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Relevance of chest CT and chest X-ray in patients of blunt trauma

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ABSTRACT

This study identifies the clinical features associated with further diagnostic information obtained on a CT chest scan compared with a standard chest X-ray in patients sustaining blunt trauma to the chest. Now a days Computed tomography (CT) scans are often used in the evaluation of patients with blunt trauma.

Methods: A 1-year prospective study of 80 patients who attended our hospital emergency for blunt trauma and had a chest CTscan and a chest X-ray as part of an initial assessment was undertaken. Data collected included vital signs, laboratory findings, interventions and the type and severity of injury.

Results: CT scan chest was significantly more effective than routine chest X-ray in detecting lung contusions, pneumothoraces, mediastinal hematomas, as well as fractured ribs, scapulas, sternums and vertebrae. All patients with a reduced air-entry (n = 33) in their clinical assessment had an abnormal CT scan. Furthermore, only 5% (3 of 60) patients with chest wall tenderness and 5% (2 of 35) patients with increased respiratory effort had a normal CT chest scan. Twenty-two percent of patients did not have any of these signs but had an abnormal CT scan.

Conclusion: In alert patients without evidence of chest wall tenderness, reduced air entry or abnormal respiratory effort, selective use of CT chest as a screening tool could be adopted. This is supported by the fact that most chest injuries can be treated with simple observation. Intubated patients, in most instances, should receive a routine CT chest scan in their first assessment.

Keywords: NIL.

INTRODUCTION

Two-thirds of patients with multiple trauma suffer from blunt chest injuries and severe thoracic trauma is associated with multiple injuries in70—90% of cases.[1,2] Among blunt injuries to the chest, lung contusion is considered one of the most important factor contributing to the increased morbidity and mortality of patients with multiple injuries.[3,4]Rapid diagnosis and treatment of traumatic pneumothorax (PTX) is important to prevent tension pneumothorax and circulatory collapse in patients with blunt and penetrating trauma. Supine chest radiograph (CXR) is traditionally employed; however, it misses up to 50% of the pneumothoraxes.

The CxR is quick, easily available and provides a good assessment of the injury to the thoracic skeleton. The most important disadvantage of a plain CxR taken in the supine position is the lack of axial resolution and the absence of the second image plane. The superimposition of different structures and organs in the anteroposterior plane makes interpretation difficult resulting in a limited diagnostic value. At the time of admission, the severity of pulmonary contusion is frequently underestimated by CxR[5,6.7]. Marths et al [8] showed that CxR revealed pulmonary contusions only in approximately one-third of the patients in whom they were present.Greene[9]demonstrated that even if a lung contusion could be demonstrated, its extent was underestimated. The deficiencies of the conventional X-rays in the diagnosis of thoracic injuries can largely be compensated for by the use of CT chest [10]. CT represents the most important examination method in the thoracic trauma patient. The use of a

spiral CT can shorten the examination period down to a few minutes [11]. The value of thoracic CT is undisputed, but people argue about the relevance of the additional information it provides [12-18]. Marths et al [8], concluded that the CT scan was superior in diagnosing pneumothorax, hemothorax, and lung parenchymal lesions (contusion/laceration). However, treatment strategy changed only in 6.5% the cases with this additional information. Another study done by Guerrero-Lopez et al [19] showed that CT scans not only aided in diagnosis of thoracic injuries but also better quantified the injury severity. This was especially true for injuries of the sternum, the spinal column, and the mediastinum. In 30% of the patients, management decisions were guided by the additional information obtained on the CT scans. McGonigal et al [14] recommended getting a thoracic CT in all high-energy polytrauma patients with an anticipated involvement of the chest as CT chest resulted in therapeutic consequences in up to 70% of patients. Karaaslan et al [20] in a study on 47 patients with isolated traumatic brain injury who were on mechanical ventilation, showed that a chest CT revealed the nature of the thoracic injury in 44 of the 47 patients. In 24 patients the injury was also seen on a conventional thoracic X-ray. Therefore, the authors recommended a CT scan of the chest in all patients requiring artificial respiration or having a GCS< 8. Ivatury& Sugarman [21] and Exadaktylos et al [22] in their prospective studies, found significant thoracic injuries on CT scan in more than 50% of patients with normal initial chest radiograph. In 1997, a prospective study [23] has shown that a CT chest as the primary diagnostic toll in the polytraumatized patient allows a substantially more exact diagnosis of thoracic injuries. Additional information in comparison to conventional radiograph were obtained in up to 65% of the cases and direct therapeutic consequences were noted in 41%of the cases. Therefore, the authors recommended that a CT scan should always be performed in case of abnormal findings on the initial chest X-ray, abnormal clinical findings, respiratory insufficiency, and high-energy thoracic trauma [23]. Looking at the results of two other studies[24,25]contrast-enhanced spiral CT, based on its high sensitivity and negative predictive value, has a critical role in the exclusion of thoracic vessels injuries in patients with major blunt chest trauma. Potentially fatal aortic lesions were diagnosed on CT scan, despite a normal initial chest radiograph in up to 10% of patients[22].The role of routine CT scan in blunt chest trauma is still under debate. The additional diagnostic value of this examination in the recent literature is accepted, the opinion about the effect on clinical outcome is controversial. The majority of studies, however, recommend primary routine chest CT scan in all trauma patients with multiple trauma and suspected thoracic injuries. Additionally, spiral chest CT is becoming a standard practice as an initial diagnostic procedure in most of the major trauma centers. In summary, it is advisable to have CT scan as the first-line exam in blunt chest trauma, only in patients with severe multiple injuries, who require emergency surgery.

Methods

Study design

A prospective study of 80 patients with blunt chest trauma who were treated in a Level 1 trauma centre between January 2017and December 2017 and who had received both CT chest scan and chest X-ray as part of their initial assessment. Data collection from medical records and the trauma registry was approved by the hospital Ethics Committee.

Patients were identified from with either an injury severity score (ISS) greater than 15, an intensive care unit (ICU) admission, a length of icu stay greater than 3 days, injuries to two or more body regions, who were transferred-into the Level 1 trauma centre, or who subsequently died in hospital. Over the 1 year period, a total of 80 patients met this criteria and were included in the study. All of them had sustained blunt trauma to the chest and had received a CT chest scan as well as a chest X-ray during their initial assessment in the emergency department.

Measurements

Information on vital signs (Glasgow Coma Score, systolic blood pressure, heart rate, respiratory rate, respiratory effort); injuries sustained and the injury severity score; clinical findings, such as chest wall bruising or tenderness, reduced air-entry and surgical emphysema; laboratory findings including baseline hemoglobin and arterial blood gas results; therapeutic interventions; outcomes was noted. The radiologist's written report was used to identify abnormal findings on both the chest X-ray and the CT scan.

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All CT scans during the study period were performed With IV-contrast and 2.5 mm slice thickness, reconstructed to 5 mm axial scans from apex to diaphragm and with sagittal reconstructions of the thoraco-lumbar spine with oblique Maximal Intensity Projections of the aortic arch.

Data analysis

In addition to the descriptive statistics, the Mc-Nemar's test was used to compare differences in the

proportion of detected clinical features using both a CT scan and routine chest X-ray. All analyses were conducted using SPSS, Version 12.0 (SPSS Inc., Chicago, IL) software.

Results

Of the 80 patients, 75% (n = 60) were men with the patients ranging in age from 17 to 89 years (mean = 47.2 years). The most common mechanism of blunt trauma to the chest was motorcycle crash(50%, n =40), pedestrian injury (25%, n = 20), motor vehicle crash (15%, n = 12), and fall (10%, n = 8) . table 1

The mean ISS was 24 (range 3—59). Almost 20% of the patients (n = 16) arrived intubated or were intubated in the emergency department. 30% patients (n = 24) had a chest tube placed prior to CT scan and an additional 20% (n = 16) of the chest tubes were placed after obtaining a CT chest scan. Two patient required needle thoracentesis. Fifty percent (n = 40) of the patients underwent an operation including two (2.5%) thoracotomies, 4 (5%) laparotomies, 12 (15%) open reductions and internal fixations of long bones and clavicle,8(10%)craniotomies,12(15%) faciomaxillary operations and 6 (7.5%) rib fixation. Table 2.

Eighty percent of the patients (n = 64) needed admission to ICU 20% of the patients intubated for an average of 5 days and stayed for an average of 8 days. The overall mortality rate of the study participants was 20% (n = 16%).

Ninety percent of patients (n = 72) had at least one pathological finding on CT scan compared to 55% of patients (n = 43) on plain chest X-ray. Additional investigations and/or interventions following CT scan were performed on 20% of patients (n = 16). These included aortic angiography (n = 2), and transesophageal echocardiography (n = 4) for aortic injuries. Thoracotomies was performed 2 patients. Intercostal catheters were required in 16 patients following the CT scan for a pneumothorax that was not seen on a plain chest X-ray or for an additional chest tube for a persisting pneumothorax. Ten percent of patients (n = 8) had no abnormality detected on CT scan. Half of those scans involved intubated patients. A widened mediastinum was suggested in 14 patients following chest X-ray. Hematoma was confirmed on CT scan in six of these; four prevertebral hematomas with vertebral fractures present and two anterior hematomas in the presence of a sternal fracture. In the two remaining cases, CT scanning could not confirm the suspicion of a widened mediastinum. CT scan picked up an additional 21 mediastinal hematomas, two of which were aortic injuries not seen initially on plain X-ray. There were three elevated hemidiaphragms on plain X-ray raising suspicion of diaphragmatic injury. Two were confirmed on CT scan and were repaired at subsequent laparotomy. The third case had an elevation on CT scan as well, but was not confirmed clinically. CT scan was significantly better than routine chest X-ray in detecting lung contusion, pneumothorax, mediastinal hematoma, as well as rib fracture, fractured scapula, fractured sternum and fractured vertebra. Table 3.

Twenty eight patients (35%) had additional findings reported by CT scan beyond that found on their chest X-ray, and a number of clinical features were found to discriminate between findings on a CT chest scan compared to a chest X-ray. All patients with a reduced air-entry (n = 33) in their clinical assessment had an abnormal CT scan. Furthermore, only 5% (3 of 60) patients with chest wall tenderness and 5% (2 of 35) patients with increased respiratory effort had a normal CT chest scan. Twenty-two percent of patients did not have any of these signs but had an abnormal CT scan.

Discussion

In this study, CT chest scanning was significantly more effective in detecting pneumothoraxes and hemopneumothoraxes, lung contusions and mediastinal hematomas compared with a chest X-ray in accordance with several studies that have shown a greater sensitivity for a CT chest scan for detecting intrathoracic injuries.[26,27] Furthermore CT chest scan was significantly better in detecting fractured ribs, scapula, sternums, vertebrae and parenchymal

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abnormalities, such as lung contusions than a chest X-ray.

The majority of patients who require intubation for respiratory failure are usually intubated on clinical grounds and often prior to obtaining a CT scan. Although CT scans may confirm the diagnosis of pulmonary contusion, therapy is based on monitoring physiologic variables, as radiographic findings have not been found to correlate with either mortality or the need for intubation.[3]The relatively low rate of thoracotomy in this study might be due to the exclusion of patients with penetrating trauma and supports again the fact that most thoracic blunt trauma can be treated conservatively.[28]The question of whether the additional information gained with CT scanning changes patient management in this early phase remains controversial. Several studies found changes in patient management of up to 70% in situations where CT chest scans were performed, such as insertion or correction of a chest tube, a change in the mode of ventilation, as well as further investigations and/or interventions.[29] In contrast, other studies have not been able to demonstrate significant therapeutic consequences and consequently, they do not recommend CT chest scans as a routine first assessment.[26,30] In this study, only 20% (n = 16) of the patients with an abnormal CT scan had a subsequent investigation and/or intervention as a direct result of the findings.Of these patients, the majority (70%, n = 56) hadchest wall tenderness, reduced air-entry, increased respiratory effort or a combination of these signs. While an apparently normal CT result might still be of considerable value in the intubated patient, for the remaining patients, factors such astransport out of the resuscitation area, exposure to radiation, possible reaction to the contrast agent, delay in treatment and additional costs need consideration.

Although an abnormal CT scan was found in 90% of patients in this study, the clinical management changed in a minority of these patients on the basis of the CT scan results. Of the 10% of patients with normal scans, half were intubated patients, in whom clinical findings are limited and CT scanning is warranted.

Conclusion

This study found that a CT chest is significantly more likely to yield additional information than a CXR alone when there is presence of chest wall tenderness, reduced air-entry and abnormal respiratory effort. Therefore, in alert patients and in the absence of those clinical findings, the results suggest that selective use of CT chest scanning can be considered. However, in intubated patients, we suggest routine CT chest scan at first assessment. Although the clinical signs we have outlined have some value, clinicians should take in to account all of the clinical features and results of other radiological investigations when making a final decision about the use of CT chest scanning. This may be particularly relevant in situations where a soft tissue injury to heart or aorta is suspected as these may not be present with the above mentioned signs.

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Table 1: showing mode of blunt chest trauma

Mode of injury	Number of patients	percentage
Motor cycle accident	40	50%
Motor vehicle accident	20	25%
Pedestrian injury	12	15%
Fall	8	105

Table 2: Various operative procedures done

Operative procedures	Number of patients	Percentage
Intercostals drains	40	50%
Needle thoracocentesis	2	2.5%
Maxillofacial surgeries	12	15%
Fixation of long bones	12	15%
Craniotomies	8	10%
Laprotomies	4	5%
Rib fixation	6	7.5%
thoracotomies	2	2.5%

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Table 3: Number (%) of positive radiological findings (n=80)

FINDINGS	CxR	CT SCAN	P- Value
Positive finding on	44(55%)	72(90%)	
Rib fractures	28 (35%)	47 (58.75%)	<0.001
Scapula fractures	5 (6.25%)	12 (15%)	0.016
Vertebra fractures	4 (5%)	13 (16.25%)	<0.001
Sternum fractures	2 (2.5%)	10 (12.5%)	<0.001
Clavicle fractures	9 (11.25%)	15 (18.8%)	0.05
pneumothorax	15(18.8%)	25 (31.25%)	<0.001
Haemothorax	10 (11.25%)	16 (20%)	0.063
Haemopneumothorax	2 (2.5%)	10 (12.5%)	<0.001
Lung contusion	14(17.5%)	25 (31.25%)	<0.001
Medistinal haematoma	14(17.5%)	35 (43.75%)	<0.001
Aortic dissection/ rupture	0 (0%)	2 (2.5%)	0.250
Ruptured diaphragm	3 (3.75%)	3 (3.75%)	1

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