Section: General Surgery

OriginalResearchArticle

DIAGNOSTIC ACCURACY OF CHEST RADIOGRAPHY COMPARED WITH COMPUTED TOMOGRAPHY FOR DETECTING RIB FRACTURES AND ASSOCIATED THORACIC INJURIES FOLLOWING CHEST TRAUMA: A PROSPECTIVE OBSERVATIONAL STUDY

Ayisha Farha S[1], Biju TP[2], Delina Rosemary Roger[3], Parvathy S Kumar[4]

[1]Senior Resident, Department of General Surgery, Government Medical College, Kannur, Kerala, India.
[2]Professor, Department of General Surgery, Government Medical College, Kannur, Kerala, India.
[3]Senior resident, Department of General Surgery, Government Medical College, Kannur, Kerala, India.
[4]Senior resident, Department of General Surgery, Government Medical College, Kannur, Kerala, India.

Received *: 08/05/2026*
Received in revised form *: 28/07/2026*
Accepted *: 13/07/2026*

Corresponding Author:
Dr. Ayisha Farha S,
Senior resident, Department of General surgery, Government Medical College, Kannur, Kerala, India.
Email: ayishafarha1996@gmail.com

DOI: 10.70034/ijmedph.2026.3.152

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 943-946

ABSTRACT

Background: Chest radiography (CXR) is the initial imaging modality for evaluating patients with chest trauma because of its widespread availability and rapid acquisition. However, compared with chest computed tomography (CT), the reference standard, its diagnostic accuracy for detecting rib fractures and associated thoracic injuries is limited. This study compared the diagnostic efficacy of chest radiography and chest CT for detecting rib fractures in patients presenting with chest trauma and to evaluate their performance in identifying hemothorax, pneumothorax, pulmonary contusions, clavicle fractures, sternal fractures, and scapular fractures.

Materials and Methods: This prospective observational study included 100 hemodynamically stable adult patients with blunt or penetrating chest trauma at a tertiary care hospital between 2023 and 2024. All patients underwent chest radiography and chest CT, with CT serving as the reference standard. The diagnostic performance of chest radiography was assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for each injury.

Results: The majority of patients were aged 18–40 years (47%), and 61% were male. Chest wall tenderness was the most common clinical finding (85%). For rib fractures, chest radiography demonstrated a sensitivity of 34%, specificity of 94%, PPV of 85%, and NPV of 59%. Sensitivities for hemothorax, pneumothorax, pulmonary contusions, and scapular fractures were 44%, 48%, 34%, and 40%, respectively, with specificity ranging from 92% to 98%. Sensitivities were higher for clavicle fractures (84%) and sternal fractures (70%), with 98% specificity for both injuries.

Conclusion: Chest radiography demonstrated high specificity but limited sensitivity for detecting rib fractures and several associated thoracic injuries compared with chest CT. These findings show that chest radiography may miss clinically important injuries, while chest CT remains the preferred imaging modality for comprehensive evaluation of chest trauma, particularly when clinical suspicion persists despite negative chest radiographic findings.

Keywords: Chest trauma, Chest radiography, Computed tomography, Rib fractures, Diagnostic accuracy.

INTRODUCTION

Chest trauma is a major cause of trauma-related morbidity and mortality worldwide, accounting for approximately 15% of traumatic injuries and contributing to mortality rates of up to 25%.[1]

Blunt chest trauma constitutes nearly two-thirds of patients with multiple injuries, and severe thoracic trauma is associated with concomitant injuries in 70–90% of cases.[2]Common thoracic injuries include rib fractures, pneumothorax, hemothorax, and pulmonary contusions, with pulmonary contusion being one of the principal contributors to increased morbidity and mortality following blunt chest trauma.[3] Early identification is essential for timely intervention and improved clinical outcomes.

Chest radiography (CXR) remains the first-line imaging modality in emergency evaluation of chest trauma because it is rapid, inexpensive, and widely available. However, important thoracic injuries such as pulmonary contusions, pneumothorax, and hemothorax may be missed during the initial assessment using conventional radiography.[4]

Chest computed tomography (CT) has demonstrated superior diagnostic accuracy for detecting both skeletal and intrathoracic injuries and is considered the imaging reference standard in patients with thoracic trauma.[5]Despite its advantages, CT is associated with substantially higher radiation exposure than plain radiography and may not be routinely performed in patients with isolated or apparently minor chest injuries because of cost and resource constraints.[6]

Rib fractures are the most common skeletal injuries following blunt chest trauma and are associated with significant complications, particularly in elderly patients and those with multiple comorbidities.[5,6] Previous studies have reported that chest radiography has limited sensitivity for detecting rib fractures, especially fractures involving the lower ribs, potentially resulting in delayed diagnosis of associated injuries.[7] Although several international studies have compared the diagnostic performance of CXR and CT, prospective data from Indian healthcare settings remain limited.

Therefore, this prospective observational study was done to compare the diagnostic efficacy of chest radiography with chest CT for detecting rib fractures in adult patients with chest trauma. The primary objective was to evaluate the diagnostic performance of CXR for rib fractures, using CT as the reference standard. Secondary objectives were to compare the diagnostic efficacy of CXR and CT in detecting hemothorax, pneumothorax, pulmonary contusions, clavicle fractures, sternal fractures, and scapular fractures.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery, Government Medical College Kannur, India, over a one-year period from 2023 to 2024. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment. Adult patients (≥18 years) presenting to the emergency department with blunt or penetrating chest trauma within 12 hours of injury were screened for eligibility. Consecutive sampling was employed, and 100 patients fulfilling the study criteria were included. Patients were eligible if they were hemodynamically stable at presentation (systolic blood pressure ≥90 mmHg with no evidence of circulatory shock) and underwent both chest radiography and chest computed tomography (CT) as part of routine diagnostic evaluation. Patients presenting more than 12 hours after trauma, those with previous rib fractures or significant thoracic trauma, rib metastases, iatrogenic chest injuries, pregnancy, or refusal to provide informed consent were excluded.

All enrolled patients initially underwent a standard posteroanterior or anteroposterior chest radiograph according to trauma protocols. Chest radiographs were independently interpreted by an experienced consultant surgeon who was unaware of the CT findings at the time of reporting, and the presence of rib, clavicle, sternal, and scapular fractures, pneumothorax, hemothorax, and pulmonary contusions was documented using a predefined proforma. Subsequently, all patients underwent multidetector chest CT with a 16-slice scanner (Toshiba Alexion, Toshiba Medical Systems, Japan), which served as the diagnostic reference standard. CT images were reviewed by experienced radiologists, and all thoracic skeletal and intrathoracic injuries were systematically recorded. The primary objective was to assess the diagnostic performance of chest radiography for detecting rib fractures, compared with CT. The secondary objective was to compare the diagnostic performance of chest radiography and CT in identifying pneumothorax, hemothorax, pulmonary contusions, clavicular fractures, sternal fractures, and scapular fractures. Demographic characteristics, mechanism of injury, imaging findings, and associated thoracic injuries were prospectively collected using a structured data collection form.

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median (interquartile range), depending on data distribution, whereas categorical variables were presented as frequencies and percentages. Chest CT was considered the reference standard for comparisons with chest radiography. Two-by-two contingency tables were constructed to determine the sensitivity, specificity, positive predictive value, negative predictive value, overall diagnostic accuracy, and likelihood ratios of chest radiography for each thoracic injury. True-positive, true-negative, false-positive, and false-negative findings were defined

based on concordance or discordance between chest radiography and CT findings. Agreement between chest radiography and CT was assessed using Cohen's kappa statistic where appropriate. A two-tailed P value of <0.05 was considered statistically significant.

RESULTS

A total of 100 patients with chest trauma were included in the study. Clinically, chest wall tenderness was the most frequent finding (85%), followed by ecchymosis (61%), lacerations/abrasions (53%), subcutaneous emphysema (39%), abnormal pulmonary sounds (25%), and sternoclavicular joint dislocation (14%). The majority of participants were aged 18–40 years (47%), followed by 41–60 years (37%), while 14% were older than 60 years. There were 61 (61%) males and 39 (39%) females. Diabetes mellitus was the most common comorbidity, present in 24% of patients, followed by hypertension (21%), coronary artery disease (8%), chronic obstructive pulmonary disease (7%), and cerebrovascular accident (4%).

For the detection of rib fractures, chest radiography showed low sensitivity (34%) and high specificity (94%), with PPV and NPV of 85% and 59%, respectively, when compared with chest CT. For hemothorax, chest radiography also showed low sensitivity and high specificity, with values of 44% and 92%, respectively, and PPV and NPV of 84.6% and 62.2%. In detecting pneumothorax, chest radiography showed 48% sensitivity and 96% specificity, with a PPV of 92.3% and NPV of 64.9%. For pulmonary contusions, the corresponding values were 34% sensitivity, 98% specificity, 94% PPV, and 60% NPV.

For clavicle fractures, chest radiography demonstrated a sensitivity of 84%, specificity of 98%, PPV of 98%, and NPV of 86%. In detecting sternal fractures, the sensitivity was 70%, the specificity was 98%, the PPV was 97%, and the NPV was 77%. For scapular fractures, chest radiography showed a sensitivity of 40%, specificity of 96%, PPV of 91%, and NPV of 62% compared with chest CT.

Table1: Baseline Demographic Characteristics (N=50)

Characteristic	Value
Age (years) - Mean ± SD	45.9 ± 13.8
Age Range	17–70
Age Median [IQR]	45 [35–56]
Sex, n (%) - Female | Male	31 (62%) | 19 (38%)
Age Distribution: <30 | 30-45 | 45-60 | >60	4 (8%) | 17 (34%) | 20 (40%) | 9 (18%)

DISCUSSION

Chest trauma remains a significant contributor to trauma-related morbidity and mortality, accounting for approximately 10–15% of all traumatic injuries and up to 25% of trauma-related deaths.[8] Rib fractures are the most common skeletal injury following blunt chest trauma and are frequently associated with intrathoracic injuries, particularly in elderly patients.[2,3]Early identification of rib fractures and associated thoracic injuries is essential for appropriate management, prevention of respiratory complications, and reduction of morbidity.[4]Although chest radiography (CXR) remains the initial imaging modality in most emergency departments because of its rapid availability and low cost, it has inherent limitations in detecting several thoracic injuries.[2,9,10] In this study, CXR showed high specificity but variable and often limited sensitivity compared with chest computed tomography (CT), especially for rib fractures and intrathoracic injuries.

The primary finding of this study was the low sensitivity of CXR in detecting rib fractures (34%), despite a high specificity of 94%. These findings are consistent with previous literature demonstrating the limited sensitivity of conventional radiography for rib fractures, particularly nondisplaced fractures and those involving the posterior or lower ribs.[11]Similar observations have been reported in several studies evaluating blunt chest trauma, with diagnostic performance varying according to patient characteristics and imaging techniques.[11-13]The limited sensitivity of CXR can be explained by the thin curved anatomy of the ribs, overlapping osseous structures, and the two-dimensional nature of radiography, all of which may obscure subtle fractures.[14]Nevertheless, the high specificity observed in our study indicates that radiographically identified rib fractures are highly reliable findings. These results support previous recommendations that CT should be considered when clinical suspicion remains high despite negative radiographic findings.[15-17]

Chest radiography also demonstrated limited sensitivity for detecting hemothorax (44%), pneumothorax (48%), pulmonary contusions (34%), and scapular fractures (40%), whereas specificity exceeded 90% for all these injuries. These findings closely resemble those reported by Kumari and Balamurugan et al., who documented sensitivities of approximately 40–50% for pneumothorax and hemothorax using CXR.[12,18] Pulmonary contusions are frequently occult on initial radiographs because alveolar haemorrhage and edema may not become radiographically apparent during the early post-traumatic period, while scapular fractures are often obscured by overlapping ribs and soft tissues.[80] In

contrast, CXR demonstrated comparatively higher sensitivity for clavicle fractures (84%) and sternal fractures (70%), likely reflecting their superficial anatomical location and better radiographic visualization.[17-20] Overall, our findings reaffirm the superior diagnostic capability of CT for comprehensive assessment of both osseous and intrathoracic injuries following chest trauma.

The present study has several important clinical implications. Chest radiography remains an appropriate initial imaging investigation in hemodynamically stable patients because of its accessibility, rapid acquisition, and high specificity. However, clinicians should recognize its limited sensitivity for detecting rib fractures and several associated thoracic injuries. Chest CT should be strongly considered in patients with persistent clinical suspicion, multiple rib tenderness, significant mechanism of injury, abnormal clinical examination, or inconclusive radiographic findings to avoid missed injuries and delayed management. Standardized imaging protocols and continued training in trauma imaging interpretation may further improve diagnostic accuracy.

CONCLUSION

Chest radiography has high specificity but limited sensitivity for rib fractures and several associated thoracic injuries compared with chest computed tomography. Chest radiography remains an appropriate initial imaging modality in hemodynamically stable patients, but chest CT provides superior diagnostic accuracy for rib fractures, pulmonary contusions, pneumothorax, hemothorax, and scapular fractures. Consider chest CT when clinical suspicion persists despite negative or inconclusive chest radiographic findings.

REFERENCES

1. Calderon G, Perez D, Fortman J, Kea B, Rodriguez RM. Provider perceptions concerning use of chest x-ray studies in adult blunt trauma assessments. The Journal of emergency medicine. 2012 Oct 1;43(4):568-74.
2. Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. Journal of Trauma and Acute Care Surgery. 1994 Dec 1;37(6):975-9.
3. Kara M, Dikmen E, Erdal HH, Simsir I, Kara SA. Disclosure of unnoticed rib fractures with the use of ultrasonography in minor blunt chest trauma. European journal of cardio-thoracic surgery. 2003 Oct 1;24(4):608-13.
4. Weyant MJ, Fullerton DA. Blunt thoracic trauma. InSeminars in thoracic and cardiovascular surgery 2008 Mar 1 (Vol. 20, No. 1, pp. 26-30). WB Saunders.
5. Exadaktylos AK, Sclabas G, Schmid SW, Schaller B, Zimmermann H. Do we really need routine computed tomographic scanning in the primary evaluation of blunt chest trauma in patients with “normal” chest radiograph?.Journal of Trauma and Acute Care Surgery. 2001 Dec 1;51(6):1173-6.
6. Gavelli G, Canini R, Bertaccini P, Battista G, Bnà C, Fattori R. Traumatic injuries: imaging of thoracic injuries. European radiology. 2002 Jun;12(6):1273-94.
7. Brink M, Deunk J, Dekker HM, Edwards MJ, Kool DR, van Vugt AB, van Kuijk C, Blickman JG. Criteria for the selective use of chest computed tomography in blunt trauma patients. European radiology. 2010 Apr;20(4):818-28.
8. Sirmali M, Türüt H, Topçu S, Gülhan E, Yazici Ü, Kaya S, Taştepe I. A comprehensive analysis of traumatic rib fractures: morbidity, mortality and management. European Journal of Cardio-Thoracic Surgery. 2003 Jul 1;24(1):133-8.
9. Carpenter AJ. Diagnostic techniques in thoracic trauma. InSeminars in thoracic and cardiovascular surgery 2008 Mar 1 (Vol. 20, No. 1, pp. 2-5). WB Saunders.
10. Caputo G, Meda S, Piccioni A, Saviano A, Ojetti V, Savioli G, Piccini GB, Ferrari C, Voza A, Pellegrini L, Ottaviani M. Thoracic trauma: current approach in emergency medicine. Clinics and Practice. 2024 Sep 10;14(5):1869-85.
11. Alzahrani NM, Jeanes A, Paddock M, Shuweihdi F, Offiah AC. The diagnostic performance of chest computed tomography in the detection of rib fractures in children investigated for suspected physical abuse: a systematic review and meta-analysis. European radiology. 2021 Sep;31(9):7088-97.
12. Kumari P. Comparative analysis of efficacy of chest X-ray and chest CT scan in patients with chest trauma: a retrospective study. Int J Contemp Med SurgRadiol. 2017;2(2):62-4.
13. Yazkan R, Ergene G, Tulay CM, Güneş S, Han S. Comparison of Chest Computed Tomography and Chest X-Ray in the Diagnosis of Rib Fractures in Patients with Blunt Chest Trauma. Journal of Academic Emergency Medicine/AkademikAcil Tip OlguSunumlariDergisi. 2012 Jul 1;11(3).
14. Li X, Thrall JH, Digumarthy SR, Kalra MK, Pandharipande PV, Zhang B, Nitiwarangkul C, Singh R, Khera RD, Li Q. Deep learning-enabled system for rapid pneumothorax screening on chest CT. European journal of radiology. 2019 Nov 1;120:108692.
15. Traub M, Stevenson M, McEvoy S, Briggs G, Lo SK, Leibman S, Joseph T. The use of chest computed tomography versus chest X-ray in patients with major blunt trauma. Injury. 2007 Jan 1;38(1):43-7.
16. Wootton-Gorges SL, Stein-Wexler R, Walton JW, Rosas AJ, Coulter KP, Rogers KK. Comparison of computed tomography and chest radiography in the detection of rib fractures in abused infants. Child abuse & neglect. 2008 Jun 1;32(6):659-63.
17. Marts B, Durham R, Shapiro M, Mazuski JE, Zuckerman D, Sundaram M, Luchtefeld WB. Computed tomography in the diagnosis of blunt thoracic injury. The American journal of surgery. 1994 Jan 1;168(6):688-92.
18. P. P. Balamurugan1, D. Jayaraja2, S. Kanaga Durga3 Comparative analysis of diagnostic efficacy of chest X-ray and chest CT scan in patients with blunt chest trauma at a tertiary hospital. J Cardiovascular Res. 2023
19. Lin ZW, Dai WL, Lai QQ, Wu H. Deep learning-based computed tomography applied to the diagnosis of rib fractures. Journal of Radiation Research and Applied Sciences. 2023 Jun 1;16(2):100558.
20. Collins CE, Giammanco PA, Trivedi SM, Sarsour RO, Kricfalusi M, Elsissy JG. Diagnostic accuracy of artificial intelligence for detection of rib fracture on X-ray and computed tomography imaging: a systematic review. Journal of imaging informatics in medicine. 2025 Jan 27:1-0.