Diagnostic value of tomography of the cervical spine in victims of blunt trauma

Valor diagnóstico da tomografia de coluna cervical em vítimas de trauma contuso

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A B S T R A C T

Objective: to assess the value of computed tomography in the diagnosis of cervical spine and spinal cord injuries in victims of blunt trauma. **Methods**: we reviewed the charts of blunt trauma victims from January 2006 to December 2008. We analyzed the following data: epidemiology, mechanism of trauma, transportation of victims to the hospital, intra-hospital care, indication criteria for CT, diagnosis, treatment and evolution of the victims. The victims were divided into two groups: Group I - without cervical spine injury, Group II - with cervical spine injury. **Results**: we gathered medical records from 3,101 victims. Computed tomography was performed in 1572 (51%) patients, with male predominance (79%) and mean age of 38.53 years in Group I and 37.60 years in Group II. The distribution of trauma mechanisms was similar in both groups. Lesions found included: 53 fractures, eight vertebral listeses and eight spinal cord injuries. Sequelae included: paraplegia in three cases, quadriplegia in eight and brain injury in five. There were seven deaths in Group II and 240 in Group I. The average length of hospital stay was 11 days for Group I and 26.2 days for Group II. **Conclusion**. A CT scan of the cervical spine in victims of blunt trauma was effective in identifying lesions of the cervical spine and spinal cord injuries. Thus, despite the cost of neck CT and the low incidence of lesions identified by it, its indication based on the usual criteria seems justified.

Key words: Spine / injuries. Injuries of the spine. Injuries of the spinal column.

INTRODUCTION

Traumatic injuries account for more than 3.2 million deaths and more than 312 million injured annually worldwide [1-3]. In the United States of America (USA) more than 60 million people, mostly aged up to 40 years, are victims of traumatic injuries each year. For every death due to trauma there are 19 hospital admissions, 233 medical consultations and 450 emergencies consultations [1,3,4]. Also in the U.S., 7,800 people annually (32 per million population) suffer spinal cord injuries due to trauma to the spine, the cervical spine representing nearly half (48.7%) of these victims[5]. In Europe,trauma is also the leading cause of death in people up to 40 years of age [3,6]. Thus, trauma has been an increasingly frequent focus of studies and investment in both developed and developing countries [7].

Traumatic injury of the cervical spinal cord is an extremely worrying problem in trauma patient care throughout the world due to the high risk of death and severe sequelae that result in serious permanent limitations, both physical, social and professional. In addition, it causes large health system expenditures, both with prolonged hospitalization and treatment, which usually lasts for years [5,8]. Besides medical treatment, social and economic costs resulting from cervical spinal cord injuries are enormous, as up to 85% of victims who resist the first 24 hours after trauma survive for more than 10 years [3] and, being in the productive age group, suffer large reduction in productivity due to prolonged absences from work, early retirement and unemployment [2,5,8-10].

Hence the great importance of early and accurate diagnosis of lesions of the spine and cervical spinal cord in victims of blunt trauma [11,12]. Several diagnostic methods are used to identify such lesions, from physical examination to more sophisticated imaging tests, such as computed tomography (CT) and magnetic resonance imaging (MRI) [5,8,12], CT being the most used feature, allowing to

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characterize the presence or absence of injury to the cervical spinal column in most cases[11,12]. Like all diagnostic methods, CT has limitations, has its costs and its indication criteria are not strictly accurate, possibly leading the physician to indicate it unnecessarily or fail to indicate it, hampering the accurate diagnosis of an important lesion [9].

A set of criteria for the indication of CT of the cervical spine was defined in a study involving 21 trauma centers evaluating 36,069 American victims of trauma and the results of the study revealed that with the use of criteria CT had a sensitivity of 99% and negative predictive value of 99.8% in the diagnosis of cervical spine injuries[12].

In this context, the objective of this study is to evaluate the importance of computed tomography (CT) in the diagnosis of cervical spine and spinal cord injuries in blunt trauma victims admitted to a university hospital in a developing country.

METHODS

This retrospective study was conducted at the Department of Surgery, Division of Emergency, Surgical Clinic III of the Central Institute of Hospital das Clinicas, Faculty of Medicine, University of São Paulo, and consisted in the analysis of medical records of victims of blunt trauma who were treated in the Service in the period from January 1st, 2006 to December 31st, 2008. For this analysis, we created a form to collect the following data: epidemiology, trauma mechanism, transportation of victims to the hospital, intra-hospital care, indication criteria for CT diagnosis, treatment, and evolution of the victims in the study.

The criteria for CT included cervical neck pain, presence of neurological deficit, reduced level of consciousness, intoxication by alcohol and other illicit drugs and increased tension in the muscles of the neck, defined as the presence of pain, either during palpation of the neck muscles in the posterior midline of the neck or reported by patients in this region when he/she moved the neck.

The three scores of trauma used in this study to quantify the severity of each trauma victim in the emergency room were: 1) ISS (Injury Severity Score), an anatomical score obtained by summing the squares of the most serious injuries among the three regions of body more severely affected; 2) the RTS (Revised Trauma Score), a physiological score obtained by summing the values previously assigned a code in c (from zero to 4), such as SAP (systolic blood pressure), RR (respiratory rate) and GCS (Glasgow Coma Scale), and then multiplied by specific coefficients in this formula: RTS = 0.7326 x PAS(c) FR + 0.2908 x(c) + 0.9368 x GCS; 3) the TRISS (Trauma and Injury Severity Score), which aims to estimate the probability of patient survival and is a mixed score that incorporates the patient's age, RTS and ISS, as well as the use of a complex statistical analysis using multiple logistic regressions, where the values derived from Major Trauma Outcome Study (MTOS) are employed. The GCS (Glasgow coma scale) is incorporated in the RTS formula and is a physiological index that evaluates the pattern of neurological trauma victims, as expressed in values ranging from three (deep coma) to 15 (normal).

For statistical purposes, the records of 1,572 trauma victims who underwent CT of the cervical spine were divided into two groups: Group I, including the records of the victims who had lesions in the cervical spine CT; and Group II, including the records of victims that showed these lesions. CT scans of all the victims were evaluated and their reports made by experienced radiologists in conjunction with surgeons at our institution.

For statistical analysis we used the likelihood ratio test (Shapiro-Wilk W Test [13]), followed by a comparison of the groups by Kruskal-Wallis test [14], and the non-parametric multiple comparisons by the Dunn test between [14] groups to identify differences between groups. We adopted a significance level of 5%[14].

RESULTS

Of the analyzed 3,101 medical records of victims of blunt trauma, it was found that CT of the cervical spine was indicated in the presence of at least one of the above criteria. The data obtained included age, sex, length of stay, ICU stay, presence of associated injuries, severity of the victim at admission (as assessed by GCS, RTS, ISS and TRISS), findings of injury cervical spine / spinal cord at CT, presence of sequelae, and mortality.

The results showed that CT of the cervical spine was performed in 1572 (51%) of the victims, and in 51 (3.2%) of them cervical spine injury was diagnosed, be it bone, ligament or spinal cord. It was found that, regardless of the mechanism of trauma, and type of transportation to our service, victims who underwent cervical CT did not display any significant difference.

The main results are presented in tables 1 to 5, and were analyzed focusing on the role of CT diagnosis, epidemiological data of the victims and mortality observed in this population. In Group I there were 1,521 victims, and in Group II, 51. There was no significant difference between the average age of the victims of Group I (38.53 years) when compared to Group II (37.60 years). In both groups there was a predominance of young adults, 21 to 40 years of age (Table 1). There was predominance (79%) of male victims in both groups. The severity of trauma (ISS, RTS, TRISS) was higher in Group II than in Group I ($p < 0.001$, Table 2). Group II did not differ from Group I as for the distribution of the mechanisms of trauma: running overs, collisions of cars, motorcycle accidents and falls from height (Table 3). It was observed that 42.5% of the victims in Group I presented, at initial assessment, the manifestation of traumatic brain injury (TBI), moderate or severe (GCS of

Table 1- Incidence of cervical trauma by age group.

Age (years)	Group I (n=1.521) Without injury to the cervical spine	Group II (n=51) With injury to cervical spine
0 – 20	297 (19,5%)	10 (19,6%)
21 – 40	632 (41,6%)	28 (54,9%)
41 – 60	357 (23,5%)	9 (17,7%)
> 60	235 (15,4%)	4 (7,8%)
Total	1,521 (100%)	51 (100%)

Table 2 - Distribution according to the severity of the lesion in groups I and II.

Trauma index *	Group I (n = 1.521) Without injury to cervical spine	Group II (n = 51) With injury to cervical spine	p value de P
ISS (average)	15.35	21.86	P < 0.001
RTS (average)	6.83	5.00	P < 0.001
TRISS (average)	89.99%	67.38%	P < 0.001

** ISS = injury Severity Score; RTS = Revised Trauma Score; TRISS = Trauma and Injury Severity Score.*

Table 3 - Mechanism of trauma in groups I and II.

Trauma mechanism	Group I (n=1.521) Without injury to cervical spine	Group II (n=51) With injury to cervical spine
Running over	351 (23.1%)	12 (23.5%)
Falls from height	375 (24.7%)	8 (15.6%)
Motorcycling accident	217 (14.3%)	8 (15.6%)
Fall from one's own height	145 (9.5%)	1 (2%)
Automobile accident	160 (10.5%)	18 (35.3%)
Bicycle accident	40 (2.6%)	2 (4%)
Assault	65 (4.3%)	1 (2%)
Other	168 (11%)	1 (2%)
Total	1,521 (100%)	51 (100%)

3 through 12), and that in the 51 victims of Group II this incidence was 55%. The incidence of severe TBI (GCS 3-8) was 31% in Group I and 45% in Group II (Table 4), thus demonstrating an association between the presence of severe TBI with the occurrence of spinal cord injury (p <0.001).

In Group II, 18 victims had more than one lesion in the cervical spine and / or spinal cord. The injuries included 53 spine fractures, seven of C1, 10 of C2 (including five of the odontoid process), four of C3, eight of C4, five of C5, seven C6, 12 of C7 and eight cases of vertebral listesis. The spinal cord injuries totaled eight. All 51 victims of the Group II also had brain damage, and several of them had other associated injuries (Table 5). Of the 51 victims, eight had spinal cord injury who developed sequelae (three paraplegia and five quadriplegia), 36 survived without sequelae of spinal cord injury, but eight had sequelae of brain injury; seven of the 51 victims died.

The average hospital stay was 11 days for Group I and 26.2 days for Group II. (P = 0.025).

The overall mortality rate observed in the total of victims of blunt trauma studied (495/3.101 = 16%) did not differ (p> 0.05) from those observed in the 1,572 victims undergoing cervical CT (16%). The mortality observed in victims of Group I (15.8%) did not differ from that in Group II [14% (p = 0.990)].

DISCUSSION

With recent technological advances such as multi-slice computed tomography and magnetic resonance

Table 4 - Glasgow Coma scale (GCS) at admission.

GCS at admission	Group I (n=1.521) Without injury to cervical spine	Group II (n=51) With injury to cervical spine
3-8	473 (31%)	23 (45%)
9-12	176 (11.5%)	5 (10%)
13-15	872 (57.5%)	23 (45%)
Total	1,521 (100%)	51 (100%)

Table 5 - Incidence of associated injuries in victims of Group II.

Associated Injury	% of victims affected in group II (n = 51)
Skull	51 (100%)
Extremities	36 (71.4%)
Pelvis	26 (50%)
Thorax	22 (42.8%)
Face	14 (28.5%)
Abdomen	11 (21.4%)

imaging (MRI), most traumatic injuries of the spine, which until a few decades ago were often not suspected, are currently identified with certainty [5,12]. Data reported by the National Spinal Cord Injury Association Resource Center [5], using the above criteria for indication of cervical CT, showed that approximately 3% of victims of blunt trauma who undergo CT of the cervical spine has some damage to the spinal cord (not necessarily cervical), such as a fracture or dislocation, and 1% of these victims have spinal cord injury. This rate is likely underestimated due to deaths at the scene [5].

In this study, the use of such criteria revealed an incidence of 1.64% (51/3.101) of cervical spine injuries in the total population of victims of blunt trauma, and in the 1,572 realized CTs of the cervical spine such incidence was 3.2% (51/1.572), of these eight had cervical spinal cord injury. Thus, the indication criteria for CT were effective in detecting cervical spine injuries, with an incidence of injuries similar to those reported in numerous case studies conducted in more developed countries, and the small number of cases of spinal cord injury found in this study does not allow statistical comparison with the literature [5,12,15].

The most commonly reported mechanism of injury in cervical spine injuries is represented by accidents involving motor vehicles, with 44% of cases, followed by violence / assault (24%), falls (22%), sports activities (8%), and other causes (2%) [5,16]. In the present study, we observed a high incidence of traffic accidents, with 74.4% involving motor vehicles (23.5% of pedestrian accidents, 35.3% of car collisions and 15.6% of motorcycle accidents), followed by falls from a height, with 15.6% (Table 3). Similarly to what happens in the literature, this study noted the predominance of accidents involving motor vehicles, being safe to mention that the participation of motorcycle accidents is increasing in our country in recent years. Among the victims of cervical spine injury in this study there was were predominance of young adult males; these data are comparable to other studies' [15].

The literature mentions the existence of an association between cervical spine injuries and traumatic brain injury (TBI). In fact, this study showed an association of 100% between cervical spine injuries and head injury. Moreover, the literature reports an average incidence of 50% of injuries to other organs associated with cervical spine injuries [12,16] and in the present study we observed an association between cervical spine injury and injuries to other organs in 100% of cases. We also found that the severity of the victims (as measured by ISS, and TRISS RTS) was higher among those who had cervical lesions at CT. Both in this and in other reports the severity of lesions in other organs has not been specifically evaluated.

Considering the increasing availability of CT as a diagnostic tool, the results of this study based on the criteria for recommending CT in the diagnosis of cervical spine injury may contribute to the improvement of trauma care.

The data from our study seem consistent with those of numerous case studies and more recent literature on various relevant aspects, including epidemiological characteristics of victims, trauma mechanisms and the diagnosis of spinal cord injury obtained.

In summary, the results of this study suggest that CT of the cervical spine is an effective diagnostic resource in identifying cervical spine injuries in their various types,

as well as spinal cord injuries in victims of blunt trauma, with results comparable to those reported by studies from developed countries. Thus, despite the cost of neck CT and the low incidence of injuries identifiable by it in blunt trauma, its indication based on the usual criteria seems justified.

R E S U M O

Objetivo. *Avaliar o valor da tomografia computadorizada no diagnóstico de lesões da coluna e medula cervicais em vítimas de trauma contuso.* ***Métodos.*** *Revisão dos prontuários de vítimas de trauma contuso atendidas de janeiro de 2006 a dezembro de 2008. Foram analisados os seguintes dados: epidemiológicos, mecanismo de trauma, transporte das vítimas para o hospital, atendimento intra-hospitalar, critérios de indicação da TC, diagnóstico, tratamento, e evolução das vítimas em estudo. As vítimas foram distribuídas em dois grupos: Grupo I - sem lesão na coluna cervical; Grupo II - com lesão na coluna cervical .* ***Resultados.*** *Foram analisados os prontuários de 3.101 vítimas. A tomografia computadorizada foi indicada em 1.572 (51%) pacientes, Foi observado predomínio masculino entre as vítimas (79%), com média etária de 38,53 anos no Grupo I e 37,60 anos no Grupo II. A distribuição dos mecanismos de trauma foi semelhante nos dois grupos. Lesões encontradas: 53 fraturas, oito listeses vertebrais e oito lesões medulares. As sequelas incluíram: três paraplegias, cinco tetraplegias e oito sequelas de lesão cerebral. No Grupo II ocorreram sete óbitos ,no Grupo I 240. A duração média de internação hospitalar foi de 11 dias para o Grupo I e 26,2 dias para o Grupo II.* ***Conclusão.*** *A TC de coluna cervical em vítimas de trauma contuso foi eficaz na identificação de lesões da coluna e medula cervicais. Assim, apesar do custo da TC cervical, e da baixa incidência de lesões por ela identificáveis, a sua indicação baseada nos critérios usuais parece justificável.*

Descritores: *Coluna vertebral/lesões. Traumatismos da coluna vertebral. Traumatismos da coluna espinhal.*

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