The Journal of Emergency Medicine, Vol. 53, No. 6, pp. 865–870, 2017

0736-4679/$ - see front matter

http://dx.doi.org/10.1016/j.jemermed.2017.08.036

Selected Topics: Emergency Radiology

LOW YIELD OF CLINICALLY SIGNIFICANT INJURY WITH HEAD-TO-PELVIS COMPUTED TOMOGRAPHY IN BLUNT TRAUMA EVALUATION

Shelby P. Murphy, MD, Noah Hawthorne, MD, David Haase, MD, Chika Chiku, BS, Jason Wen, MD, and Robert M. Rodriguez, MD

Department of Emergency Medicine, University of California, San Francisco, San Francisco, California
Corresponding Address: Robert M. Rodriguez, MD, Department of Emergency Medicine, University of California, San Francisco, 1001 Potrero Avenue, San Francisco, CA 94110

☐ **Abstract—Background: Many trauma centers have adopted routine head-to-pelvis computed tomography (CT) imaging for the evaluation of adults with blunt trauma. Objective: We sought to determine the yields of detecting clinically significant injuries (CSIs) with CT in >1 anatomic region. Methods: We conducted this observational cohort study of all trauma activation patients >14 years of age who received CT imaging during blunt trauma evaluation at a Level 1 trauma center from April to October 2014. Expert panels determined the clinical significance of head, neck, chest, abdomen, and pelvis injuries seen on CT. We calculated yields of CSI, defined as the number of patients with CSI divided by the total number of patients who underwent CT imaging. The 3 specified anatomic regions considered were head/neck, chest, and abdomen/pelvis. Results: The median age of 1236 patients who had CT was 48 years; 69% were male; 51.2% were admitted; and hospital mortality was 4.4%. Yields of CSI with 95% confidence intervals (CIs) were: head/neck region injury 11.3% (9.6–13.3%); chest region injury only 7.9% (6.0–10.4%); abdomen/pelvis region injury only 5.1% (3.7–7.0%); both head/neck and chest CSI 2.8% (1.7–4.5%); both head/neck and abdomen/pelvis CSI 1.6% (0.9–2.9%); and both chest and abdomen/pelvis CSI 1.1% (0.5–2.4%). The yield of CSI in all 3 anatomic regions with head-to-pelvis CT was 0.6% (0.2–1.7%), and 76.7% (68.8–83.1%) of CSIs occurred in isolation. Conclusions: During multiple anatomic region CT imagng for adult blunt trauma evaluation, the yield for CSI in >1 region is low. In low-risk populations, selective CT imaging of anatomic regions (instead of reflexive head-to-pelvis CT imaging) may be more appropriate.** © 2017 Elsevier Inc. All rights reserved.

☐ **Keywords—CT; diagnostic yield; head-to-pelvis computed tomography; pan-scan; selective imaging; whole-body CT; yields of CT**

Reprints are not available from the authors.

INTRODUCTION

Although the use of computed tomography (CT) imaging for trauma began primarily with the evaluation of the head and brain, the widespread availability of rapid CT and the desire to detect injuries with high sensitivity has fueled a dramatic rise in chest, abdomen, and pelvis CT over the past decade (1–3). In fact, many trauma centers have adopted routine head-to-pelvis CT imaging protocols, often referred to often as "pan-scan," for adult blunt trauma evaluation—even occasionally in low-risk cases when injury is suspected in only 1 anatomic region.

The indiscriminate use of CT and reflexive pan-scan may be associated with at least 3 major problems: cost, radiation exposure, and the need to workup incidental findings (4–6). The exact costs for CT are essentially impossible to determine, but the median charge for chest CT alone at 9 Level 1 trauma centers in 2013 was $3294, and the charge for head-to-pelvis CT at the lead site for

Received: 7 August 2017;
Accepted: 11 August 2017

Table 1. Multidisciplinary Expert Panel Classification of Clinically Significant Injuries

Anatomic Region	Clinically Significant Injuries
Head/neck	All skull fractures
	Injury in both the head and the neck
	Subdural, epidural hematoma, cerebral hemorrhage, or subarachnoid hemorrhage: received any surgical intervention
	Any other traumatic brain injury with Rotterdam score >2
	All large-vessel vascular injuries in neck
	Any cervical spine fracture that received surgical intervention
	Any fracture associated with C1 or C2
	Fractures in >1 vertebrae
	Any facet injuries
	Any spinal hematoma
	Any vertebral fracture with associated antero- or retrolisthesis
	Cervical spine injury with hematoma or soft-tissue swelling concerning for ligament injury
	Cervical spine injury: any findings that led to MRI
Chest	All aortic or great vessel injuries
	All ruptured diaphragm
	Pneumothorax: received evacuation procedure (chest tube or other procedure)
	Hemothorax: received drainage procedure (chest tube or other procedure)
	Sternal fracture: received surgical intervention
	Multiple rib fracture: received surgical intervention or epidural nerve block
	Pulmonary contusion: received mechanical ventilation of any type
	Thoracic spine injury requiring stabilization or TLSO brace
	≥3 injuries in the chest
Abdomen or pelvis	All abdominal aortic or great vessel injuries
	Splenic injury requiring surgical intervention or blood transfusion
	Liver injury requiring surgical intervention or blood transfusion
	Kidney injury requiring surgical intervention or blood transfusion
	Pancreatic injury requiring surgical intervention or blood transfusion
	Small- or large-bowel injury requiring surgical intervention or blood transfusion
	Bladder or urethra injury requiring surgical intervention or blood transfusion
	Uterine or ovarian injury requiring surgical intervention or blood transfusion
	Pelvic bone fracture requiring blood transfusion, stabilization or surgical intervention
	Lumbar spine fracture requiring stabilization or surgical intervention
	Pelvic vessel injury requiring surgical or interventional radiologic procedure or blood transfusion
	≥3 injuries in the abdomen or pelvis

C = cervical; MRI = magnetic resonance imaging; TLSO = thoracolumbosacral orthosis.

this study was $11,383 (7). Healthcare BlueBook, a listing of fair market value for health care services based on average insurance payments, lists a head-to-pelvis CT value of $2444 (8). In terms of radiation exposure, CT delivers a relatively high effective radiation dose to sensitive organs, which may induce future cancer in young patients who make up a sizable portion of trauma patients (9–11). Incidental abnormalities, especially in the chest, kidneys, adrenal glands, and liver, are commonly seen with CT—detecting these abnormalities with greater frequency may lead to a cascade of additional imaging and obtaining biopsy specimens (5). Head-to-pelvis CT also routinely incorporates intravenous contrast that may place patients at risk for contrast-induced nephropathy (12).

The broad, long-term goals of this research are to improve blunt trauma CT utilization efficiency and to decrease unnecessary CT scans. As a preliminary step toward these goals, we sought to assess the yields of trauma CT of various anatomic regions. Our specific objectives in this study were to determine: 1) the yields of CT for any traumatic injury and for clinically significant injury (CSI) in 3 anatomic regions (i.e., head/neck, chest, and abdomen/pelvis); 2) the rates of concomitant injury seen in >1 of these 3 anatomic regions; and 3) the yield of head-to-pelvis CT for CSI in >1 anatomic region. We hypothesized that the incidence of CSI in >1 anatomic region is low with multianatomic region CT and that the yield of injuries in all 3 regions is very low with head-to-pelvis CT.

METHODS

We conducted this retrospective study of all trauma activation patients >14 years of age who received CT imaging as part of their blunt trauma evaluation at an urban Level 1 trauma center emergency department between April and October 2014. We identified patients from our trauma database and used standard chart abstraction techniques (with checks on interabstractor reliability) to review radiology reports and emergency department and inpatient charts.

We recorded all injuries noted on CT readings in 3 anatomic regions: the head/neck, chest, and abdomen/pelvis. Our primary outcome of CSI was determined a priori by classifying injuries via expert panel consensus. To classify head/cervical spine injuries, we convened a panel