CT SCAN AFTER SUSPECTED INTRACRANIAL INJURIES: CORRELATION BETWEEN PERFORMANCE SPEED AND FINDINGS

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ABSTRACT:

Introduction: Computed tomography (CT) is the first-choice examination for a possible head trauma because of its accuracy, reliability, safety, and accessibility. During the acute period of trauma, early diagnostics and application of treatment manipulation can reduce the sickness rates and death rates of trauma patients, as well as the risk of complications, time spent in hospital, and the amount of funds spent on health care.
Methods: Patients selected for the study were aged over 18 and had CT scanning carried out in 2015 in LSMUL KK emergency department (ED) after suspecting intracranial injury (TLK–10–AM:S06). Patients who suffered penetrating trauma, had neuro deficit or skull bone fractures, were excluded from the study. The following data were collected: patient age, sex, times of arriving in the ED and of the CT performance, radiological findings present. The patients were divided into two groups: CT scanning performed in less than 1 hour or performed in over 1 hour.
Results: A total of 2,119 patients with suspected intracranial injury after head trauma underwent CT scanning. 31.4% patients were female, while 68.6% male. For 50.1% patients CT was preformed in less than 1 hour. 84.0% of all patients did not present any radiological alterations related with intracranial injuries. CT was performed in less than 1 hour in 69.6% of cases with diagnosed injuries caused by intracranial trauma, while in the remaining 30.4% of cases – CT was performed in more than 1 hour. A statistically significant difference was observed.
Conclusions: Intracranial injuries in males are suspected twice as often as in females. Most of the patients did not present any radiological alterations related with intracranial injuries. The most often-diagnosed intracranial alteration was subdural haemorrhage. CT was significantly more often performed within the first hour in those cases, where an intracranial injury was detected.

INTRODUCTION

In western countries, head trauma is one of the most frequent causes for contacting emergency department (ED). It is claimed that the rates of head trauma fluctuate between 100 and 300 for a hundred thousand citizens, while intracranial injuries comprise two thirds of all deaths by trauma [1]. The first choice in terms of tests, when y demand prompt further treatment of the patient [1, 4]. In such case, it is important to carry out injury diagnostics as early as possible. During the acute period of trauma, early diagnostics and application of treatment manipulation can reduce the sickness rates and death rates of trauma patients, as well as the risk of complications, time spent in hospital, and the amount of funds spent on health care [5, 6]. Images of performed radiology tests may present brain and skull injuries, they may be used to evaluate the level of trauma, possibility for surgical treatment, especially when extensive neurological tests are not possible, and they provide information about prognostic factors that determine the aggressiveness of treatment [7, 8]. Alterations of microcirculation, impaired autonomy regulation, brain oedema and axon damage symptoms begin to emerge immediately after the trauma and take the form of a combination of biochemical, clinical and radiological alterations [9, 10]. CT images allow precise localisation of brain oedema and foreign bodies, as well as quick diagnosis of skull fractures, epidural and subdural hematoma, and haemorrhagic and non-haemorrhagic contusion [9, 10, 11]. Due to the wide use of CT, the amount of angiography, X-ray tests, and surgical interventions has decreased.

THE AIM OF THE STUDY

To evaluate the distribution of patients, who had CT carried out in 2015 in the Hospital of the Lithuanian University of Health Sciences (LSMUL), Kauno Klinikos (KK) ED, after suspected intracranial injury; to evaluate CT alterations present in patients, and the relationship with the speed with which the test was carried out.

METHODS

Patients selected for the study were aged over 18 and had CT scanning carried out in 2015 in LSMUL KK ED after suspecting intracranial injury (TLK–10–AM:S06). Patients who suffered penetrating trauma, had neuro deficit or skull bone fractures, were excluded from the study. Overall, the study included 2,119 patients. Using the sample size determination equation (Schwarze, 1993©), it was calculated that a minimum of 325 cases would reflect the whole group of subjects, given a 95% reliability and a 5% margin of error. By way of random selection, 368 patients were chosen and a retrospective analysis of their patient histories was carried out. Out of 368 patient histories, 19 were excluded due to flaws in the medical paperwork. The 349 remaining patient histories were studied. The following data were gathered: patient age, sex, times of arriving in the ED and of the CT scanning, radiological findings. The time between arriving in the ED and performing the CT was evaluated taking into account the algorithm for examining head trauma in grown-up individuals; in accordance with that, CT were classed as performed in less than 1 hour or performed in over 1 hour [2]. For the statistical analysis of the data, SPSS 23.0 software was used. To describe the quantitative characteristics, averages, frequency of features (%) and their 95% confidence intervals (CI) were used. $\chi 2$, Mann Whitney, and Stjudent T tests were applied. Data were considered statistically reliable when $p<0.05$.

RESULTS

Overall in 2015 the ED admitted 2,119 patients, for whom, after head trauma, an intracranial injury was suspected and a CT was carried out. 31.4% (95% CI: 29.4–33.4, N=665) of patients were female, other 68.6% (95% CI: 66.6–70.6, N=1,454) were male. It was observed that intracranial injuries were suspected in male patients twice as often as in females. Overall average patient age was 47.6 yrs. Average age of males was 45.1 yrs., females – 54.8 yrs. The peak of suspected intracranial injuries in male patients was between their 30s and 60s, while in female – between 40s and 90s (Table 1).

When evaluating the time when CT was performed counting from the moment of arrival in the ED, a near–equal distribution was observed among the subjects: for 50.1% out of the 349 patients analysed (95% CI: 44.9–55.4, N=175), the CT was preformed quicker than in 1 hour. For the remaining 49,9% (95% CI: 44.6–54.1, N=174), the CT performance took longer than 1 hour after arriving in the ED. After performing the CT, 84.0% of the patients did not present any radiological alterations related with intracranial injuries. Intracranial traumatic alterations were diagnosed in 56 patients. The most often-observed intracranial injury was subdural haemorrhage, diagnosed in 36 patients. 7 patients presented with subarachnoid haemorrhage, 5 – epidural haemorrhage, 4 – focal brain contusion, 2 – focal brain hematoma, 2 – brain oedema (Table 2). In cases with diagnosed injuries caused by intracranial trauma, the CT was performed less than in 1 hour for 69.6% of patients, and later than in 1 hour for the remaining 30.4% of patients; a statistically significant difference was observed. Without intracranial–trauma–related alterations observed radiologically, over half of the patients had the CT performed later than 1 hour period from arrival at the ED (Table 3). It was observed that CT was performed within the first hour significantly more often in those cases, where an intracranial injury was detected ($P<0.05$).

DISCUSSION

In Lithuania, same as in other countries in Europe and around the world, computed tomography remains the first–choice when diagnosing intracra-

nial injuries. According to the data of our study, most LSMUL KK ED patients with head trauma and suspected intracranial injury, who had computer tomography performed, were male (68.6%). A similar trend in distribution between sexes was also observed when analysing a study carried out in hospitals of the Netherlands [13]. In our study, it was observed that intracranial injuries were suspected in male patients twice as often as in females. The same ratio between males and females was detected in the study carried out by Bordignon K et al. [14]. A different ratio between sexes was ascertained in the United States of America, where males experience head trauma three times as often as females [15]. For male patients tested at LSMUL KK ED, intracranial injuries were more often suspected between their 30s and 60s, while for females a similar distribution was observed between their 40s and 90s. A slightly different distribution according to age groups was detected in the study carried out by Bordignon K et al., where males usually experienced head trauma between their 20s and 40s, and females – between their 20s and 30s. In this study, the overall average age of the subjects was 47.6 yrs., average age of males – 45.1 yrs., average age of females – 54.8 yrs. A lower average age, 30.5 yrs., was detected in the study performed by Bordignon et al. [14]. In this study, the most often–observed intracranial injury was a subdural haemorrhage, diagnosed in 10.3% of subjects. In 2.0% of cases subarachnoid haemorrhage was detected, in 1.4% – epidural haemorrhage, in 1.1% – focal brain contusion, in 0.6% of cases – a focal brain hematoma and 0.6% with brain oedema. In the study mentioned above, with 2,000 patients tested, brain oedema was diagnosed in 1,95% cases, subarachnoid haemorrhage – 1,7%, subdural hematoma –1,65%, brain contusion – 1,15% and haemorrhagic contusion in 1,05% cases [14]. After reviewing the recommendations of the National Institute for Health and Care Excellence (NICE), Scandinavian guidelines for initial management of minimal, mild and moderate head injuries in adults, and Canadian CT Head Rule (CCHR) recommendations, common features can be distinguished, one of the most important of them being the Glasgow Coma Scale (GCS), which is used primarily to evaluate the state of patients in cases of head trauma [2, 4, 16]. This evaluation and present clinical symptoms (e.g. vomiting more than once, post-traumatic seizure, focal neurologic deficit) or other suspected serious pathology (e.g. skull base fractures), are factors that determine the promptness of performing the CT, as well as the further treatment of the patient in general. Most researchers, who have evaluated recourse after head trauma, also evaluate clinical symptoms and GCS in their studies. In our case we were aiming to evaluate the time when CT was carried out, measuring from the moment of arrival in the ED, and the correlation between this time period and the rate of intracranial injury detection, without evaluating the clinical state of the patient. According to study data, in cases where intracranial injury was detected, CT was significantly more often performed faster than in one hour, however, when considering the CT performance speed among all patients, an equal distribution is observed (49.9% and 50.1%). This means that for some patients, who were not diagnosed with any intracranial traumatic alterations, CT was also carried out faster than in one hour. Therefore, it is difficult to determine whether the presented clinical symptoms and GCS evaluation at the time had any influence on the speed of CT performance, but precisely the fact that we have not taken into account the prevailing symptoms, could be named as a shortcoming of our study.

CONCLUSIONS

Intracranial injuries in males are suspected twice as often as in females; a statistically significant difference is observed. Injuries in males are usually diagnosed in between their 30s and 60s, in females – between 40s and 90s.

An equal distribution was observed between patients for whom the CT was carried out either quicker or slower than in 1 hour from arriving in the ED (respectively 50.1% and 49.9%).

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ological alterations related with intracranial injuries. The most often–diagnosed intracranial alteration was subdural haemorrhage.
CT was significantly more often performed within the first hour in those cases, where an intracranial injury was detected.

APPENDIX

Table 1. Prevalence of intracranial injuries in different age groups

Age (decades)	Number of patients (N)	Prevalence (%)	95 % CI
	MALES		
<20	54	3,7	2,7–4,7
20-29	273	18,8	16,8–20,8
30-39	265	18,2	16,2–20,2
40-49	281	19,3	17,3–21,3
50-59	272	18,7	16,0–20,7
60-69	172	11,8	10,1–13,5
70-79	93	6,4	5,1–7,6
80-89	36	2,5	1,7–3,3
>90	8	0,6	0,2–0,9
	FEMALES		
<20	18	2,7	1,5–3,9
20-29	77	11,6	9,1–14,0
30-39	95	14,3	11,6–16,9
40-49	96	14,4	11,6–16,9
50-59	99	14,9	12,1–17,6
60-69	84	12,6	10,1–15,2
70-79	92	13,8	11,2–16,5
80-89	87	13,1	10,5–15,6
>90	17	2,6	1,4–3,8

CI- confidence intervals

Table 2. CT findings in patients with intracranial injuries

Intracranial injury	Number of patients (N)	Prevalence (%)	95% CI
Subdural haemorrhage	36	10,3	7,1–13,5
Subarachnoid haemorrhage	7	2,0	0,5–3,4
Brain oedema	2	0,6	0–1,4
Focal brain hematoma	2	0,6	0–1,4
Focal brain contusion	4	1,1	0–2,3
Epidural haemorrhage	5	1,4	0,2–2,7
Total:	56	16,0	

CI- confidence intervals

Table 3. CT performance duration when intracranial injuries are detected or not detected

CT test was performed	Number of patients (N)	Prevalence (%)	95% CI
	Detected II		
Less than in 1 hour	39	66,9	57,6–81,7
Later than in 1 hour	17	30,4	18,3–42,4
	Not Detected II		
Less than in 1 hour	157	53, 6	47,9–59,3
Later than in 1 hour	136	46,4	40,7–52,1
Total:	***349***		

II – intracranial injury, CI – confidence intervals, CT – computed tomography.

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