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Ability of a chest X-ray and an abdominal computed tomography scan to identify traumatic thoracic injury

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Abstract

OBJECTIVE: Our objective was to show that a chest X-ray (CXR) and an abdominal computed tomography (CT) scan are sufficient to identify most clinically significant thoracic injuries in trauma patients, rendering the thoracic CT scan useful in only a subset of patients.

METHODS: A retrospective study identified thoracic injuries in 374 trauma patients evaluated with a CXR, a thoracic CT scan, and an abdominal CT scan. Injuries seen on the initial CXR versus those seen on a CT scan only (occult) were identified and assessed for clinical relevance.

RESULTS: An abdominal CT scan identified 65% (15/23) of occult pneumothoraces, 100% (25/25) of occult hemothoraces, 64% (18/28) of occult pulmonary contusions, and 58% (18/31) of occult rib fractures. No occult pneumothoraces seen on the thoracic CT scan alone required tube thoracostomy.

CONCLUSIONS: Our pilot study suggests that a CXR and an abdominal CT scan will identify most occult intrathoracic injuries. Reserving a thoracic CT scan for patients with an abnormal CXR or high-risk mechanism could safely reduce cost and radiation exposure while still diagnosing significant thoracic injuries.

High-energy blunt thoracic trauma can result in multiple injuries with varying grades of severity. Thoracic injuries contribute to approximately 25% of deaths from trauma.[1] Historically, the standard diagnostic tool for the early evaluation of patients with thoracic trauma in the emergency department is the plain chest radiograph (CXR).[2] Improved diagnostic tools, such as a computed tomography (CT) scan, have clearly been shown to elucidate injuries with greater sensitivity than CXR,[3] leading to an increase in the identification of these injuries. Injuries are considered "overt" if found on initial CXRs. When injuries are seen on a CT scan but not a CXR, they are referred to as "occult" and are frequently of lesser severity.

The current clinical dilemma is whether occult injuries identified by a thoracic CT scan will require aggressive management in the same fashion as diagnoses from plain films or change the management of patients with multiple blunt thoracic injuries. Furthermore, many of these occult injuries may be elucidated on an abdominal CT scan because the regions scanned by thoracic CT and abdominal CT scans overlap. Therefore, the same areas of injury would be captured, rendering a thoracic CT scan unnecessary in most instances.[4] To clarify whether a thoracic CT provides further information, we performed a retrospective study of patients with thoracic injury. Our hypothesis is that most patients with occult thoracic injuries will have been diag-

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Table 1 Comparison of thoracic injuries detected in overt and occult patients

Injury detected	Overt (%)	Occult (ACT) (%)	Occult (TCT only) (%)
Pneumothorax (n = 41)	18 (43.9)	15 (36.6)	8 (19.5)
Hemothorax (n = 35)	10 (28.6)	25 (71.4)	0
Rib fracture (n = 63)	32 (50.8)	18 (28.6)	13 (20.6)
Pulmonary contusion (n = 50)	22 (44)	18 (36)	10 (20)
Aortic injury diagnosed (n = 5)	0	0 (0)	5 (100)
Pericardial effusion (n = 4)	0	4 (100)	0
Thoracic spinal fracture (n = 9)	0	9 (100)	0
Scapula fracture (n = 6)	5 (83.3)	0	1 (16.7)
Clavicle fracture (n = 14)	13 (92.9)	0	1 (7.1)
Sternal fracture (n = 7)	0	0	7 (100)

ACT = abdominal computed tomography; TCT = thoracic computed tomography.

nosed with those same injuries on a routine abdominal CT scan, rendering a thoracic CT scan useful in only a select subset of thoracic trauma patients.

Materials and Methods

This was a retrospective study conducted at our large urban level 1 trauma center. The trauma registry was examined for all thoracic trauma patients admitted to our center with diagnoses of thoracic trauma over the period of April 2007 to June 2007. The University of California, Irvine Medical Center is the only level 1 center in all of Orange County. Information regarding all patients' demographics and objective medical data points was collected and compiled into a database. Included patients were those who received all 3 diagnostic radiologic studies, which included a CXR, a thoracic CT scan, and an abdominal CT scan. All radiologic findings were from final attending radiologist reads.

The mechanism of injury was recorded, along with injury severity (including the Injury Severity Score [ISS], the Revised Trauma Score [RTS], and the Abbreviated Injury Score).[5,6,7] Demographic data collected included patient age, sex, mechanism of injury, hospital length of stay, intensive care unit (ICU) length of stay, and survival. Statistical analysis was performed using the Student *t* test to compare groups. Overt diagnoses were compared with occult findings. All radiographic findings on the abdominal and thoracic CT scans were recorded. We then compared occult findings found on a routine abdominal CT scan with those identified by a thoracic CT scan, with particular attention directed toward identifying injuries that would have been missed if a thoracic CT scan had not been obtained. The clinical management of overt and occult diagnoses was also evaluated and contrasted for clinical significance.

Results

A total of 374 thoracic trauma patients who were examined by a CXR, an abdominal CT scan, and a thoracic CT scan were admitted during the study period, with 341 (91%) sustaining blunt thoracic trauma. The patients were 73% male, had an average age of 34 years, and a 98% survival rate.

The comparison between patients with thoracic injuries detected as overt versus occult revealed that almost all clavicle (93%) and scapula fractures (83%) were seen on a CXR (Table 1). A CXR in combination with an abdominal CT scan identified most thoracic injuries. A CXR detected 44% (18/41) of pneumothoraces, 51% (18/31) of rib fractures, and 44% (22/50) of pulmonary contusions. A CXR yielded 29% (10/35) of hemothoraces, and an abdominal CT identified 71% (25/35) (Table 1). Compared with thoracic CT findings, the abdominal CT scan identified a significant number of occult pneumothoraces (65% [15/23]), 100% (25/25) of occult hemothoraces, 64% (18/28) of occult pulmonary contusions, and 58% (18/31) of occult rib fractures. All occult thoracic spine injuries were seen on an abdominal CT scan (Table 1).

There were 41 patients with pneumothorax. A CXR detected 18 (43%). An abdominal CT scan identified 15 (37%), and 8 (20%) were seen on a thoracic CT scan only. Of patients with overt pneumothorax, 7 of 18 (39%) had a tube thoracostomy placed for clinical suspicion before the initial CXR. Only 8 of 23 (35%) of all occult pneumothoraces required tube thoracostomy. All 8 were identified on an abdominal CT scan, whereas none of the occult pneumothoraces seen on a thoracic CT scan only required intervention (8/15 [53%] vs 0/8 [0%], $P = .009$).

Patients with occult pulmonary contusions were significantly less severely injured, with a lower ISS and a higher RTS as well as fewer cases of severe multisystem trauma as defined by the Abbreviated Injury Scale Score ≥3 in 2 or more body regions (Table 2). Only 1 patient with occult pulmonary contusion required intubation compared with 6 patients with contusion seen on a CXR. Of the patients with occult pulmonary contusions seen on a thoracic CT scan only, none required ICU stay for respiratory complications.

Patients with occult rib fractures were less severely injured (ISS: 14 vs 23 and 18 vs 23, $P = .01$) and required fewer tube thoracostomies compared with patients with