

RECENT ADVANCES IN THE MANAGEMENT OF NON-PENETRATING HEART TRAUMA: A REVIEW OF DIAGNOSTIC AND THERAPEUTIC PRACTICES

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Abstract: Objective: This study reviews recent advances in the management of non-penetrating cardiac trauma, providing insights for clinical practice and the development of future therapeutic guidelines. Methods: To employ the PubMed database, 455,170 articles were initially evaluated. A rigorous selection restricted the analysis to 9 articles, published between 2013 and 2024, using well-defined inclusion and exclusion criteria. This thorough review provided a comprehensive and up-to-date overview of methods of managing these traumas. Results: Initial clinical assessment, including history and clinical signs, is vital for diagnosing non-penetrating cardiac trauma. Diagnostic exams such as radiography (X-ray) and electrocardiogram (ECG) are essential. The gold standard for identifying myocardial contusion is still the post-mortem evaluation of cardiac tissue, however, the combination of ECG and troponins has shown efficacy in live diagnosis. Cardiac markers such as cTnI and cTnT along with transesophageal echocardiography (TEE) are effective in detecting myocardial injury. Thoracic computed tomography (CT) is preferred to evaluate blunt trauma. Pericardiocentesis is used to treat cardiac tamponade, with surgical intervention being considered after meticulous planning. Conclusions: This systematic review highlights the complexity of managing non-penetrating cardiac trauma, underlining the importance of a multidisciplinary approach that integrates clinical assessment, use of biomarkers and advanced imaging to guide appropriate treatment.

Keywords: Non-penetrating cardiac trauma; clinical diagnosis; cardiac biomarkers

INTRODUCTION

Non-penetrating cardiac trauma, defined as cardiac injury resulting from a blunt event without direct penetration of the chest, is more common than penetrating trauma. Studies indicate that the incidence of cardiac injury in cases of thoracic trauma varies significantly, being present in 8% to 86% of cases. In the United States, approximately 30,000 cases of non-penetrating cardiac trauma are reported annually (Fadel, El-Menyar, ElKafrawy, Gad, 2019).

The medical literature also highlights a wide variation in the incidence of these injuries, with them representing around 15% of all emergency visits (Eghbalzadeh et al., 2017). These variations in the incidence and potential severity of these injuries highlight the importance of appropriate diagnostic and therapeutic procedures, which can be controversial and often delay the necessary assistance to the patient.

The most common causes of non-penetrating cardiac trauma include massive compression of the chest in automobile accidents and falls from great heights. These injuries are highly serious and evolve quickly, which requires an immediate and effective approach to avoid severe complications such as arrhythmias, rupture of the myocardial wall, and valve damage, which can lead to death if not managed promptly (Fadel et al., 2019).

The most effective interventions in medical practice today include placement of chest tubes and, in fewer cases, immediate surgical interventions. Troponin is widely recognized as an effective biomarker of myocardial injury in these patients. Furthermore, the electrocardiogram remains a crucial method for cardiac diagnosis and monitoring, helping to define complications and secondary risks after trauma (Eghbalzadeh et al., 2017; Fadel et al., 2019).

Therefore, this research aims to deepen the understanding of the most efficient practices, technological advances and multidisciplinary strategies adopted to optimize clinical results in patients who have suffered non-penetrating cardiac trauma, contributing to the improvement of treatment guidelines and the prognosis of these patients.

METHODOLOGY

This study adopted a literature review methodology based on the PVO model, which includes Population or research problem, Intervention and Outcome. The guiding question was formulated as: “What are the most current and effective approaches to managing non-penetrating cardiac trauma and how have these approaches evolved in response to the most recent scientific evidence?”

To identify relevant literature, a systematic search was carried out in the PubMed – MEDLINE (Medical Literature Analysis and Retrieval System Online) database, using a combination of specific terms and Boolean operators. The keywords used included “Non-penetrating cardiac trauma”, “Blunt cardiac injury”, “Cardiac contusion” in combination with “Management”, “Treatment”, “Therapy”, “Approach” and complemented by “Diagnostic techniques”, “Imaging modalities”, “Technological innovations”, “Computed tomography”, “CT scan”, “Echocardiography”, using the “AND” and “OR” operators.

Initially, the search identified an extensive number of articles, specifically 455,170. This set was then subjected to a rigorous selection process with well-defined inclusion and exclusion criteria to ensure the quality and relevance of the studies. The inclusion criteria included articles in English, published between 2013 and 2024, addressing topics related to the management of non-penetrating cardiac trauma and that were available in full. Various

types of studies were considered, including reviews, meta-analyses, observational studies, case reports and cross-sectional studies.

The exclusion criteria removed duplicate articles, abstracts, and those that did not directly correspond to the study proposal.

After applying the aforementioned criteria, the selection was reduced to 9 articles. These were organized and analyzed systematically, and relevant information was extracted and tabulated according to the variables of interest. This rigorous methodological process guarantees the obtaining of reliable and robust data, allowing for accurate analysis and interpretation of results, and contributing to the validity and credibility of the review. This approach ensures that the study reflects the most recent and effective advances in the management of non-penetrating cardiac trauma, providing valuable information for clinical practice and the future development of treatment guidelines.

DISCUSSION

MULTIDISCIPLINARY APPROACHES IN THE MANAGEMENT OF NON-PENETRATING CARDIAC TRAUMA

Shoar et al. (2021) emphasize that the management of non-penetrating cardiac trauma begins in the pre-hospital environment, where the triage team plays a crucial role in gathering essential information about the location and severity of the trauma. These data are essential to identify the mechanism of injury and, consequently, determine the appropriate investigative tests for each patient.

According to Gao et al. (2020), collecting a detailed clinical history, which includes previous comorbidities, risk factors and medications used by the patient, is vital to identify possible injuries resulting from trauma. Furthermore, clinical signs such as Beck's triad, which includes hypotension,

muffled heart sounds and jugular venous distension, may suggest cardiac tamponade. Other indicators such as hemothorax, evidenced by shock when changing position and refractory hypotension, are also relevant, although these clinical signs are not very sensitive and serve mainly to indicate the need for more specific exams such as radiography (X-ray), electrocardiogram (ECG), markers cardiac, transesophageal echocardiography (ECHO), computed tomography (CT) and magnetic resonance imaging (MRI).

To identify heart damage before starting treatment is crucial. Cardiac tamponade, for example, is a serious complication of non-penetrating cardiac trauma that is usually initially treated with pericardiocentesis to relieve the pressure exerted by blood in the pericardium on the heart chambers. However, Kyriazidis et al. (2023) warn that, in cases of right atrium rupture, pericardiocentesis may be contraindicated, as it can reduce cardiac output and cause cardiogenic shock.

Nair, Winkle and Senanayake (2023) discuss that the treatment of non-penetrating cardiac trauma varies depending on the patient's clinical status, and surgical intervention can be a crucial predictor for survival. The surgical approach must be meticulously planned to minimize blood loss and maintain hemodynamic stability. Patients in unstable conditions often require thoracotomy.

Bellister, Dennis and Guillaumondegui (2017) emphasize that the pillar of blunt cardiac trauma treatment is clinical support. Given the high mortality rate associated with these traumas, it is essential to hemodynamically stabilize the patient and continuously monitor it through electrocardiogram and cardiac enzymes. In cases where imaging tests initially do not reveal abnormalities, it may be necessary to repeat the chest tomography and maintain close observation of the patient (Shoar et al., 2021).

EARLY DIAGNOSIS IN NON-PENETRATING CARDIAC TRAUMA

Diagnosis of myocardial contusion remains a significant challenge, even with advances in medical technology. Traditionally, the gold standard for identifying myocardial contusion is the evaluation of post-mortem cardiac tissue, which limits diagnostic options in living patients (Van Lieshout et al., 2021). Therefore, it is crucial to optimize and combine established diagnostic tools, such as the electrocardiogram (ECG) and cardiac biomarkers, to improve the identification of this condition. In a recent systematic review, Kyriazidis et al. (2023) demonstrated that a normal ECG associated with normal levels of cardiac troponin I is effective in ruling out myocardial contusion, with a sensitivity of 85%.

According to Bellister, Dennis and Guillaumondegui (2017), the ECG is a crucial component in the initial screening of patients with suspected cardiac trauma, presenting a sensitivity of up to 89% when performed serially. This method has a high negative predictive value, especially when combined with cardiac troponin measurement. If both the ECG and troponins remain unchanged after 8 hours, blunt myocardial injury can be effectively ruled out. These findings are corroborated by Van Lieshout et al. (2021), who also recommend performing an echocardiogram when there are electrocardiographic or enzymatic changes.

Accuracy in detecting blunt myocardial injuries is crucial in modern medicine. Recent research has emphasized the diagnostic utility of combining cardiac markers, such as cardiac troponin I (cTnI) and cardiac troponin T (cTnT), which demonstrate significant sensitivity and specificity; cTnI achieves a specificity of 84.1%, while cTnT reaches 85.5% (Kyriazidis et al., 2023). Furthermore, transesophageal echocardiography (TEE) has

proven to be highly effective in identifying blunt myocardial injuries and diagnosing ischemic heart failure. TEE offers superior sensitivity and specificity compared to other diagnostic methods, allowing the visualization of deep and difficult-to-access lesions. However, it is important to highlight that TEE requires advanced skills to perform and is not available in all highly complex medical centers, in addition to being contraindicated in patients with suspected esophageal injuries.

Regarding the evaluation of blunt chest trauma, chest computed tomography (CT) is generally preferable to chest radiography, being able to identify additional findings in approximately half of cases. However, CT may not be indicated in situations such as high cost, significant time demand, high risk of radiation exposure in young patients or when a previous chest x-ray shows no changes. Situations that favor the use of CT include changes in the chest wall, decreased cardiac and pulmonary auscultation, hemodynamic instability, significant tachypnea (>20 breaths per minute) and mechanisms of high-intensity trauma (Safari et al., 2020).

FINAL CONSIDERATIONS

Current practices for the management of non-penetrating cardiac trauma were reviewed based on a systematic database search, highlighting the importance of collecting detailed information about the mechanism of trauma and the patient's history. This process is crucial to identify risks of hemodynamic compromise, such as cardiac tamponade and rupture of the heart walls. The evaluation includes measurements of cardiac biomarkers and, when indicated, imaging tests such as transesophageal echocardiography, which offers high sensitivity and specificity to detect deep lesions. Alternatively, electrocardiogram and ultrasound can be used, reserving tomography for cases of recurrent clinical instability.

Treatment is defined according to the cardiac lesion identified, and may include clinical or surgical interventions. These findings are fundamental to improving the standardization of assessment practices in

emergencies and trauma rooms. However, other studies need to confirm these results to develop more effective, appropriate and accessible diagnostic methods for different populations.

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