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Comparative analysis of conventional X-ray chest Vs. NCCT chest in patients of blunt trauma chest: An observational study

Dr. Prashant Pandey
Associate Professor, Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, Uttar Pradesh, India

Dr. Vijay Kumar Goel
Professor, Department of General Surgery, Hind Institute of Medical Sciences, Safedabad, Barabanki, Uttar Pradesh, India

Dr. Madhulika Mishra
Associate Professor, Department of Obstetrics and Gynaecology, Hind Institute of Medical Sciences, Safedabad, Barabanki, Uttar Pradesh, India
Corresponding author email: frcsmadhu@gmail.com

Dr. Sushma Pandey
Consultant, Department of Radiology, Sahara Hospital, Viraj Khand, Gomti Nagar, Lucknow, Uttar Pradesh, India

***Abstract*---**Background: Chest X-Ray (CXR) is routinely used as the primary diagnostic technique in chest trauma but some possibly life-threatening injuries are repeatedly missed on CXR. Non contrast computed tomography (NCCT) scan is a superior diagnostic device in blunt trauma chest. Aim: To compare efficacy of the x-ray versus NCCT chest in diagnosis of blunt trauma chest. Methodology: The present cross sectional study was performed in the admitted patients in causality in Surgery Department of Hind Medical College, Safedabad, Barabanki (U.P). The patients who were treated in level 1 trauma centre for blunt chest trauma and received both Chest X-ray and CT chest scan during study period 2020 - 2021. Identification of the patients was done from the hospital's registry. Results: while 39 (24.38%) patients were undetected on chest X-ray chest. However, the fractures could not be detected in only 2 (1.25%) patients on NCCT scan chest. Statistically significant variance was found in circumstances of sternum fracture, rib fracture, scapula fracture, lung contusion and pneumothorax. The sensitivity of CXR for sternum fracture, rib fracture, lung contusion and pneumothorax were 100.00% and other injuries like clavicle fracture, scapula fracture, diaphragmatic rupture, and hemothorax were 88.89%, 87.50%,

66.67% and 90.91%%, respectively. Conclusion: Chest NCCT is the best and significantly more sensitive radiological method than CXR in the identification of rib fractures. It should be used routinely in the initial assessment of chest trauma, but chest X-ray may be a suitable technique in the follow-up period.

***Keywords*---**Blunt trauma chest, diagnostic accuracy, NCCT chest, X-ray Chest.

Background

Trauma fulfils the disease classification criteria for a global pandemic, this being a recurrent and significant source of morbidity and mortality over time and across continents despite efforts to control its impact. Chest trauma is one of the most serious injuries of the chest and also a common cause of significant disability and mortality. Chest trauma is the leading cause of death from physical trauma after head and spinal cord injury. Thoracic injuries are primary or a contributing cause of about one fourth of all trauma-related deaths. The mortality rate in these cases is about 10%. Thoracic injuries account for approximately 20–25% of deaths due to trauma, 16,000 deaths occurs per year in India alone as a result of chest trauma. In India, every 1.9 min, trauma related death occurs. Approximately 1 million people die and 20 million are hospitalized every year due to injuries.[1] Blunt trauma chest contributes to major accidental injuries in India, due to increased incidence of road traffic accidents (6% of global vehicular accidents) due to increased road traffic, availability of new high-speed vehicles and less awareness regarding traffic rules. A very few studies had been conducted to analyse its magnitude and management in Indian scenario.[2]

Minor blunt chest trauma comprises more than half of the rib fractures without any complications such as pneumothorax, haemothorax or pulmonary contusion, and is often treated on an outpatient basis.[3] The diagnosis of chest injuries begins with a careful history and examination of the patient.[4] Today, because of the complex technology, this simple first step is all too often overlooked.**Error! Bookmark not defined.** The usual diagnostic study in the emergency department for blunt chest injuries is a chest X-ray,[5] and significant injury detection with CXR ranges between 6.3% and 12.4%.[6] CXR can show a severe pneumothorax, a large hemothorax, tube and line malpositioning, but some of injuries such as pulmonary contusion, occult pneumothorax and small to moderate hemothorax can be missed during initial evaluation.[7] Chest CT scan is the gold standard imaging tool in emergency room.[8] Nowadays there is a marked increase in use of chest CT scan as the initial evaluation for patients with chest trauma.**Error! Bookmark not defined.**,**Error! Bookmark not defined.**,[9] CT scan is an accurate tool for detection of injuries in trauma setting and is able to find the injuries that were occult in CXR.[10] In past years the utility of CT scan was limited to severe trauma injuries but now is used in less severely injured trauma patients.[11] Aim of the present study was to comparative analysis of X-ray versus NCCT chest in blunt trauma chest.

Material & Method

The present study was conducted in the Surgery Department of Hind Medical College Safedabad, Barabanki (U.P). After approval of ethical committee of the institute the study was started. For this study, we retrospectively regarded the previous medical records of the patients who were treated in level 1 trauma centre for blunt chest trauma and received both Chest X-ray and CT chest scan. Identification of the patients was done from the hospital's during study period 2020 - 2021. All patients with blunt trauma chest in HRCT chest done were included in the study. Penetrating chest injury and patients who absconded or left against medical advice were excluded from the study.

The study was conducted over the patients admitted from casualty, in Surgery Department and those who transferred from other wards. After eliciting the proper history and mode of trauma, vitals were regarded, and initial airway, breathing, circulation, and deformities were assessed without any delay. After stabilizing the vitals, the patients who were diagnosed as blunt trauma chest were assessed properly and sent for lab investigations and X-ray was done. The patients were then shifted to ward and sent for NCCT chest. The reports of X-ray chest and NCCT chest were analysed and recorded in proforma.

All these data were recorded meticulously in proforma and master chart after that systematic tabulation, observation, and analysis done. The statistical analysis of the data was done using SPSS program version 20.0 for windows. The significance of the data was checked using Chi-square test. P value less than 0.05 was predetermined as statistically significant.

Observation

In the present study, a total of 160 patients participated. Out of 160 patients, 118 (73.75%) were males. The mean age of the patients were 35.41±12.34 years with age range from 19-68 years. We observed major causes of blunt trauma to chest, road traffic accident (56.26%) and fall from bike (17.50%); followed by fall from height (14.38%), slip & fall (5.63%), violence/assault (4.38%) and only 1.88% accident in their work. [Table No. 1]

The right side fractures were detected in 56 (35.00%) patients, left side fractures were detected in 53 (33.12%) patients and bilateral fractures were detected in 12 (7.50%); while 39 (24.38%) patients were undetected on chest X-ray chest. However, the fractures could not be detected in only 2 (1.25%) patients, right side fractures were detected in 68 (42.50%) patients, left side fractures were detected in 62 (38.75%) patients, and bilateral fractures were detected in 28 (17.50%) patients on NCCT scan chest. [Table No. 2]

Table No. 3 shows the comparison of Positive Radiological findings in Chest X-ray and CT scan. We observed that CT scan is more accurate than chest CXR in reporting the lesion. Statistically significant variance was observed in cases of sternum fracture, rib fracture, scapula fracture, lung contusion and pneumothorax.

The sensitivity of CXR for sternum fracture, rib fracture, lung contusion and pneumothorax were 100.00% and other injuries like clavicle fracture, scapula fracture, diaphragmatic rupture, and hemothorax were 88.89%, 87.50%, 66.67% and 90.91%%, respectively as shown in Table No. 4.

Discussion

Chest trauma is one of the greatest severe injuries of the chest and also a common cause of significant disability and mortality. Chest traumas establish 10-15% of several traumas and are the reason of death in 25% cases of total mortalities due to trauma.[12] In children 81% of thoracic injuries were due to blunt trauma chest and in elderly person it was 78%, minor blunt trauma chest is the maximum communal form of blunt trauma chest.[13] Motor vehicle accidents are the most predominant reason for,[14] and rib fractures are the greatest communal (25.0%) injuries consequential from, blunt trauma chest.[15] Chest X-Ray (CXR) is the first steps in diagnosis and treatment of clinically apparent injuries like rib fractures, severe pneumothorax, or large hemothorax. NCCT (Non contrast computed tomography) scan is the gold standard investigative instruments in chest trauma, which may be identify pulmonary contusion, hemothorax, pneumothorax, rib fracture and thoracic spinal injuries with great sensitivity.[16] Rapid diagnosis of these injuries in patients with blunt trauma chest has directed to significant progress in patient management.**Error! Bookmark not defined.** Still, CXR is deliberated a valuable bedside and cost-effective modality given that reliable evidence in the preliminary assessment of trauma patients.

In this study, we compared the efficacy of chest X-ray and chest NCCT scan in patients with chest trauma. We retrospectively watched the medical records for patients treated in level 1 trauma centre for chest trauma. We noted that 65.63% patients were ≤40 years of age group with mean age 35.41±12.34 (19-68 years). 73.75% studied patients were males. We also noted that road traffic accident was the most communal reason for chest trauma followed by fall from bike and fall from height. Previous studied Kumari P,[17] Vatsa A et al,[18] Arab WA et al,[19] Yazkan R et al[20] and Sahu SK et al[21] also reported the similar demographic and mode of injury in their respective study.

Our study noted that the right side fractures were detected in 35.0% patients, left side fractures were detected in 33.12% patients and bilateral fractures were detected in 7.50%; while 24.38% patients were undetected on chest X-ray chest. However, the fractures could not be detected in only 1.25% patients, right side fractures were detected in 42.50% patients, left side fractures were detected in 38.75% patients, and bilateral fractures were detected in 17.50% patients on NCCT scan chest. In a similar study Yazkan R et al**Error! Bookmark not defined.** also reported the rib fractures could not detected in 19.3% patients, right rib fractures were detected in 38.6% patients, left rib fractures were detected in 33.7% patients, and bilateral rib fractures were detected in 8.4% patients on chest X-ray. However, the rib fractures could not be detected in only 1.2% patient, right rib fractures were detected in 42.2% patients, left rib fractures were detected in 39.8% patients, and bilateral rib fractures were detected in 16.9% patients on computed tomography.

In our study, CXR identified sternum fracture in 1.88% cases in study sample compare to CT chest which identified 11.25% cases in study patients, (P<0.001 [S]). CXR identified rib fracture in 29.38% cases in study sample compare to CT chest which identified 42.50% cases in study patients, (P=0.014). CXR identified scapula fracture in 5.0% cases in study sample compare to CT chest which identified 11.88% cases in study patients, (P=0.027). CXR identified lung contusion in 3.13% cases in study sample compare to CT chest which identified 14.38% cases in study patients, (P<0.001), and CXR identified pneumothorax in 5.63% cases in study sample compare to CT chest which identified 15.63% cases in study sample, (P=0.003); while CXR identified hemothorax in 12.75% cases in study sample compare to CT chest which identified 19.38% cases in study patients, (P=0.176), CXR identified clavicle fracture in 11.25% cases in study sample compare to CT chest which identified 13.13% cases in study patients, (p=0.608) and CXR identified diaphragm rupture in 5.63% cases in study sample compare to CT chest which identified 8.13% cases in study sample, (p=0.377). In a similar study Sahu SK et al**Error! Bookmark not defined.** reported the CXR identified hemothorax in 16.4% cases in study sample compare to CT chest which identified 29.5% cases in study sample, (p=0.0185), CXR identified pneumothorax in 9.0% cases in study sample compare to CT chest which identified 27.4% cases in study sample, (p=0.00224), and CXR identified hemopneumothorax in 7.5% cases in study sample compare to CT chest which identified 17.9% cases in study sample, (p=0.036). In another study, Traub et al[22] found CXR identified hemothorax in 7.0% cases, where CT chest found hemothorax in 11.3% cases. The same result also is seen in pneumothorax, where X-ray chest detects 6.4% cases of pneumothorax and CT chest found 22.0% cases of pneumothorax, and CXR identified hemopneumothorax in 0.7% cases, where CT chest found hemopneumothorax in 11.3% cases.

Positive Radiological findings in Chest X-ray and CT scan. We noted that CT scan is more accurate as compared to chest X-ray in reporting the lesion. Statistically significant difference was seen in cases of sternum fracture, rib fracture, scapula fracture, lung contusion and pneumothorax. CXR alone is not effective in the management of the patient and finally CT scan should be used. This finding is complementary to Wicky et al[23] study in which they concluded that CXR is the most efficient modality for all chest trauma patients because of its ability to detect most life-threatening lesions. However, Exadaktylos et al[24] recommended CT scan as the primary diagnostic tool in patients with major chest trauma because they showed that over 50% of patients with abnormal CXR had multiple injuries on the CT scan.

Our study noted that the sensitivity of CXR for sternum fracture, rib fracture, lung contusion and pneumothorax were 100.0% and other injuries like clavicle fracture, scapula fracture, diaphragmatic rupture, and hemothorax were 88.89%, 87.50%, 66.67% and 90.91%, respectively. In a previous study Kumai P**Error! Bookmark not defined.** reported that CT scan is more sensitive and accurate as compared to chest X-ray for diagnosis of sternum fracture, rib fracture, scapula fracture, lung contusion and pneumothorax. Chardoli M et al[25] reported that rib fracture was the most common finding of CXR (12.5%) and CT scan (25.5%). The sensitivity of CXR for hemothorax, thoracolumbar vertebra fractures and rib fractures were 20.0%, 49.0% and 49.0%, respectively. Eckstein et al[26] estimated

sensitivity of CXR to be 42.0% in diagnosis of pneumothorax, sensitivity and specificity in diagnosis of pulmonary contusion were 40% and 100%. In another previous study, El Wakeel et al[27] documented the NCCT shows higher sensitivity than the CXR in diagnosis of intra-thoracic injuries. Similar studies conducted by other authors in the pat have shown similar results.

Conclusion

Rib fractures are the maximum communal injuries consequential from blunt trauma chest. Confirmation of rib fractures is imperative, because they can have some associated complications in the early or late period, such as lung contusion, pneumothorax and hemothorax. Chest NCCT is the best and significantly more sensitive radiological method than CXR in the diagnosis of rib fractures. It should be used routinely in the preliminary valuation of chest trauma, but CXR may be a appropriate technique in the follow-up period.

Table No. 1: Demographic and Mode of injury distribution in studied patients

Variables		Frequency (n=160)	Percentage
Age Group (Years)	≤40	105	65.63%
	>40	55	34.38%
Mean±SD (Min to Max)		35.41±12.34 (19-68 years)	
Sex	Male	118	73.75%
	Female	42	26.25%
Mode of injury	RTA	90	56.26%
	Fall from bike	28	17.50%
	Fall from height	23	14.38%
	Slip and fall	9	5.63%
	Violence/assault	7	4.38%
	Work	3	1.88%

Table No. 2: Location of rib fractures identified by CXR and NCCT chest

	Right	Left	Bilateral	Undetected
Chest X-ray	56 (35.00%)	53 (33.12%)	12 (7.5%)	39 (24.38%)
Chest Computed Tomography	68 (42.50%)	62 (38.75%)	28 (17.50%)	2 (1.25%)

Table No. 3: Comparison of findings on CXR and NCCT chest

Findings	Chest X-ray (n=160)	CT scan (n=160)	Chi-square value	P value
Sternum fracture	3 (1.88%)	18 (11.25%)	11.467	<0.001
Clavicle fracture	18 (11.25%)	21 (13.13%)	0.263	0.608
Rib fracture	47 (29.38%)	68 (42.50%)	5.986	0.014
Scapula fracture	8 (5.00%)	19 (11.88%)	4.894	0.027
Diaphragm rupture	9 (5.63%)	13 (8.13%)	0.781	0.377
Lung contusion	5 (3.13%)	23 (14.38%)	12.681	<0.001

Pneumothorax	9 (5.63%)	25 (15.63%)	9.080	0.003
Haemothorax	22 (12.75%)	31 (19.38%)	1.832	0.176

Table No. 4: Diagnostic evaluation of CXR with respect to NCCT chest (Gold Standard) for various chest trauma findings

	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Sternum fracture	100.00%	90.45%	16.67%	100.00%	90.62%
Clavicle fracture	88.89%	96.48%	76.19%	98.56%	95.62%
Rib fracture	100.00%	81.42%	69.12%	100.00%	86.88%
Scapula fracture	87.50%	92.11%	36.84%	99.29%	91.87%
Diaphragm rupture	66.67%	95.36%	46.15%	97.96%	93.75%
Lung contusion	100.00%	88.39%	21.74%	100.00%	88.75%
Pneumothorax	100.00%	89.40%	36.00%	100.00%	90.00%
Haemothorax	90.91%	92.03%	64.52%	98.45%	91.88%

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