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Blunt chest trauma associated cardiac injury diagnosis in the emergency department: A systematic review

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Abstract

Background: Diagnosing cardiac contusions from forceful chest trauma is still difficult due to the non-specific symptoms it produces and the absence of reliable diagnostics to identify myocardial damage. This study's aim to assess how well diagnostic techniques identify blunt heart damage and its consequences.

Method: PRISMA criteria were followed in the conduct of this systematic review study. Two reviewers searched the MEDLINE, Scopus, and Embase databases to locate relevant works from 2014 to 2024. The search was limited to publications written in English. We considered case series, observational studies, and prospective or retrospective cohort studies that look at ways to diagnose blunt cardiac damage. Studies that evaluate biomarker-based diagnostics or imaging modalities. We incorporate research that reports on the diagnostic modalities' sensitivity, specificity, and accuracy. Research assessing the clinical results of using these diagnostic instruments.

Result and conclusion: The complexity of BCI diagnosis and treatment indicated the necessity for an all-encompassing diagnostic strategy. Although CMR and DECT provide excellent diagnostic accuracy, they are occasionally unsuitable in situations involving severe trauma. TEE has become a very useful bedside technique, particularly for patients who are unstable. Troponins and ECG are screening tests that can be used to rule out BCI because of their moderate sensitivity and high specificity.

Keywords: Blunt Chest Trauma; Diagnosis; Myocardial Contusions; Emergency Department

1. Introduction

Fifteen percent of emergency department admissions globally are due to blunt chest injuries (BCI), which are linked to high rates of morbidity and death (El-Chami et al. 2008; FRAZEE et al. 1986; van Wijngaarden et al. 1997). They might happen after a car crash, a fall from a height, a violent attack, or an injury sustained in sports. Decelerating forces applied on the anterior portion of the chest wall are believed to be the cause of the damage to the heart, which puts the heart's viscoelastic qualities to the test (FRAZEE et al. 1986). Following the impact, the heart is free to travel along the anterior-posterior axis of the thoracic cavity. It may then be crushed just against the posterior of the sternum or, in the case of a more forceful impact, "squashed" between the sternum and the anterior aspect of the thoracic spine.

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It is clear that the clinical appearance of individuals with BCI varies widely since these injuries include a wide range of causes and intensities. A silent clinical finding or varying physiological instability degrees are possible presentations, but in some cases, injuries to key structures like the pericardium, valves, chordae tendinae, papillary muscle, coronary artery, or ventricular septum may be "catastrophic" (El-Chami et al. 2008; FRAZEE et al. 1986; Sade et al. 2017).

The words "cardiac contusion" and "BCI" are frequently used interchangeably in the literature. The phrase myocardial contusion should no longer be used as a diagnostic for admission or rating of injury severity (andNA; 1992). This study's main goal is to assess how well diagnostic techniques identify blunt heart damage and its consequences.

2. Method

This systematic review study was conducted according to PRISMA guidelines. To find pertinent papers from 2014 to 2024, two independent reviewers examined the MEDLINE, Scopus and Embase databases. Only English-language publications were included in the search. The titles, abstracts, and full texts of the articles were then read in order to filter them.

We included prospective or retrospective cohort studies, observational studies, or case series; studies that investigate diagnostic methods for blunt cardiac injury (BCI). Studies that assess imaging modalities (CT, DECT, CMR, echocardiography) or biomarker-based diagnostics (ECG, troponins). We include studies reporting on diagnostic accuracy, sensitivity, and specificity of the above modalities. Studies evaluating clinical outcomes associated with the use of these diagnostic tools (e.g., Major Adverse Cardiac Events [MACE], mortality, or need for intervention).

The dispute among the reviewers over eligibility was resolved through discussion. After the discovered records were first sorted by title and abstract, potentially relevant articles were examined in their entirety. The references in the listed papers were screened for eligibility. If the full-text version of the work was not available, an email was sent to the related authors; if they did not respond, a follow-up email was sent.

We extract data on a predesigned Google sheet, we extracted data on study characteristics (author, study design, and study area); population and participants characteristics; diagnostic methods; and key findings.

Quality assessment of the included studies was performed according to ROBINS-I tool. Burrell et al. (2017) study (Burrell et al. 2017) showed a moderate risk of bias, due to confounding and missing data from a small sample size. Hammer et al. (2015) (Hammer et al. 2016) showed a high risk of bias, in confounding and measurement due to the retrospective nature and CT's poor sensitivity in detecting cardiac contusions. Sade et al. (2017) had a low to moderate risk of bias. Vasileiou et al. (2019) had a high risk of bias, in confounding and measurement because CXR alone is not a dependable diagnostic tool. Audette et al. (2014) had a moderate risk of bias, with concerns over missing data and variability in ECG and troponin measurement.

Table 1 Quality assessment of the included studies with the ROBINS-I tool

Study (Author, Year)	Burrell et al., 2017	Hammer et al., 2015	Sade et al., 2017	Vasileiou et al., 2019	Audette et al., 2014
Bias due to Confounding	Moderate	High	Moderate	High	Moderate
Bias in Selection of Participants	Low	Moderate	Low	Moderate	Low
Bias in Classification of Interventions	Low	Low	Low	Low	Low
Bias due to Deviations from Intended Interventions	Low	Low	Low	Low	Low
Bias due to Missing Data	Moderate	Moderate	Low	Moderate	Moderate
Bias in Measurement of Outcomes	Low	High	Low	High	Moderate
Bias in Selection of Reported Results	Low	Moderate	Low	Moderate	Moderate

Overall Risk of Bias	Moderate	High	Low to Moderate	High	Moderate

3. Result

In this systematic review study, we include 5 articles published in the period from 2014 to 2024. The studies aimed to assess the role of diagnostic methods in detecting cardiac contusions and associated injuries in patients with blunt cardiac trauma.

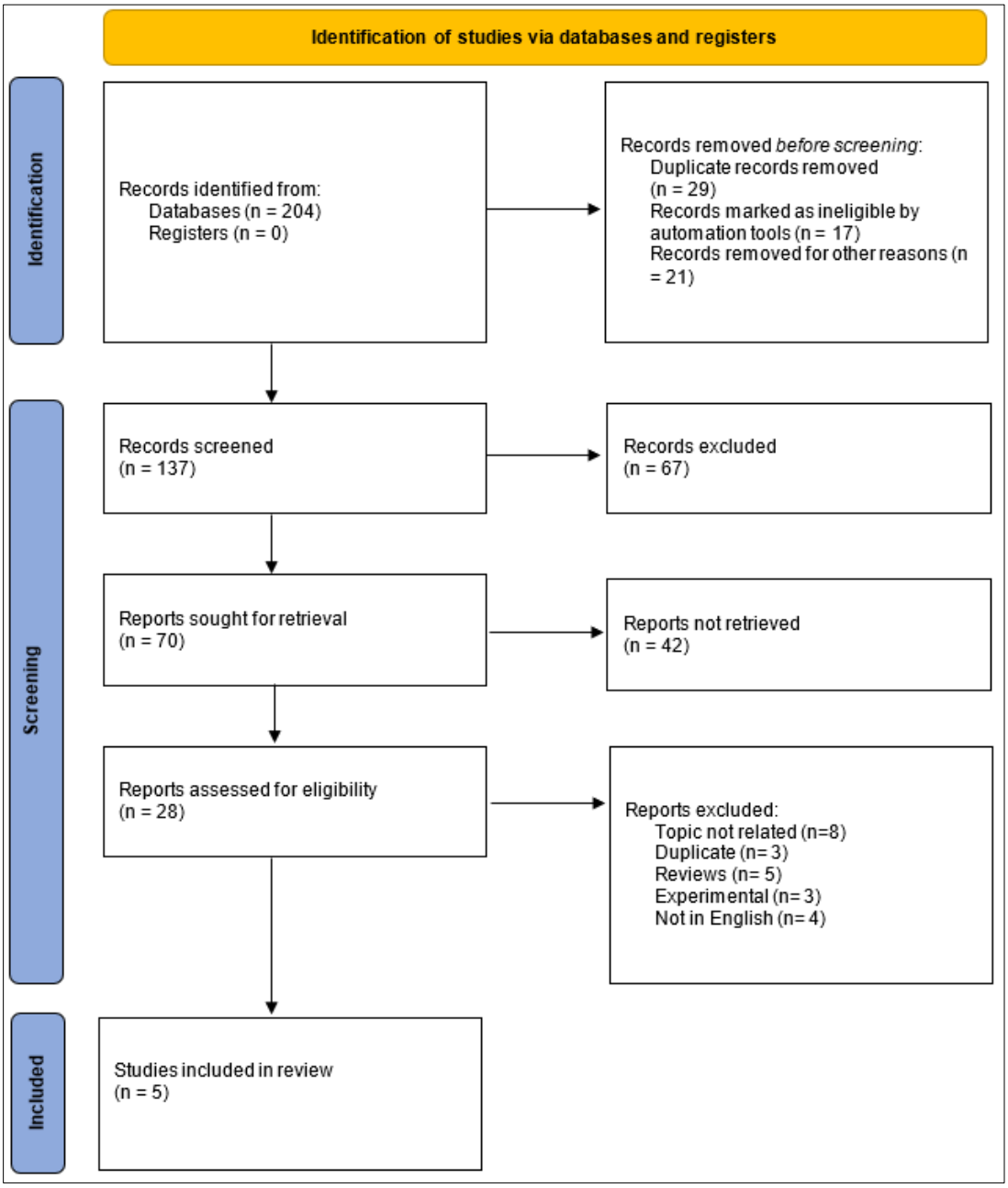

Figure 1 PRISMA consort chart of studies selection

Burrell et al. (2017) study examined the use of cardiac magnetic resonance imaging (CMR) in diagnosing blunt cardiac injury (BCI). This prospective cohort study includes 42 major trauma patients, 21 with of chest injury and elevated troponin levels, and 21 controls. The study found that 28% of patients with chest injuries exhibited abnormal CMR findings, such as myocardial edema, regional wall motion abnormalities, and myocardial hemorrhage. Left ventricle was the most commonly affected area. Major adverse cardiac events (MACE), including ventricular arrhythmia and

hypotension requiring inotropes, occurred in five patients. The study found that CMR has a 60% sensitivity and 81% specificity MACE prediction, it's found to be better in the diagnosis of suspected BCI in comparison to conventional methods like electrocardiography (ECG) and troponin.

Hammer et al. (2015) retrospective study assessed the use of computed tomography (CT) in cardiac contusions diagnosis in blunt trauma patients. His study includes 42 patients with clinically diagnosed BCI. CT identified abnormalities of the heart or pericardium in 82% of patients with confirmed BCI. However, the detection of myocardial contusions was poor, CT sensitivity was 0% for right ventricular contusions and 22% for left ventricular contusions. The study emphasized that CT disgnosis of severe thoracic trauma indirectly indicate BCI, and myocardial hypoenhancement on CT alone is not a dependable diagnostic tool. The authors advised using CT as a complementary tool with echocardiography or CMR for diagnosing BCI.

Sade et al. (2017) study examined the feasibility of dual-energy computed tomography (DECT) in diagnosing cardiac contusions in blunt cardiac injuries. They included 17 patients who underwent DECT within 48 hours of trauma, with a follow-up scan conducted one year later. Contusions were primarily located in the left ventricular free wall, ventricular septum, and apex. In 10 patients, contusion areas resolved completely on follow-up, while in four patients, contusions persisted and showed significant improvement. Findings indicate high interobserver agreement in detecting contusions, suggesting DECT as a potentially effective tool for diagnosing blunt cardiac injuries.

Vasileiou et al. (2019) retrospective cohort study examined the clinical significance of a widened mediastinum (WM) on chest X-ray (CXR) following blunt trauma. Among 749 patients analyzed, 67% had a WM. Despite the initial suspicion that WM indicate aortic injury (AI), 26% had positive findings on CT, with just two confirmed cases of AI. The study reported a 100% sensitivity and 33% specificity for CXR in detecting AI, highlighting its limited diagnostic accuracy. Audette et al. (2014) retrospective descriptive study examined the use of ECG and troponin in diagnosing myocardial contusion in trauma patients with sternal fractures. Among 54 patients, 72% underwent initial ECGs, and 33% received follow-up ECGs. Additionally, 30% had troponin testing, and 2% showed elevated levels. A combination of ECG and troponin testing yielded a 100% sensitivity and 45-89% specificity.

Table 2 characteristics of include studies

Study (Author, Year)	**Study Design**	**Study Aim**	**Participants Characteristics**	**Outcome**	**Methodology**
Burrell et al., 2017	Prospective cohort study	To evaluate the incidence and severity of blunt cardiac injury (BCI) using cardiac magnetic resonance (CMR) and compare it to standard diagnostic methods	42 major trauma patients (21 with chest trauma and 21 controls), July 2013 - Jan 2015	6/21 (28%) patients with chest injuries had abnormal CMR scans; MACE occurred in 5 patients	CMR within 7 days, ECG, Troponin, and echocardiography
Hammer et al., 2015	Retrospective study	To evaluate CT findings in blunt cardiac injury	42 patients with blunt cardiac injury (Median age: 52, 86% male)	CT was poorly sensitive for right ventricular contusions (0%) and left ventricular contusions (22%)	Chest CT, ECG, Troponin, and echocardiography
Sade et al., 2017	Prospective study	To assess the feasibility of dual-energy computed tomography (DECT) for diagnosing cardiac contusion	17 patients (10 men, 7 women, median age 51)	DECT identified contusions primarily in the left ventricle; follow-up showed recovery in most patients	DECT imaging within 48 hours of trauma, follow-up DECT at ~1 year
Vasileiou et al., 2019	Retrospective cohort study	To determine the significance of widened	749 blunt trauma patients (67% MVC, 76% male)	Only 26% had positive CT findings; sensitivity	CXR, Chest CT

		mediastinum on chest X-ray (CXR) in blunt trauma		of WM for aortic injury was 100%, specificity was 33%	
Audette et al., 2014	Retrospective descriptive study	To evaluate the use of ECG and troponin in assessing myocardial contusion in sternal fracture cases	54 trauma patients with suspected sternal fracture (51 years mean age, 54% female)	72% had initial ECGs, 33% had follow-up ECGs, 30% had troponin dosage; ECG + troponin combination had 100% sensitivity	ECG, follow-up ECG, Troponin, Chest X-ray, Cardiac ultrasound

Table 3 Main findings of the included studies

Study (Author, Year)	Demographics	Study Duration	Type of Trauma	Methods Used for Diagnosis	Accuracy of Method (Sensitivity/Specificity)
Burrell et al., 2017	42 major trauma patients	July 2013 - Jan 2015	Blunt cardiac injury	Cardiac Magnetic Resonance Imaging (CMR)	Sensitivity: 60%, Specificity: 81%
Hammer et al., 2015	42 patients with blunt cardiac injury	2006 - 2013	Blunt cardiac injury	Computed Tomography (CT), ECG, Troponin, Echocardiography	Myocardial hypoenhancement on CT: Sensitivity: 0% (RV), 22% (LV)
Sade et al., 2017	17 patients (10 men, 7 women, median age 51)	Feb 2014 - Sept 2015	Mildest blunt cardiac injury	Dual-Energy CT (DECT)	High interobserver agreement (κ = 1.0) but no clear sensitivity/specificity reported
Vasileiou et al., 2019	749 patients with widened mediastinum	Jan 2017 - June 2017	Blunt trauma	Chest X-ray (CXR), Chest CT	Sensitivity: 100%, Specificity: 33%
Audette et al., 2014	54 patients with suspected sternal fractures	Jan 2007 - Oct 2010	Sternal fracture trauma	ECG, Troponin	ECG + Troponin: Sensitivity: 100%, Specificity: 45-89%

4. Discussion

BCI diagnosis remain difficult due to its variable clinical presentations and the lack of accepted gold standard for diagnosis. The included five studies (Audette et al. 2014; Burrell et al. 2017; Hammer et al. 2016; Sade et al. 2017; Vasileiou et al. 2019) focused on imaging modalities, including CMR, CT, and DECT to assess BCI.

The use of imaging modalities in BCI diagnosis still a topic of debate. CXR always used initial screening tool, but studies found that a widened mediastinum on CXR has low specificity (33%) for detecting aortic injury (Vasileiou et al. 2019), making it an unreliable diagnostic tool on its own (Girón-Arango and D'Empaire 2022). CT has been more widely used due to its ability to detect associated thoracic injuries. Hammer et al. (2015) found that CT has poor sensitivity in myocardial contusions detection, particularly in the right ventricle (Girón-Arango and D'Empaire 2022). Sade et al. (2017) examined DECT as an alternative, finding that it shows a high interobserver agreement in detecting myocardial contusions, with improved accuracy.

CMR was highly sensitive imaging modality for detecting myocardial edema and fibrosis. Burrell et al. (2017) found that CMR detected myocardial abnormalities in 28% of patients with suspected BCT and show a strong correlation with clinical outcomes (Girón-Arango and D'Empaire 2022). Despite its diagnostic accuracy, CMR is not practical in the acute

trauma setting due to patient instability and limited availability. Shoar et al. (2021) suggested that although CMR and DECT are valuable, their application in emergency settings remains limited.

Lieshout et al. (2021) evaluated transthoracic echocardiography (TTE). TTE show a poor sensitivity (45%) for myocardial contusion, and 88% specificity (Van Lieshout et al. 2021). TEE show advantages in perioperative trauma patients, as it provides better imaging quality in hemodynamically unstable patients (Girón-Arango and D'Empaire 2022). A systematic review and meta-analysis, found that TEE had a sensitivity of 86.7% and specificity of 72.1%, which support its use in suspected BCI cases (Kyriazidis et al. 2023).

ECG and cardiac biomarkers were used widely as cost-effective screening tools. Audette et al. (2014) tested the role of ECG and troponin in myocardial contusion assessment and found that ECG abnormalities were detected in many patients with suspected BCI, but its specificity varied (Girón-Arango and D'Empaire 2022). The combination of ECG and troponin I (cTnI) had a 100% negative predictive value for clinically significant BCI, making it a highly effective rule-out strategy (Salim et al. 2001). ECG and cardiac biomarkers show high specificity (>80%), and low sensitivity, so they should not be used in isolation for diagnosis (Kyriazidis et al. 2023).

The findings of the included studies highlight the need for a multimodal approach to diagnose BCI. Liedtke and DeMuth study provided a historical perspective, show that BCI sometimes goes undiagnosed due to the overshadowing effects of other traumatic injuries (Liedtke and DeMuth 1973). This remains relevant today, as many patients with significant thoracic trauma not exhibit immediate cardiac symptoms, necessitating careful monitoring. Shoar et al. (2021) detected the variability in clinical presentation and the importance of combining multiple diagnostic modalities to improve diagnosis.

Early identification of high-risk patients is important to start management. Patients with normal ECG and troponin can sometimes safely discharged (Salim et al. 2001). Patients with persistent ECG abnormalities, elevated biomarkers, or imaging-confirmed structural injuries require close monitoring and possible intervention. Hemodynamically unstable patients, particularly those with tamponade or valvular rupture, should be assessed for the need of urgent surgical management (Girón-Arango and D'Empaire 2022).

List of abbreviations

- BCI, Blunt Cardiac Injury
- CMR, Cardiac Magnetic Resonance Imaging
- CT, Computed Tomography
- DECT, Dual-Energy Computed Tomography
- TEE, Transesophageal Echocardiography
- ECG, Electrocardiography
- cTnI, Cardiac Troponin I
- CXR, Chest X-ray
- WM, Widened Mediastinum
- AI, Aortic Injury
- MACE, Major Adverse Cardiac Events
- MVC, Motor Vehicle Collision
- PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- ROBINS-I, Risk of Bias in Non-Randomized Studies - of Interventions
- PPV, Positive Predictive Value
- NPV, Negative Predictive Value

5. Conclusion

Multifaceted nature of BCI diagnosis and management, suggested the need for a comprehensive diagnostic approach. CMR and DECT offer high diagnostic precision, they are sometimes impractical in acute trauma settings. TEE has emerged as a highly effective bedside tool, especially in unstable patients. ECG and troponins were screening tools, they show high specificity and moderate sensitivity, and can be used to rule out BCI. Future research should establish standardized diagnostic guidelines which integrate these methods to improve BCI early detection and management.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] andNA. Blunt Cardiac Injury. J Trauma. 1992 Nov;33(5):649–50. doi: 10.1097/00005373-199211000-00001.

[2] Audette JS, Emond M, Scott H, Lortie G. Investigation of Myocardial Contusion with Sternal Fracture in the Emergency Department: Multicentre Review. Can Fam Physician. 2014 Feb;60(2):e126–30. PMID: 24522690.

[3] Burrell AJC, Kaye DM, Fitzgerald MC, Cooper DJ, Hare JL, Costello BT, Taylor AJ. Cardiac Magnetic Resonance Imaging in Suspected Blunt Cardiac Injury: A Prospective, Pilot, Cohort Study. Injury. 2017 May;48(5):1013–19. doi: 10.1016/j.injury.2017.02.025.

[4] El-Chami MF, Nicholson W, Helmy T. Blunt Cardiac Trauma. J Emerg Med. 2008 Aug;35(2):127–33. doi: 10.1016/j.jemermed.2007.03.018.

[5] Frazee RC, Mucha P, Farnell MB, Miller FA. Objective Evaluation of Blunt Cardiac Trauma. J Trauma. 1986 Jun;26(6):510–20. doi: 10.1097/00005373-198606000-00004.

[6] Girón-Arango L, Pérez D'Empaire P. Is There a Role for Transesophageal Echocardiography in the Perioperative Trauma Patient? Curr Anesthesiol Rep. 2022 Jun;12(2):210–16. doi: 10.1007/s40140-022-00526-0.

[7] Hammer MM, Raptis DA, Cummings KW, Mellnick VM, Bhalla S, Schuerer DJ, Raptis CA. Imaging in Blunt Cardiac Injury: Computed Tomographic Findings in Cardiac Contusion and Associated Injuries. Injury. 2016 May;47(5):1025–30. doi: 10.1016/j.injury.2015.11.008.

[8] Kyriazidis IP, Jakob DA, Hernández Vargas JA, Franco OH, Degiannis E, Dorn P, Pouwels S, Patel B, Johnson I, Houdlen CJ, Whiteley GS, Head M, Lala A, Mumtaz H, Soler JA, Mellor K, Rawaf D, Ahmed AR, Ahmad SJS, Exadaktylos A. Accuracy of Diagnostic Tests in Cardiac Injury after Blunt Chest Trauma: A Systematic Review and Meta-Analysis. World J Emerg Surg. 2023 Apr;18(1):36. doi: 10.1186/s13017-023-00504-9.

[9] Liedtke AJ, DeMuth WE. Nonpenetrating Cardiac Injuries: A Collective Review. Am Heart J. 1973 Nov;86(5):687–97. doi: 10.1016/0002-8703(73)90349-9.

[10] Van Lieshout EMM, Verhofstad MHJ, Van Silfhout DJT, Dubois EA. Diagnostic Approach for Myocardial Contusion: A Retrospective Evaluation of Patient Data and Review of the Literature. Eur J Trauma Emerg Surg. 2021 Aug;47(4):1259–72. doi: 10.1007/s00068-020-01305-4.

[11] Sade R, Kantarci M, Ogul H, Bayraktutan U, Uzkeser M, Aslan S, Aksakal E, Becit N. The Feasibility of Dual-Energy Computed Tomography in Cardiac Contusion Imaging for Mildest Blunt Cardiac Injury. J Comput Assist Tomogr. 2017 May;41(3):354–59. doi: 10.1097/RCT.0000000000000545.

[12] Salim A, Velmahos GC, Jindal A, Chan L, Vassiliu P, Belzberg H, Asensio J, Demetriades D. Clinically Significant Blunt Cardiac Trauma: Role of Serum Troponin Levels Combined with Electrocardiographic Findings. J Trauma. 2001 Feb;50(2):237–43. doi: 10.1097/00005373-200102000-00008.

[13] Shoar S, Hosseini FS, Naderan M, Khavandi S, Tabibzadeh E, Khavandi S, Shoar N. Cardiac Injury Following Blunt Chest Trauma: Diagnosis, Management, and Uncertainty. Int J Burns Trauma. 2021 Apr;11(2):80–89.

[14] Vasileiou G, Qian S, Al-Ghamdi H, Pace D, Rattan R, Mulder M, Namias N, Yeh DD. Blunt Trauma: What Is Behind the Widened Mediastinum on Chest X-Ray (CXR)? J Surg Res. 2019 Sep;243:23–26. doi: 10.1016/j.jss.2019.04.079.

[15] van Wijngaarden MH, Karmy-Jones R, Talwar MK, Simonetti V. Blunt Cardiac Injury: A 10-Year Institutional Review. Injury. 1997 Jan;28(1):51–55. doi: 10.1016/S0020-1383(96)00118-0.