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THE INFORMATIVENESS OF METHODS OF RADIATION DIAGNOSTICS IN THE DETECTION OF SKULL FRACTURES

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In 157 (16.2 %) of 969 patients who were injured for various reasons, X-ray diagnostics was performed, in 447 (46.1 %) – CT, in 33 (3.4 %) patients – MRI. The results were subjected to comparative analysis. In total, 167 people were diagnosed with traumatic brain injury. Among patients with identified traumatic brain injuries, X-ray examination was performed in 98 (58.7 %), CT – in 162 (97.0 %), MRI – in 20 (12.0 %) patients. Combined trauma was noted in 63 (88.7 %), isolated trauma – in 8 (11.3 %) patients. Based on the results of the study in detecting head injuries as a result of road accidents, CT can be considered a more effective method due to its sensitivity (89.0 %) and specificity (98.4 %). When detecting a combined traumatic brain injury, MRI due to its specificity (100.0 %), and CT with specificity (96.7 %) and sensitivity (91.8 %) were accepted as more informative methods of examination. It was found that the reformation of CT images in axial and cranial projection allows timely and correct diagnosis of fractures and tomography of the skull bones.

Keywords: traumatic brain injury, combined trauma, radiation diagnostics, sensitivity, specificity

Г.Ш. Гасимзаде

ІНФОРМАТИВНІСТЬ МЕТОДІВ ПРОМЕНЕВОЇ ДІАГНОСТИКИ ПРИ ВИЯВЛЕННІ ПЕРЕЛОМІВ КІСТОК ЧЕРЕПА

У 157 (16,2 %) із 969 пацієнтів, які отримали травми з різних причин, проведено рентгендіагностику, у 447 (46,1 %) – КТ, у 33 (3,4 %) пацієнтів – МРТ. Результати були піддані порівняльному аналізу. Загалом у 167 осіб діагностовано черепно-мозкову травму. Серед пацієнтів із виявленими черепно-мозковими травмами рентгенологічне дослідження виконано у 98 (58,7 %), КТ – у 162 (97,0 %), МРТ – у 20 (12,0 %) пацієнтів. Комбінована травма відзначена у 63 (88,7 %), ізольована травма – у 8 (11,3 %) пацієнтів. На підставі результатів дослідження при виявленні травм голови внаслідок дорожньо-транспортних пригод, КТ можна вважати ефективнішим методом завдяки його чутливості (89,0 %) та специфічності (98,4 %). При виявленні комбінованої черепно-мозкової травми, МРТ у зв'язку з її специфічністю (100,0 %), а КТ зі специфічністю (96,7 %) та чутливістю (91,8 %) були прийняті як більш інформативні методи обстеження. Встановлено, що реформування зображень КТ в аксіальній та краніальній проекції дозволяє своєчасно та правильно діагностувати переломи та отримати томографію кісток черепа.

Ключові слова: черепно-мозкова травма, комбінована травма, променева діагностика, чутливість, специфічність.

The study of skull fractures is important both in clinical medicine and in forensic pathology. Currently, head injuries resulting from fractures of the skull bones remain a serious medical and social problem [1,14]. Skull fractures are observed in 3.5–24 % of patients with traumatic brain injury (TBI). Fractures of the bones of the skull, allocated to open and closed fractures, in comparison with fractures of the bones of the whole body, are among the most dangerous fractures. In addition, there may be an incomplete fracture, a crack, comminuted fractures, as well as depressed fractures. Local symptoms are wounds and hematomas. Since the base of the skull has a complex anatomical structure, the initial injury can lead to complications ranging from cranial nerve deficiency to devastating vascular damage. Injuries to the base of the skull are observed in facial or orbital fractures, and the identification of fractures of the base of the skull is important, because even fractures with nonlinear displacement can cause intracranial and orbital injuries, multiple critical complications, including cerebrospinal fluid release - paralysis of cranial nerves and vascular damage. With a closed skull fracture, symptoms of concussion and brain damage are observed [14]. The degree of fractures of the skull depends on the force of the impact, the place of impact on the skull and the internal features of the skull itself [6].

Skull fractures are one of the leading causes of death in many developing countries. According to WHO, 10 million people receive head injuries every year, 250–300 thousand of them die. 60–85 % of victims with TBI have long-term neurological and psychological disorders after injury, which leads to disability and increased costs of treatment and rehabilitation [1,13]. According to statistics from 2005–2014, the frequency of TBI per 1000 people is 22.1, and the frequency of complications after TBI is 0.16. The causes of head and brain injuries are blows, bicycle and car accidents. In Europe, the number of visits to the emergency department with head injuries is 2.3 per 1000 population [7]. In observations conducted among 260 patients who went to the emergency department in Ethiopia in 2016, 53.3 % of patients with traumatic brain injury had mild TBI, and 63.8 % had open TBI [15]. In developing countries and Asian countries, the injury to the base of the skull is 3.5–24 %, while the highest rates are noted in Nigeria – 33–46 % [8]. Every year, about 2 million people in India are injured, and half of them die from traumatic brain injuries. More than 50–60 % of cases occur due to road accidents, followed by falls from a height and blows [3].

Proper and accurate examination of skull fractures can be of great practical importance in the timely prevention of complications of TBI. Methods such as X-ray, computed tomography (CT) and magnetic resonance imaging (MRI) are mainly used in the examination of skull fractures. Recent advances in X-ray imaging may make it possible to quickly and noninvasively detect fractures of the skull bones [11].

Transverse fractures of the middle cranial fossa through the carotid canal are associated with a high risk of vascular damage and screening by vascular studies such as CT angiography is required. Fine multispiral CT reformations as well as 3D reconstructions are useful for detecting fine fractures of the skull base [5]. To visualize the base of the skull, high-resolution axial images with coronary and sagittal formats are required. In addition to the usual CT scan of the head (axial sections of 5 mm), high-resolution images through the base of the skull are necessary to assess damage to the base of the skull (axial sections of 1–3 mm). The need for additional imaging is determined by the clinical picture and the presence of the lesion. This may include CT angiography of the head and neck or MRI of the craniocervical junction to look for concomitant complications. MRI can also detect concomitant injuries, such as spinal injury or subtle intracranial injuries that are poorly visualized by CT, including diffuse damage to axons, brain stem injury and small contusions of the cerebral cortex. MRI is also useful for assessing long-term post-traumatic effects, such as damage to cranial nerves [5,11].

The purpose of the study was to investigate the specificity (SP) and sensitivity (SN) of X-ray examination methods (radiography, CT and MRI) in determining fractures of the skull bones.

Materials and methods. During the study, out of 969 victims who were injured for various reasons, 167 patients (133 (79.6 %) - men, 34 (20.4 %) - women) were diagnosed with fractures of the skull bones. Among the victims with skull injuries, 48 (67.6 %) were injured in a car accident, 20 (28.2 %) – in a fall, 3 (4.2 %) – in the pelvic area as a result of compression. Among these patients, 63 (88.7 %) had concomitant and 8 (11.3 %) patients had isolated TBI.

Among the patients examined for TBI, the cause was not established in 3 (1.8 %) patients, in 84 (50.3 %) patients the cause of TBI was a car accident, in 65 (38.9 %) patients the cause was a fall from a height, in 3 (1.8 %) patients compression, 12 (7.2 %) received TBI as a result of the impact.

In this study, a comparative analysis of the results of X-ray, CT and MRI examinations of the skull of patients with varying degrees of trauma was carried out. X-ray examination of the skull was performed on 157 (16.2 %) victims, CT – 447 (46.1 %), MRI – 33 (3.4 %) patients.

A total of 167 patients had skull fractures. X-ray examination was performed in 98 (58.7 %) patients with fractures of the skull bones, CT in 162 (97.0 %), MRI in 20 (12.0 %) patients.

Medical statistical methods and the κ-kappa criterion were used to evaluate the results. All calculations were performed in the MS EXCEL-2013 spreadsheet and the SPSS-26.0 batch program.

Results of the study and their discussion. Among the 134 patients without TBI, 131 (97.8 %) had no X-ray confirmation of such an injury, and false positive results were obtained in 3 (2.2 %) patients. Only 7 (30.4 %) of the 23 victims with TBI had this diagnosis confirmed by X-ray examination, and 16 (69.6 %) had no head injury.

X-ray examination was regarded as a statistically significant study in determining head injury ($\kappa=0.368$; $p<0.001$), the SP of this study was 97.8 %, the SN was 30.4 %.

According to CT results, traumatic brain injury was confirmed in 149 (92.0 %) patients, not detected in 13 (8.0 %) patients. In 277 (97.2 %) of 285 patients without traumatic brain injury, CT showed a true negative result, that is, confirmed the absence of injury, but in 8 (2.8 %) patients a false positive result was obtained, that is TBI was indicated. CT examination in determining TBI is statistically significant (k=0.898; p<0.001), SP was 97.2 %, SN – 92.0 % (Table 1).

During MRI examination, only 7 (50.0 %) of the 14 victims with TBI had this diagnosis confirmed, and the remaining 7 (50.0 %) had no TBI. Although the absence of TBI was confirmed by MRI in 18 (94.7 %) of 19 patients, a negative result was obtained in 1 (5.3 %) patient, that is, the skull injury was misdiagnosed. According to statistical calculations, the MRI examination was statistically significant (κ=0.474; p=0.003) in determining TBI with a SP of 94.7 % and a SN of 50.0 %.

Table 1

Informative value of X-ray, CT and MRI examinations in the detection of traumatic brain injury

Type of examination	The result of the survey	number	Cranial injury		κ	p
			There's not	There is		
X-ray	There's not	n	131	16	0.368	<0.001
		%	97.8 %	69.6 %		
	There is	n	3	7		
		%	2.2 %	30.4 %		
CT	There's not	n	277	13	0.898	<0.001
		%	97.2 %	8.0 %		
	There is	n	8	149		
		%	2.8 %	92.0 %		
MRI	There's not	n	18	7	0.474	0.003
		%	94.7 %	50.0 %		
	There is	n	1	7		
		%	5.3 %	50.0 %		

Thus, a comparative analysis of the results of all three examination methods showed that the greatest informative value of the kappa coefficient was determined by CT examination. Compared to X-ray and MRI, CT can be considered a more effective examination method due to its SP and SN (Fig. 1).

We compared the results of our study to determine which of the examination methods is best suited for detecting head injuries caused by accidents of various etiologies. Of those injured in a car accident, 69 (16.6 %) patients underwent cranial radiography, 208 (50.1 %) had CT scans, and 18 (4.3 %) patients had MRI scans. In most of the victims of a car accident, it was not possible to detect TBI during X-ray examination, since 7 (63.6 %) of the 11 victims without TBI had a false negative result, and 4 (36.4 %) had this injury.

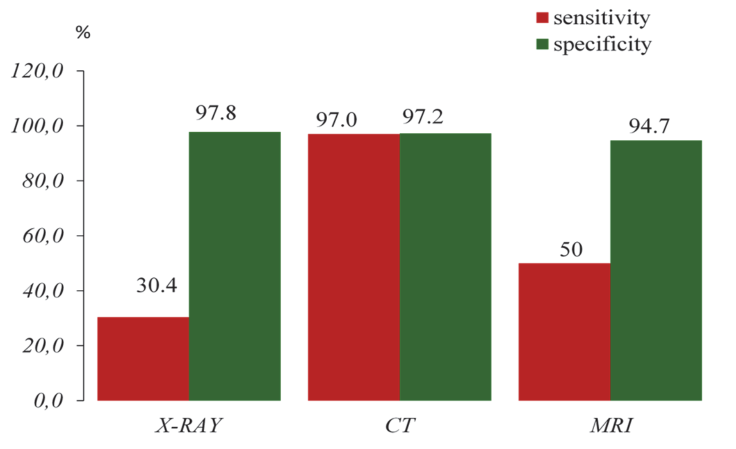

Fig. 1. SP and SN radiography, CT and MRI in the detection of traumatic brain injury.

At the same time, it was proved that 57 (98.3 %) of the victims did not have a TBI (κ=0.445; p<0.001). As can be seen from the results obtained, the SP of X-ray examination in detecting skull injuries in persons injured in car accidents was determined at the level of 98.3 %, and the SN was 36.4 %.

In 73 (89.0 %) of 81 victims with TBI in a car accident, a head injury was confirmed according to CT data, and 9 (11.0 %) received a false negative result.

124 (98.4 %) of the victims were diagnosed without TBI, which was true, 2 (1.6 %) of the victims received a false positive result (k=0.868; p<0.001). CT SP in the detection of TBI in car accidents was 98.4 %, SN – 89.0 %. MRI examination also has poor information content in the detection of head injury in an accident. Thus, out of 10 victims with TBI, based on this examination, this injury was detected in only 4 (40.0 %), and in the remaining 6 (60.0 %) patients it was not detected. The absence of TBI was confirmed by MRI examination (k=0.372; p=0,043) in 8 (100 %) patients. SP MRI in detecting TBI in car accidents was 100.0 % and SN – 40.0 %.

In order to identify head injuries caused by a fall, X-ray examination of the skull was performed in 47 (12.9 %) patients, CT – 161 (44.1 %), MRI – 9 (2.5 %) patients.

In 3 (42.9 %) patients with TBI, this injury was confirmed by X-ray examination, and in 4 (57.1 %) patients it was not determined. X-ray examination showed that 39 (97.5 %) patients had no head injury (κ=0.490; p<0.001), 1 (2.5 %) patient had a false positive result. Based on a CT scan, the diagnosis was confirmed in 61 (95.3 %) of 64 patients with TBI, and in 3 (4.7 %) patients it was not confirmed and a false negative result was obtained. Although the CT scan determined the absence of head injury in 93 (95.9 %) patients, it showed a false positive result in 4 (4.1 %) patients (κ=0.909; p<0.001).The MRI examination did not detect trauma in all patients without TBI – 7 (100.0 %) patients (k=0.609; p=0.047).The SP of X-ray examination in detecting head injury in a fall was 97.5 %, SN – 42.9 %; SP CT scan – 95.9 %, SN – 95.3 %; SP MRI scan was 100.0 %.

According to the results, CT can provide more accurate information, in comparison with X-rays and MRI, when detecting head injuries in patients with fall injuries, due to both its SP and SN.

Skull radiography was performed in 38 (35.8 %) of the victims of the impact, CT was performed in 59 (55.7 %) patients, and MRI was performed in 4 (3.8 %) patients. In these patients, X-ray examination did not give an effective result in detecting a skull injury, since this injury was detected in 5 (100.0 %) patients with a skull injury. However, in 32 patients (97.0 %) who did not receive TBI, it showed a truly negative result (κ=-0.046; p=0.693). During CT examination, this injury was detected in 10 (90.9 %) of 11 TBI victims and was not detected in only 1 (9.1 %) patient. As a result of CT examination, 46 (95.8 %) patients who did not have TBI showed the absence of this injury, while false positive results were obtained in 2 (4.2 %) patients (k=0.838; p<0.001).The SP of X-ray examination in detecting skull injury as a result of impact was 97.0 %; SP and SN CT were 95.9 % and 90.9 %, respectively.

As it can be seen, CT is more effective in detecting TBI in patients with shock injuries, both in relation to SP and in relation to SN. Therefore, the CT examination method can be considered as a more effective and accurate method for detecting TBI of various etiologies.

Table 2

Informative value of various research methods in the detection of single and combined traumatic brain injury

Type of injury	type of survey	The result of the survey	number	Skull injury		κ	p
				There's not	There is		
Isolated injury	X-ray	There's not	n	28	3	0.368	0.007
			%	100.0 %	75.0 %		
		There is	n	0	1		
			%	0.0 %	25.0 %		
	CT	There's not	n	100	0	0.879	<0.001
			%	98.0 %	0.0 %		
		There is	n	2	8		
			%	2.0 %	100.0 %		
Combined injury	X-ray	There's not	n	29	13	0.319	0.006
			%	96.7 %	68.4 %		
		There is	n	1	6		
			%	3.3 %	31.6 %		
	CT	There's not	n	88	13	0.863	<0.001
			%	96.7 %	8.4 %		
		There is	n	3	141		
			%	3.3 %	91.6 %		
	MRI	There's not	n	8	7	0.421	0.015
			%	100.0 %	50.0 %		
		There is	n	0	7		
			%	0.0 %	50.0 %		

Head injuries are often accompanied by damage to other organs. An isolated (single) skull injury was found in 9 (5.4 %) patients with TBI, and a combined injury was found in 158 (94.6 %) patients. Of the 17.2 % of TBI victims, 16.3 % had combined injuries, and 0.9 % had single injuries. Of the victims with combined trauma, 130 (77.8 %) had TBI, 76 (45.5 %) had damage to the maxillofacial region, 29 (17.8 %) had rib damage, 46 (27.6 %) had lung damage, 13 (7.8 %) patients had spinal cord damage, 3 (1.8 %) patients had spinal cord injury, 31 (18.6 %) patients had damage to surrounding bones, 15 (9.0 %) patients had joint damage.

X-ray examination did not confirm the diagnosis in 3 (75.0 %) of the 4 victims with a single TBI. At the same time, it was shown that 28 (100.0 %) of the victims without TBI did not actually have a pelvic injury (κ=0.368; p=0.007). As a result of CT examination, it was confirmed that 100 (98.0 %) people did not have TBI, but false positive results were obtained in 2 (2.0 %) patients. As can be seen, X–ray has a high SP, and CT has a high SN when detecting single head injuries (Table 2).

In the X-ray examination performed to identify head trauma in victims with combined trauma, 29 (96.7 %) patients did not have a head injury, and 1 (3.3 %) patient received a false positive result. X-ray examination did not allow to determine the skull injury in 13 (68.4 %) patients out of 19 with TBI, and in 6 (31.6 %) patients a truly positive result was obtained (k=0.319; p=0.006).

During CT examination, 88 (96.7 %) of 91 patients without TBI had a true negative result, 3 (3.3 %) had a false positive result. According to CT data, out of 147 patients with TBI, this diagnosis was confirmed in 141 (91.6 %), false negative results were obtained in 13 (8.4 %) (κ=0.863; p<0.001). The MRI examination showed the absence of injury in all patients without TBI – 8 (100.0 %), the diagnosis was confirmed in 7 (50.0 %) of 14 patients with TBI (k=0.421; p=0.015).

The frequency of X-ray examination in detecting combined TBI is 31.6 %, SP – 96.7 %; SN CT frequency was 91.6 %, SP – 96.7 %; SN MRI frequency was 50.0 %, SP – 100.0 %. When detecting combined TBI, MRI can be considered a more informative examination method due to its SP, and CT due to SN.

Patient A.V.M., 33 years old, male, I/b No. 3718, was admitted to the Clinical Medical Center in 2017 with combined injuries sustained as a result of a car accident. A) axial, B) coronary, C) sagittal CT images in the bone window, D) CT images of soft tissues in the coronary plane, and E) 3D reformed CT images of bones were obtained. As a result of severe bruising and damage to the head and brain, fractures with displacement of the left temporal bone and fractures without displacement of both occipital bones were observed. Subdural hematoma is observed in the left temporal lobe (Fig. 2).

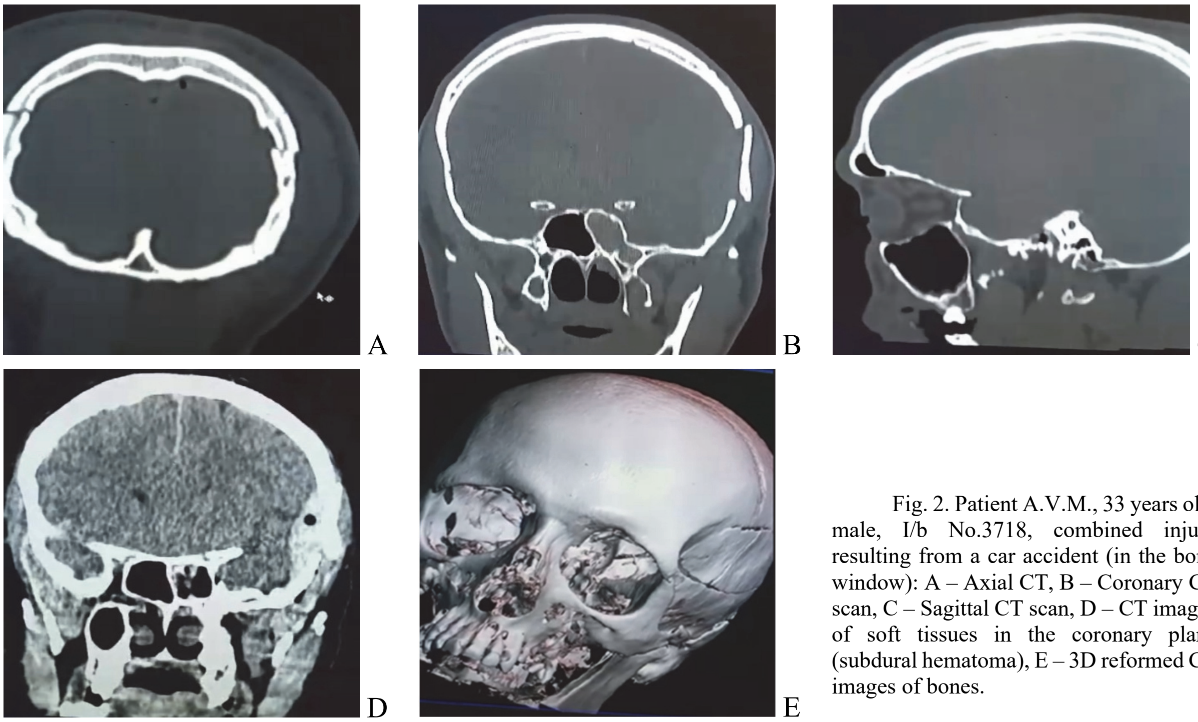

Fig. 2. Patient A.V.M., 33 years old, male, I/b No.3718, combined injury resulting from a car accident (in the bone window): A – Axial CT, B – Coronary CT scan, C – Sagittal CT scan, D – CT images of soft tissues in the coronary plane (subdural hematoma), E – 3D reformed CT images of bones.

Diagnosis: Severe combined injury. Severe brain injury. Hemorrhagic lesions of contusion in the left temporal lobe and malleus. Closed chest injury. Bruised lungs. Left-sided hemopneumothorax. Vegetative state.

Patient G.N.N., 20 years old, male, I/b No. 5909, was admitted to the Clinical Medical Center in 2017 as a result of a fall. X-ray images were obtained in A) coronary and B) sagittal projections, CT images in the bone window in C) axial projection and D) three-dimensional CT images with bone reformatting in the coronary projection. While the fracture is not clearly visible during X-ray examination, a comminuted depressed fracture of the right frontotemporal bone attracts attention during CT examination (Fig. 2).

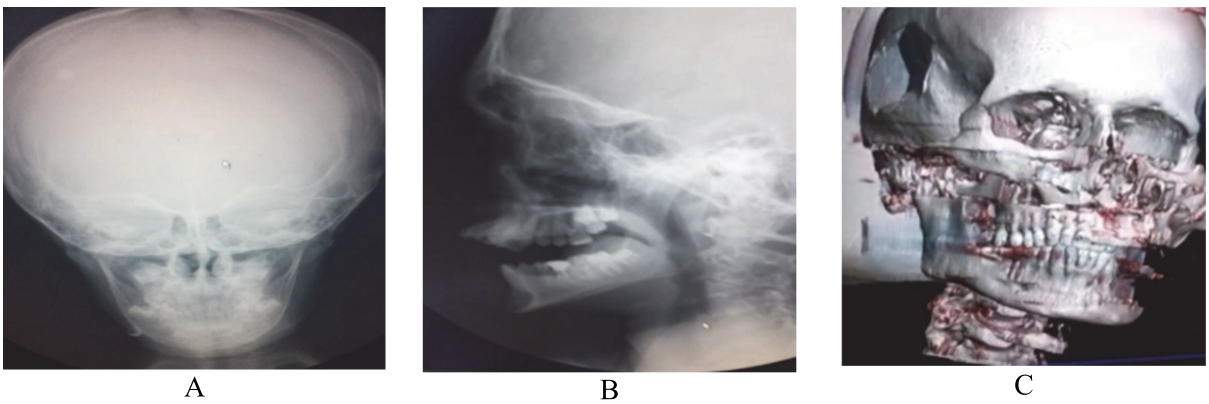

Fig. 3. Patient G.N.N., 20 years old, male, I/b No. 5909, combined skull injury resulting from a fall (in the bone window): A – Axial CT, B – Sagittal CT scan, C – Three-dimensional CT image.

Diagnosis: Combined TBI. Concussion of the brain. Compression depressed fracture of the frontal bone. Slight contusion of the frontal lobe of the brain.

If CT is available for a patient with TBI, CT should be performed, since X-ray examination can lead to loss of time and additional radiation load in the diagnosis of intracranial injury. Although MRI is more sensitive than CT in detecting cerebral pathology, CT has advantages in the treatment of the acute phase of closed TBI. It was found that in skull fractures, SN CT was 85.4 %, SP – 100 %, kappa coefficient – 0.787 (p<0.001). [4].

CT is considered the main method of screening for TBI. CT scans can reveal fractures of the base of the skull, extraaxial hematomas and parenchymal lesions. The main advantage of CT in the diagnosis of TBI is its high PM in determining the mass effect, size and structure of the ventricles, acute bleeding, as well as in determining skull fractures. Some researchers show that it is not possible to completely identify fractures of the skull with axial CT tomography, and the frequency of missed fractures is 14.6 % compared with autopsy. The detection of unspecified skull fractures is also possible with the use of coronary and sagittal reformed CT with multidetector technique [3]. CT gives a three-dimensional, clear and three-dimensional image of bones, with this method the doctor can not only identify fractures in bones, but also examine the adjacent structures of soft tissues. X-ray examination of the skull is considered to be the last tool for visualizing trauma in the absence of CT [15].

Thus, CT is the main imaging method for the initial assessment of patients with suspected TBI, since it has a high SN and SP.

Conclusion

X-rays and MRI scans play an important role in the timely detection of skull fractures. From this point of view, the informative value of X-ray examination methods (radiography, CT and MRI) in determining TBI was evaluated taking into account their SP and SN. To this end, 157 (16.2 %) victims who were injured for various etiological reasons (especially in car accidents and as a result of blows) underwent X–ray examination of the skull, 447 (46.1 %) underwent CT, 33 (3.4 %) patients underwent MRI. Compared to X-ray and MRI, CT can be considered a more effective examination method due to its SP and SN. CT examination can be considered a particularly effective examination method for detecting head injuries as a result of road accidents due to its SN (89.0 %) and SP (98.4 %). When detecting a combined traumatic brain injury, MRI in connection with his joint venture (100.0 %), and CT in connection with his joint venture (96.7 %) and SN (91.8 %) were accepted as more informative examination methods. Axial cranial reformed CT is the main method of diagnosis of skull fractures.

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DYNAMICS OF THE PSYCHOPHYSICAL STATE OF FUTURE LAW ENFORCEMENT OFFICERS IN THE COURSE OF THEIR PROFESSIONAL TRAINING

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The research aimed to investigate the dynamics of indicators of physical and mental states of cadets, i.e. future law enforcement officers in the course of their training at a higher educational institution with specific learning environment. The research involved 96 male cadets aged 17–20 who entered the National Academy of Internal Affairs in 2018. The research lasted 4 years. Cadets' physical state was assessed by the indicators of their body weight, body length, age, heart rate, and blood pressure and was determined by the formula of the physical state index proposed by Ye. A. Pirohova. Cadets' mental state was assessed by the indicators of situational anxiety (methodology of Ch. D. Spielberger, Yu. L. Khanin) and well-being, activity, and mood ("WAM"). A significant improvement in cadets' physical state index during the first and second years of their training ($p < 0.05$–0.001) and an insignificant deterioration in the third training year ($p > 0.05$) was revealed. At the same time, the level of cadets' anxiety significantly ($p < 0.001$) decreases during their training, and their emotional state improves. This indicates the effectiveness of professional training of future law enforcement officers in general and physical training in particular. However, the deterioration of the physical state index in cadets during the third year of their training proves the need to improve the educational process in the academic subject area referred to as "Special Physical Training" by increasing the share of general physical training.

Key words: physical state, mental states, cadets, law enforcement officers, professional training, physical training.

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ДИНАМІКА ПСИХОФІЗИЧНОГО СТАНУ МАЙБУТНІХ ПРАВООХОРОНЦІВ ПІД ЧАС ПРОФЕСІЙНОЇ ПІДГОТОВКИ

Метою було дослідити динаміку показників фізичного та психічного станів курсантів – майбутніх правоохоронців під час навчання у закладі вищої освіти зі специфічними умовами навчання. У дослідженні взяли участь 96 курсантів-чоловіків віком 17–20 років, які вступили на навчання до Національної академії внутрішніх справ у 2018 році. Тривалість дослідження – 4 роки. Фізичний стан курсантів оцінювався за показниками маси тіла, довжини тіла, віку, ЧСС, тиску та визначався за формулою індексу фізичного стану, запропонованою Є. А. Пироговою. Психічний стан курсантів оцінювався за показниками ситуативної тривожності (методика Ч. Д. Спілбергера, Ю. Л. Ханіна) та самопочуття, активності і настрою (методика «САН»). Виявлено достовірне покращення індексу фізичного стану у курсантів під час навчання на першому та другому курсах ($p<0,05$–$0,001$) та недостовірне погіршення на третьому ($p>0,05$). При цьому рівень тривожності курсантів достовірно ($p<0,001$) знижується впродовж навчання, а емоційний стан – покращується. Це свідчить про ефективність професійної підготовки майбутніх правоохоронців в цілому та фізичної підготовки зокрема. Однак погіршення індексу фізичного стану у курсантів на третьому курсі доводить необхідність удосконалення освітнього процесу з дисципліни «Спеціальна фізична підготовка» шляхом збільшення частки загальної фізичної підготовки.

Ключові слова: фізичний стан, психічний стан, курсанти, правоохоронці, фахова підготовка, фізична підготовка.

The study is a fragment of the research project "Research on determinants of health and scientific substantiation of approaches to the organization of medical care and services to different contingents of the population in the period of development of the public health system", state registration No. 0122U201336.

Today, the law enforcement officers of the National Police of Ukraine face extremely difficult and responsible tasks, including combating crime, which is becoming more widespread and dangerous, ensuring public safety and order, protecting human rights and freedoms, as well as the interests of society and the state, providing assistance to persons who need such support for personal, economic, social reasons or as a result of emergencies. The conditions in which these tasks are performed are extreme and require constant growth of law enforcement officers' professionalism and a high level of their professional training [13, 14].