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Impact of Clinical Symptoms on CT Ordering Policy in Minor Head Injuries

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Introduction: The aim of our study was to determine the impact of clinical signs and symptoms on CT ordering policy in minor head injuries. **Patients and methods:** The study encompassed 1830 patients that have sustained minor or mild head injury, as assessed by clinical criteria. Basic clinical variables were recorded and a subset of patients meeting either Canadian or New Orleans criteria were subjected to CT. Outcome in terms of "positive" CT scans and number of patients requiring surgery was recorded. **Results:** The mean age was 30.4 years (ranging from 10 days to 80 years). 176 patients were subjected to CT scan (based on clinical criteria). CT scan revealed intracranial pathology in 29 patients (16.5% of patients subjected to CT scan) and 19 patients were subsequently subjected to surgery (accounting for 10.8% of patients subjected to CT scan and 1.0% of all patients with mild or minor head injuries). Brain contusions were detected in 10 (5.7%) patients, followed by epidural hematomas (10 patients or 5.7% were found to harbor an epidural hematoma) and subdural hematomas, that were found in 7 patients or 4.0% of patients subjected to CT scan. **Discussion**: Despite numerous studies that have analyzed the importance of clinical signs and CT in the diagnosis and treatment of minor head injuries, there is still much controversy about the mode of treatment of these patients. Canadian protocol really reduces the need for CT of the brain in relation to the New Orleans protocol, which suggests more observation in hospital patients with minor or mild head injury. **Conclusion**: The authors conclude that minor or mild head injuries should prompt a CT as recommended by Canadian or New Orleans guidelines and that the strongest scientific evidence available at this time would suggest that a CT strategy is a safe way to triage patients for admission. Key words: head injury, amnesia, CONSCIOUSNESS.

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1. INTRODUCTION

There are no universally accepted criteria for defining minor or mild head injuries and this lack of standardized definition has led to confusion and difficulty in analyzing treatment results. The term "minor head injury" was first used by Rimel in 1981 (1). Servadei et al. (2) have suggested that acutely head injured patients, previously designated to harbor minor, mild, or trivial injuries should be reclassified as "mildly head injured," and that further subgroups should be recognized: "low-risk mild head injury," "medium risk mild head injury," or "high-risk mild head injury." Low-risk mildly injured patients are those with a Glasgow Coma Score (GCS) of 15 and without a history of loss of consciousness, amnesia, vomiting, or diffuse headache (2). This subgroup is usually designated "minor head injury" by other authors (3).

Mild head injury is a common reason for hospital admission after trauma. Traditionally, the management of mildly head injured patients has been based on in-hospital observation (4, 5, 6, 7). An increasing number of patients currently receive computed tomography (CT) in addition to in-hospital observation (7, 8). It has been suggested that patients can be triaged for admission with an early CT scan thereby avoiding unnecessary admissions when findings are normal (9). At the same time, better care could be provided for the estimated 8% of patients with abnormal CT findings and a higher risk for complications (10). Early CT for these patients could result in better supervision and more rapid access to treatment, possibly yielding a better

Head injury severity category	Clinical criteria
Minimal	GCS 15, no loss of consciousness
Mild	GCS 14 or 15, brief (5 minutes) loss of consciousness or amnesia, or impaired alertness or memory
Moderate	GCS 9–13, or loss of consciousness for 5 minutes, or focal neurological deficit
Severe	GCS 3–8

TABLE 1 Head injury severity classification

Indication	CT scans		Admissions	
	n	%	n	%
Loss of consciousness and amnesia	41	23.3	40	22.6
Loss of consciousness and vomiting	3	1.7	3	1.8
Loss of consciousness, vomiting and amnesia	8	4.6	8	4.7
Isolated loss of consciousness	12	6.8	8	4.7
Vomiting	13	7.4	13	7.4
Amnesia	17	9.6	13	7.4
Alcohol intoxication	17	9.6	0	0,00
Post- concussion syndrome	17	9.6	17	9.6
Anticoagulant drugs	3	1.7	0	0,00
Injury during seizure	10	5.7	0	0,00
Seizure after injury	3	1.7	3	1.7
Skull base fracture	6	3.4	6	3.4
Suspected other skull fracture	20	11.5	0	0,00
Other	6	3.4	6	3.4
Total	176	100.0	119	67.7

TABLE 1. Indications for CT scan or admission in mildly head injured patients

prognosis (11, 12, 13, 14). A strategy based on CT to triage for admission depends heavily on the ability of an early CT scan to identify abnormal changes associated with the risk for later deterioration. If unsuccessful, the patient could deteriorate after having been transferred home instead of during in-hospital observation, which might be more hazardous. Many clinicians in emergency medicine express uncertainty about the safety of an early CT scan in patients with mild head injury, due to occasional anecdotal accounts of rapid and dramatic deterioration normal findings on the CT scan (15, 16, 17). In a survey of emergency physicians, more than half insisted that a clinical decision rule for minor head injury must have a sensitivity of 100 percent (18). Thus, the use of CT to screen patients with minor head injury for intracranial lesions has become routine, but such screening is expensive. According to one estimate, even a 10 percent reduction in the number of CT scans in patients with minor head injury would save more than 20 million dollars per year (19). Many neurosurgical associations have suggested management protocols (NICE protocol, the Montreal Protocol, Scandinavian-Swedish protocol, the New Orleans USA protocol). The Scandinavian protocol, for instance, proposes hospital admission followed by a short home treatment and early return to previous activities (10). Both USA and Scandinavian protocols recommended psychologist and psychiatrist treatment in case of persistent disturbances (20).

It has been a common practice in the Western world for mildly head injured patients to be treated by emergency services or trauma departments. Neurosurgical treatment is generally indicated only after a CT scan discloses an intracranial pathology. For practical reasons, patients with negative CT scan are usually not admitted. In contrary to the afore mentioned practice Neurosurgical service in Tuzla is compelled to manage all head injured patients (regardless of the type and degree of injury).

The goal of our study was to develop and validate a simple set of clinical criteria for identifying patients with minor head injury who should undergo CT scanning.

2. PATIENTS AND METHODS

The study encompassed all patients examined for various degrees of head injury in the period between January and December 2007. This study was done retrospectively in 1830 patients with minor or mild head injury examined in neurosurgical ambulance. Data were analyzed with ambulance cardboard from the Departement of Neurosurgery. Overview and initial treatment consisted of neurosurgeons. Basic demographic and clinical variables were recorded. A portion of patients was subjected to head CT scan based on clinical criteria. Positive (pathological) CT scans and a need for subsequent surgery were related to clinical variables. At the neurosurgical department Tuzla applies to USA from the protocol. Servis of the neurosurgery in Tuzla still care all brain injury regardless of the intensity and type of injury. Neurosurgical treatment is indicated only in serious condition and severe (mild, severe) head injury. In regard to minimal and mildly head injured patients a CT scan was ordered and depending on the CT scan of the indications for hospitalization. The results are presented as demographic characteristics, values GCS and symptoms evidenced during the initial examination. The results are presented also based on the findings of brain CT and the indications for neurosurgical intervention. It was corelated results with the earlier published reports.

3. RESULTS

In the period between January and December 2007 a total of 2120 patients with various degrees of head injuries were examined. Males accounted for 68% (1442), as opposed by 32% of female patients (678). Average age was 30.4 years (ranging from 10 days to 80 years).

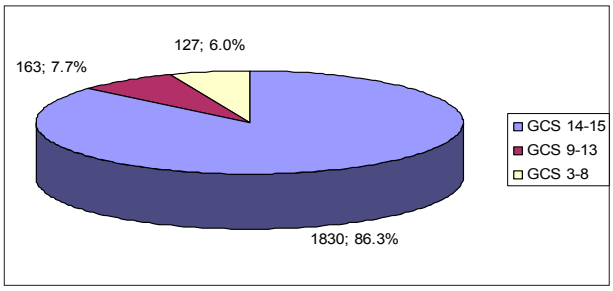

FIGURE 1. GCS values at the initial examination

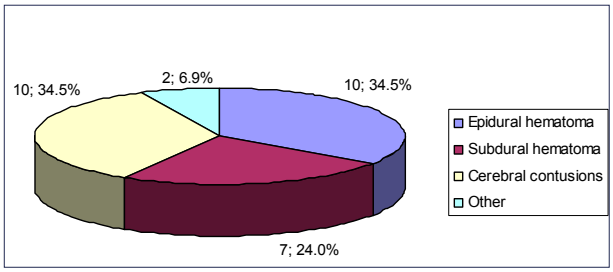

FIGURE 2. Distribution of intracranial pathologies in patients with "positive" CT

Probable risk factor	Number of patients	Normal CT scan	Abnormal CT scan	X^2 value	Odds ratio (95% CI)
PTU*	78	74 (94.9%)	4 (5.1%)	0.01	2.371 (.970 - 5.797)
PTA**	44	40 (90.9%)	4 (9.1%)	0.000	2.654 (.899 - 7.838)
Seizure	2	2 (100.0%)	0	?	-
Confusion	90	85 (94.4%)	5 (5.6%)	0.01	3.940 (1.758 - 8.830)
FND***	1	0	1(100%)	0,00	-
Vomiting	39	31 (79.5%)	8 (20.5%)	0.000	8.333 (3.996 -17.375)
Headache	94	92 (97.9%)	2 (2.1%)	0.032	2.125 (.841-5.372)
Skull fracture	12	10 (83.3%)	2 (6.7%)	0.000	8.873 (1.711- 46.008)
Age > 60 Y	40	35 (87.5%)	5 (12.5%)	0.000	4.971 (2.064-11.972)
Coagulopathy	1	1 (100.0%)	0	?	-
*PTU: Post Traumatic Unconsciousness **PTA: Post Traumatic Amnesia ***FND: Focal Neurological Deficit Saboori et al (23)					

Table 3. Predicting CT abnormalities from clinical variables

Minimal and mildly head injured patients accounted for vast majority of all patients with head injury 1830 (86. 3%) (Figure 1).

In regard to mildly head injured patients a CT scan was ordered in 176 (9.6 %) patients and 119 (6.5%) patients were admitted. Indications for CT and admission are presented in Table 1.

A CT scan revealed intracranial pathology in 29 patients (16.5%) and 19 patients required craniotomy (10.8 %). The lesion was evident on the initial CT scan in all patients ultimately requiring surgery. Figure 2. depicts distribution of various intracranial lesions disclosed by CT scan.

4. DISCUSSION

Minor and/or mild head injuries account for the vast majority of head injured patients. Despite this high incidence and numerous studies performed, there is still an ongoing debate regarding the correct evaluation of these patients (20). Various studies reveal that 70–90% of all treated brain injuries are mild, and that the incidence of hospital-treated minor traumatic brain injury is about 100–300/100,000 population. Population-based surveys of self-reported head injury yield much higher rates, and the Task Force estimated the true traumatic brain injury rate to be above 600/100,000 (21).

We have retrospectively analyzed demographic data, symptoms and the results of physical examination of patients with minor head injury who have been treated in neurosurgical emergency department. Our data reveal that we manage over 2000 head injured patients per year.

The most common causes of head injuries were shown to be (in decreasing order of frequency): traffic accidents, assaults, followed by profession - related injuries. An average age of our study group (30,4 years) reflects the fact that most injuries were sustained in traffic accidents. These data are concordant with findings by other authors (22).

Numerous national and international guidelines regarding the use of CT in patients with a minor head injury have been published; some of these guidelines are in part based on published algorithms, such as the New Orleans criteria and the Canadian CT head rule. These guidelines were suggested to reduce costs involved with CT scanning and reduce the strain on emergency, neurology, and radiology departments (23). The Canadian CT Head Rule reduced the need for CT scans more than the New Orleans Criteria (USA) in minor head injury (24, 25, 26). Accurate financial information on the economic rationality of one or other methods have not been published. Avoiding systematic CT scan indication implies a rate of misdiagnosis that should be known and assumed when planning treatment in these patients by using guidelines based on clinical parameters (27). The estimated prevalence of intracranial computerized tomography (CT) scan abnormalities is 5% in accepted studies of patients presenting to hospitals with a Glasgow Coma Scale (GCS) score of 15 and 30% or higher in patients presenting with a score of 13. About 10% of all hospital treated patients with minor head injury required neurosurgical intervention in these studies.

Our data suggest that the most common reason for either admission or CT scaning was loss of consciousness, followed by vomiting and amnesia. These data are in concordance with other authors (23). Results obtained by Saboori et al (22) are depicted in Table 3.

In the study by Saboory and Ahmadi (22) 4 patients eventually required craniotomy (out of 46 patients with „positive" CT scan). 19 patients in our study required surgical intervention, which is significantly more compared to other similar studies, although distribution of lesions is similar.

The lesion was evident on the initial CT scan in all patients ultimately requiring surgery in our study. The two prospective studies, both from the United States and published in 1999/2000, included 1170 and 2152 patients respectively (28, 29). Both studies had a short follow up period (23 and 20 hours). No relevant cases for our study question were identified in either study. In one study, four patients had injuries that were missed on the preliminary CT reading and later required intervention (two received intensified neurological monitoring and two received ICU admission and anticonvulsant/antioedema medications). All recovered without sequelae. However, the study included patients with GCS 14–15, but did not present the results separately. No additional data were delivered upon request to the authors. The authors of both studies concluded that "patients with a cranial CT scan, obtained on a helical CT scanner, that shows no intracerebral injury and who do not have other body system injuries or a persistence of any neurological findings can be safely discharged from the emergency department without a period of either inpatient or outpatient observation".

5. CONCLUSION

We suggest that the presence of one or more risk factors after mild head injury should prompt a head CT scan due to high proportion of "positive" CT scans (over 15% chance of encountering intracranial pathology). A significant portion of patients in our study subsequently required craniotomy (over 10%) which should also reaffirm clinicians

in the intent to oreder a CT scan. Our results also confirm the fact that a CT strategy is a safe way to triage patients for admission.

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