



A COMPARATIVE EVALUATION OF X-RAY AND COMPUTED TOMOGRAPHY SCAN IN BLUNT THORACIC TRAUMA

General Surgery

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ABSTRACT

Blunt chest trauma results in significant mortality and morbidity. Delay in diagnosis and treatment results in a worse outcome. Our study aims to compare conventional chest X-ray (CXR) and thoracic computed tomography (CT) in terms of accuracy in detecting pathologies in such patients. This institution-based, observational descriptive study included patients with blunt chest trauma. Patients were evaluated with both CT thorax and CXR to detect intrathoracic injuries such as pneumothorax, hemothorax and lung contusions. Appropriate treatment protocol was followed which was modified as per need.

A total of 150 patients were included in the study. Males outnumbered females. Mean age of presentation was 42.9 years with RTA, fall and assault being major modes of injury.

CT was significantly more accurate in detecting pneumothorax, hemothorax, pulmonary contusions and atelectasis as compared to CXR. Bony injuries and malpositioned chest tubes were also more easily diagnosed on CT.

KEYWORDS

Chest trauma, X-Ray, CT scan, Chest drain.

INTRODUCTION

Trauma remains one of the main causes of mortality worldwide which exceeds losses from heart disease, cancer, and stroke combined. In India too, trauma is a major problem due to a very high incidence of vehicular accidents (6% of global vehicular accidents), other accidental injuries, crime and violence.

Blunt chest injuries accounts almost 20-25% of all trauma deaths. Chest injuries are major contributing factors for developing multi-organ failure in polytrauma. Appropriate management of the injuries and complications can decrease the mortality and morbidity of the patients. Effective trauma management requires minimizing time to definitive treatment of life-threatening conditions. Mortality and morbidity depend on several factors, among these mode of injury and energy transfer are important. CT scan is accurate in visualizing occult intrathoracic injuries such as pneumothorax, hemothorax and lung contusions. Use of CT scan may help to diagnose thoracic injuries not evident on a chest X-ray. This study aims at comparing the efficacy of thoracic CT scan with that of a chest X-ray in diagnosing chest injuries.

With recent trauma care centers in India and a multidisciplinary approach to handle these patients, it is important to diagnose and treat injuries quickly and accurately, the first step towards effective treatment.

Aims

1. To identify the utility of thoracic computed tomography (CT) in blunt chest trauma.
2. To evaluate superiority of thoracic CT scan to routine chest X-ray in diagnostic work up of blunt chest trauma.

Review of Literature

The Edwin Smith Papyrus, written at the time of the Great Pyramid, circa 3000 BC, gave explicit instructions regarding management of a wide variety of chest injuries. These included wounds in chest with or without ribs fractures [1]. The Advanced Trauma Life Support (ATLS) approach [2] to management of major trauma stresses the simultaneous diagnosis and management of conditions.

Radiology plays a central role in the management of chest trauma with rapid interpretation of the supine and PA CXR. CT scan is much more sensitive for pneumothoraces, fluid collections and infiltrates. CT scan discovers unsuspected injuries in about two-thirds of major trauma patients who have evidence of chest injury on their initial CXR. More importantly, when the CXR was abnormal the new CT findings resulted in significant management changes 20% of the time. In patients with a high-energy mechanism of injury but a normal CXR, CT found new pathologies in significant number of patients which ultimately led to change in treatment plan of patients [3]. CT scan led to

changes in initial management and it ranges from 20% to 60% in different studies [4, 5]. CT scan of the thoracic spine is now the gold standard for identifying the extent of vertebral body injuries as well as the degree of involvement of the posterior elements [6, 7]. A CT scan may also benefit by selective management based upon the risk of injury to specific organs [8].

The presence of greater than three rib fractures on CXR in adults may be associated with solid visceral trauma and increased morbidity with mortality [9]. Rib fractures are less common in children due to the resilience of their bony chest wall. Thus, children may suffer major intrathoracic injury without rib fractures and the presence of any rib fracture in a child should be considered a marker for severe injury [10].

The need for ventilator support, increased ICU days and overall length of stay, pneumonia and mortality are clearly higher in elderly rib fracture patients than in younger patients [11]. Complications are more seen in the subset of elderly patients with pre-existing cardiopulmonary diseases [12]. Mortality of patients with flail chest is found to increase with age [13].

Association of pulmonary contusion on CXR with flail chest more than doubles the mortality of either condition seen independently [14] and associated flail chest makes patients with pulmonary contusion far more likely to require mechanical ventilation [15].

The rate of missed pneumothoraces on the supine AP CXR has been estimated at 20-35%. The reported incidence of these occult pneumothoraces is between 2-8% of all blunt trauma victims [16].

Although tube thoracostomy insertion can be a life-saving procedure and is often relatively straightforward, it has complication rates of 25% [17]. Important factors in determining complication rates included the urgency of placement, the location of tube placement, and the level of operator experience [18]. Utilizing CT scanning, diagnosis of chest tube malposition ranges from 26-30.3% [19, 20].

MATERIALS AND METHODS

It is an observational descriptive study at a tertiary care hospital over a period of 18 months. Patients admitted with principal diagnosis of blunt chest trauma were included in the sample. Patients with concurrent penetrating chest trauma, major central nervous system, cardiac, diaphragmatic, orthopedic trauma and intra-abdominal injury were excluded.

On admission, they were assessed regarding time, mechanism and severity of injury. Patients suspected or diagnosed of having blunt trauma chest were subjected to available required investigations like chest X-ray, CT scan thorax and laboratory tests.

Appropriate treatment (resuscitation followed by operative intervention) was done based on the standard guidelines including conservative treatment and surgical procedures like chest drain insertion as indicated.

Data was collected regarding efficacy of both CXR and CT scan regarding detection of bony injury (rib, clavicle and scapular fractures), surgical emphysema, hemothorax, pneumothorax, lung contusions, atelectasis etc. The position of chest drain was also assessed by post procedural CXR and CT scans before removal and appropriate corrective measures taken.

The collected data were analyzed using standard statistical methods with SPSS v25 statistical software including frequency analysis and descriptive statistics.

RESULTS AND ANALYSIS

A total of 150 patients (M:F=89:61) were included. The mechanisms of blunt trauma chest were road traffic accidents (M:F=43:30), fall from height (M:F=38:23) and physical assault (M:F=8:8).

All patients had rib, clavicular or scapular fractures (100%) with 37 patients having subcutaneous emphysema (24.66%).

Pneumothorax was detected in 36.67% (n=55) lungs. Right sided pneumothorax was 18% (n=27) on CT of which CXR could detect only 10. This difference in detection was statistically significant (p=0.037). The incidence of left sided pneumothorax was 18.67% (n=28) on CT of which CXR could detect only 6. This difference too was statistically significant (p=0.03).

The incidence of hemothorax was 64.67% (n=97). Right sided hemothorax on CT was 39.33% (n=59) of which CXR could detect only 34 (57.6%) This difference was statistically significant (p=0.028). The incidence of left side hemothorax was 18.67% (n=38) on CT of which CXR could detect only 17 (44.7%). This difference too was statistically significant (p=0.022). So CT was significantly superior to CXR in detecting both pneumothorax and hemothorax in these patients.

The percentage of lung contusions was 36% (n=54). Right sided contusion was found in 22% (n=33) on CT of which only 45.45% (n=15) were found on CXR (p=0.032), which is significantly lesser. Left sided contusion on CT was present in 14% (n=21) of which CXR showed only 33.33% (n=7, p=0.039) which was significantly less.

Incidence of lungs with atelectasis was 47.33% (n=71). Right lung atelectasis as detected on CT in 30% (n=45) of which CXR was positive in only 26.67% (n=12, p=0.41). Left lung atelectasis on CT was 17.33% (n=26). CXR showed only 11.5% (n=3, p=0.023) of these, a significant difference.

A malpositioned chest drain was found in 28.67% (n=43). CT could detect 18.67% (n=28) such incidents on the right side, of which CXR showed only 14.28% (n=4, p=0.031, significantly less). A similar difference was present on the left side where CT found 10% (n=15) malpositioned tubes and CXR showed only 26.67% (n=4) of these.

Among bony injuries (fractures of ribs, clavicle and scapula), CT and CXR could detect injuries equally in 36 patients whereas CT could detect more injuries than CXR in 114 patients.

Table 1: Differences in accuracy of CXR and CT and their statistical significance

	Pneumothorax		Hemothorax		Contusion		Atelectasis		Malposition of Chest Drain	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Detected on CXR	10	6	34	17	18	7	12	3	4	4
Detected on CT	27	28	59	38	33	21	45	23	28	15
Kappa value	0.565	0.244	0.592	0.505	0.712	0.540	0.395	0.571	0.612	0.267
P value	0.037	0.030	0.028	0.022	0.032	0.039	0.041	0.023	0.031	0.028

p < 0.05 is significant

DISCUSSION

Accidents and trauma are leading causes of mortality worldwide. Rising population, urbanization, industrialization and a drastic rise in vehicular transport have contributed to an annual increase in road traffic accidents by three percent. There is a growing population of traumatized patients requiring highly sophisticated and specialized care in India. Chest injuries are very common in polytrauma patients and are responsible for 20-25% of all trauma deaths.

This study was done in a tertiary hospital in the department of surgery on 150 patients with blunt chest trauma. The mean age of patients was 42.94yrs (range 16-70 years). Incidence of blunt chest trauma was more in male (59.33%) than female (40.66%). Modes of injury were road traffic accidents (RTA), fall and physical assault. RTA accounted for 48.66%, followed by fall (40.66%) and physical assault (10.66%). So RTA is more common mode of injury than fall and physical assault in our study. A majority of patients (97.33%, n=146) presented with pain while 42 patients (28%) presented with respiratory distress. Pain is the most common presenting symptom in patients of blunt chest trauma.

Subcutaneous emphysema is a complication secondary to underlying rib fractures and injury to the lung or bronchi. In our study subcutaneous emphysema was present in 24.66% of patients which was in agreement with Serifa Tuba Liman [21]. Presence of subcutaneous emphysema suggests underlying rib fractures, but its absence does not exclude rib fracture.

CT scan identified 55 cases of pneumothorax out of which CXR only detected 16 cases. This finding was in agreement with Trupka and Waydhas [22] where CT scan detected 27 cases of pneumothorax not detected by CXR.

There were 46 missed hemothoraces detected by CT scan but not by CXR due to superior detection quality of CT scan. Other observers [22] too found 21 missed cases (out of 103 patients studied) of hemothorax missed on CXR but detected by CT scan. So CT scan can diagnose more cases of pneumothorax and hemothorax than CXR.

In this study CT scan detected 36% (n=54) of pulmonary contusions out of which CXR identified only 16.66% (n=25) cases. So CXR missed 29 such findings. This was in agreement with the various other studies [22, 23].

Similarly in our study CT scan detected more cases (47.33%) of lung atelectasis than CXR (10%). So CT was significantly more accurate in detecting the same.

A malpositioned chest tube was found on CT in 43 patients (28.66%) which shows agreement with Francis et al [24]. CXR detected only 8 (5.33%) cases of malpositioned chest tube, missing 35 cases (23.33%). Repositioning of chest tube was done in these 35 patients. So CT scan led to change in treatment management proving CT scan to be better than CXR.

CT scan showed better accuracy than CXR in detection of bony injuries (fracture of ribs, clavicle and scapula) in our study. Findings of bony injury on CXR and CT scan concurred in 36 patients, but in 114 patients CT scan was better in revealing more such injuries.

Table 2: Comparison of present study to other similar ones in terms of findings

	Present Study	Serifa Tuba Liman et al21	Trupka et al22	Keel et al23	Francis et al24
Subcutaneous emphysema	37/150 (24.67%)	383/1490 (25.7%)	-	-	-
Missed pneumothorax	39/150 (26%)	-	27/103 (26.21%)	-	-
Missed hemothorax	46/150 (30.67%)	-	21/103 (20.38%)	-	-
Percentage of contusions (CXR:CT)	16.67:36	-	-	16.3:31.3	-
Malpositioned drain (% detected on CT)	28.67%	-	-	-	26%

Summary and Conclusion

Our study aims to identify the utility of thoracic computed tomography in assessment of patients with blunt chest trauma and evaluate its superiority vis-a-vis conventional chest X-ray (CXR).

One hundred and fifty patients were evaluated regarding demographics, mode of injury, presenting symptoms and radiological findings on CXR and CT. Modes of injury of blunt chest trauma were RTA, fall and physical assault. Common symptoms and signs were pain, respiratory distress and subcutaneous emphysema.

Detection of pneumothorax, hemothorax, pulmonary contusions and atelectasis was significantly more accurate on CT than CXR proving it to be superior to CXR as diagnostic modality.

CT scan also detected malpositioned chest drain tubes more accurately leading to repositioning them. CXR was less accurate in diagnosis of all the above findings.

CT scan found more bony injuries as compared to CXR in majority of patients thus reiterating its superiority. So CT scan should be the preferred investigation for blunt chest trauma patients.

The advantage of CXR are its availability, low cost, less exposure to radiation, less time consumption and easy interpretation.

To conclude, CT can detect additional findings which help to detect extra pathologies to diagnosis as well as follow up the patients. These additional findings may significantly change therapeutic decision plan thus helping decrease the morbidity and mortality of the blunt chest trauma patients.

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