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ROLE OF CT IN ASSESSMENT OF BLUNT CHEST TRAUMA

By

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ABSTRACT

Background: Blunt chest trauma is a significant problem affecting mainly young males between 20-40 years and it is usually caused by motor vehicle accidents. It is common and contributes significantly to morbidity and mortality of trauma patients. It has an overall fatality rate of 15-25%.

Objective: To evaluate the role of multi-detector computed tomography in assessment of patients with blunt chest trauma.

Patients and Methods: This study involved 50 patients; 40 males (70%) and 10 females (30%). Their ages range was 2-75 years (mean age= 51.4 years). They were exposed to blunt chest trauma and referred to the Emergency Radiology Department in Nasr City Hospital and Al-Azhar University Hospitals for multi detector computed tomography (MDCT) of the chest over a period of 6 months starting from November 2019 to April 2020.

Results: Multi-planner and 3D reconstruction images were sensitive in the evaluation of different skeletal injuries especially dorsal spine, scapular and sternal fractures. Its high resolution provides more sensitivity in the evaluation of lung contusion that helped in predicting the need for mechanical ventilation. MDCT was more accurate and sensitive in the diagnosis and characterization of different types of pleural and mediastinal injuries. Multidetector CT generated virtual bronchoscopy represented one of the most recent developments in three-dimensional (3D) visualization technique which allowed a 3D evaluation of the airways down to the sixth- to seventh-generation. MDCT not only detected small diaphragmatic discontinuities, but also identified the herniated fat or viscera.

Conclusion: The information provided by MDCT may lead to critical changes in patients' management, so that clinicians, radiologists, and radiology residents should be familiar with the different aspects of MDCT evaluation of this non-negligible group of patients.

Keywords: Blunt Chest Trauma, CT, MDCT.

INTRODUCTION

Chest trauma is classified as blunt or penetrating, with blunt trauma being the cause of most thoracic injuries (90%). The main difference lies in the presence of an opening to the inner thorax in penetrating trauma, created by stabbing or gunshot wounds, which is absent in blunt chest trauma *(Mirka et al., 2012).*

Penetrating injuries frequently cause pneumothorax or hemothorax and blood loss with cardiac or vascular injuries may be catastrophic. Patients often deteriorate rapidly but with appropriate management,

have the potential to improve rapidly *(Blyth, 2014)*.

Blunt trauma in addition to pneumothorax and hemothorax typically causes organ damage by compression, acceleration or deceleration and shear forces. In contrast to penetrating trauma, the majority of blunt injuries are managed non-operatively, responding to emergency department interventions such as intubation and ventilation or intercostal drainage *(Blyth, 2014)*.

Imaging studies play an essential part of thoracic trauma care. Chest radiography (CXR) has been the traditional screening technique to evaluate thoracic trauma. However, the information obtained is suboptimal for the diagnosis of vascular and nonvascular thoracic injuries, as it underestimates the severity and extent of chest trauma and, in some cases, fails to detect the presence of injury. There is a growing evidence that multi detector computed tomography (MDCT) is more sensitive than CXR in the detection and characterization of thoracic injuries after trauma *(Palas et al., 2014)*.

MDCT has dramatically decreased imaging times and offers readily available multiplanar reformatted images or more sophisticated volume-rendered and MIP images. Therefore, it has been established as the gold standard for the imaging evaluation of chest trauma and trauma in general *(Davies et al., 2016)*.

The aim of this study was to evaluate the role of multi-detector computed tomography in assessment of patients with blunt chest trauma.

PATIENTS AND METHODS

This study involved 50 patients; 40 males (70%) and 10 females (30%), their age range was 2-75 years (mean age= 51.4 years).They were exposed to blunt chest trauma and referred to the emergency radiology department in Nasr city hospital and Al-Azhar University Hospitals for MDCT of the chest over a period of 6 months starting from November 2019 to April 2020.

Inclusion criteria: All cases with blunt chest trauma either as a sole presentation or as a part of poly-traumatic insults were included in this study.

Exclusion criteria: Patients in need of emergency transfer to surgery. Patients who were hemodynamically unstable. Lactating and pregnant females.

An approval of the study was obtained from Al- Azhar University academic and ethical committee. Every patient signed an informed written consent for acceptance of the operation or informed written consents were obtained from relatives of all participants in this study.

All patients were subjected to:

1. Thorough clinical examination with history taking, general and chest examination.
2. Plain chest X-ray AP (supine) views were done to all patients.
3. CT chest (Table 1 shows the MSCT technique) was done to all patients as requested using 16 channels MSCT.

Table (1): NECT technique

	Siemens Emotion 6 MSCT 16 channel
Scout	Kv120 mA25 Holding breath
Scan type	Helical
Detector row	16
Helical thickness	1.25 mm
Interval	1 cm
FOV	351 mm from root of the neck to level of renal arteries.
KV	120
mA	20
Total exposure time	0.8 sec

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean and standard deviation.

RESULTS

Out of the 50 patients, 74% (n=37 patients) were males and 26% (n=13 patients) were females with age ranging from 2-75 years (mean=51.4 years) and most of the patients were in the age group 21–50 years (n=31 patients) (62%) **(Table 2)**.

Table (2): Number of patients in different age groups

Age group	Number of patients (%)
0-10	4 (8%).
11-20	5 (10%).
21-30	9 (18%).
31-40	12 (24%).
41-50	10 (20%).
51-60	5 (10%).
61-70	2 (4%).
71-80	3 (6%).

The most common mechanism of blunt chest trauma was as a result of motor vehicle accidents 58% (n=29 patients) followed by falling from height 36% (n=18 patients) then direct blow to chest 6% (n=3 patients) **(Table 3)**.

Endotracheal tube was inserted in 8 patients (16%) in the Emergency Department. chest tube placed prior to MDCT scan in 14 patients (28%). Central venous line and nasogastric feeding tube were inserted in 9 (18%) and 6 (12%) patients respectively **(Table 3)**.

The most common clinical presentations were chest pain (n=38 patients) (76%), dyspnea (n=35 patients) (70%), local chest tenderness (n=12 patients) (24%) and hemoptysis (n=5 patients) (10%); More than one presentation was also encountered in the same patient **(Table 3)**.

Table (3): Mechanism of injury, Intervention done and Clinical presentations in the 50 patients

Patients / Parameters	No. (%)
Mechanism of injury:	
Motor vehicle accidents	29(58%)
Falling from height	18(36%)
Direct blow to the chest	3(6%)
Intervention done:	
Chest tube	14(28%)
Central venous line	9(18%)
Endotracheal tube	8(16%)
Nasogastric feeding tube	6(12%)
Clinical presentations:	
Chest pain	38(76%)
Dyspnea	35(70%)
Local chest tenderness	12(24%)
Hemoptysis	5(10%)

According to side of affection; both sides were affected in 21 patients (42%), right side in 17 patients (34%) and left side in 12 patients (24%). Positive radiological findings among patients in order of frequency were pleural injuries in 36 patients (72%), parenchymal lung injuries in 30 patients (60%), chest wall injuries in 17 patients (34%), mediastinal injuries in 7 patients (14%), diaphragmatic injuries in 2 patient (4%) and finally tracheo-bronchial injuries in 1 patient (2%) **(Table 4)**.

Out of a total of 50 patients;

Chest wall injuries were detected in 17 (34%) patients **(Table 4)**:

Bony chest wall injuries included:

- Rib fractures were detected in 9 patients (18%) (5 cases on right side, 3 cases on left side and 1 case on both sides). It was detected in only one patient at childhood age group. Sternal fracture was detected in 1 patient (2%), Clavicular fractures were detected in 2 patients (4%) both were on the right side and Scapular fractures were detected in 3 patients (6%) both were on the right side all fractures at scapular body and not reaching articular surfaces. Dorsal spine fractures were detected in 2 patients (4%).

Soft tissue chest wall injuries included:

- Surgical emphysema was detected in 15 patients (30%) (5 cases on left side, 6 cases on right side and 6 cases on both sides). Chest wall hematoma was detected in 9 patients (18%) (5 cases on right side, 3 cases on left side and one case on both sides). All cases of chest wall hematomas were related to fractured ribs.

Pleural space injuries were detected in 36 (72%) patients (Table 4):

Pleural fluid collection were detected in 21 patients (42%) (6 cases on left side, 7 cases on right side and 8 cases on both sides). Pneumothorax were detected in 10 patients (20%) and they are classified as following: Simple pneumothorax was detected in 7 patients (3 cases on left side 2 cases on right side and 2 cases on both sides). Tension pneumothorax was detected in 3 cases (1 case on left side and 2 cases on right side). Hydro-pneumothorax was detected in 5 patients (10%) (2 cases on left side, 3 cases on right side).

Lung parenchymal injuries were detected in 30 (60%) patients (Table 4):

contusion was detected in 28 patients (56%) (9 cases on left side, 14 cases on right side and 5 cases on both sides). Lung laceration was detected in 2 patients (4%).

Mediastinal injuries were detected in 7 (14%) patients (Table 4):

Pneumo-mediastinum is detected in 5 patients (10%). Hemo-pericardium (pericardial collection) is detected in 3 patients (6%). Pneumo-pericardium is detected in 2 patients (4%). Esophageal injuries are suspected in 0 patients (0%).

Diaphragmatic injuries were detected in 2 (4%) patients (Table 4):

Both cases were right sided diaphragmatic herniation.

Tracheo-bronchial injuries were suspected in 2 (4%) patients (Table 4):

One case was partial avulsion of right main bronchus and another case shows complete avulsion of left main bronchus with fallen lung sign noted, both cases are confirmed by three dimensional virtual bronchography.

Table (4): Summary of CT findings in blunt chest trauma

Radiological Findings \ Cases		No. (%)
Thoracic wall Injuries	Rib Fracture	9(18%)
	Sternal Fracture	1(2%)
	Clavicular Fracture	2(4%)
	Scapular Fracture	3(6%)
	Dorsal Spine Fracture	2(4%)
	Surgical emphysema	15(30%)
	Chest Wall hematoma	9(18%)
Pleural Injuries	Pleural fluid collection (hemothorax)	21(42%)
	Simple pneumothorax	7(14%)
	Tension pneumothorax	3(6%)
	Hydro-pneumothorax	5(10%)
Lung Parenchymal Injuries	Lung Contusion	28(56%)
	Lung Laceration	2(4%)
Mediastinal Injuries	Pericardial collection (hemopericardium)	3(6%)
	Pneumo-pericardium	2(4%)
	Esophageal injuries	0(0%)
	Pneumo-mediastinum	5(10%)
Tracheo-bronchial Injuries		1(2%)
Diaphragmatic injuries		2(4%)

DISCUSSION

Out of the 50 patients in this study, 37 were males and 13 were females (ratio 2.5:1). Age of patients involved in this study was 2-75 years (average of 51.4 years) and most of patients were in the age group 21-50 years (62%).

These result consistent with *Dabees et al. (2014)* who stated that 70% of patients exposed to blunt chest trauma are males. They also consistent with *Dabees et al. (2014)* who stated that 60% of patients in their study were in the age group 20-40 years.

In this study, motor vehicle accidents were the most common cause of trauma accounting for 58% of the cases. The second most common cause of injury in this study was fall from height, which occurred in 36% of the patients and this was consistent with *Alborzi et al. (2016)* who stated that most common causes of blunt chest trauma are road traffic accidents followed by fall from height and acts of violence are also relevant causes.

In this study, pulmonary contusions were the most common parenchymal lung injury detected. It was found in 56%. This was accepted by *Miele et al. (2016)* who reported that pulmonary contusion is the most common lung injury from blunt chest trauma, with a prevalence of 17–70% and chest MDCT is highly sensitive in identifying pulmonary contusion and may help in predicting the need for mechanical ventilation.

Parenchymal lung lacerations were found in 2 patients (4%). MDCT scan is highly sensitive in detecting lung lacerations compared to poor sensitivity by chest radiography. This coincided with *Miele et al. (2016)* who stated that pulmonary lacerations were considered as uncommon injury before the widespread use of MDCT in trauma patients as these were not frequently identified on chest radiographs.

In this study, hemothorax was detected in 42%. These results coincided with *Kaewlai et al. (2010)* as he stated that hemothorax occurs in 30-50 % of patients with blunt chest trauma.

Pneumothorax was detected in 20% simple pneumothorax in 14%, tension pneumothorax in 6% and hydropneumothorax in 10%. These results coincided with *Nelson et al. (2013)* as he stated that pneumothorax occurs in 30-40% of trauma patients.

In this study, rib fracture was detected in 18%. However *Dabees et al. (2014)* stated that rib fractures are the most common type of injury after blunt chest trauma and occur in about 50 % of the patients. In this study rib fractures were detected by CT in only in 28 patients (22.4%). These results may be coincided with *Ringl et al. (2015)* who stated that detecting rib fractures in CT can be a quite challenging task.

Scapular factures were found in 6%. This was in agreement with *Wirth and Stephan (2016)* who reported that fractures of the scapula are uncommon, accounting for 3–5% of all shoulder girdle fractures and occurring in 3.7% of patients with multiple injuries.

Clavicular fractures were found in 4%. This coincided with *Maier et al. (2011)* who reported that clavicular fractures from blunt chest trauma account for 2.6–5% of all fractures.

Sternal fractures were detected in 2%. This coincided with *Wirth and Stephan (2016)* who stated that sternal fractures are rather seldom, appearing in 3–8 % of patients after severe blunt chest trauma and they always be interpreted as a sign of a large amount of energy having been transmitted to the chest wall and deeper structures, particularly in combination with a fracture of the scapulae.

Dorsal spine fractures were detected in 4%. Those were at level of D12 vertebrae and coincided with *Geyer and Linsenmaier (2016)* who stated that the most vulnerable site is between the ninth and twelfth vertebra.

In this study, soft tissue chest wall hematoma was detected in 18% and in all cases it was related to rib fractures. This coincided with *Chung et al. (2010)* who stated that Soft tissue hematomas may occur during direct compression trauma when rib fractures cause laceration of veins or arteries.

Subcutaneous emphysema was found in 30%. These findings were in agreement with *João et al. (2014)* who stated that subcutaneous emphysema is present in up to 34 % after blunt chest trauma.

In this study, there were 10% with pneumo-mediastinum. This coincided with *Oikonomou and Prassopoulos (2011)* who stated that pneumo-mediastinum occurs in up to 10% of patients with blunt chest trauma.

Pneumopericardium was detected in 2 patients (4%) this coincided with *Mirka et al. (2012)* as they stated pneumopericardium is a rare finding in blunt chest trauma. Hemopericardium was detected in 6%. This coincided with *João et al. (2014).*

In this study, tracheobronchial injuries were detected in 2% on MDCT scan. This was in agreement with *Scaglione et al. (2016)* who reported that tracheobronchial injuries are rare in clinical practice because most patients die before arriving at the emergency department from either associated injuries to vital structures, hemorrhage, tension pneumothorax, or respiratory insufficiency or from an airway injury. In clinical series, blunt tracheobronchial trauma has been reported as accounting for 0.2–8% of all cases of blunt chest trauma.

In this study, diaphragmatic injury was detected in 4%. This coincided with *João et al. (2014)* who stated that diaphragmatic rupture occurs in 0.8–7% of patients hospitalized with a blunt trauma. MDCT not only detects small diaphragmatic discontinuities, but also identifies the herniated fat or viscera.

CONCLUSION

The information provided by MDCT may lead to critical changes in patients' management; so that clinicians, radiologists, and radiology residents should be familiar with the different aspects of MDCT evaluation of this non negligible group of patients.

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دور التصوير المقطعي في تقييم الصدمات الغير حادة للصدر

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خلفية البحث: تعتبر الصدمة الصدرية الغير حادة مشكلة كبيرة تؤثر بشكل اساسى على ذكور الشباب الذين تتراوح اعمارهم بين 20-40 سنة، وعادة ما يكون سببها حوادث السيارات. وهو أمر شائع، ويساهم بشكل كبير في اعتلال ووفيات مرضى الصدمات، و يبلغ معدل الوفيات الإجمالية من 15-25٪.

الهدف من البحث: تقييم دور التصوير المقطعي متعدد المقاطع في تقييم المرضى الذين يعانون من صدمة غير حادة في الصدر.

المرضي وطرق البحث: إشتملت هذه الدراسة على 50 مريضاً مقسمين إلى 40 ذكراً (70%) و10 إناث (30%)، وكانت أعمارهم تتراوح مابين 2-75 سنة (متوسط العمر = 51.4 سنة) وقد تعرضوا لصدمة حادة في الصدر وتم تحويلهم إلى قسم الأشعة الطارئة بمستشفى التأمين مدينة نصر ومستشفيات جامعة الأزهر لعمل التصوير المقطعى متعدد المقاطع على مدار 6 أشهر بدءًا من نوفمبر 2019 وحتى أبريل 2020.

نتائج البحث: يعتبر التصوير المقطعى متعدد المقاطع والتصوير الثلاثى الابعاد ذو حساسية في تقييم إصابات الهيكل العظمي المختلفة وخاصة العمود الفقري، وكسور الكتفين. ويوفر دقة عالية وحساسية أكبر في تقييم كدمات الرئة، كما أنه أكثر دقة وحساسية في تشخيص وتوصيف أنواع مختلفة من اصابات الغشاء البلوري والتأموري ويمثل واحدا من أحدث التطورات في تقنيات التصور ثلاثي الأبعاد الذي يسمح لتقييم الشعب الهوائية وصولا إلى الجيل السادس والسابع.

الإستنتاج: قد تؤدي المعلومات التي يقدمها التصوير المقطعى متعدد المقاطع إلى تغييرات جوهرية في التعامل مع المرضى. بحيث يجب على الطبيب المعالج وأخصائي الأشعه وأطباء الأشعة المقيمين أن يكونوا على دراية بالجوانب المختلفة لتقييم التصوير المقطعى متعدد المقاطع لهذه المجموعة من المرضى.