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ORIGINAL RESEARCH

Prospective Evaluation of a Protocol of Whole Body CT based only in Mechanism of Injury in Major Trauma Patients

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ABSTRACT

Background: There is an important increase in the use of whole body computed tomography (WBCT) around the world although its benefits are still controversial.

We hypothesized that the use of a WBCT protocol in the major trauma patients based on mechanism of injury alone would reduce the number of injuries that would have been missed if CT was only done based on clinical findings.

Study design: A prospective observational study with the inclusion of 144 patients with major blunt trauma during 5 months at our academic center. Data were collected from all patients including: epidemiology, clinical status on scene and at the emergency department, time of the scan (including patient handling), clinical findings during initial assessment and WBCT scan findings, dividing exams in with or without findings (normal). Looking for findings that would go unnoticed if CT was done based on clinical findings. Glasgow coma scale (GCS) 15 and GCS <15 were compared and data are presented as absolute values of mean ± SD. Analysis of data was done with Chi-square test ($p < 0.05$).

Results: One hundred forty-four patients with major trauma that were included in the protocol. Normal CT scan was found in 44 cases and 100 scans had at least one positive finding associated with the trauma and 35 CTs (25%) had at least one injury that would be missed without the WBCT protocol. Glasgow coma scale of 15 patients and those with 14 or less were compared regarding the number of normal *vs* positive scan ($p = 0.45$) and for scans with unnoticed injuries ($p = 0.1$) and there was no difference between the two groups.

Conclusion: A significant number of injuries would have been missed if a WBCT scan protocol based on mechanism of injury was not used in our center. There was no difference in the number of probably missed injuries in patients with a GCS = 15 or those with GCS ≤14.

Keywords: Computed tomography, Major trauma evaluation, Whole body computed tomography.

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INTRODUCTION

Trauma is the 4th cause of death in the world killing more than 5 million people every year. In Brazil, the investments made in care, research and prevention of trauma are inversely proportional to the rapid progression of trauma and violence.

The use of whole body computed tomography (WBCT) scanning is rapidly increasing around the world, especially in North America and Europe. In Sweden, for example, 94% of its hospitals have been using major trauma CT scanning since 2001. Nowadays that is possible due to modern multichannels CT scans that allows a fast exam without impairing the evaluation of major trauma patients, and still acquiring good quality images.

Despite the rapid increase in WBCT conducted, the benefit of this technology in the care of the major trauma is still controversial. It could provide earlier diagnosis, leading to a faster transfer to the OR, resulting in better outcomes, as it is known that delayed surgical procedures are one of the causes of preventable deaths in trauma. Another fact that supports the use WBCT is the earlier hospital discharge of patients with major trauma and a normal exam. On the other hand we cannot oversee the use of radiation, higher costs and the risks of transporting unstable patients to the scan.

Hypothesis

We hypothesized that the use of a WBCT protocol in the major trauma patients based on mechanism of injury alone would reduce the number of injuries that would have been missed if CT was only done based on clinical findings associated with the thorax and pelvis X-ray. We also sought to examine if there was a difference between patients with a GCS of 15 or less.

Note: Paper presented in Resident Research Competition at the Annual Congress of Panamerican Trauma Society, Panama City, Panama, November 2015.

Table 1: Targeted regions for CT scan before and after WBCT

Before WBCT Protocol			*Whole Body CT Protocol*
Head/cervical	*Thorax*	*Abdomen/pelvis*	- Road traffic collision with presumed high-energy trauma (> 50 km/h).
- GCS score < 15	Chest X-ray alterations:	- Abdominal pain	- Evidenced by extrication or death at the scene.
- Age > 60 years	- Widening mediastinum	- FAST +	- Victim ejected from the vehicle.
- Age < 5 years	- Clavicle fracture	- Pelvic X-ray with fracture	- Pedestrian struck.
- Vomiting > two episodes	- Suspected vascular injury	- Hematuria	- Fall from height > 3 meters.
- Coagulation disorders			- Unknown mechanism of trauma.
- Amnesia			- Patient physical examination unconditionally reliable
- Mechanism of trauma			

MATERIAL AND METHODS

We performed a prospective observational study starting in June/2013 with the inclusion of 144 patients with major blunt trauma during 5 months at our academic center. Constituted the sample of the present study all patients with major trauma treated in the emergency room of our service with indication of whole body CT by the protocol. Patients transferred from other services and with more than 12 hours after injury were excluded. Before the introduction of our protocol CT scans were targeted to specific body regions and performed based on clinical findings (Table 1).

We prospectively collected data from all patients including: patient age and sex, mechanism of injury, respiratory rate, blood pressure, heart rate and Glasgow coma scale (GCS) on scene and at the emergency department, time of the scan (including patient handling), clinical findings during initial assessment and WBCT scan findings.

A senior radiologist saw all scans. We divided exams in with or without findings (normal). We also considered normal (without significant findings) those exams with the following findings: subgaleal hematoma, mild soft-tissues injuries and limb fractures.

For analyzing the findings that would go unnoticed without the protocol the scans were divided by body

Table 2: Results of the injuries that would go unnoticed without the protocol of WBCT

Findings WBCT				
Normal CT			*44*	
Positive CT			*100*	
Findings by body segments	*Positive*	*Negative*	*Injuries that would have been missed*	
Head/Neck	60 (42%)	84	3 (2%)	- Internal carotid dissection
				- Thrombosis of the left jugular vein
				- Internal carotid dissection
Thorax	58 (40%)	86	12 (8%)	- Hemothorax (x2)
				- Moderate pneumothorax (x2)
				- Superior mediastinum hematoma
				- Traumatic aortic rupture
				- Minor pneumothorax (x6)
Abdomen	26 (18%)	118	8 (6%)	- Dissection of bilateral iliac arteries
				- Hepatic trauma (2x Grade III)
				- Splenic trauma (1x Grade III)
				- Renal trauma (2x Grade I + Grade II)
				- Aortic dissection with no perfusion of left kidney
Pelvis/vertebrae	28 (19%)	116	12 (8%)	- Fracture of T12
				- Fractures of T5–7
				- Fractures of T11–12, L3–4
				- Fractures of T8–10
				- Fracture of L5 + pubic branches + sacrum
				- Fractures of L1–2
				- Left psoas hematoma with active bleeding
				- Fractures of L1–4
				- Fracture of L3
				- Fractures of T5, T6, T9
				- Fractures of L1, L5
WBCT with possible missed injuries	35 (25%)			

segments: head/neck, thorax, abdomen, pelvis/thoracic and lumbar vertebras.

Head and neck missed injuries were only those found on the angiography phase of the CT scan. Thoracic mild injuries as: simple costal fractures and small pulmonary contusions were not included in the analysis. In the abdomen we only considered as possible missed injuries those found in patients that had normal abdominal exam and/or negative FAST and/or no hematuria. Pelvic and vertebrae injuries were only included in patients without any clinical finding during initial assessment.

We compared patients with a GCS 15 and GCS < 15, and between body segments. Data are presented as absolute values of mean ± SD unless otherwise stated. Analysis of categorical independent non-parametric data was done with Chi-square test ($p < 0.05$).

RESULTS

We had a total of 144 patients in the 5 months period of the study with major trauma that were submitted to whole body CT scan. Of those 120 (83%) were men and mean age was 25 years (±17). The mean time to start the scan after indication was 59 minutes (±48) and 30 minutes (±13) for completing the exam and returnig to the ED. The main mechanism of injury was fall from height greater than 3 m in 42 cases (29%), followed by motorcycle accidents in 33 (23%), runovers in 32 (22%), car accidents in 29 (20%) and aggression in 7 (5%).

A normal CT scan was found in 44 cases and 100 scans had at least one positive finding associated with the trauma and 35 exams (25%) had at least one injury that would be missed without the WBCT protocol (comparer com outros dados). In Table 2, we show the results of the injuries that would go unnoticed without the protocol of WBCT divided by body segments. We compare patients with a GCS of 15 and those with 14 or less regarding the number of normal *vs* positive scan ($p = 0,45$) and for scans with unnoticed injuries ($p = 0,1$) and there was no difference between the two groups.

DISCUSSION

A significant number of injuries would have been missed if a WBCT scan protocol based on mechanism of injury was not used in our center. There was no difference in the number of probably missed injuries in patients with a GCS = 15 or those with GCS ≤14.

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Trauma care emphasizes the early detection and treatment of injury in the initial assessment of the patient. Computed tomography (CT) has revolutionized the field of imaging and medicine and it is associated with reduced missed injury rates and reduced delays to definitive management. The introduction of multislice CT in 1998 made whole-body CT (WBCT) technically feasible, with high diagnostic safety, and substantial reduction in scan time. Many trauma centers have advocated the use of WBCT in the primary phase of trauma care, replacing plain radiography. Nowadays many trauma guidelines consider the practice of WBCT scan as a standard of care in the early stage of trauma management in order to analyze the extent of injury. Huber-Wagner et al published a retrospective data from the trauma registry of the German Trauma Society and showed in this multicenter analysis that the use of WBCT in early trauma care significantly decreased the probability of death in trauma patients.

The liberal use of CT is not without potential consequences. Whether the advantages of this technique justify its use against cost and radiation exposure associated to the increase of individual's risk of cancer is controversial. Protocols for WBCT with single-pass acquisition sequence to scan the head, neck, chest, abdomen, and pelvis result in lower radiation exposure than do segmented, partially overlapping protocols.

In this prospective study, the authors from Sao Paulo, Brazil, presented the initial experience after adopt a new protocol considering the mechanism of injury with high energy to indicate WBCT. The criteria followed before WBCT protocol considered mechanism of trauma only to perform head and cervical CT and thorax and pelvic X-rays were decisive to triage the patients to WBCT. The study started in June 2013, but is possible that segmental scan CT was performed in selected cases based on mechanism of trauma before this period.

There is no unified imaging protocol for the trauma patient and the differences in the type of CT machines and automatic injectors have resulted in a variety of imaging protocols. The authors should give more details about their WBCT protocol, like the CT scanner characteristics, slice thickness, contrast protocol and if iterative reconstructions were available. In the present study, the WBCT was evaluated by a senior radiologist, but we know if you have more senior professionals evaluating the exams is possible to increase a little more the accuracy.

Evaluating 144 cases the authors identified normal WBCT in 30.5% of cases. Some studies have advocated the selective use of WBCT according to clinical judgment to significantly reduce the number of WBCT scans for blunt trauma, considering the exam unjustified in the absence of a clinical indication. The incidence of at least one injury that would be missed without the WBCT protocol was 25%. This is in accordance with the literature. The study identified more findings in thorax CT, mainly pneumothorax, what can be dangerous in asymptomatic patients. Other studies have suggested that the occult injuries found on routine CT scanning might have little impact on patient management or prognosis.

Other important finding in the present study was the same incidence of normal or positive scan, and the same incidence of unnoticed injuries in the two groups: patients with Glasgow coma scale (GCS) of 15, and patients with GCS less than 15. We can conclude that even in asymptomatic trauma patients after high-energy mechanism is possible to identify injuries at WBCT.

There are some limitations of the present study. A relatively small but acceptable cohort of patients was examined in order to compare the two protocols. Although the results reached interesting conclusions, further studies with larger cohorts of patients are warranted to answer the question if routine WBCT for patients with high-energy blunt trauma is necessary.

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