications.

of these patients.

INTRODUCTION

The thoracic region is largely affected in individuals with polytrauma, with an estimated incidence between 45% and 65%. This region is also responsible for the main cause of mortality in this group of patients, with a rate of up to 25%, being surpassed only by severe cranial injuries. The lungs, due to their extensive occupation in the thoracic cavity and their intimate relationship with the surrounding bony structures, are often directly or indirectly damaged in cases of polytrauma (PETRONE et al., 2019).

In particular, penetrating pulmonary artery trauma is associated with a high immediate mortality rate and frequently requires pneumonectomy to control bleeding. In cases of uncontrolled active bleeding, immediate surgical intervention is required. In patients with apparently controlled bleeding, it is crucial to ensure hemodynamic stability and perform imaging tests for an adequate approach (NAIDOO & HARDCASTLE, 2021).

Traumatic injuries involving large vessels are a surgical challenge due to the anatomical complexity of these structures and the possibility of damage to adjacent organs. Pulmonary artery injuries, in particular, are rapidly fatal due to rapid hemorrhage and mediastinal compression, resulting in a high mortality rate. Less than 25% of patients with thoracic vascular injury arrive at the hospital alive and more than 50% die within the first 24 hours (PARRA et al., 2021).

Given this context, the objective of this literature review is to investigate the available evaluation and emergency management options for traumatic pulmonary artery injuries, considering the most effective diagnostic and therapeutic approaches to minimize damage and improve the prognosis

METHODOLOGY

This is a bibliographic review developed following the criteria of the PVO strategy, which means research population or problem, variables and outcome. The research was elaborated based on the following guiding question: "What are the options for evaluation and emergency management available for traumatic lesions of the pulmonary artery?". In this sense, according to the parameters mentioned above, the population or problem of this research refers to patients who suffered traumatic injury to the pulmonary artery and the variables are related to evaluation and emergency management to improve the patient's prognosis. The searches were carried out in the PubMed and Scielo databases. Descriptors combined with the Boolean term "AND" were used, namely: pulmonary artery, diagnosis, therapy, chest injuries and complications. After the search, 8 articles were found, which were subsequently submitted to the selection criteria. Inclusion criteria were: articles in Portuguese, English and Spanish; published in the period from 2000 to 2021 and that addressed the themes proposed for this research, including reviews and original articles, available in full. Exclusion criteria were: duplicate articles, available in summary form, which did not directly address the studied proposal and which did not meet the other inclusion criteria. After associating the descriptors used in the searched databases, a total of 159 articles were found, of which 131 articles belonged to the PubMed database and 28 articles to Scielo. After applying the inclusion and exclusion criteria, 5 articles were selected from the PubMed database and 2 articles from Scielo, a total of 7 studies being used to compose the collection.

RESULTS

DIAGNOSIS OF TRAUMATIC PULMONARY ARTERY INJURY

Suspected pulmonary artery injury requires management that considers the mechanism of injury and the patient's hemodynamic status. Most of these traumatic injuries are due to contusion (80.8%) or penetrating trauma, which can progress to rupture, pseudoaneurysm, or both (QUESADA et al., 2020; PETRONE et al., 2019). The initial approach focuses on treating injuries that are immediately life-threatening, following the principles of Advanced Trauma Life Support (ATLS) (NAIDOO & HARDCASTLE, 2021).

The diagnosis of these lesions has shown significant advances due to the use of computed tomography angiography, minimally invasive surgical techniques and developments in endovascular therapy. In emergency situations, Extended Focused Assessment with Sonography in Trauma (eFAST) and ultrasound are widely used to rule out hemothorax, cardiac tamponade, pneumothorax or abdominal injury (NAIDOO & HARDCASTLE, 2021; PETRONE et al., 2019). In cases where large active hemorrhages are identified, immediate surgical intervention, such as thoracotomy or sternotomy, is imperative. On the other hand, in hemodynamically stable patients, it is possible to proceed with imaging tests (NAIDOO & HARDCASTLE, 2021).

Chest radiography plays an auxiliary role in the diagnosis, mediastinal widening being the most suggestive sign of vascular injury, such as a mediastinal hematoma, which requires further investigation (NAIDOO & HARDCASTLE, 2021). Pulmonary arteriography is also useful in the evaluation of vascular injuries, including in rare conditions such as pulmonary artery dissection (QUESADA et al., 2020).

COMPLICATIONS AND RISKS

There are several complications resulting from traumatic injury to the pulmonary artery. Pulmonary artery dissection is associated with trauma, especially thoracic trauma, severe and penetrating contusions, it can lead to rupture, pseudoaneurysm or both conditions (QUESADA et al., 2020). Most cases of pulmonary artery dissection have symptoms, and progression of the dissection towards the pericardium with cardiac tamponade can have fatal consequences. Therefore, early diagnosis and immediate treatment are essential. In addition, pulmonary artery injuries can result in vessel rupture, causing focal bleeding into the adjacent lung parenchyma. This bleeding can be contained by thrombus formation or by compression of the extravascular tissue, thus originating a pulmonary artery pseudoaneurysm, which, in turn, presents a greater risk of rupture due to its structure, which does not involve all three layers of the vascular wall as one true aneurysm (FELTEN et al., 2018).

Rupture is frequent, making the immediate treatment of diagnosed cases crucial. Significant hemoptysis is a common and clinically relevant symptom and can be potentially fatal due to blood aspiration and resulting asphyxia. In addition, symptoms such as cough, hypoxemia, and exsanguination are indicative of pulmonary artery rupture. In view of the severity of the clinical condition, it is imperative to carry out an immediate diagnosis and management. Pulmonary arteriography is considered the gold standard for the diagnosis of pulmonary artery pseudoaneurysm, due to its ability to provide detailed anatomical information. With regard to therapy, it is necessary to address not only the vascular injury itself, but also the underlying cause, using medical, surgical and endovascular approaches. Endovascular procedures are less invasive, have lower morbidity and

mortality compared to conventional surgery, and reduce complications associated with general anesthesia, especially in patients with comorbidities (ZUGAZAGA et al., 2021).

INITIAL MANAGEMENT AND THERAPY

The initial approach in the management of patients with suspected pulmonary artery injury is focused on stabilizing the patient, following the guidelines of the Advanced Trauma Life Support (ATLS) program. This approach involves assessment of the airway, breathing, circulation, neurologic dysfunction, and exposure. Intravenous access is inserted for pressure monitoring and fluid control. Depending on the clinical picture, orotracheal intubation, fluid replacement, hemodynamic stabilization and resuscitation may be necessary. In hemodynamically stable or responsive patients, after the ATLS assessment and insertion of the intravenous line, the initial approach is to perform a CT scan to assess the extent of the lesion and the presence of other associated lesions. Based on the results, it can be determined whether the treatment will be non-operative or whether an open repair will be required (PARRA et al., 2021).

On the other hand, in hemodynamically unstable patients (with sustained systolic blood pressure below 70 mmHg) or unresponsive, it is necessary to change the access to a femoral sheath and proceed with the insertion of a REBOA (Aortic Endovascular Balloon Resuscitative Occlusion). in zone 1. In these cases, orotracheal intubation is also performed and the patient is sent directly to the operating room, activating the massive transfusion protocol (PARRA et al., 2021). According to Deneuille (2000), early selective intubation is especially indicated in cases of tension pneumothorax or massive hemoptysis. Hemodynamic shock in association with

massive hemothorax or hemoptysis is the most common manifestation of pulmonary artery injuries.

During surgery, immediate surgical control is performed to stop bleeding, including median sternotomy and drainage of mediastinal hematoma or massive hemothorax. In cases of suspected cardiac tamponade, pericardiectomy is performed to evacuate the pericardial hematoma. If REBOA is not available, immediate aortic clamping can be performed, opening the left mediastinal pleura and locating the vascular lesion in the thoracic outflow tract just below the exit of the left subclavian artery, considering the AAST 13 classification. After bleeding with temporary or permanent repair, negative pressure is applied and the mediastinum is compressed using a dressing, keeping the median sternotomy open. The patient is transferred to the intensive care unit to control complications such as hypothermia, hypocalcemia, acidosis and coagulopathy. Generally, between 6 and 24 hours after the initial surgery, the patient returns to the operating room for mediastinal lavage and definitive reconstruction of the sternum (PARRA et al., 2021).

The study by Gonçalves and Saad Jr. (2016), discusses the results of applying the thoracic damage control surgery technique. The main objective of the damage control technique is to stabilize patients with severe chest injuries, including pulmonary artery injuries and their complications. According to the authors, thoracic damage control surgery has been shown to be effective in stabilizing polytrauma patients with severe thoracic injuries, allowing safer and more agile management of these complex cases. The technique is especially useful in situations of hemorrhagic shock, cardiac tamponade and thoracic vascular injuries, in which immediate complete surgery may be associated with high

risks and complications.

CONCLUSION

Appropriate evaluation and emergency management of patients suffering from traumatic pulmonary artery injuries are extremely important, considering the high mortality rate associated with these injuries. The approach to patients with suspected pulmonary artery injury varies according to the patient's hemodynamic status. For those

who are hemodynamically stable, after the application of ATLS, the initial conduct is to perform a computed tomography to assess the extent of the lesion. On the other hand, for hemodynamically unstable patients, it is necessary to insert a REBOA device and immediately refer them to the operating room. Through this bibliographical review, the importance of proper management of these patients is emphasized in order to increase their survival.

REFERENCES

- DENEUVILLE M. Injury of the pulmonary artery and its branches due to penetrating chest trauma. **Annals of vascular surgery**, v. 14, n. 5, p. 463-467, 2000.
- FELTEN J., et al. Atypical right pulmonary artery dissection complicating severe blunt chest trauma. In: *Seminars in Thoracic and Cardiovascular Surgery*. **WB Saunders**, v. 31. p. 137-139, 2019
- NAIDOO S. & HARDCASTLE T.C., Timothy Craig. Traumatic injury to the great vessels of the chest. **Mediastinum**, v. 5, 2021.
- PARRA, M. W. et al. Damage control surgery for thoracic outlet vascular injuries: the new resuscitative median sternotomy plus REBOA. **Colombia Médica**, v. 52, n. 2, 2021.
- PETRONE P., et al. Prevalencia, diagnóstico y tratamiento de las lesiones pulmonares traumáticas. **Revista Colombiana de Cirugía**, v. 34, n. 2, p. 132-143, 2019.
- QUESADA D., et al. Pulmonary Artery Dissection Post-blunt Thoracoabdominal Trauma. **Clinical Practice and Cases in Emergency Medicine**, v. 4, n. 3, 2020.
- ZUGAZAGA A., et al. Pulmonary artery pseudoaneurysms: endovascular management after adequate imaging diagnosis. **European Radiology**, v. 31, p. 6480-6488, 2021.