Injury, Int. J. Care Injured 46 (2015) 849–853

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

# The significance of routine thoracic computed tomography in patients with blunt chest trauma

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ARTICLE INFO

*Article history:*
Accepted 19 December 2014

*Keywords:*
Chest trauma
CT
Emergency radiology
Thorax

ABSTRACT

*Purpose:* The purpose of this study is to investigate whether the use of thoracic computed tomography (TCT) as part of nonselective computed tomography (CT) guidelines is superior to selective CT during the diagnosis of blunt chest trauma.

*Subjects and methods:* This study was planned as a prospective cohort study, and it was conducted at the emergency department between 2013 and 2014. A total of 260 adult patients who did not meet the exclusion criteria were enrolled in the study. All patients were evaluated by an emergency physician, and their primary surveys were completed based on the Advanced Trauma Life Support (ATLS) principles. Based on the initial findings and ATLS recommendations, patients in whom thoracic CT was indicated were determined (selective CT group). Routine CTs were then performed on all patients.

*Results:* Thoracic injuries were found in 97 (37.3%) patients following routine TCT. In 53 (20%) patients, thoracic injuries were found by selective CT. Routine TCT was able to detect chest injury in 44 (16%) patients for whom selective TCT would not otherwise be ordered based on the EP evaluation (nonselective TCT group). Five (2%) patients in this nonselective TCT group required tube thoracostomy, while there was no additional treatment provided for thoracic injuries in the remaining 39 (15%).

*Conclusion:* In conclusion, we found that the nonselective TCT method was superior to the selective TCT method in detecting thoracic injuries in patients with blunt trauma. Furthermore, we were able to demonstrate that the nonselective TCT method can change the course of patient management albeit at low rates.



## Introduction

Trauma is the third leading cause of death in populations around the world, and chest trauma contributes to approximately 25% of those [1–3]. Therefore, fast and accurate diagnosis of chest trauma as well as prompt and proper intervention is critical in reducing mortality and morbidity from such injuries. However, there is no consensus established yet in medical practice on the most beneficial methods of imaging, which are essential in the diagnostic process [4].

Based on the widely accepted recommendations of Advanced Trauma Life Support (ATLS) guidelines, after physical examination, conventional radiographies, chest X-ray (CXR), pelvic X-ray, and focused abdominal sonography in trauma (FAST) are obtained first during the management of blunt trauma, followed by computed tomography (CT) of the specific body region if indicated. This approach is called the *selective CT method*, and it has remained unchanged in the eighth and ninth editions of ATLS [5–7]. However, the criteria for thoracic computed tomography (TCT) have not been described clearly in the ATLS guidelines. Although some criteria are described for TCT such as clinical suspicion of severe chest injury and thoracolumbar vertebral injury on physical examination, subjective impression of abnormal mediastinum, fracture of more than three ribs, pulmonary consolidation suspected to be

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http://dx.doi.org/10.1016/j.injury.2014.12.022
0020–1383/

pulmonary contusion, and subcutaneous emphysema suspected to be pneumothorax on CXR, most physicians think that these criteria are very subjective. Many studies have reported that injuries such as haemothorax, pneumothorax, and lung contusion can remain undiagnosed by plain CXR [8,9]. In addition, some studies have reported that routine TCT as part of routine whole-body imaging in patients with blunt trauma – *nonselective CT* – is more sensitive than selective CT for detecting thoracic injury [10–12]. Therefore, many trauma centres prefer to use nonselective CT in the management of trauma and use routine TCT in patients with chest trauma.

On the other hand, some concerns have been raised by researchers and clinicians about the use of nonselective CT. One such concern states that using routine TCT can increase the risk of cancer in young populations, is associated with substantial charges, costs, and expenditures, and increases time spent in the emergency department (ED) [13,14]. In addition, some studies have reported that, although routine TCT is superior to CXR in detecting thoracic injuries in patients with blunt trauma, these additional diagnoses do not change the management of patients significantly [15].

The purpose of the present study was to determine whether using routine TCT as a part of nonselective CT in the diagnosis process in patients with blunt chest trauma was superior to selective CT. In addition, we also aimed to determine if additional diagnoses detected by routine TCT would change the course of patient management.

## Materials and methods

### *Study design*

This study was designed as a prospective cohort study, and it was conducted at the ED of the Antakya State Hospital (Turkey) between 1 July 2013 and 1 July 2014. Adult patients (18 years and older) who presented to the ED during the study period with complaints related to blunt chest trauma were enrolled in the study. The exclusion criteria are presented in Table 1. An informed consent form was signed by the patient and/or a family member. The approval of a local ethics committee was also obtained prior to the study.

### *Clinical evaluation, imaging studies, and data collection*

All study patients were evaluated by one of the five emergency physicians (EPs) acting as team leaders. Upon arrival in the ED, an EP conducted a primary survey and patient examination; ordered CXR, other conventional radiographs, and laboratory tests as indicated; and performed a focused assessment with sonography for trauma (FAST). Patients who were found to have tension pneumothorax or those with free abdominal fluids with unstable haemodynamic parameters were directly referred for surgical evaluation and thus excluded from the study. Similarly, patients who developed cardiac arrest during the primary survey underwent cardiac resuscitation, and they were excluded from the study.

After completing the primary survey, the responsible EP recorded the demographic information, vital signs, exam findings, as well as findings from CXR and FAST. Each one of the EPs also decided if patients satisfied the criteria for TCT based on the ATLS selective CT recommendations. The criteria for selective TCT on physical examination were subcutaneous emphysema, asymmetric auscultative findings, tenderness in the chest wall on palpation, and neurological findings to be spinal injury. The criteria for selective TCT on CXR were fracture of more than three ribs, first or second rib fracture, scapular fracture, subjective impression of an abnormal mediastinum, suspicion of lung contusion, haemothorax, and pneumothorax. Following these evaluations, routine TCT was performed on all patients as part of the nonselective CT procedure. The selective TCT group consisted of the patients in whom CXR was abnormal and TCT was decided by the EP, and those with normal CXR but TCT was requested by the EP based on abnormal physical examination findings. On the other hand, the nonselective TCT group consisted of those with normal CXR and physical findings prompting no ordering of TCT by the EP.

Indications of placing the chest tube were open pneumothorax, tension pneumothorax, and pneumothorax detected on CXR (overt pneumothorax) in the selective TCT group. The indications of placing the chest tube for occult pneumothorax (OP), which was not suspected on the basis of either clinical examination or initial CXR but is subsequently detected on a CT scan, were pneumothorax larger than 1 cm; need for positive pressure ventilation; and severe respiratory distress findings such as decreased oxygen saturation, tachypnea, hypoxia, and hypercapnia on arterial blood gases. Finally, we defined clinically significant thoracic injury as pneumothorax when placement of the chest tube or thoracotomy was required, haemothorax when surgical drainage was required, pulmonary contusion when mechanic ventilation including noninvasive mechanic ventilation was required (the clinical criteria for performing mechanic ventilation were as follows: persistent hypoxaemia despite high-flow oxygen supplementation, moderate or severe dyspnoea, acute respiratory acidosis, accessory respiratory muscle recruitment, and paradoxic abdominal movements), and sternum and multiple rib fracture when surgical intervention was required.

All injuries, including thoracic injuries found after the nonselective TCT and corresponding treatment methods, were recorded. Similarly, the Injury Severity Scores (ISS), the ED course, and the patients' length of stay (LOS) in hospital were also recorded.

### *Statistical analysis*

Statistical analyses were performed using SPSS 11.0 (Chicago, IL, USA). The Kolmogorov–Smirnov test was used to assess the normal distribution of the variables. The independent variables were tested with the Mann–Whitney *U* test and expressed as medians with interquartile ranges. The categorical data were analyzed for significance with Pearson's chi-squared test and expressed as numbers and percentiles. A $p$-value $< 0.05$ was considered statistically significant.

**Table 1**
Exclusion criteria.

| |
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| Age <18 years |
| Requirement of urgent surgery or death before TCT |
| Referral to another hospital |
| Missing data |
| Known pregnancy |
| Patients who do not wish to participate in the study |

## Results

A total of 472 patients with blunt chest trauma were evaluated during the study period. Of these, 138 were excluded, because they were under 18 years of age. Similarly, 10 patients who died before the CT exams, 11 patients who underwent emergent surgery, and 32 patients who were referred to tertiary centres were excluded from the study. Another 21 patients were excluded because of incomplete documentation (Fig. 1). The demographic characteristics of the 260 patients included in the study are provided in Table 2. Of these patients, 113 (43.5%) were discharged from the ED, while 47 (18.1%) were admitted to the intensive care unit (ICU)