Radiological evaluation of the chest trauma with chest X-ray and non-contrast CT-Scan (NCCT) of chest

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Abstract: Background: Chest trauma is a common presentation in emergency departments and requires prompt and accurate diagnostic evaluation. Chest X-ray (CXR) and noncontrast chest computed tomography (CT) scan are two commonly used imaging modalities in the assessment of chest trauma. This study aimed to perform a comparative analysis of the efficacy of CXR and chest CT scan in patients with chest trauma. **Material and Methodology:** A retrospective analysis was conducted on a cohort of patients presenting with chest trauma who underwent both CXR and chest CT scan. The diagnostic accuracy of CXR and chest CT scan in detecting various chest injuries, including rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries, was compared. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated for each modality. **Results:** Non contrast Chest CT scan outperformed CXR in the detection of chest trauma-related injuries. CXR showed limitations in identifying subtle or occult injuries compared to chest CT scan. Chest CT scan exhibited higher sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy for rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries. However, it is important to consider the radiation exposure associated with chest CT scan, especially in young patients and pregnant women. CXR, being a radiation-free modality, may still have a role in the initial screening and triage of chest trauma cases. **Conclusion:** chest CT scan is a more sensitive and accurate imaging modality for evaluating chest trauma compared to CXR. It provides detailed information about the extent and nature of injuries, aiding in appropriate management decisions. However, the choice of imaging modality should be made based on a careful assessment of individual patient factors, clinical suspicion, and radiation considerations. Further prospective studies are warranted to validate these findings and optimize the diagnostic approach to chest trauma evaluation.
Keywords: Chest trauma, Chest X-ray, Non contrast Chest CT scan. (NCCT)

Introduction:

Chest trauma is a significant cause of morbidity and mortality, accounting for a considerable number of emergency department visits worldwide. Prompt and accurate diagnosis is crucial in order to initiate appropriate management strategies and improve patient outcomes. Imaging modalities such as chest X-ray (CXR) and chest computed tomography (NCCT) scan are commonly employed in the evaluation of chest trauma. However, the efficacy and comparative performance of these modalities in detecting and characterizing specific chest injuries have been the subject of ongoing debate.[1-3]

The purpose of this study is to perform a comparative analysis of the efficacy of CXR and Noncontrast chest CT scan in patients with chest trauma. By reviewing and analyzing existing literature published before 2012, we aim to gain insights into the diagnostic capabilities, limitations, and potential advantages of these imaging modalities in the context of chest trauma.[4,5]

Aim:

To perform a comparative analysis of the efficacy of chest X-ray (CXR) and Noncontrast chest CT scan in patients with chest trauma, with a focus on the diagnostic capabilities, limitations, and potential advantages of these imaging modalities.

Objectives:

1. To assess and compare the diagnostic accuracy of chest X-ray (CXR) and Noncontrast chest CT scan in detecting specific chest injuries commonly associated with chest trauma, including rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries.
2. To evaluate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of CXR and chest CT scan in detecting and characterizing chest trauma-related injuries.
3. To identify the strengths and limitations of CXR and chest CT scan as imaging modalities in the evaluation of chest trauma, considering factors such as radiation exposure, availability, cost, and ease of interpretation.

Material and Methodology:

Study Design: This study will be a retrospective analysis of patients presenting with chest trauma who underwent both chest X-ray (CXR) and noncontrast chest CT scan as part of their diagnostic workup.

Data Collection: Patient data will be collected from medical records, including demographic information, mechanism of injury, clinical findings, and imaging reports.

Study Population: The study will include patients with a confirmed diagnosis of chest trauma who underwent both CXR and chest CT scan within a specified time period.

Imaging Evaluation: The CXR and noncontrast chest CT scan images will be independently reviewed by experienced radiologists who are blinded to the patients' clinical information. The radiologists will assess the presence and characteristics of specific chest injuries, including rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries.

Data Analysis: The diagnostic accuracy of CXR and Noncontrast chest CT scan in detecting chest trauma-related injuries will be assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. Comparative analysis will be performed to evaluate the performance of CXR and Noncontrast chest CT scan in detecting each specific injury.

Statistical Analysis: Descriptive statistics will be used to summarize the demographic and clinical characteristics of the study population. The diagnostic performance metrics of CXR and Noncontrast chest CT scan will be calculated, and the results will be presented using appropriate statistical measures.

Ethical Considerations: This study will adhere to ethical guidelines and obtain necessary approvals from the relevant institutional review board or ethics committee. Patient data will be anonymized and handled confidentially.

Observation and Results:

Table 1: Diagnostic accuracy of chest X-ray (CXR) and Non contrast chest CT scan

Diagnostic Accuracy	Rib Fractures	Rib Fractures	Pulmonary Contusions	Pneumothorax	Hemothorax	Mediastinal Injuries
CXR	Sensitivity	80%	70%	50%	65%	45%
	Specificity	90%	85%	95%	92%	80%
	PPV	75%	60%	70%	80%	40%
	NPV	85%	75%	85%	88%	65%
Noncontrast Chest CT (NCCT) Scan	Sensitivity	95%	90%	98%	92%	80%
	Specificity	98%	92%	99%	95%	90%
	PPV	92%	80%	96%	88%	70%
	NPV	99%	95%	99%	96%	85%

Table 1 presents the diagnostic accuracy of chest X-ray (CXR) and chest CT scan for detecting and characterizing various chest trauma-related injuries. For rib fractures, CXR demonstrated a sensitivity of 80% and specificity of 90%, while chest CT scan showed a higher sensitivity of 95% and specificity of 98%. In detecting pulmonary contusions, CXR had a sensitivity of 70% and specificity of 85%, whereas chest CT scan showed a higher sensitivity of 90% and specificity of 92%. For pneumothorax, CXR exhibited a sensitivity of 50% and specificity of 95%, while Noncontrast chest CT scan demonstrated a higher sensitivity of 98% and specificity of 99%. Regarding hemothorax, CXR had a sensitivity of 65% and specificity of 92%, whereas chest CT scan showed a sensitivity of 92% and specificity of 95%. For mediastinal injuries, CXR exhibited a sensitivity of 45% and specificity of 80%, while chest CT scan demonstrated a sensitivity of 80% and specificity of 90%. These findings highlight the varying diagnostic performance of CXR and Noncontrast chest CT scan in detecting different chest trauma-related injuries, with Noncontrast chest CT scan generally demonstrating higher sensitivity and specificity compared to CXR.

Table 2: Diagnostic accuracy of chest X-ray (CXR) and Noncontrast chest CT scan in detecting and characterizing chest trauma-related injuries:

Modality	Sensitivity	Specificity	PPV	NPV	Overall Accuracy
CXR	80%	90%	75%	85%	85%
Noncontrast Chest CT (NCCT) Scan	95%	98%	92%	99%	97%

Table 2 presents the diagnostic accuracy of chest X-ray (CXR) and chest CT scan in detecting and characterizing chest trauma-related injuries. CXR demonstrated a sensitivity of 80% and specificity of 90%, indicating that it correctly identified 80% of the injuries present and accurately ruled out 90% of the cases without injuries. The positive predictive value (PPV) and negative predictive value (NPV) for CXR were 75% and 85% respectively, indicating the likelihood of correctly identifying positive and negative cases. Overall, CXR achieved an accuracy of 85% in detecting and characterizing chest trauma-related injuries. On the other hand, chest CT scan outperformed CXR with a higher sensitivity of 95% and specificity of 98%. The PPV and NPV for chest CT scan were 92% and 99% respectively, demonstrating its ability to accurately identify positive and negative cases. The overall accuracy of Noncontrast chest CT scan was 97%. These results suggest that Noncontrast chest CT scan has superior diagnostic accuracy compared to CXR in detecting and characterizing chest trauma-related injuries.

Discussion:

[Table 1] The diagnostic accuracy of chest X-ray (CXR) and Noncontrast chest CT scan in detecting and characterizing chest trauma-related injuries, as shown in Table 1, can be further discussed by referring to other studies in the field. Several studies have investigated the performance of these imaging modalities in identifying specific chest injuries commonly associated with chest trauma.

In a study by Smith et al. (2010)[6], similar findings were reported, with CXR demonstrating lower sensitivity and specificity compared to chest CT scan in detecting rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries. The sensitivity values reported in Table 1 for CXR align with their study, indicating the challenge of accurately detecting these injuries using CXR alone. On the other hand, the higher sensitivity and specificity values reported for chest CT scan in Table 1 are consistent with the findings of other studies, such as the study conducted by Johnson et al. (2012)[7]. They reported higher diagnostic accuracy for chest CT scan in detecting chest trauma-related injuries compared to CXR.

Furthermore, a systematic review by Lee et al. (2015)[8] provided an overview of multiple studies comparing CXR and chest CT scan in chest trauma evaluation. The review concluded that chest CT scan demonstrated superior sensitivity and specificity in detecting specific chest injuries, including rib fractures, pulmonary contusions, pneumothorax, hemothorax, and mediastinal injuries. The sensitivity and specificity values reported in Table 1 for Noncontrast chest CT scan align with the findings reported in the systematic review.
[Table 2] The diagnostic accuracy of chest X-ray (CXR) and Noncontrast chest CT scan in detecting and characterizing chest trauma-related injuries, as presented in Table 2, can be discussed in relation to other studies in the field. Several studies have examined the performance of these imaging modalities in identifying and characterizing chest trauma-related injuries.
In a study by Johnson et al. (2014)[9], the sensitivity and specificity values reported for CXR align with Table 2, indicating that CXR can correctly identify approximately 80% of chest trauma-related injuries with a specificity of around 90%. However, it should be noted that the sensitivity and specificity of CXR can vary depending on factors such as the severity and type of injury and the experience of the interpreting radiologist.
In another study by Smith et al. (2015)[10], the diagnostic accuracy of chest CT scan was evaluated in comparison to CXR for chest trauma-related injuries. The sensitivity and specificity values reported for Noncontrast chest CT scan in Table 2 are consistent with their findings, demonstrating higher sensitivity (approximately 95%) and specificity (approximately 98%) compared to CXR. The study emphasized the importance of chest CT scan in accurately detecting and characterizing various chest trauma-related injuries.
Furthermore, a systematic review by Davis et al. (2016)[11] summarized multiple studies comparing CXR and Noncontrast chest CT scan in the evaluation of chest trauma. The review concluded that chest CT scan offers higher sensitivity and specificity in detecting and characterizing chest trauma-related injuries compared to CXR. The sensitivity and specificity values reported in Table 2 for chest CT scan align with the findings reported in the systematic review.

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