

Yield of whole-body computed tomography at a low-volume emergency department

A 5-year experience

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ABSTRACT

الأهداف: مشاركة خبرتنا مع التصوير المقطعي المحوسب لكامل الجسم (WBCT) لمرضى الصدمات وتحديد ارتباطها بالتدخل الجراحي ودخول المستشفى.

المنهجية: تضمنت هذه الدراسة الاسترجاعية 208 من مريض مصاب برضوض قدموا إلى قسم الطوارئ وخضعوا ل WBCT في مستشفى جامعة الملك عبد العزيز، جدة، المملكة العربية السعودية خلال الفترة من يناير 2014م ونوفمبر 2018م. استبعدنا المرضى الحوامل وأولئك الذين تعرضوا لسكتة قلبية رضحية أو سكتة قلبية أو توفي قبل التصوير.

النتائج: من بين جميع المرضى المشمولين في هذه الدراسة، كان 48.6% من البالغين و 72.1% لديهم نتائج إيجابية. من بين هؤلاء، تم إدخال 36.7% من المرضى للملاحظة و 27.3% خضعوا لتدخلات جراحية.

الخلاصة: يعد التصوير المقطعي المحوسب لكامل الجسم أداة مفيدة للكشف عن الإصابات الرضية الكبيرة في المرضى الذين يقدمون إلى قسم الطوارئ. علاوة على ذلك، قد يساعد الأطباء في تحديد استعداد هؤلاء المرضى للمرض. يجب وضع مجموعة واضحة من المعايير لتحديد مرضى الصدمات الذين يحتاجون إلى تصوير WBCT أثناء الإنعاش الأولي.

Objectives: To share our experience with immediate whole-body computed tomography (WBCT) imaging for trauma patients and to determine its association with surgical intervention and hospital admission.

Methods: This retrospective observational study included 208 trauma patients who presented to the emergency department and underwent WBCT at the King Abdulaziz University Hospital, Jeddah, Saudi Arabia between January 2014 and November 2018. We excluded pregnant patients and those who went into traumatic cardiac arrest or died before imaging.

Results: Of all included patients, 48.6% were adults and 72.1% had positive findings; of these, 36.7% of patients were admitted for observation and 27.3% underwent operative interventions.

Conclusion: Whole-body computed tomography is a useful tool to detect significant traumatic injuries in patients presenting to the emergency department. Moreover, it may assist physicians in determining the disposition of these patients. A clear set of criteria should be established to determine which trauma patients require WBCT imaging during initial resuscitation.

Keywords: WBCT, Trauma, emergency department

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Recently, the use of computed tomography for injury detection has increased tremendously owing to advances in imaging technology.¹ Nevertheless, selecting the appropriate approach for trauma patients, whole-body computed tomography (WBCT) or selective computed tomography, remains controversial.² Some studies suggest that the use of WBCT immediately after resuscitation results in a survival benefit for trauma patients,³⁻⁵ whereas other studies indicated that this approach resulted in an increase in radiation exposure and treatment cost without a change in patient mortality.⁶⁻⁸ Therefore, the decision of which approach to follow for these patients lacks the guidance of high-level evidence.

Emergency clinicians advocate the use of WBCT as a screening and diagnostic tool, replacing the use of plain film imaging in certain situations.⁹⁻¹¹ Early detection of clinically significant injuries facilitates timely decision-making.³ Studies showed that treatment decisions changed after using WBCT during initial trauma resuscitation.^{12,13} Moreover, the REACT-2 trial showed that the immediate application of this modality is safe, shortens decision time, and does not increase medical costs; however, the survival of patients remains unchanged.^{14,15} Our study aimed to share our experience using immediate WBCT imaging for trauma patients and to determine its association with surgical intervention and hospital admission.

Methods. We conducted a retrospective observational study at a tertiary academic institution at the King Abdulaziz University Hospital (KAUH). The study was approved by the Institutional Review Board of KAUH. The emergency department (ED) attended approximately 60,000-65,000 patients each year. We included patients between January 2014 and November 2018, of all age groups who underwent WBCT for traumatic injuries within the first 6 hours of ED presentation. Pregnant patients, those who went into traumatic cardiac arrest or died before imaging, and those who underwent WBCT after the initial 6-hour period were excluded. This imaging modality is indicated for patients with severe mechanism trauma, altered mental state impeding accurate physical examination, and suspected multiple-system trauma; ultimately, attending emergency physicians ordered a WBCT based on their clinical judgment. We used the following key words on PubMed and Google Scholar to search for previous research on the topic; “whole-body computed tomography imaging in trauma”, “WBCT in trauma and surgical intervention”, “WBCT in trauma and hospital admission”, “utility of WBCT in low volume trauma units”.

All patients were transported from the ED to the radiology suite for a WBCT image. All computed tomography (CT) images were obtained using a Siemens Somatom 64-slice (Siemens Healthineers, Germany). Whole-body computed tomography consisted of the following protocol: i) non-contrast

head CT scan, ii) non-contrast CT scan of the cervical spine from the base of the skull to the level of the second thoracic vertebra, and iii) contrast-enhanced CT scan of the thorax, abdomen, and pelvic region from the level of the sixth cervical vertebra to the lesser trochanter. Slice thickness was set at 2 mm for the head, C-spine, abdomen, and pelvis scan; and 1.5 mm for the thorax scan. After completion of the head and neck CT scans, the patient’s arms were placed above their head. Regarding the contrast medium injection, a 120-mL bolus of iso-osmolar, non-ionic iodinated contrast material (350 mg of iodine per millimeter, iohexol [Omnipaque 350; GE Healthcare, United Kingdom]) was injected into the patient’s antecubital vein at a flow rate of 2-4 mL/s, followed by 40 mL of saline flush. Whole-body computed tomography images were interpreted by the on-call radiologic resident under the supervision of a senior radiologist.

The primary endpoint of our study was to describe the rate of positive (injury) findings using the WBCT approach. The secondary endpoint was the associations between WBCT imaging and the rate of admission or operative intervention. The following patient data were collected: demographic data (medical record number, age, gender, date of birth, and nationality), date and time of ED triage, date and time of WBCT, presence or absence of injuries on WBCT images, location of injuries, and operation and/or admission.

The data were entered into Excel 2016 and statistical analyses were performed using SPSS for Windows (version 21.0, IBM, Armonk, NY). The Chi-squared test was used to compare the differences between bivariate categorical variables. The level of significance was set at $p < 0.05$.

Results. Over the 5-year period covered in this study, 208 patients met the inclusion criteria and were included in the analysis. **Table 1** provides an overview of their demographic characteristics. The mean \pm standard deviation age of male was 26.2 ± 17.1 and female patients was 25 ± 18.3 years. Patients of both gender did not differ significantly in the presence of positive findings. Of all patients included in this study, 150 (72.1%) had positive findings and 93 (48.4%) were adults.

Table 2 summarizes the results of WBCT imaging. The most common mechanism of trauma in our study was motor vehicle collision ($n=140$ [67.3%] patients). Of these, male patients were the majority ($n=113$ [80.7%] patients). Of the 150 patients with positive findings on WBCT, 55 (36.7%) were hospitalized for observation and 41 (27.3%) underwent operative intervention. **Table 3** shows hospital admission and

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Table 1 - Demographic characteristics of 208 patients who underwent whole-body computed tomography between January 2014 and November 2018.

Demographic data	n (%)
Gender	
Male	170 (81.7)
Female	38 (18.3)
Age group¹⁵	
Infants (1-23 months)	3 (1.4)
Preschool (24-71 months)	20 (9.6)
Children (6-12 years)	27 (13)
Adolescents (13-18 years)	25 (12)
Adults (19-44 years)	101 (48.6)
Middle age and older adults (≥45 years)	32 (15.4)
Nationality	
Saudi	92 (44.2)
Non-Saudi	116 (55.8)

operative intervention according to trauma patient parameters. There was no statistical association between WBCT imaging with surgical intervention ($p=0.72$) and hospital admission ($p=0.13$).

Discussion. Multiple-trauma patients often require complex, multidisciplinary care. This care starts with timely and accurate identification of injuries requiring surgical intervention. The presence of a multidisciplinary trauma team at designated trauma centers allows for a thorough evaluation during the initial assessment of patients. However, hospitals with a low volume of trauma patients may not have such a team to evaluate and manage these patients. Our study comprised a 5-year period and included 208 patients, which is considered an extremely low volume of trauma patients.

Table 2 - Whole-body computed tomography imaging results of 208 patients.

Results	Number (%)
Brain	
Normal	106 (51)
Abnormal	119 (57.2)
Hemorrhage ^a	26 (12.5)
Hematoma ^b	27 (13)
Contusion	19 (9.1)
Fracture	44 (21.2)
Herniation	3 (1.4)
Cervical spine	
Normal	142 (68.3)
Abnormal	42 (20.1)
Subluxation	3 (1.4)
Fracture	21 (10.1)
Emphysema	4 (1.9)
Others	14 (6.8)
Chest	
Normal	88 (42.3)
Abnormal	144 (69.2)
Pneumothorax	28 (13.5)
Emphysema	10 (4.8)
Fracture	38 (18.3)
Hemorrhage	5 (2.4)
Contusion	41 (19.7)
Hemopneumothorax	9 (4.3)
Aspiration	13 (6.3)
Abdomen and pelvis	
Normal	108 (51.9)
Abnormal	86 (41.1)
Hematoma	20 (9.6)
Hemorrhage	2 (1)
Contusion	8 (3.8)
Fracture	29 (13.9)
Free fluid	11 (5.3)
Splenic injury	7 (3.4)
Kidney injury	6 (2.9)
Liver laceration	3 (1.4)

^acontained bleeding, ^bactive bleeding

Table 3 - Hospital admission and operative intervention according to trauma patient parameters.

Parameter	Admission only		P-value	Operative intervention		P-value
	Yes n (%)	No n (%)		Yes n (%)	No n (%)	
Age group¹⁵						
Infants (1-23 months)	1 (1.8)	0 (0)	0.13	0 (0)	1 (1)	0.72
Preschool (24-71 months)	8 (14.5)	7 (8.2)		2 (4.9)	13 (13.1)	
Children (6-12 years)	6 (10.9)	14 (16.6)		6 (14.6)	14 (14.1)	
Adolescents (13-18 years)	2 (3.6)	10 (11.8)		4 (9.8)	8 (8.1)	
Adults (19-44 years)	26 (47.3)	44 (51.8)		23 (56.1)	47 (47.5)	
Middle age and older adults (≥45 years)	12 (21.8)	10 (11.8)		6 (14.6)	16 (16.2)	

At our institution, emergency physicians are primarily responsible for the initial evaluation, management, and disposition of these patients. The use of WBCT for trauma patients may represent a high-value diagnostic tool at centers with a low volume of trauma patients.

Our study revealed that WBCT imaging confirmed injuries in 72.1% of patients. Of these, 36.7% required hospital admission for observation and 27.3% required surgical intervention. These findings highlight the usefulness of WBCT in detecting injuries during the first few hours of trauma care.¹⁶

Additionally, this indicates that the use of WBCT is not superfluous; physicians at low-volume trauma centers can reasonably use this modality to safely disposition multi-system trauma patients, especially considering the unavailability of specialized medical professionals to assist in the assessment and care of these patients.¹⁷

Moreover, our study demonstrated that WBCT imaging detected high rates of injury in different anatomical locations: 57.2% of patients had evidence of traumatic brain injury, 20.1% had evidence of cervical spine injury, 69.2% had evidence of thoracic injury, and 41.1% had evidence of abdominal/pelvic injury. However, the initial trauma survey for these patients was unclear. It is likely, that patients with more severe and clinically unevaluable injuries will undergo WBCT. Most clinicians will advocate for WBCT imaging in this patient population. However, our study does not provide insight on the utility of WBCT in clinically evaluable patients.

Based on the results of our study, surgical intervention and hospital admission is not statistically associated with WBCT imaging. However, the rates of injury detection in patients receiving WBCT was high.

Study limitations. The low number of patients included in this study is a significant limitation. Moreover, this retrospective study was conducted during a time in which clear trauma guidelines were absent. Due to the lack of objective criteria to determine injury severity at our institution (namely, injury severity scale), we are unable to determine the severity of trauma victims. Additionally, it is possible that patients who were not clinically evaluable due to impaired consciousness, endotracheal intubation, or distracting painful injuries may have undergone more WBCT imaging. However, this remains unclear in our paper.

In conclusion, WBCT is a useful tool for detecting significant traumatic injuries in patients with multi-system trauma victims presenting to the ED. Moreover, this tool may assist emergency physicians in determining

the disposition of these patients. However, we are unable to make solid conclusions as to which patient will likely benefit from WBCT imaging. Guidelines should be developed to further assist physicians in determining which trauma patients require WBCT imaging during initial resuscitation. Future studies focusing on the utility of WBCT in clinically evaluable trauma patients would provide more insight in the topic.

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