

Professional practice assessment for minor head injury management in emergency department and clinical impact of a simulation-based training: Interventional study (before/after)

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ABSTRACT

BACKGROUND: Minor head injury is a frequent reason for consultation in the emergency department. The use of computed tomography (CT) has increased dramatically in patients' care. Good time management implementation and interpretation are required. To study the level of agreement with recommendations for a minor head injury in emergency department management and the impacts of simulation-based training (SBT) on professional practice changes.

METHODS: Evaluation of professional practice for patient care in an emergency department according to the recommendations of the French Emergency Medicine Society (SFMU) established in 2012 before and after an SBT, including theoretical and simulation courses. It was based on the analysis of time to carry out a CT scan. It was also based on analysis of adherence to brain and spine scan indications and to hospitalization criteria.

RESULTS: The SBT carried out in the evaluation of the professional practices makes it possible to acquire the notion of urgency to obtain the CT Scan within one hour when the criteria are met ($p=0.007$). Rater reliability for agreement with the hospitalization recommendations was better after SBT ($p=0.03$, increased Kappa from 0.73 to 0.93). On the other hand, there appeared to be a lack of essential information in the medical file, such as time of onset of head trauma.

CONCLUSION: Management of this type of patient appeared to be satisfactory. It can be improved by SBT on the basis of the SFMU 2012 consensus conference. There is a need to improve the software used by the emergency departments, which should include the time of trauma and recommendations. The association of the clinic and the biomarkers could help to limit the indications of the CT scan, and thus to have it organized more rapidly.

Keywords: Cervical spine; CT scan; emergency medicine minor head injury; evaluation of professional practice; hospitalization.

INTRODUCTION

Minor head injury (MHI) is a frequent reason for emergency treatment with an estimated incidence in Europe of 235 per

100,000 people.^[1] When a patient is admitted to the emergency department (ED) for this reason, the primary goal of the emergency physician (EP) is to identify patients at risk for cranio-cerebral lesions based on anamnestic and clinical cri-

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teria.^[2] The reference examination for the detection of these lesions is the computed tomography (CT) scan in bone and parenchymal sections.^[2,3] It can detect 8% to 15% of non-neurosurgical intracranial hemorrhagic lesions and fewer than 1% of lesions requiring a neurosurgical remedy according to the studies.^[4,5] Indeed, the number of CT scans increased by 80% between 2000 and 2005 in the USA.^[6] In France, EDs have largely followed this trend with the resulting problems of radiation.^[6] This growth of the use of the CT scan nonetheless leads to questions about compliance with the recommendations without precautionary effect facilitated by easy access to this imagery. This situation may lead to excessive prescriptions because of fear of medical error.^[6] In addition, the contribution of an examination depends on good management of the time required to complete and interpret, and therefore on the use of the relevant examination within appropriate deadlines. However, access circuits to emergency CT scan lack fluidity.^[6] At the same time, respect of the indications limits useless examinations and consequently overloads of the apparatuses

and delay in patient care.^[6] Thus, CT is at the center of a public health debate establishing rules of prescription for.^[7-10] The management of MHI was defined in France by the 2012 consensus conference of the French Society of Emergency Medicine (SFMU).^[9] It was based on the National Institute for Health and Clinical Excellence (NICE) recommendations.^[11] In ED, a patient with MHI must receive an initial assessment within 15 minutes of arrival by the reception nurse or the EP.^[12] Glasgow Coma Scale (GCS) should be specified (with details) during this initial evaluation.^[13] In the ED of the University Hospital of Poitiers, there is a significant increase in the demand for scanners and especially CT-scan, while the radiology department cannot meet this demand. This situation contributes to very significant delays in obtaining the imagery and contributes to the saturation of the ED. An initial evaluation of professional practice in ED aimed to estimate the risk of cerebral or cervical spinal cord injury and to determine the indication of the CT and spinal scan as well as its completion time (Table 1). We detected a non-respect of the French recommendations.

Table 1. Indication of the CT scan in case of minor head injury

Indications of the CT scan between 4 and 8 hours after the trauma	Indications of the CT scan between 4 and 8 hours after the trauma	Indications of the CT scan between 4 and 8 hours after the trauma	Indications of the CT scan between 4 and 8 hours after the trauma
<ul style="list-style-type: none"> • Focused neurological deficit • Amnesia facts more than 30 minutes before the trauma (retrograde amnesia) • Loss of consciousness or amnesia of the facts associated with <ul style="list-style-type: none"> - a traumatic mechanism: pedestrian overturned by a motorized vehicle, patient ejected from a vehicle or falling from a height of more than one meter - or over the age of 65 • Suspicion of open fracture of the skull or embarrassment • Any sign of fracture of the base of the skull (hemotympanum, bilateral periorbital bruise), otorrhea or rhinorrhea of cerebrospinal fluid • >1 vomiting in adults • Coagulation disorder (anticoagulant and/or antiplatelet treatment) 	<ul style="list-style-type: none"> • Focused neurological deficit • GCS score <15 at 2 hours of trauma • Suspicion of open fracture of the skull or embarrassment • Any sign of fracture of the base of the skull (hemotympanum, bilateral periorbital bruise), otorrhea or rhinorrhea of cerebrospinal fluid • More than one episode of vomiting in adults • Post-traumatic convulsion • Treatment with Vitamin K antagonists (VKA) or other anticoagulant medications 	<ul style="list-style-type: none"> • Patients unable to perform active 45 ° neck rotation (if spinal mobilization can be performed) • Cervical pain or contracture in a patient over 65 years • Trauma with high risk: fall of more than 1 m or five steps, axial impacts on the head (diving), high-energy collision <p>^a <i>The maneuver can be done if the accident of car with simple rear shock, no embarrassment in sitting position, walk since the accident, absence of cervical contracture or secondary cervicalgia</i></p>	<ul style="list-style-type: none"> • Significant anomalies in the scan • GCS score <15 after CT-scan, whatever the result • Impossibility of performing CT scan despite its indication (unavailability of CT scan, transiently non-cooperating patient) • Persistence of severe vomiting and/or headache • Anticoagulant and/or antiplatelet treatment • Ethyl or medications poisoning • Suspicion of mistreatment • Other reasons: social isolation, unreliable surveillance externally

GSC: Glasgow coma scale; CT: Computed tomography.

Moreover, in some cases of MHI, there is an indication of hospitalization for clinical monitoring (Table 1).^[4] Education in the principles and practice of evidence-based practice is widely accepted as a core component of professional education for healthcare professionals.^[14] Our hypothesis is that simulation-based training (SBT) for EP would enhance professional practice by improving indications and the time to obtain CT and spinal scan, as well as respect for hospitalization's indications.

MATERIALS AND METHODS

Setting

This prospective, single-center, and interventional study analyzed the impacts of a simulation course on management of patients admitted to an ED for an MHI between 1 January 2017 and 31 July 2017. This study took place at the University Hospital of Poitiers, France. ED welcomes more than 40,000 patients each year.^[15] It includes a medical team of 34 doctors and 10 residents. The first phase of this study took place from January 1st, 2017, to March 31th, 2017. The first phase in the present study aimed to analyze the management of MHI and to identify areas for improvement during the course. The second phase of the study took place from May 1, 2017 to July 31, 2017 after training of physicians and residents. The aim in the second phase was to analyze the clinical impacts of the SBT on MHI management.

Objectives

In this study, the primary objective was to analyze the clinical impacts of theoretical training and simulation on the timeless characteristics of the CT scan according to the protocol on use of a scanner for an MHI, and based on the codified recommendations made by the SFMU.^[4]

Secondary objectives were to assess:

- Impacts of the course on agreement with the protocol on the use of a scanner for an MHI,
- CT scan indications and analysis of the outcome of patients who did not have a CT scan when it was indicated,
- Hospitalizations for MHI,
- Cervical spine scan carried out in patients with MHI,
- Management of the patients having anticoagulant and/or antiplatelet,
- Evaluation of the SBT.

Population

Physicians and Residents

Inclusion criteria: emergency physicians and residents working in the ED of the university hospital of the Poitiers.

Non-inclusion criteria: EPs and residents who could not be trained.

Exclusion criteria: emergency physicians and residents who never worked during one of the two assessment periods.

Patients

Eligible patients were patients admitted for an MHI in the ED of the university hospital of the Poitiers over the period of this study.

The inclusion criteria were patients aged 18 years or older who had an MHI according to the SFMU recommendations, following a fall, a road accident or an assault.

The non-inclusion criteria were severe head trauma, head trauma with associated extra-cranial lesions. Exclusion criteria were non-exploitable data (coding error; unspecified schedule of the brain injury), discharge against medical advice, and other reasons.

Intervention

We used an educational intervention to enhance uptake of a specific clinical protocol using the "GREET" reporting standards.^[14]

Definitions

MHI is defined as an acute brain injury resulting from mechanical energy to the head from external physical forces associated with at least one of the following criteria: 1) confusion or disorientation; 2) loss of consciousness for 30 minutes or less; 3) resolute post-traumatic amnesia estimated for less than 24 hours during ED consultation; 4) other transient neurological abnormalities, such as focal signs; 5) seizures and intracranial lesions that do not require surgery; 6) a Glasgow Coma Scale (GCS) score between 13 and 15, 30 minutes after the injury or later during the ED visit. The following time intervals were recorded: time (minutes) between the MHI and the arrival at the ED, time (minutes) before performing the scan.

Theoretical and Simulation Course

The SBT was conducted in the ED by AG (principal investigator) and PV (investigator) who have a university pedagogic diploma and are Directors of a Teaching Centre of Emergency Cares, with over six years' experience of teaching. The course was provided face to face with a ratio of four learners to one instructor. It was based on a 15-minute PowerPoint presentation (theoretical course) and two 60-minute simulated patient simulation sessions (practical course). The theoretical course presented a definition of MHI and risk for the patient if not correctly managed. Then, it addressed the 2012 consensus conference of the French Society of Emergency Medicine (SFMU) for MHI management.^[4] Learning objectives were: concerning Indications of the CT scan between four and eight hours after the trauma, indications in the hour after immediate request, Indications of the cervical spine scan, and indication to hospitalization (Table 1). Finally, it incorporated the points of the recommendations not respected within the ED, aiming to focus on these points and their potential risk for the

patient. This theoretical course was followed by a simulation session. Two scenarios were pre-established (the first one: a 20 years old helmeted biker and without antecedent, an accident at low speed in the city; the second one: an 86-year-old patient with anticoagulant who had a mechanical fall on the stairs). Each learner was an observer and participant in one of the two scenarios. Each 10-minute scenario was preceded by a briefing of five minutes and a debriefing of 15 minutes. At the end of the training, 15 minutes were dedicated to a summary, with the possibility of asking questions about MHI management. All in all, the training lasted 90 minutes. Written support summarizing recommendations for the management of MHI was issued at the end of the session (Table 1). This training was mandatory for all doctors and residents. The SBT was evaluated by the participants concerning satisfaction and self-assessment of knowledge acquisition and a written test before and after training, 10 minutes before and 10 minutes after the training (Appendix 1). Several training sessions were conducted over one month to train the entire team.

Evaluation of professional practices was conducted over two periods of three months before (period 1) and after SBT (period 2). Period 2 began after all training sessions were completed. Physicians and residents were advised of the MHI management assessment in both periods but were not aware of the primary and secondary outcomes. The residents were asked during the two periods to immediately refer to the referring senior physician for all patients with an MHI they had seen so that they could manage the patient collaboratively.

Main Outcome

The main outcome was the percentage of patients meeting the 1-hour or 8-hour imaging time frame and time frame for completion of imaging according to the time of MHI.

Secondary outcomes were

- concordance between management concerning the recommended prescription of CT scan and cervical spine scan
- criteria for hospitalization for the surveillance of a minor brain injury
- analysis of the subgroup of patients with anticoagulant and/or antiplatelet
- objective evaluation of the SBT by a knowledge test before and after training and by self-assessment questionnaire.

Data Collection

The data of the patients admitted for MHI to the ED were carried out by NJ and MSJ using the ED's electronic medical record system RESURGENCES® database and its statistical tool using the S06.0 code (head injury)^[16] over the period concerned. For each MHI, extracted data included: sex, age, mechanism, emergency arrival times, CT scan times, and clinical data.

Statistics

All anonymized data were analyzed using Statview® 4.5 (SAS Institute Inc., Cary, NC). Quantitative variables were described by their median, 1st and 3rd interquartile range [Q1; Q3]. Qualitative variables were described by number and percentage (n, %). The comparative analysis of the quantitative variables used a Mann Whitney's non-parametric U test. Chi² test was used to compare qualitative variables. Rater reliability for the level of agreement with recommendations used Cohen's kappa. A value of $p < 0.05$ was considered.

Ethics

This study was considered as an evaluation of the professional practice by the Agence Nationale de Sécurité du Médicament (the French National Medication Safety Agency) and was approved by the ED committee on ethics of the University Hospital of Poitiers. In accordance with the instructions of the ethics committee, the patients were informed by the flyer. The emergency staff gave them an explanatory document. Then, the agreement of the patients (or family) was obtained verbally. All the data collected were recorded in the patient file with an anonymous number for each patient. This coding was independent of the identity of the participants and any information that could identify them. The doctors and the residents of the department were informed of the evaluation of the professional practices. The methodology was approved by the Statistic and Epidemiologic Research Center (INSERM-U1153), Sorbonne Paris Cité (Paris, France), and statistical analysis was performed independently from the investigators by AC.

RESULTS

Population

Emergency Physicians and Residents

Thirty-four physicians and ten residents worked in the ED during both periods of this study. Thirty-two doctors and all residents were trained. Two doctors were off work during the training and were not included in this study. One doctor was excluded from this study, having left the service during the second period of this study. In total, the evaluation of professional practices involved 31 doctors. The level of experience of physicians averaged six years [2; 16].

Patients

One hundred and sixty-seven patients were eligible for the first phase of the evaluation of professional practices before training (period 1) and 170 for the second phase following training (period 2). Ninety-two files were included in Period 1 and 83 in Period 2. Details are given in the flow chart (Fig. 1).

The characteristics of the population studied during Period 1 and Period 2 are given in Table 2. The characteristics of the two excluded populations over the two periods were ana-

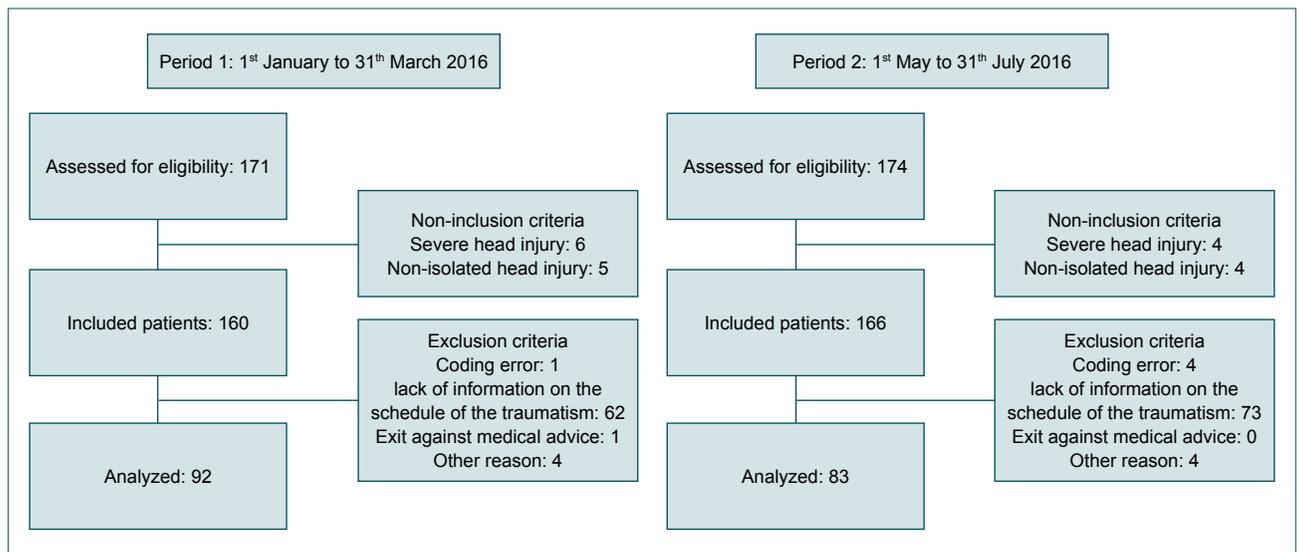


Figure 1. Flow chart.

lyzed because of a large number of exclusions. The excluded patients were similar in both periods: 37 men (49%) during period 1 and 41 (47%) during period 2. The average age over these two periods was 70 years [33; 84] and 69 years old, respectively [31; 83].

Main Outcome

The timeliness of the CT scan was significantly improved by the training and implementation of the decision support protocol for scans to be completed within one hour. There was no difference for the time between trauma delay–emergency arrival in period 1 and period 2 ($p=0.33$) (Table 3). CT scan performed before HI after request according to the decisional algorithm represented 31.8% of cases (7 of 22 cases) in period 1 vs. 73.7% of cases (17 out of 19 cases) in period 2 ($p=0.007$). The number of CT scans indicated and performed in concordance with the consensus conference between H4 and H8 after the trauma was 55.6% (15 out of 27 cases) in

period 1 vs. 65.5% (17 of 26 cases) ($p=0.46$) in period 2. The times taken to perform the CT scan (in minutes) during the two periods are given in Table 3. These delays were significantly improved for the scans to be performed within one hour ($p=0.014$) during period 2 compared to period 1. There was no difference for the patients having to have the scanner within eight hours following the trauma ($p=0.23$).

Secondary Outcomes

Indications of CT scan were considered correct if it was performed when indicated or not performed if it was not recommended. The CT scan indications were correct in 83.7% of the cases during period 1 and in 85.5% of the cases during period 2. In period 1, 10 patients did not have the CT scan, whereas it should have been done. For nine patients who could be contacted directly or through the GP, there was no complication. During period 2, seven patients did not have the scanner as recommended. One of them was hospitalized one day later for monocular blindness related to hemorrhage affecting the area of the optic nerve. For patients with anticoagulants or antiplatelet, there was 95.3% (37 out of 39) compliance with the indications during period 1 and 96.1% (38 out of 40) during period 2 ($p=0.98$). Indications for hospitalization to monitor MHI when justified were significantly improved in period 2 compared to period 1 ($p=0.03$). Non-performance of cervical imaging when it was not indicated was also improved in period 2 ($p=0.04$) (Table 4a). All hospitalization situations that were not performed while recommended were those of patients with antiplatelet. Cohen’s kappa was higher for all items in period 2 than in period 1, especially for hospitalization recommendations (0.73 in period 1 vs. 0.93 in period 2) (Table 4b).

Table 2. Patient characteristics

Characteristic	Period 1	Period 2
Demographic characteristics, n (%)		
Population	92 (100)	83 (100)
Median age, [Q1; Q3]	69 [35; 82]	71 [41; 84]
Male sex	47 (51)	42 (51)
Minor head injury mechanism, n (%)		
Fall	68 (74)	60 (73)
Road accident	9 (10)	6 (7)
Aggression	14 (15)	16 (19)
Other	1 (1)	1 (1)

Legend: [Q1; Q3]: 1st and 3rd interquartile range; MHI: minor head injury; Period 1: assessment before the course; Period 2: assessment after the course.

DISCUSSION

SBT significantly improved the time needed for “urgent” CT

Table 3. The timeless characteristic of CT-scan in case of minor head injury

Characteristic	Period 1	Period 2	p
CT scan correctly indicated			
Required within 1 hour (n)	22	19	
Required within 8 hours (n)	27	26	
Number of CT scan carried out			
Within 1 hour, n (%)	7 (31.8)	17 (73.7)	0.007
Within 8 hours, n (%)	15 (55.6)	17 (65.5)	0.46
Time in minutes			
Required CT-scan in the hour after immediate request, Median time [Q1; Q3]	99 [46; 150]	60 [39; 91]	0.014
Required CT-scan before 8 hours after the trauma, Median time [Q1; Q3]	499 [271; 593]	400 [235; 518]	0.23
Delay Trauma – emergency arrival, Median time [Q1; Q3]	131 [74; 154]	144 [84; 169]	0.33

Legend: [Q1; Q3]: 1st and 3rd interquartile range; Period 1: assessment before the course; Period 2: assessment after the course. CT: Computed tomography.

Table 4. Analysis of the indications to perform or not CT scan and cervical spine scan, and to monitor patients in case of minor head injuries before and after simulation-based training for emergency physicians and residents

(a) Percent agreement		Required		Not required	
		Period 1	Period 2	Period 1	Period 2
CT scan	In theory (n)	59	52	33	31
	In practice (n)	49	45	28	26
	p		0.61		1
Cervical spine scan	In theory (n)	23	28	69	55
	In practice (n)	15	15	55	51
	p		0.40		0.04
Hospitalization	In theory (n)	54	48	38	37
	In practice (n)	46	47	35	35
	p		0.03		1
(b) Rater reliability using Cohen's kappa		Theory (Period 1)		Theory (Period 2)	
		Required	Not required	Required	Not required
CT scan in practice	Carried out	49	5	45	5
	Not carried out	10	28	7	26
	Kappa		0.66		0.70
Cervical spine scan in practice	Carried out	15	14	15	4
	Not carried out	8	55	13	51
	Kappa		0.41		0.51
Hospitalization in practice	Carried out	46	3	47	2
	Not carried out	8	35	1	35
	Kappa		0.76		0.93

CT: Computed tomography.

scans to be performed within one hour of medical prescription. On the other hand, the course did not show any improvement in the time taken for CT scan to be performed

between four and eight hours after the head trauma. SBT also helped to make EPs more aware of the criteria for hospitalization and the criteria of gravity requiring appropriate

monitoring. The training significantly limited unjustified spinal imaging. Participants were satisfied with the training, which objectively improved their theoretical knowledge.

Our study showed that SBT based on an initial evaluation of professional practices significantly shortened the time to perform a CT scan in MHI. The circumstances of head trauma occurrence were dominated by falls (74% in the first phase and 73% in the second phase), as described in some European studies.^[17-19] Despite the existence of recommendations on the management of cranial trauma and prescription rules for scan, its application was not always respected; they were observed in almost 85% of cases. Even if strict adherence to the guidelines does not provide full protection against malpractice claims, its application improves the quality of management in an ED and reduces adverse outcomes. A very recent retrospective study based on Canadian CT guidelines^[20] noted an unjustified number of CT scans of 10.9% overall and 37.3% for the patients under 65.^[21] Another prospective multicenter study estimated this rate at 27%.^[22] An American, retrospective study assessed compliance with the rules adopted by the American College of Emergency Medicine for prescribing the CT scan in case of minor brain injury, and it showed that the rules were applied for 75.5% of the patients.^[23] The decision of whether or not to perform a CT scan notwithstanding knowledge of the consensus conference on minor brain injury management may be influenced by clinical and non-clinical factors.^[24-26] Such management decisions have an impact on the functioning of a department: a significant increase in the use of CT in traumatic conditions over the past decade has resulted in longer times in ED for patients, as well as increased health care costs and unnecessary exposure to irradiations.^[27]

The notion of urgency to scan within one hour after prescription, when the relevant criteria were fulfilled, was accepted.^[4] However, this was not the case concerning the CT scan to be carried out between four and eight hours following MHI. Several parameters could intervene: the time of head trauma may not have been noted. Our analysis made it possible to identify the first area in need of improvement. The software package could be enhanced by adding an alert or a time slot so that this information is obligatorily notified and not lost. Moreover, access to the support given during the training, posters and computerized access to the protocol recalling recommendations for MHI management (Table 1) in emergencies should be set up.^[4] Another difficulty could consist of access to the scanner extraneous to the particular case allowing a scan to be performed within one hour. Access circuits to emergency CT scans lack fluidity (busy hours on weekdays, absence of dedicated machines, organizational problems that make emergencies interfered with programmed activity on the scanner).^[6] In addition, this access can be slowed by the involvement of non-emergency responders, such as the stretcher-bearer, the radiological manipulator and the radiologist himself, who may not be sufficiently aware of this notion of delay. Several axes could be envisaged to improve the

fluidity of the circuit from the patient to the scanner. First, this training could be extended to the radiology department. Actions could be taken to simplify the scanner access circuit. For example, some emergency and radiology departments have recommended bringing patients to radiology without prior discussion between an emergency physician and a radiologist for a CT scan. This practice, currently customary for standard X-rays, would limit the elements rendering this examination difficult to perform within the recommended time limits. Authors have suggested the use of biomarkers, such as the S-100 β protein assay in adults as an aid to the diagnosis of lesions in case of head trauma;^[28,29] they have shown a very strong negative predictive value, close to 100%.^[30] Routine use of this marker would quickly rule out any brain damage, at no risk for the patient, and thereby avoid approximately 30% of unnecessary CT scan.^[30] However, this biomarker rapidly decreases and quickly loses its negative predictive value and sensitivity if not used early.^[31] Through the initial evaluation, this study determined areas needing improvement. First, the undiagnosed complication in one patient due to lack of a CT-scan confirmed the need for strict compliance with the recommendations. In addition, the first phase of the study revealed non-compliance with the indications for spinal imaging and hospitalization. This analysis helped to focus on these important points during the training. The scores significantly improved on account of the training, and they were confirmed by a change in professional practice during the second, evaluated phase of the study, as well as the clinical impacts for the patient. Few studies have analyzed the clinical impacts of an SBT. In Kirkpatrick's pyramid, there are 4 levels of evaluation for a course: level 1: satisfaction of the participants, level 2: acquisition of knowledge, skills, and attitude, level 3: changes in professional practices, and level 4: clinical impacts for the patient.^[32,33] Level 4 (patient outcomes) is poorly studied in studies evaluating training, including simulation.^[34,35] In addition to the improvement in CT scan times, other clinical impacts on the patient have been observed: respect for hospitalization criteria and conditions for cervical spine scan. A very recent study has shown that in the anticoagulant or antiplatelet population, the error was more related to the indication of hospitalization than to CT scan indication.^[36] Our SBT revealed these errors and corrected them during simulation training. Based on Cohen's kappa interpretation,^[37] it was improved from the moderate level in period 1 to almost perfect level in period 2 meaning that rater reliability for the level of agreement with the recommendations was better after SBT. However, even after the training, there was one case of non-hospitalization despite antiplatelet treatment. Alert implementation in the software used in the ED in case of antiplatelet or anticoagulant treatment could help to limit this type of error. Easier access to the consensus conference in the software could also help to systematize compliance with the recommendations. Finally, this evaluation revealed that 39.7% of patient data in period 1 and 46.3% in period 2 could not be used due to lack of information. This was related to the trauma schedule, in which four of the records failed to

report on clinical examination, and only gave CT scan results. Indeed, they could not determine the time elapsed between the trauma and the use of the scanner, thereby leading to undetected errors.

Limitations

This monocentric study limits its external validity.^[23,38] This study was carried out in a university hospital center where the CT scan is not performed without prior discussion between emergency physician and radiologist. These data cannot be generalized to hospitals where the CT scan is more systematically carried out. Finally, some general hospital centers only have one emergency doctor (especially during the night). Thus, time elapsed could be higher. Another limitation of this study was the change of residents during the study period. Nevertheless, to attenuate this bias, the residents who participated in period 1 and 2 had a similar experience, received the SBT, and were asked to immediately refer to the EP for each patient with MHI.

Conclusion

Clinical impacts of SBT on patients with MHI were assessed: an SBT combining theoretical course and practical simulation significantly improved MHI management. Areas for future improvement concern CT scan to be performed within eight hours and the contents of medical records, including schedules. Improvements to the software used in EDs, with access to consensus conferences and visual alarms, could help. This evaluation of professional practices has shown that although the indications for CT scan appear to be accepted, there is a lack of performance concerning strict compliance with deadlines, as well as indications for cervical scan and hospitalization when monitoring is required.

Availability of Supporting Data: The data supporting statistic findings are included in the manuscript. Please contact the corresponding author for other data requests.

Ethics Committee Approval: This study was considered as an evaluation of the professional practice by the Agence Nationale de Sécurité du Médicament (the French National Medication Safety Agency) and did not need ethical approval. It was approved by the local Emergency Department committee on ethics of the University Hospital of Bichat. All patients were verbally informed that their medical data should be used for the present study under an anonymous number. Data were not used in case of patient refusal.

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: D.A.G.; Design: D.A.G.; Supervision: D.A.G.; Materials: P.V., D.A.G.; Data: P.V.; Analysis: D.A.G., A.C.; Literature search: P.V., N.J., D.A.G.; Writing: P.V., D.A.G.; Critical revision: A.C., N.J.

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ORIJİNAL ÇALIŞMA - ÖZET

Acil serviste hafif kafa travması yönetimi için profesyonel uygulamanın değerlendirilmesi ve simülasyon tabanlı eğitimin klinik etkisi: Girişimsel çalışma “öncesi-sonrası”

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AMAÇ: Hafif kafa travması acil servise (AS) konsültasyon için sık başvurulma nedenidir. Bilgisayarlı tomografi (BT) kullanımı hastaların bakımını önemli ölçüde iyileştirmiştir. İyi bir zaman yönetimi ve yorumu gereklidir. Bu yazıda, AS yönetiminde hafif kafa travması önerilerine uyum düzeyi ve simülasyon temelli bir eğitimin (SBT) profesyonel uygulama değişiklikleri üzerindeki etkisi incelendi.

GEREÇ VE YÖNTEM: Bir AS’de, SBT öncesinde ve sonrasında hasta bakımı için profesyonel uygulamanın 2012 yılında kurulan Fransız Acil Tıp Derneği’nin (Société Française de Médecine d’Urgence: SFMU) önerilerine göre teorik ve simülasyon kurslarını içeren değerlendirmesi yapıldı. BT taraması yapmak için zaman analizine, ayrıca beyin ve omurga tarama endikasyonlarına ve hastaneye yatış kriterlerine uyum analizine dayanıyordu.

BULGULAR: Mesleki uygulamaların değerlendirilmesinde gerçekleştirilen SBT, kriterleri karşıladığında bir saat içinde BT taraması sonucunu alma açısından aciliyet kavramını edinmeyi mümkün kılmaktadır ($p=0.007$). SBT’den sonra hastaneye yatış önerilerine uyumuna ilişkin değerlendirici güvenilirliği daha iyi idi ($p=0.03$, Kappa’yı 0.73 ’den 0.93 ’e yükseltti). Öte yandan, tıbbi dosyada kafa travmasının oluş zamanı gibi temel bilgilerin eksik olduğu ortaya çıktı.

TARTIŞMA: Bu tip hastanın yönetimi tatmin edici görünmektedir. SBT tarafından SFMU 2012 uzlaşma konferansı temelinde SBT uygulanarak bu durum geliştirilebilir. Acil servisler tarafından kullanılan ve travma zamanını ve önerileri içermesi gereken yazılımı geliştirmeye ihtiyaç vardır. Klinik ve biyobelirteçlerin birlikteliği BT taramasının endikasyonlarını sınırlamaya ve böylece daha hızlı organize edilmesine yardımcı olabilir.

Anahtar sözcükler: Acil tıp; BT taraması; hafif kafa travması; hastaneye yatış; mesleki uygulamaların değerlendirilmesi; servikal omurga.

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Appendix I: QUESTIONNAIRE PRE/POST-TRAINING

Management of minor head injuries in Emergency Department

QUESTION 1: Check the correct answer(s) concerning the factors to be checked immediately (maximum within one hour of the request)

- A: anticoagulant treatment
- B: antiplatelet treatment
- C: vomiting
- D: GCS score <15 one hour after head trauma
- E: post-trauma convulsions

QUESTION 2: Check the correct answer(s) for the factors that should be taken into consideration to make cervical spine scan

- A: fall of less than 5 steps
- B: Inability to perform active rotation of the neck by 45°
- C: patient over 65 years old
- D: pain or contracture in a patient over 65 years old
- E: 3 m drop

QUESTION 3: Check the correct answer (s) for hospitalization criteria for minor head injuries:

- A: impossibility to perform the brain scan even if the indication is required
- B: associated intoxication (drug, alcohol, ...)
- C: normal scan at 6 hours after head trauma
- D: anticoagulant treatment
- E: antiplatelet treatment

QUESTION 4: Check the correct answer (s) for the risk factors leading to performance of a CT scan:

- A: high kinetic energy in road traffic injury
- B: patient over 65 years old
- C: focused neurological deficit
- D: amnesia of facts in a 40-year-old patient
- E: otorrhagia

QUESTION 5: Check the correct answer (s) for the management of patients with minor head injuries:

- A: a pregnancy test must be performed beforehand in pregnant women if a CT scan is to be performed
- B: in cervical trauma of medium gravity, cervical spine X-ray should be preferred
- C: at least 24h monitoring is required for patients with head trauma if they have an anticoagulant or antiplatelet treatment
- D: CT scan is mandatory in a patient with head trauma associated with drug intoxication
- E: a head trauma with a normal early scan does not require monitoring

RESPONSES

1. ACE
2. BDE
3. ABDE
4. ACE
5. C
6. C