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Badanie ultrasonograficzne szerokości osłonki nerwu wzrokowego w praktyce szpitalnego oddziału ratunkowego – doniesienie wstępne

Ultrasound examination of the optic nerve sheath width in practice of the emergency department – preliminary report

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Abstract

Background. Ultrasound measurement of the optic nerve sheath width is a good diagnostic method which facilitates the diagnosis of increased intracranial pressure. However, it is rarely performed to assess the condition of patients hospitalized in Emergency hospital departments (ED). ***Objective.*** The study aimed to assess the usefulness of ultrasound examination of the optic nerve sheath width in the diagnosis of Emergency Department patients with head injuries, loss of consciousness and with consciousness disturbances. ***Material and methods.*** Ultrasound examination of optic nerve sheath width was performed in 22 patients. The results were compared with the respective head computed tomography (CT) scans. It was assessed whether the abnormal results of the ultrasound were confirmed by the respective CT scans. ***Results.*** Normal ultrasound results were reported in 13 (59.1%) out of 22 patients. Borderline normal results were found in 5 (22.7%), and results above the norm - in 4 (18.2%) patients. 15 patients had normal CT scan results. In 7 patients the CT showed abnormalities, but only 3 of those patients had an indication for hospitalization due to the severity of the condition. ***Conclusions.*** Ultrasound examination (USG) of optic nerve sheath width may be useful in the preliminary diagnosis of Emergency Department patients with head injuries, loss of consciousness and with consciousness disturbances. *Anestezjologia i Ratownictwo 2016; 10: 145-149.*

Keywords: optic nerve sheath width, intracranial pressure, head injury, loss of consciousness, USG examination, emergency department

Introduction

Emergency hospital departments, being the last link of the chain of survival and the first link of the specialist hospital therapeutic practice, admit patients with various conditions, both minor internal diseases and severe multiorgan injuries. As regards post-injury patients, the most common group consists of patients with head injuries, usually mild ones [1]. According to various studies they constitute approx. 70% of post-injury patients [2] and from 1.7% to even 20% of all ED patients [3-5]. The most popular guidelines concerning the diagnostic work-up of these patients (loss of consciousness, retrograde amnesia, Glasgow Coma Scale (GCS) at 13-15 points) are known as Canadian CT Head Rule (CCTHR) and New Orleans Criteria (NOC). According to these guidelines head CT should be performed if GCS is below 15 pts at two hours after injury, there is a suspicion of a skull fracture, there are manifestations of basal skull fracture, the patient vomited more than once, patient's age is ≥ 65, retrograde amnesia covers the period of at least 30 minutes prior to the injury and there was a dangerous mechanism of injury [6]. The NOC criteria include headache, vomiting, age > 60, drug or alcohol intoxication, memory disturbance, visible injury above

the clavicle and seizure [7]. The implementation of such criteria resulted in the reduction of the number of head CT scans in the United States (USA) [8]. Conversely, in Europe the number of these examinations has increased [9], probably due to a higher number of patient claims and the necessity to protect doctors from the responsibility for errors.

Head CT scan is not only performed in post-injury patients, but also in individuals with consciousness disturbances, including alcohol-intoxicated ones and those who had lost consciousness. Therefore, head CT is becoming the most common imaging examination which is performed in ED.

Recently, there have been reports of successful use of ultrasound examination of the optic nerve sheath width in the diagnostic work-up of head injury and consciousness disturbance [10]. There are numerous advantages: ultrasound examination is inexpensive, easy to learn [11], it has a high sensitivity, quite high specificity and is a fast way of detecting increased intracranial pressure [12]. However, the precise diagnosis of the reason for the increased ICP is impossible with an ultrasound. CT scan remains the gold standard in the diagnosis of intracranial pathologies, but it would be advisable to consider whether the preliminary ultrasound examination of the optic nerve sheath may facilitate the decision of the necessity to perform CT, at the same time reducing the number of patients undergoing CT scans to the reasonable minimum.

Objective

The study aimed to assess the usefulness of ultrasound examination of the optic nerve sheath width in the diagnosis of Emergency Department patients with head injuries, loss of consciousness and with consciousness disturbances.

Material and methods

22 ultrasound examinations of the optic nerve sheath were performed in the Emergency Department of Child Jesus Teaching Hospital between May 7th, 2013 and March 12th, 2014. Patient data and the reasons for hospital stay are presented in the table I.

Ultrasound examinations were performed with the same device in all patients, paying attention to current standards. We used SonoSite MicroMaxx USG device with linear 6 MHz probe. Each examination was started with the right eye. Some patients (8) underwent the examination of both eyes twice. In such situations the sheath width was calculated as the average of both measurements.

During the examination we used special sterile ophthalmic gel which was applied on the closed eyelids. Then we gently adhibited the probe of the device over the upper eyelid in the transverse dimension. For each eye the measurement was made at a distance of 3 mm from the edge of the retina [13]. We measure the internal dimension of the optic nerve sheath. All examinations were done by the same person - the doctor with specialization in emergency medicine.

CT scan was performed after the ultrasound examination. We have done it in all cases when the extension of the optic nerve sheath was found or in patients with the absence of improvement after the treatment or in the event of any doubt to improve the diagnosis. Head CT was also performed in patients:

- following a head injury with loss of consciousness,
- following a head injury if the patient reported headache or if any abnormalities were detected in the neurological examination,
- following a head injury in patients taking anticoagulants,
- following a head injury in patients > 65 years old,
- in all patients with consciousness disturbances.

Results

The hospitalized group of patients included 13 women and 9 men. The youngest person was 19 and the oldest was 89 years old. The most common cause of hospital stay was head injury – 16 persons. Two patients were admitted due to alcohol intoxication and two after syncope. One person overdosed drugs and in one there was a suspicion of stroke. The width of the optic nerve sheath was normal (up to 5 mm) in 13 (59.1%) individuals. Borderline normal result (5-6 mm) was reported in 5 (22,7%) individuals: one eye affected in 3 patients and both eyes affected in 2 (18.2%) patients. The diameter of the optic nerve sheath was above 6 mm in 4 patients, but only one of them had both eyes affected.

One patient with a bilateral widening of the optic nerve sheath also had abnormalities indicative of increased intracranial pressure visible on the CT scan. The patient was admitted to the hospital.

Unilateral widening of the sheath was visible in the CT scan of one patient. The abnormalities did

Table I. Clinical characteristic of patients

No.	Date of admission	Initials / Gender	Age	The reason for hospital stay	The result of optic nerve ultrasound / CT
1.	07/05/2013	FB M	59	alcohol intoxication	R-3.2 mm, L-3.1 mm. CT normal
2.	24/06/2013	KH F	82	drug-related suicide attempt	R-3.2 mm, L-3.4 mm. CT normal
3.	15/07/2013	OP F	20	head injury - beating	R-4.4 mm, L-4.0 mm CT normal
4.	19/07/2013	SzM M	47	head injury, loss of consciousness	R-3.6 mm, L-4.2 mm CT normal
5.	20/08/2013	GP M	31	alcohol intoxication	R-4.2 mm, L-5.0 mm ventricular system slightly dilated, 9 mm, no shift
6.	29/08/2013	BA F	28	loss of consciousness, seizure	R-4.4 mm, L-5.2 mm CT normal
7.	10/10/2013	TK F	78	limb paresis, sensory impairment, aphasia	R-4.8 mm, L-5.1 mm CT - hypodense foci, leukomalacia
8.	10/10/2013	ChU F	20	head injury	R-6.2 mm, L-5.1 mm CT normal
9.	10/10/2013	SA F	19	syncope, head injury	R-4.3 mm, L-4.3 mm CT normal
10.	11/10/2013	FM M	26	head injury - traffic accident	R-5.7 mm, 4.7 mm CT normal
11.	11/10/2013	BW M	44	head injury, loss of consciousness	R-7.7 mm, L-7.4 mm contusions and haemorrhagic foci, dilated pericerebral fluid space
12.	10/12/2013	MŁ M	26	head injury, loss of consciousness	R-5.3 mm, L-6.1 mm CT normal
13.	20/01/2014	PB F	43	head injury, loss of consciousness	R-4.5 mm, L-3.8 mm CT normal
14.	20/01/2014	WM F	31	head injury	R-5.0 mm, L-4.5 mm CT normal
15.	23/01/2013	KP M	35	head injury, loss of consciousness	R-5.1 mm, L-4.9 mm CT normal
16.	24/01/2014	PJ F	82	head injury	R-3.8 mm, L-4.4 mm CT – lesions of vascular origin, atrophy
17	30/01/2014	MG F	49	head injury	R-4.1 mm, L-4.8 mm CT normal
18.	30/01/2014	DJ F	78	head injury	R-4.6 mm, L-6.3 mm CT – minor haemorrhagic imbibitions, subgaleal haematoma
19.	24/02/2014	PI F	89	head injury	R-4.6 mm, L-4.9 mm CT – subarachnoid haemorrhage, pericerebral haematoma
20.	04/03/2014	BT M	48	head injury	R-5.0 mm, L-4.9 mm CT normal
21.	06/03/2014	SzA F	24	head injury	R-4.8 mm, L-4.9 mm CT normal
22.	12/03/2014	ŻS M	61	head injury	R-5.7 mm, L-5.8 mm CT – ventricular system slightly dilated, fluid spaces slightly dilated, atrophy

M- male, F – female, R – right, L - left

not result in the increase of the intracranial pressure. However, the patient was admitted to the hospital. The remaining two patients with unilateral sheath widening had normal CT results.

Borderline values of the optic nerve sheath width were reported in 5 patients. They resulted from intracranial pathology in two of them (one person with bilateral and the other with unilateral widening). The intracranial pressure was not increased in these patients. The remaining three patients had normal head CT results.

Eleven patients who had normal ultrasound values of the optic nerve sheath width also had normal head CT results.

There were two patients with normal sheath examination results, but the CT scan showed minor widening of the ventricular system without increased intracranial pressure in one patient and subarachnoid haemorrhage and minor pericerebral haematomas in the other patient, which was an indication for hospitalization.

Discussion

Individuals with consciousness disturbances or after a head injury are a very numerous group of ED patients. Such a group includes patients with health--threatening conditions, with post-traumatic lesions, subarachnoid haemorrhages or strokes which require immediate treatment, and a large group of individuals with minor injuries or alcohol-intoxicated ones, whose life or health are not threatened. The popularity of CT scans, the requirement of having a CT device in every ED and the fear of patient claims resulted in a substantial extension of indications for a head CT in patients after an injury or with consciousness disturbances. Criteria which have been implemented to date, such as signs of concussion or abnormalities in neurological examination are often extended. As a result, in some EDs, head CT is performed in almost all cases of head injury.

The indications for head CT in alcohol-intoxicated patients are another issue. Such patients have consciousness disturbances and taking a history is often difficult. Therefore, even if there are no traces of an injury, head CT is performed in almost all cases.

However, head CT scan has some serious defects and limitations. It is time-consuming and the patient needs to be transported to a CT laboratory which has to be situated in the proximity of ED. The examination is expensive and it requires the work of two additional members of hospital staff (a radiologist and a radiology technician). Moreover, the patient has to wait for the results to be described and there is a certain amount of radiation that the patient is exposed to. The examination of the optic nerve sheath width does not have all these defects. It may be performed at bedside immediately after admission. The examination is carried out by one doctor, usually the one who is on duty, and the result is available instantly. Numerous studies confirmed the high sensitivity and specificity of this examination [14,15].

The comparison of ultrasound examination results of optic nerve sheath width with head CT scans demonstrated that the former may be effectively used in the diagnostic work-up of patients after an injury and with consciousness disturbances. The study demonstrated that ultrasound examination did not fail to show increased intracranial pressure if it was reported via a CT scan. Moreover, ultrasound showed the widening of the sheath even in patients with intracranial pathology without increased pressure. There were two cases in which the ultrasound was normal and the CT scan demonstrated some abnormalities which were not associated with increased intracranial pressure. One patient with borderline values of the sheath width (5 mm in one eye) had some lesions reported in the CT findings, but the lesions were not life-threatening and they did not require any treatment. The other patient (woman) with a normal ultrasound result had some lesions visible in CT which constituted an indication for a hospital stay. However, she was the oldest person in the group and it may be assumed that the subarachnoid haemorrhage which was detected, resulted in the increased intracranial pressure due to cerebral tissue atrophy and the resultant compensation within dilated (appropriately as regards the age) fluid spaces.

Performing ultrasound examination of the optic nerve sheath diameter we must always keep in mind that this examination shows only an increase in intracranial pressure, but does not show the direct cause of this growth. This pathology, besides injuries, may be caused by brain tumors, abscesses, meningitis, hydrocephalus, ischemic and hemorrhagic stroke, venous or brain sinus thrombosis, metabolic disorders such as hyponatremia or less common causes e.g. papillomas. For the differential diagnosis of these reasons computed tomography or magnetic resonance of the head must be done.

The presented material is relatively small, so full statistical analysis is impossible to conduct yet. However, further research should be carried out. It is possible that the research will lead to the determination of standard procedures of care which will accelerate and facilitate the diagnosis of patients with head injuries and consciousness disturbances in ED, and also cause the reduction of ED costs.

Conclusion

Ultrasound examination of optic nerve sheath width may be useful in the preliminary diagnosis of Emergency Department patients with head injuries, loss of consciousness and with consciousness disturbances.

Conflict of interest
None

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