Original Article

Basic Principles And A Brief History Of The Organization Of Neurotraumatology Care For Patients With Acute Traumatic Brain Injury

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DOI: 10.47750/pnr.2023.14.S01.54

Abstract

The organization of neurotraumatology care for victims with acute traumatic brain injury (TBI) is a system of measures for the prevention, diagnosis, conservative and surgical treatment and rehabilitation of patients with acute TBI.

Traumatic brain injury is an urgent problem in medicine and healthcare in most countries, including Russia. This state of affairs is due to the widespread prevalence of this pathology, high levels of temporary disability, disability and mortality. Accordingly, TBI is objectively positioned as a serious socio-economic problem. For example, in the United States, the economic damage from TBI amounts to an average of $37.8 billion per year.

Keywords: traumatic brain injury, international treatment experience, organization of neurotraumatology care, stages of rendering

Introduction

The effectiveness of treatment of patients with acute TBI depends mainly on the organization of neurotraumatology medical care, the shortcomings of which significantly worsen the results even of highly qualified specialists.

The organization of neurotraumatology care for patients with acute traumatic brain injury (TBI) is a system of measures for the prevention of traumatic brain injury, early diagnosis and timely full-volume conservative and surgical treatment followed by rehabilitation therapy and rational employment.

Preventive measures include compliance with safety regulations at work and home; compliance with traffic rules by drivers and pedestrians; the use of passive safety measures in transport (seat belts, inflatable airbags in cars, protective helmets for motorcyclists); active promotion of a healthy lifestyle, including anti-alcohol propaganda; improvement of living conditions (security work with normal housing conditions, a sufficient level of wages, etc.).

There are three stages in the organization of medical care for victims with acute TBI: pre-hospital, hospital and post-hospital. The quality and timeliness of medical care and the continuity of the activities carried out at all three stages are essential.

The study's objectives included the analysis of only the first two stages.

Scheme of organization of medical care for victims with acute TBI

I. Pre-hospital stage.

1. Pre-medical medical care: self-help and mutual assistance; assistance of secondary medical workers in the first-aid posts of institutions, enterprises, children's institutions, sports organizations, emergency rooms and polyclinics, and by ambulance.
2. General medical care: linear ambulance; in trauma centres, polyclinics, health centres, medical units of institutions and enterprises, medical offices of schools, kindergartens and nurseries, and emergency departments of hospitals and clinics.
3. Specialized medical care: neurological, psychiatric and resuscitation ambulance teams; neuropathologists of

polyclinics; duty doctors-neurosurgeons, neuropathologists, resuscitators, ophthalmologists, ENT specialists, psychiatrists and other specialists in the emergency departments of hospitals and clinics.

II. Hospital stage.

1. Non-core hospitalization: in traumatology, general surgery, psychiatric, infectious diseases and other departments of hospitals with the call, if necessary, of a consultant neurosurgeon.

2. Profile hospitalization: in neurosurgical or intensive care units (wards) with subsequent transfer to a neurosurgical bed.

III. Post-hospital stage.

1. Rehabilitation departments at polyclinics.

2. Rehabilitation departments within hospitals.

3. Special sanatoriums for patients after neurotrauma.

4. Rational employment of patients after TBI.

There are possible options when the patient is examined for the first time by a neurosurgeon at an outpatient appointment a few weeks or even months after receiving a TBI (for example, in cases of chronic subdural hematomas). Thus, the neurosurgeon begins to provide medical care from the moment the victim with acute TBI is admitted to the emergency department of a hospital or clinic. From that moment on, medical care for these patients acquires a neurosurgical character.

The procedure for hospitalization of victims with acute TBI is regulated by order of the Ministry of Health of the Russian Federation dated November 12, 2012, N 901n "On approval of the procedure for providing medical care to the population in the profile "traumatology and orthopaedics" (as amended on 02/21/2020). According to the Order, in all cases of TBI, patients are sent for inpatient treatment to neurosurgical departments regardless of severity. Patients with severe and moderate TBI, in combination with soft tissue injuries of the trunk and limbs, with fractures of small bones of the limbs, are treated in neurosurgical departments with the participation of a traumatologist. Patients with mild and moderate TBI in combination with fractures of the pelvis, hip, shin, shoulder and forearm bones are treated in trauma departments with the participation of a neurosurgeon. Patients with mild and moderate TBI, in combination with trauma to the abdominal and thoracic cavities, should be treated in a surgical department with the participation of a neurosurgeon. Victims with severe closed and open TBI violations of vital functions are sent to intensive care units or the intensive care wards of the neurosurgical department, and the treatment of such patients is carried out by resuscitators and neurosurgeons [1, 2, 3, 4].

Currently, patients with severe TBI are treated in large cities, including Moscow, as a rule, only in neurosurgical departments, in which intracranial operations are performed in such patients in the vast majority of cases. In rural areas of the Russian Federation, intracranial operations for patients with severe TBI are carried out in the trauma departments of the CRH by traumatologists who have specialized in neurotraumatology.

In large cities, if a patient with severe TBI has been admitted to the trauma department, a consultant neurosurgeon is urgently called, who transfers such a patient to the neurosurgical department or operates on the spot if he is not transportable. In large cities, trauma surgeons, as a rule, do not perform intracranial operations.

Such a situation with intracranial surgical interventions in patients with severe TBI in the Russian Federation has not always been. In the early 1990s, most of the victims with acute traumatic intracranial hematomas, with depressed fractures of the skull bones, were operated on by traumatologists, even in large cities, because the neurosurgical service was poorly developed. In 1990 In the Russian Federation, in addition to two neurosurgical institutes in Moscow and Leningrad, there were only eight neurosurgical departments: in Gorky, Kazan, Novosibirsk, Rostov-on-Don, Saratov, Sverdlovsk and Leningrad (V.M.Bekhterev Psychoneurological Institute - 40 beds). In several regions of the country, 5-10 neurosurgical beds were allocated as part of traumatology or surgical departments. The total neurosurgical bed fund consisted of 400 beds. It was not enough for a country like Russia. There were also few neurosurgeons in the country. All complex intracranial operations in patients with severe TBI were left to traumatologists and general surgeons [5, 6, 7].

The Order of the Ministry of Health and Social Development of the Russian Federation dated March 31, 2010, N 201n "On approval of the Procedure for providing medical care to the population with injuries and diseases of the musculoskeletal system" draws attention to the prevention of industrial and domestic injuries. It is recommended to increase awareness of safety, teach the population, especially preschool children and elementary school students, the rules of traffic and behavior on the street, and lead the people to the laws of first aid in case of injuries on the principle of self- and mutual assistance. The order defines the stages of medical care for road traffic injuries: stage I - at the scene of the accident, stage II - assistance on the way to a medical institution, and stage III - medical care in a medical institution. It was planned to expand the network of trauma centres and trauma departments and improve their equipment with diagnostic equipment and medical equipment [8, 9, 10].

The Order of the Minister of Health of the Russian Federation No. 931n, dated November 15, 2012, "On approval of the Procedure for providing medical care to the adult population in the "neurosurgery" profile", notes that the number of patients with CNS trauma hospitalized in neurosurgical departments of Russia increased from 67% in 2009 to 80% in 2016. Despite the increase in the neurosurgical bed stock in the country, a significant part of the victims with neurotrauma continues to be hospitalized in surgical and traumatology departments, especially in remote areas of Russia. The provision of children's neurosurgical beds is deficient.

In current conditions, the issues of optimizing public health protection remain relevant and are put among the main ones by the President and the Government of the Russian Federation. At the same time, the healthcare system's complexity create significant organizational difficulties for its improvement and social accessibility [11]. It, in turn, determines the importance and relevance of improving the procedure for providing various types of medical care at the regional level, including for diseases and injuries of the nervous system of a neurosurgical profile. Medical care for patients with this pathology is provided under Appendices No. 1-4 to the procedure for providing medical care for diseases and injuries of the nervous system of a neurosurgical profile, approved by order of the Ministry of Health and Social Development of the Russian Federation dated 13.04.11, No. 317n [10, 11].

The purposeful long-term work of our state on developing the country's neurosurgical service has yielded results. According to official data of the Department of Medical Statistics and Informatics of the Ministry of Health of the Russian Federation, the number of neurosurgeons in 2016 amounted to 2095 people, and the neurosurgical bed fund of the country reached 14906 beds. The provision of the population of Russia with neurosurgical beds is 1.1 per 10 thousand people, and in large cities - 2.0 or more beds per 10 thousand people. Since 2010, when the Order of the Minister of Health of the Russian Federation on the establishment of the Neurosurgical Service of Russia was issued, significant changes have taken place: hundreds of new hospitals equipped with modern diagnostic and surgical equipment have been built. Currently, CT and MRI are available in almost every region, province, and the republic of the Russian Federation.

An essential role in the development and improvement of the neurosurgical service of the country has been played. It continues to be played by the Institute of Neurosurgery of the N.N.Burdenko Russian Academy of Medical Sciences and the A.L.Polenov RNHI, which since 1947 has been the Main institution for neurosurgery in the Russian Federation.

In Moscow, the principles of organizing medical care for patients with acute TBI are the same as in the whole of the Russian Federation, set out above: first aid is provided by ambulance workers, trauma centres and polyclinics, health centres and medical units of institutions and enterprises, in the emergency departments of city hospitals and research institute clinics. Inpatient care is provided in neurosurgical traumatology and surgical departments (combined trauma, SGM and UGM of mild and moderate degree) and neurological departments (SGM and UGM of mild degree). There are two neurosurgical advisory teams (for adults and children) in the city, whose doctors carry out emergency advisory examinations of patients with various neurosurgical pathologies, including severe TBI, in non-core (traumatology, surgical, neurological) departments of city hospitals. Patients with severe TBI are transferred to the neurosurgical department for further treatment or operated on by a consultant neurosurgeon on the spot if the patient is not transportable.

The medical care organization for patients with acute TBI in Europe, the USA, Canada, South America, Asia, Australia and New Zealand differs significantly from that in the Russian Federation and the former republics of the Soviet Union. The main distinguishing feature is the absence of a unified state system for providing medical care to the population (except for the UK, where there is a state system of emergency medical care).

The provision of emergency medical care to patients with neurotrauma in Western countries is dispersed among different services and institutions. Private blades play an important role. All medical services are paid. Therefore, it is of great importance that the victims have insurance. People without health insurance may be denied medical care [12, 13, 14].

Inpatient neurosurgical care is provided in large cities' neurosurgical clinics of large medical centres. Victims come directly from the accident scene or the intensive care wards (departments) of general hospitals that do not have surgical beds [15].

In many Western countries, there are paid hospitals, well equipped with modern diagnostic and surgical equipment, where experienced, qualified specialists work, and municipal public hospitals, where the technical equipment is much worse and less skilled medical staff works. In the first medical institutions, rich, well-financially secure people are usually treated, and in the second - low-income citizens with medical insurance [16].

Таким образом, в историческом отношении нейротравматология в странах Запада возникла в конце XIX-начале XX в. на базе травматологии и неврологии. До 1990-2000-х гг. сложные внутричерепные операции производились, в основном, травматологами. По мере становления нейрохирургической службы нейрохирургические вмешательства на черепе и головном мозге стали относиться к компетенции нейрохирургов.

В настоящее время, например, в США больные с тяжелой ЧМТ, находящиеся на лечении в травматологических центрах первого (самого высокого) уровня, обязательно осматриваются консультантом-нейрохирургом, который переводит больного в нейрохирургическую клинику либо оперирует его на месте, если больной оказывается нетранспортабельным. Травматологи, как правило, больных с внутричерепными гематомами не оперируют.

Thus, in historical terms, neurotraumatology in Western countries arose at the end of the XIX beginning of the XX century based on traumatology and neurology. Until the 1990s-2000s, complex intracranial operations were performed mainly by traumatologists. As the neurosurgical service became established, neurosurgical interventions on the skull and brain began to fall within the competence of neurosurgeons. Currently, for example, in the USA, patients with severe TBI who are being treated in trauma centres of the first (highest) level are necessarily examined by a consultant neurosurgeon who transfers the patient to a neurosurgical clinic or operates on the spot if the patient turns out to be untransportable. Traumatologists, as a rule, do not work on patients with intracranial hematomas.

References:

1. Herkul Yu.A., Gulyaev D.A., Ivanova N.E. Surgical rehabilitation of patients with craniofacial deformities (literature review) // Russian Neurosurgical Journal named after Professor A.L. Polenov - Volume XIV, No1-1, 2022 – pp. 146-153.
2. Dreval O. N., Neurosurgery. Guidelines for doctors in 2 volumes / O. N. Dreval, A.V. Baskov, G. I. Antonov // GEOTAR-Media, 2013.
3. Efimov A.V., Strelkina K.A., Zabrodskaya Y.M., Kiyashko S.S., Sidorin V.S., Orlov A.Y. Chordoma in neurosurgical practice: clinical and morphological aspects. Materials of the Russian Neurosurgical Institute named after prof. A.L. Polenov from 2011-2021//The Russian Neurosurgical Journal named after Professor A.L. Polenov - Volume XIV, No1-1, 2022 – pp.34-41.
4. Morbidity of the entire population of Russia in 2020 Statistical materials. Part II. 2018. Ministry of Health of the Russian Federation; Federal State Budgetary Institution Central Research Institute of Organization and Informatization of Healthcare of the Ministry of Health of the Russian Federation.
5. Healthcare in Russia 2019: Statistical collection / Federal State Statistics Service (Rosstat). – M, 2020. – 174.
6. Kocharyan E.V., Sarkisyan T.G., Kovalev G.I., Bogrova M.I., Muzlaev G.G. Decompressive craniectomy in the treatment of vascular complications after removal of brain tumours // Russian Neurosurgical Journal named after Professor A.L. Polenov - Volume XIV, No1-1, 2022 –47-55.
7. Konovalov, A. N. Reconstructive and minimally invasive surgery of the consequences of traumatic brain injury / A. N. Konovalov, A. A. Potapov, L. B. Lichterman, V. N. Kornienko, A.D. Kravchuk, V. A. Okhlopkov, N. E. Zakharova, S. B. Yakovlev // M.: Antidor. - 2012.
8. Krylov V. V., Neuro-resuscitation. Practical guide. / V. V. Krylov, S. S. Petrikov, G. R. Ramazanov, A. A. Solodov // GEOTAR-Media, 2016.
9. Lichterman, L.B. Classification of traumatic brain injury. – Part II. Modern principles of TBI classification / L.B. Lichterman // Forensic medicine. – 2015. – No. 3. –37-39.
10. Likhterman L.B., Kravchuk A.D., Okhlopkov V.A., Likhterman B.L. Principles of modern diagnosis of traumatic brain injury. Journal of Neurology and Psychiatry named after S.S. Korsakov. 2018;118(11):93 99.
11. Aguzzi, A. Microglia: scapegoat, saboteur, or something else? / A. Aguzzi, B.A. Barres, M.L. Bennett // Science. – 2013. – Vol. 339. – № 6. – P. 156-161.
12. Akhtar, L.N. Suppressor of cytokine signalling 3 inhibits antiviral IFN-beta signalling to enhance HIV-1 replication in macrophages / L.N. Akhtar et al. // J. Immunol. – 2010. – Vol. 185. – P. 2393-2404.
13. Bhattacharya, P. Aquaporin-4 inhibition mediates piroxicam-induced neuroprotection against focal cerebral ischemia/reperfusion injury in rodents /P. Bhattacharya et al. //PLoS One. – 2013 Sep 4;8(9):e73481. doi: 10.1371/journal.pone.0073481. eCollection
14. Borregaard, N. Neutrophils, from marrow to microbes / N. Borregaard //Immunity. – 2010. – Vol. 33. –N 5. – 657-670.
15. Byvaltsev, V. A. A case of successful treatment of post-traumatic frontal lobe brain abscess in patient during subacute period of penetrating craniovertebral trauma / V. A. Byvaltsev, A. A. Kalinin, A. F. Khachikyan, G. S. Zhdanovich, A. V. Egorov, S. Y. Panasenkov, B. B. Damdinov, E. G. Belykh, S. T. Antipina, V. A. Sorokovikov // The new Armenian medical journal. - 2015. - Vol. 9. - № 4. - P. 80-88.