ORIGINAL ARTICLE

Role of Multidetector Computed Tomography in the Assessment of Blunt Chest Trauma

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Abstract

Background: ***Thorax injuries rank as the 3rd most predominant injuries among trauma cases, following head and extremity injuries.***

Aim: ***The current research aimed to investigate the efficacy of multidetector computed tomography in evaluating cases with blunt chest trauma.***

Patients and methods: ***The investigation comprised 120 cases of blunt chest trauma referred from the emergency department to the radiology department for MDCT of the chest.***

Results: ***In the Emergency Department, endotracheal tubes were inserted in 16% of patients, chest tubes in 27.2%, and central venous lines and nasogastric feeding tubes in 19.2% and 9.6% respectively. Common clinical presentations included dyspnea, chest pain, hemoptysis, and local chest tenderness. Forty-two patients experienced both sides of affection, while 28.8% had both sides affected. Positive radiological results indicated pleural injuries in ninety percent of cases, parenchymal lung injuries in fifty-six percent, mediastinal injuries in 11.2 percent, and chest wall injuries in 40.8 percent.***

Conclusion: ***We conclude that the data obtained by MDCT could result in significant alterations in case management; therefore, physicians, radiologists, and radiology residents must be well-versed in all aspects of MDCT assessment for this patient group.***

Keywords: Role; Blunt chest trauma; Multidetector computed tomography

1. Introduction

Thorax injuries rank as the 3rd most common injuries among trauma cases, following head and extremity injuries.[1]

The total mortality rate for thoracic trauma is 10.1 percent, with the highest rates observed in cases suffering tracheobronchial-oesophageal or cardiac injuries.[2]

The occurrence of thoracic injuries in the setting of multisystem trauma can significantly elevate the death rate of patients.[3]

Over 2/3 of blunt thoracic trauma cases in developing nations result from motor vehicle collisions. The remaining cases stem from falls, blunt force trauma, or stab injuries.[4]

Conventional radiography is usually utilized for initial imaging assessment; nevertheless, computed tomography is more precise than radiography for evaluating lung parenchymal injuries such as contusions, facilitating early prediction of respiratory compromise.[5]

The present research aimed to test the efficacy of MDCT in evaluating cases with acute chest trauma.

2. Patients and methods

The investigation comprised 120 cases of blunt chest injuries and was referred from the emergency room to the radiology department for MDCT of the chest.

Inclusion criteria: This research includes every case of blunt chest trauma, whether presented alone or as part of polytrauma.

Exclusion criteria: The subsequent groups of cases have been excluded: Cases requiring emergency transfer to operations, cases that are hemodynamically unstable, and cases involving lactating and pregnant women.

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Methods

All cases have been exposed to the following:

A thorough clinical assessment, including history taking, general inspection, and chest inspection, has been conducted for all cases. Additionally, plain chest X-rays in anteroposterior (supine) views were performed, and all cases had CT chest imaging with 16-channel multi-slice computer tomography. Cases have been assessed in the supine posture, and the field of view will be modified to get complete anatomical imaging of the chest. Injection of intravenous contrast media: volume (1.5 - 2 milliliters per kilogram), concentration (350–400 milligrams per milliliter), rate (2.5–3 milliliters per second), and scanning delay (30–40 s).

Imaging Methods for Pulmonary Trauma

In blunt thoracic trauma, the NEXUS chest decision algorithm identifies factors warranting further imaging, including age over 60, chest pain, rapid deceleration, altered mental status, intoxication, chest wall tenderness, and distracting injury.[6] Chest radiographs are the primary screening tool, though some centers use FAST, which is rapid, bedside-deployable, and radiation-free, aiding in detecting intrathoracic and pericardial free fluid, pneumothorax, and rib fractures.[7] A positive FAST in an unstable case may indicate urgent surgery. Portable AP chest radiographs are commonly used to identify rib fractures, foreign bodies, contusions, hemothorax, pneumothorax, and mediastinal injuries, with computed tomography for further evaluation. Expiratory views help detect subtle pneumothoraces. Contrast-enhanced computed tomography with multiplanar reformations is the standard trauma imaging tool due to its speed and ability to assess multiple body regions.[8] In unstable patients, imaging follows stabilization. Recommended collimation is ≥1.25 millimeters for four- and 16-section scanners and 0.6 millimeters for 64-section scanners. Single-phase imaging covers the thoracic inlet to pelvis with a seventy-second delay, while multiphasic imaging improves vascular injury detection.[9] If active bleeding is suspected, a delayed phase can confirm findings.8 Magnetic resonance imaging and nuclear medicine aren't routine in trauma, but may assess post-traumatic cardiac and vascular complications once the patient is stable.[10]

3. Results

The majority of the 125 patients, 59.2%, were aged 21-40, with 72% male and 28% female, ranging from 2-75 years. (Table 1)

Table 1. Exhibits cases number in distinct age groups

AGE GROUP	CASES NUMBER (%)
0-10	7 (5.6%).
11-20	11 (8.8%).
21-30	36 (28.8%).
31-40	38 (30.4%).
41-50	18 (14.4%).
51-60	10 (8%).
61-70	3 (2.4%).
71-80	2 (1.6%).

The predominant cause of blunt chest trauma was motor vehicle accidents, accounting for 56.8 percent (n=71 cases), then fall from height at forty percent (number=fifty), and direct blows to the chest at 3.2 percent (number=four cases). Table 2.

Table 2. Illustrations injury mechanism in 125 cases

INJURY MECHANISM	CASES NO. (%)
MOTOR VEHICLE ACCIDENTS	71(56.8%)
DIRECT BLOW TO THE CHEST	4(3.2%)
FALLING FROM HEIGHT	50(40%)

In the Emergency Department, endotracheal tubes were inserted in 16% of patients, chest tubes were placed in 27.2% of patients, and nasogastric feeding tubes and central venous lines were inserted in 9.6% and 19.2% of cases correspondingly. (Table 3)

Table 3. Shows intervention done for the 125 patients

INTERVENTION DONE	CASES NUMBER .(%)
CHEST TUBE	34(27.2%)
CENTRAL VENOUS LINE	24(19.2%)
ENDOTRACHEAL TUBE	20(16%)
NASOGASTRIC FEEDING TUBE	12(9.6%)

The predominant clinical manifestations included chest pain (number = ninety-five cases) (seventy six percent), dyspnea (n=88 cases) (70.4percent), local chest tenderness (number=thirty cases) (twenty four percent), and hemoptysis (number=twenty-five cases) (twenty percent); several presentations were also observed in the same case. Table 4

Table 4. Shows clinical presentations detected in the 125 cases

CLINICAL PRESENTATIONS	CASES NO. (%)
DYSPNEA	88(70.4%)
CHEST PAIN	95(76%)
HEMOPTYSIS	25(20%)
LOCAL CHEST TENDERNESS	30(24%)

42 patients (41.6%) experienced both sides of affection, while 36 patients (28.8%) had both sides affected. Radiological results indicated pleural injuries in ninety cases (seventy two percent), parenchymal lung injuries in seventy-one cases (56.6 percent), chest wall injuries in fifty-one cases (40.8 percent), diaphragmatic injuries in six cases. (4.8 percent), and mediastinal injuries in fourteen cases (11.2 percent). Table 5

Table 5. Summary of computed tomography results in blunt chest trauma.

RADIOLOGICAL RESULTS		CASES NUMBER (%)
THORACIC WALL INJURIES	Rib Fracture	28(22.4%)
	Sternal Fracture	2(1.6%)
	Clavicular Fracture	3(2.4%)
	Dorsal Spine Fracture	3(2.4%)
	Scapular Fracture	5(4%)
	Surgical emphysema	34(27.2%)
	Chest Wall hematoma	13(10.4%)
PLEURAL INJURIES	Pleural fluid collection (hemothorax)	53(42.4%)
	Tension pneumothorax	5(4%)
	Simple pneumothorax	16(12.8%)
	Hydro-pneumothorax	21(16.8%)
LUNG PARENCHYMAL INJURIES	Lung Contusion	71(56.8%)
	Lung Laceration	7(5.6%)
MEDIASTINAL INJURIES	Pericardial collection (hemopericardium)	3(2.4%)
	Pneumo-pericardium	1(0.8%)
	Esophageal injuries	2(1.6%)
	Pneumo-mediastinum	8(6.4%)
TRACHEO-BRONCHIAL INJURIES		2(1.6%)
DIAPHRAGMATIC INJURIES		6(4.8%)

4. Discussion

The research was conducted using a multidetector computed tomography of the chest in 125 cases referred to the emergency radiology unit at Bab Elshearia University Hospital. All cases had blunt chest trauma with varying chest symptoms.

Among the 125 cases in this research, ninety were male and thirty-five were female, resulting in a ratio of 2.5:1. This result aligns with Dabees et al.[11] who reported that seventy percent of cases subjected to acute chest trauma are male.

The age of cases in this investigation ranged from two to seventy-five years, with an average of 51.4 years; the majority of cases have been aged between twenty and forty years, comprising 59.2 percent of the cohort. This is also similar with Dabees et al.[11] who reported that sixty percent of cases in their research were aged between twenty and forty.

In this research, motor vehicle accidents constituted the predominant source of trauma, representing 56.8 percent of the patients. The 2nd most prevalent etiology of injury in this investigation was falls from height, affecting forty percent of cases. This aligns with Mancini et al.[12] who indicated that the primary etiology of blunt chest trauma is road traffic accidents, followed by falls from height, with acts of violence also being significant etiologies.

This investigation identified pulmonary contusions as the predominant parenchymal lung injury seen. It has been identified in seventy-one cases (56.8%). Kaewlai et al.[13] acknowledge that pulmonary contusion is the predominant lung injury resulting from blunt chest trauma, with an occurrence ranging from seventeen percent to seventy percent. Furthermore, chest MDCT demonstrates great sensitivity in detecting pulmonary contusion and can help in predicting the necessity for MV.

Parenchymal lung lacerations have been identified in seven cases (5.6%). The MDCT scan exhibits superior sensitivity in identifying lung lacerations, in contrast to the limited sensitivity of chest radiography.

Hemothorax was identified in fifty-three cases (42.4 percent) in this investigation. These findings align with Sangster et al.,[14] who indicated that hemothorax occurred in thirty to fifty percent of cases with blunt chest injuries.

Pneumothorax has been identified in forty-two cases (33.6 percent); simple pneumothorax in sixteen cases (12.8 percent), tension pneumothorax in five cases (four percent), and hydropneumothorax in twenty-one cases (16.8 percent).

This investigation identified rib fractures as the predominant skeletal damage observed. It was identified in twenty-eight cases (22.4%), accounting for sixty-eight percent of all documented fractures. Kaewali et al.[13] indicated that rib fractures represent the predominant damage following blunt chest trauma, affecting approximately fifty percent of cases; in this investigation, rib fractures have been identified using computed tomography in just twenty-eight cases (22.4 percent). These outcomes could align with Ringl et al.[15] who asserted that identifying rib fractures in computed tomography can be a particularly difficult task. Each rib possesses a complicated morphology and extends across multiple segments, while exhibiting twisting along its longitudinal axis. The methodical rib-by-rib assessment of the entire thorax is tedious and time-intensive. Moreover, fractures might be difficult to detect, particularly if they are aligned with the section or not dislocated. Most rib fractures missed on computed tomography are situated near the anterior arc, with more than fifty percent exhibiting a buckled morphology. They manifest symmetrically on both sides of the thoracic cage. Missed fractures often occur on the same rib or the adjacent rib of identified fractures.

The research identified soft tissue chest wall hematomas in thirteen cases (10.4 percent), all associated with rib fractures, corroborating the

findings of Oikonomou and Prassopoulos,[16] who noted that hematomas soft tissue can arise from direct compression trauma when rib fractures result in the laceration of arteries or veins.

The current study included eight cases with pneumomediastinum, representing 6.4 percent of the total group. This coincided with Oikonomou and Prassopoulos16 that pneumomediastinum occurs in up to ten percent of cases with blunt chest trauma.

Tracheobronchial injuries have been identified in two cases (1.6%) with MDCT scan in this investigation.

This aligns with the findings of Kaewali et al.[13] who indicated that tracheobronchial injuries are infrequent in clinical practice, as most cases present prior to reaching the Emergency Department due to injuries related to hemorrhage, vital structures, respiratory insufficiency, tension pneumothorax, or airway injury. Blunt tracheobronchial trauma constitutes 0.2–8 percent of all instances of blunt chest trauma in clinical series.

The research identifies diaphragmatic injury in six cases (4.8%), aligning with Jo˜ao et al.[17] who reported that diaphragmatic rupture occurs in 0.8–7 percent of cases admitted with blunt trauma. Multidetector computed tomography not only reveals minor diaphragmatic discontinuities but also detects herniated adipose tissue or viscera. In this investigation, just fifty percent of diaphragmatic hernia cases were observed on the left side. Jo˜ao et al.[17] indicated that between seventy-seven percent and ninety percent of diaphragmatic ruptures occur on the left side due to the liver's protection of the right hemidiaphragm.

4. Conclusion

We determined that the data obtained by MDCT could result in significant alterations in case management; therefore, physicians, radiologists, and radiology residents must be well-versed in all aspects of MDCT assessment for this negligible patient group.

Disclosure

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