Journal of Trauma & Treatment
ISSN: 2167-1222

Rad et al., J Trauma Treat 2013, 2.1
DOI: 10.4172/2167-1222.1000158

Research Article Open Access

CT in Acute Trauma: Observations from a Level One Trauma Centre in Western Australia

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Abstract

Background: The use of diagnostic imaging in medicine has changed with the advancement of technology – now faster, more detailed and more available. Advanced Trauma Life Support (ATLS) provides clear criteria for plain film assessment but the guidance on CT scanning in acute trauma is defined less well and depends upon national guidelines and local protocols. There has been a marked increase in the use of CT across the spectrum of trauma patients. This has paved the advent of multiple scans on admission and Whole-Body CT (WBCT) scans during resuscitation. The question is: Is it truly indicated?

Methods: Over a ten-month period from June 2011 to April 2012, 100 adults admitted to the state trauma unit were randomly selected for prospective data collection. Our primary outcome was mortality and our secondary outcome was identification of a Significant Injury (SI) on CT scanning. A significant injury was defined as; any finding on CT which resulted in a change of management.

Results: There were 100 patients recruited for prospective data collection during ten months, from June 2011 and April 2012. The study population was predominantly males (79%), from the metropolitan area, involved in motor vehicle accidents. Mortality rate was 0% at three months follow up. The prevalence of significant injury demonstrated on WBCT and regional body CT appear equivocal, with the exception of CT pelvis.

Conclusion: In the acute trauma setting CT of head and cervical spine delivers valuable clinical information in a timely and low cost manner. With consideration for cost and long term implications on patient safety, we believe that further scanning of the Chest/Abdomen/Pelvis should be clinically driven. We propose that continued careful history taking and physical examination remain a key component to assessing the indication for CT Chest/Abdomen/Pelvis in acute trauma patients.

Keywords: Trauma; CT scan; Pan-man scan

Introduction

The use of diagnostic imaging in medicine has changed with the advancement of technology –now faster, more detailed and more available. The medical profession has overcome Computed Tomography (CT) being too time consuming in the acute trauma setting [1]. This has paved the advent of multiple scans on admission and Whole-Body CT (WBCT) scans during resuscitation. The question is: Is it truly indicated?

In the U.S. almost 41 million radiographic procedures and 8 million CT or MRI examinations were recorded in emergency departments in 2002 [1]. A 2007 estimate of overall CT use reports 62 million scans per annum in U.S. alone. Further, it has been calculated, that from 1995 to 2007 the number of CT examinations for ED presentations increased from 2.7 to 16.2 million. This equates to a compound annual growth of 16 percent [2-4].

Advanced Trauma Life Support (ATLS) provides clear criteria for plain film assessment but the guidance on CT scanning in acute trauma is defined less well and depends upon national guidelines and local protocols [5]. Currently, there appears to be two opposing schools of thought in the literature. A growing disquiet has developed amongst practitioners regarding overuse of CT, the ethics and risks involved and undocumented long-term complications of increased radiation exposure [6]. On the other hand it has been proposed that WBCT should be considered to be part of a modified advanced trauma life support treatment [7] or even scanning unexamined patients [8]. This is a continuation of the shift in practice from clinically directed investigations to imaging intensive evaluation of patients.

A recent retrospective multi-centre study favoured the use of whole body CT in the acute severely injured patient setting. It linked WBCT and increased survival [9]. However the indications for WBCT were not clearly defined nor did it show causality, rather association [9]. Following this Sierink et al. [10] have commenced a multicentre, randomized controlled trial of immediate WBCT scanning in trauma patients [10]. Again this trial focuses on severely injured patients.

The arrival of WBCT is but a reflection of the ongoing expansion of CT use in all trauma care. Smucker et al. [11] recently investigated radiation exposure in the trauma patient over a six year period comparing samples from 2002, 2005 and 2008 [11]. In this study, trauma patients were divided into three categories, category 1 being most severe and category 3 being the most stable. This demonstrated a marked increase in CT scans not just for category 1 but also less severely injured category 2 patients. They also noted a marked increase in overall radiation dose. Interestingly, in 2008 category 2 patients averaged a higher total dose than category 1 at 33.6 mSv and 37.5 mSv respectively.

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Received February 07, 2013; **Accepted** February 26, 2013; **Published** February 28, 2013

Citation: Rad H, Tristan Cassidy J, Halloran EO, Zellweger R (2013) CT in Acute Trauma: Observations from a Level One Trauma Centre in Western Australia. J Trauma Treat 2: 158. doi:10.4172/2167-1222.1000158

These findings were also associated with significant cost rises consistent with increased scanning, equating to over $3000 increase in category 2 patients from 2002-2008. Despite this escalation of cost and investigation, there was no associated change in injury severity (as measured by Injury Severity Score (ISS)) or mortality over time [11].

There has been a marked increase in the use of CT across the spectrum of trauma patients. We question the clinical need for this additional costly practice which is not without long term risk [4]. Using data from a level-one trauma centre in Australia we examined current CT practices. We hypothesized that CT was becoming routine in acute trauma patients. We planned to use our findings as a platform for further research.

Methods

Over a ten month period from June 2011 to April 2012, 100 adults admitted to the state trauma unit were randomly selected for prospective data collection. All adults for whom a trauma call was activated were eligible for inclusion. From this cohort 4 patients were excluded from the study due to incomplete data. Statistical analysis was performed on 96 participants in total. Mortality was reviewed at three months post injury.

Our primary outcome was mortality and our secondary outcome was identification of a Significant Injury (SI) on CT scanning. SI was identified from radiologist reported CT scans. A significant injury was defined as any finding on CT which resulted in a change of management. Change in medical therapies, further investigations, surgical intervention and change of clinical care were all classified as a change in management.

Descriptive statistical analysis was performed on the study cohort. Comparisons were made between conventional regional body CT examinations and WBCTs. Spectrum bias was addressed by analysing the largest group, Motor Vehicle Accidents (MVA), separately.

Results

There were 100 patients recruited for prospective data collection during ten months, from June 2011 and April 2012. Patients with incomplete data were excluded; statistical analysis was performed on 96 participants in total.

Table 1 represents the demographics of the study cohort. The study population was predominantly males (79%), from the metropolitan area, involved in motor vehicle accidents. Fifty per cent of the cohort was aged between 27 and 56 years. Almost one third of patients had alcohol intoxication. The MVA group had high rates of intubation (16%) and often impaired GCS on presentation, consistent with the high-energy mechanism of injury.

Mortality rate was 0% at three months follow up. Table 2 shows SIs found per CT scan by region. Table 3 further compares significant injuries identified by WBCT and regional CT. The prevalence of significant injury demonstrated on WBCT and regional body CT appear equivocal, with the exception of CT pelvis. It is important to note that the high risk, MVA group account for 78% of patients in the WBCT group. The average yield of significant injury from WBCT was 1.4 significant injuries per case. Figure 1 graphically represents the scanning trends in the MVA group, in general more regional CT scans were performed, however many patients had more than one body region scanned simultaneously (figure 2). In particular, the majority of regional CT scans were of the head and cervical spine combined.

Characteristic	Study Cohort n=96 No. (%)	MVA Subgroup n=57 No. (%)
Age (years) Median (IQR) †; Minimum, Maximum	39 (27-56); 17,87	43 (27-58); 17, 87
Gender		
Male	76 (79)	39 (68)
Female	20 (21)	18 (32)
Alcohol Intoxication	27 (28)	18 (32)
Arrived Intubated	12 (12.5)	9 (16)
Glasgow Coma Score (GCS)		
14-15	82 (85.5)	49 (86)
9-13	11 (11.5)	5 (9)
≤ 8	3 (3)	3 (5)
Mechanism of Injury		
Motor vehicle accident (MVA)	57 (59)	
Motorbicycle accident (MBA)	20 (21)	
Fall	12 (13)	
Interpersonal violence (IPV)	5 (5)	
Crush	2 (2)	

† IQR: Interquartile range

Table 1: Demographic of 96 adults, randomly selected for prospective data collection during a 10 month period following acute trauma injury, Western Australia.

CT Body Region	No. (%)
Head	63 (66)
Significant Injury	21 (33)
Performed as part of WBCT	27 (43)
Performed as regional CT	36 (57)
Concurrent CT C-Spine	33 (52)
C-Spine	77 (80)
Significant Injury	25 (32)
Prior X-Ray	24 (31)
Chest	45 (47)
Significant Injury found	19 (42)
Performed as part of WBCT	27 (60)
Abdomen	57 (59)
Significant Injury	17 (30)
Performed as part of WBCT	27 (47)
CT Pelvis	47 (49)
Significant Injury	11 (23)
Performed as part of WBCT	27 (57)

Table 2: Results of all CT imaging.

	WBCT n=27 No. (%)		Regional body CT n=66 No (%)	
Age(years) Median (IQR) †; Minimum, Maximum	34 (22-47); 18, 83		39 (25-39); 17, 87	
Prehospital				
Intubated	9 (33)		3 (4.5)	
In Hospital				
Intoxicated	8 (30)		19 (29)	
Admitted to ICU	13 (48)		5 (8)	
	All WBCT	MVA n=21	All regional CT	MVA n=36
Significant injuries	39	22	93	34
CT Head	9 (33)	7	21 (33)	5
CT C-Spine	9 (33)	4	25 (32)	14
CT Chest	11 (40)	4	19 (42)	5
CT Abdomen	8 (30)	4	17 (30)	7
CT Pelvis	4 (15)	3	11 (23)	3

Table 3: Comparison of significant injuries demonstrated on WBCT and regional body CT.

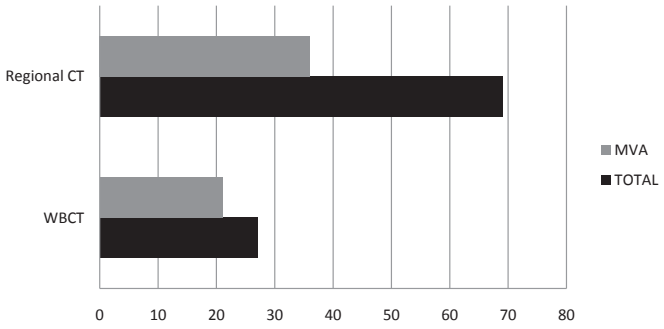

Figure 1: Proportion of Regional and WBCT performed in MVA group.

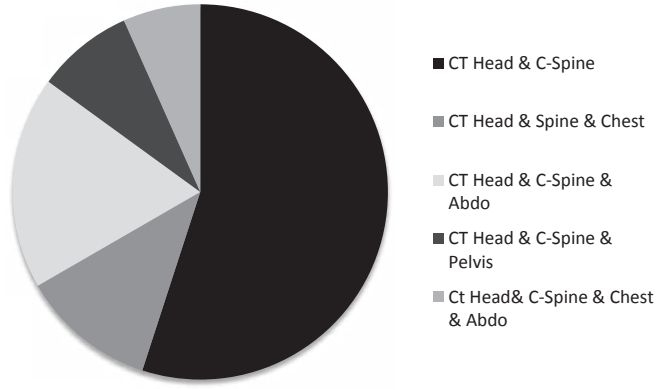

Figure 2: Grouping of body sites in regional CT scanning after motor vehicle accident.

Discussion

Computed tomography revolutionised trauma care enabling expeditious, accurate imaging of patients [5]. CT is becoming routine and is not without drawbacks, particularly as described above, with regards to cost and patient safety. In recent literature it has been acknowledged that CT's indications have changed from clinically based to mechanism/non-clinically based [12]. CT scanning makes up approximately 15% of all imaging studies, but they account for 75% of the total population radiation dose [13]. The pros and cons of this trend in practice warrant investigation.

In our cohort significant injuries were demonstrated in 33% and 32% of CT head and cervical spines respectively. Comparing regional vs. WBCT these rates remain equivocal and consistent (Table 2). Of the 77 patients who had CT cervical spine, 24 had first line plain films.

In a large multicentre study the rate of cervical spine injury among patients radio-graphically screened was 2% [14]. According to a recent meta-analysis of CT vs. plain film radiography the pooled sensitivity for cervical spine injury was 98% for CT and 54% for plain films [15]. With respect to the cervical spine, the time required to CT scan is now less than a complete set of plain films [16]. A 1999 study found cervical spine screening using CT to be more cost effective than plain films. With the significant morbidity and mortality associated with delayed or missed diagnoses of cervical spine injury, and analogous cost and time profile compared to plain films, it is unsurprising that CT has become the vanguard of cervical spine screening. Our findings are consistent with this trend.

Millo et al. [17] reports performing CT chest, abdomen and pelvis in blunt trauma patients with normal examination has a minimal clinical yield [17]. Paluska et al. [18] reviewed the use of CT chest in over 2000 patients during period of seven years and found no difference in the number requiring treatment, instead a marked increase in incidental findings. Incidental finding are more common in the Abdomen/Pelvis and sap resources from trauma centres to ensure appropriate follow up [18]. CT of the Chest/Abdomen/Pelvis is associated with longer, more costly scanning and higher radiation doses without improvement in mortality.

In our study the rates of significant injury found on WBCT and regional scans are similar with the exception of CT pelvis (Table 3). MVA accounted for the majority of cases within the WBCT subgroup. Despite this confounding factor regional CT performed comparatively, with less radiation dose and cost.

Conclusion

In the acute trauma setting CT of head and cervical spine delivers valuable clinical information in a timely and low cost manner. With consideration for cost and long term implications on patient safety, we believe that further scanning of the Chest/Abdomen/Pelvis should be clinically driven. We propose that continued careful history taking and physical examination remain a key component to assessing the indication for CT Chest/Abdomen/Pelvis in acute trauma patients.

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