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ETIOLOGY, FREQUENCY AND CONSEQUENCES OF POLYTRAUMA. LITERATURE REVIEW

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Abstract

Background: Polytrauma is one of the most alarming elements of road injuries because it usually accompanies severe injuries such as traumatic brain injury (TBI) and spinal cord injury (SCI). The consequences of injury cause life loss and disability for victims as well as represent a burden to healthcare systems and economies through loss of productivity and high healthcare costs (James et al. 2019; Abbafati et al. 2020b). A recently published Global Burden of Diseases (GBD) study showed that road injuries ranked first in the top 10 causes among people aged 10 to 49 years. The evaluation, management, and prognosis of a polytrauma are substantially different and challenging due to its complicated mechanisms, which are road traffic collision, drops from heights, and homicides. According to the WHO Global Status Report on Road Safety states that road accidents caused more than 1.3 million deaths and severe injuries globally every year disproportionately affecting mostly middle-income countries.

Aim of this study was to explore etiology, frequency and consequences of polytrauma.

Methods: Manuscripts dealing with polytrauma were reviewed. Also we reviewed English- and Russian-language articles in PubMed and eLibrary.ru. The following search modules were selected in PubMed Medline and eLibrary.ru: Polytrauma, Definition of the term "polytrauma", Golden Hour, Infectious and noninfectious complications in polytraumatized patients. We studied data on from the period of 2000 to 2020. Case reports and case series were excluded. Studies of isolated trauma patients and childhood trauma were excluded.

Results: Presents a review of etiology, frequency of occurrence of polytrauma, their temporary and permanent consequences in patients. The article also gives definition of the term "polytrauma" and explains the importance of the rule of "Golden Hour". The frequency of infectious and noninfectious complications in polytraumatized patients was analyzed on the basis of the literature data.

Conclusion: In literary sources, it can be noted that the intensive development of the technical and construction industries provokes an increase in the number of polytraumas not only in our country, but throughout the world. Although patients with polytrauma remain alive, many of the consequences persist and lead to temporary or permanent disability. According to the rule of "golden hour", the sooner a patient receives definitive care, the higher is the likelihood that medical and surgical treatment will prevent their death. Therefore, when clinical teams and facilities are organized to meet best practice clinical guidelines and standard services within the trauma system, each patient's mortality and morbidity could be significantly reduced.

Keywords: polytrauma, etiological factors, motor vehicle collision, complications, disability, lethality.

Резюме

ЭТИОЛОГИЯ, ЧАСТОТА И ПОСЛЕДСТВИЯ ПОЛИТРАВМЫ. ОБЗОР ЛИТЕРАТУРЫ

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Актуальность: Политравма является одним из наиболее тревожных элементов дорожных происшествий, поскольку обычно сопровождается тяжелыми травмами, такими как черепно-мозговая травма (ЧМТ) и травма спинного мозга (ТСМ). Последствия травм приводят к потере жизни и инвалидности жертв, а также создают бремя для систем

здравоохранения и экономики вследствие потери производительности и высоких затрат на здравоохранение (Джеймс и др., 2019; Аббафати и др., 2020b). Недавно опубликованное исследование глобального бремени болезней (ГББ) показало, что дорожные травмы занимают первое место в десятке основных причин среди людей в возрасте от 10 до 49 лет. Оценка, лечение и прогноз политравмы существенно отличаются и сложны ее механизмы, такие как дорожно-транспортное происшествие, падение с высоты и убийства. Согласно отчету ВОЗ о глобальном состоянии безопасности дорожного движения, ежегодно в результате дорожно-транспортных происшествий более 1,3 миллиона человек умирают и получают тяжелые травмы, что непропорционально влияет на страны со средним уровнем дохода.

Целью данного исследования было изучить этиологию, частоту и последствия политравмы.

Методы: Проанализированы рукописи, посвященные политравме. Также мы рассмотрели англоязычные и русскоязычные статьи в PubMed и eLibrary.ru. В PubMed Medline и eLibrary.ru были выбраны следующие поисковые модули: Политравма, Определение термина политравма, Золотой час, Инфекционные и неинфекционные осложнения у пациентов с политравмой. Отчеты о случаях и серии случаев были исключены. Также были исключены исследования пациентов с изолированными травмами и детскими травмами.

Результаты: представлен обзор этиологии, частоты встречаемости политравмы, её временные и постоянные последствия у пациентов. Дано определение термина «политравма», и разъяснена важность правила «Золотого часа». На основании литературных данных проведен анализ частоты встречаемости инфекционных и неинфекционных осложнений у пациентов с политравмой.

Вывод: В литературных источниках можно отметить, что интенсивное развитие технической и строительной отраслей провоцирует рост количества политравм не только в нашей стране, но и во всем мире. Хотя пациенты с политравмой остаются живы, многие последствия сохраняются и приводят к временной или постоянной инвалидности. Согласно правилу «золотого часа», чем раньше пациенту будет оказана окончательная помощь, тем выше вероятность того, что медикаментозное и хирургическое лечение предотвратит его смерть. Следовательно, когда клинические бригады и учреждения организованы в соответствии с передовыми клиническими рекомендациями и стандартными услугами в рамках системы травматологии, смертность и заболеваемость каждого пациента могут быть значительно снижены.

Ключевые слова: политравма, этиологические факторы, дорожно-транспортное происшествие, осложнения, инвалидность, летальность.

Түйіндеме

ПОЛИЖАРАҚАТТЫҢ ЭТИОЛОГИЯСЫ, КЕЗДЕСУ ЖИІЛІГІ, ЖӘНЕ САЛДАРЫ. ӘДЕБИ ШОЛУ

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Полижарақат – жол көлік жарақаттарының ең үрей тудыратын элементтерінің бірі, себебі ол әдетте бас миының (БМЖ) және жұлын бағанының жарақаты (ЖБ) сияқты бірнеше ағзалардың ауыр зақымдалуымен бірге жүреді. Жарақат салдары адамдардың қайтыс болуы мен мүгедектікке әкеледі, сонымен қатар өнімділіктің төмендеуі мен полижарақат алған науқастарға кететін шығын көлемінің жоғары болуына байланысты денсаулық сақтау жүйелері мен экономикаға да кері әсерін тигізеді (Джеймс және басқалар 2019; Аббафати және басқалар. 2020). Жуырда жарияланған Жаһандық ауырулардың ауыртпалығын зерттеу (ЖАА) мәліметі бойынша, 10 мен 49 жас аралығындағы науқастардың қайтыс болуының 10 себебі ішінде жол-көлік оқиғасы бірінші орында тұр. Полижарақатты бағалау, емдеу және болжау айтарлықтай ерекшелінеді және күрделі, себебі жол-көлік оқиғасы, биіктен құлау, адамды өлтіру сияқты күрделі механизмдердің әсерінен болады. ДДҰ-ның әлемдегі жол-көлік қозғалысының қауіпсіздік жағдайы туралы мәліметі бойынша жыл сайын әлем бойынша жол-көлік оқиғасынан 1,3 миллион адам қайтыс болады және ауыр жарақаттар алады, бұл дамушы елдер арасында айтарлықтай кері әсерін тигізеді.

Мақсаты: Полижарақаттың этиологиясын, жиілігін және салдарын зерттеу.

Зерттеудің әдісі: Полижарақатқа арналған рецензирленген қолжазбалар қаралды. Сондай-ақ біз ағылшын және орыс тілді мақалаларды PubMed және eLibrary.ru мағлұматтар базасынан қарастырдық. PubMed Medline және eLibrary.ru сайттарында келесі іздеу модульдері таңдалды: Полижарақат, полижарақат терминінің анықтамасы, Алтын сағат ережесі, полижарақат алған науқастардағы инфекциялық және инфекциялық емес асқынулар. Біз 2000 жылдан 2020 жылға дейінгі кезеңдегі мәліметтерді зерттедік. Оқиғалар туралы есептер мен топтамалар алынып тасталды. Сондай – ақ жекелеген жарақаттар мен балалар жарақаты зерттеуге алынбады.

Нәтижесі: Бұл жұмыста полижарақаттың этиологиясына, кездесу жиілігіне, полижарақаттан емделіп шыққан науқастарда қалатын уақытша және тұрақты салдарларына әдеби шолу жасалынды. Полижарақатқа түсініктеме

беріліп, «Алтын сағат» ережесінің маңыздылығы айқындалды. Әдебиет көздеріне сүйене отырып, полижарақат алған науқастарда болатын инфекциялық және инфекциялық емес асқынулардың кездесу жиілігіне талдау жасалынды.

Қорытынды: Әдеби дереккөздердегі мәліметтерге негізделіп, техникалық және құрылыс салаларының қарқынды дамуы полижарақат санының тек біздің елде ғана емес, бүкіл әлемде көбеюіне түрткі болатындығын атап өтуге болады. Полижарақаттан тірі қалған науқастарда көптеген салдары сақталып, олардың уақытша немесе тұрақты еңбекке жарамсыздығына әкеледі. «Алтын сағат» ережесі бойынша полижарақат алған науқасқа неғұрлым тезірек сапалы көмек көрсетілсе, соғұрлым медициналық және хирургиялық емдеуде олардың өліміне жол бермеу ықтималдылығы жоғары болады. Сондықтан, жарақаттану жүйесіндегі клиникалық нұсқаулар мен стандартты қызметтерге сәйкес келетін клиникалық топтар мен қондырғылар ұйымдастырылған кезде, әр науқастың өлімі мен мүгедектігі едәуір төмендеуі мүмкін.

Түйін сөздер: полижарақат, этиологиялық факторлар, жол-көлік оқиғасы, асқынулар, мүгедектік, өлім.

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Introduction

Acceleration of urbanization, increase in transport, broad development of the construction industry, automation of industries and agriculture in recent years has led to an increase in injuries not only in our country but also worldwide. [9,10, 45, 37,53,56]. According to the World Health Organization (WHO), approximately 2 million people die each year as a result of injuries. [Kulesha. N.V., 2006; Grishanova T. G. etc., 2011]. Traumas are second in the list of causes of temporary disability, and third in the list of causes of primary disability; they are also the second leading reason of all deaths and are the first leading cause of deaths among the working age people. [5, 24, 56]. The lethality resulting from traumas does not decrease, but only increases from year to year. Thus, in 1939 injuries took 5th place in terms of total mortality, in 1959 - 3rd place, and in 1992 - 2nd place. [38, 19]. One of the main frequent causes of health impairment, which were reported are motor vehicle collisions (MVC). About 20 million road crashes per year worldwide, which lead to major traumas in 50 million people and approximately 1.25 million human lives are cut short. According to the World Health Organization statistics, number of traffic-related deaths in Kazakhstan is higher than in European countries (24,2% per 100 000 population) [71].

By the end of the 20th century the structure of injuries had completely changed. In terms of the level of mortality and disability, the main place is occupied by numerous injuries called "polytrauma" (PT). (Shedrenko V.V. and co-author, 2007; Sherbuk. U.A. and co-author, 2007). Due to the intensive growth of transport services, manufactories, high-rise buildings, the frequency and severity of multiple traumatic injuries has increased, so did the percentage, it increased by 8-12%. [44, 23, 52]. Polytrauma ranks third in terms of lethality after cancer and cardiovascular diseases. Percentage of deaths resulted from traumas reaches 85%, despite the fact that PT accounts for 8-12% of all injuries. Degree of polytrauma is 10 times greater in comparison with an isolated injury's degree in terms of disability and

incapacity. [8]. That is why providing medical care to those who have received multiple traumas is currently one of the most important problems in emergency medicine. [6]. The significance of this problem is not only in the annual increasing quantity of survivors, comparing to an isolated injury, but also in a process that requires specific diagnostic and treatment tactics. [11, 46].

Aim of this study was to explore etiology, frequency and consequences of polytrauma.

Methods: Manuscripts dealing with polytrauma were reviewed. Also literature review was carried out by examining databases English- and Russian-language articles in PubMed and eLibrary.ru. The following search modules were selected in PubMed Medline and eLibrary.ru: Polytrauma, Definition of the term "polytrauma", Golden Hour, Infectious and noninfectious complications in polytraumatized patients. We studied data on from the period of 2000 to 2020. We found 6 peer-reviewed manuscripts for our work. 437 English-language articles were found through PubMed, 23 articles were retrieved for final analysis. 825 Russian-language literatures were found through eLibrary.ru, of which 41 were accepted for final analysis.

Inclusion criteria:

1. Patients with polytrauma over 15 years old;
2. ISS> 17.

Exclusion:

1. Case reports and case series;
2. Studies of isolated trauma patients;
3. Childhood trauma;
4. Treatment of patients with polytrauma.

General notions about polytrauma.

"Polytrauma" and "Multiple trauma" are terms describing presence of two or more lesions in one or more anatomical areas, when one or a combination of traumatic injuries poses a danger to the life and health of the human. [Y.G. Shaposhnikov,1997].

The invention and implementation of the International Injury Severity System AIS/ISS allowed the experts of the

AO/ASIF (association for the study of immersion-fixation) to define a polytrauma as multiple traumatic syndrome accompanied by a sequential reaction with dysfunction of individual organs and anatomical systems which were not affected, with a total injury severity score of greater than 17 points on the AIS/ISS system. Damages to the musculoskeletal system and internal organs affected by PT cannot be treated separately from each other, as these lesions with negative effects are occurring in the same organism. The above terminological definitions have organizational and practical significance. Because a good result in the treatment of polytrauma is based on the organization of medical care, the establishment of the severity of the injury, the development of effective methods of diagnosis and treatment [55,63].

The main features of polytrauma:

- The syndrome of mutual aggravation and traumatic illness;
- Atypical symptoms that make diagnosis difficult;
- Increased risk of traumatic shock and massive bleeding;
- Instability of compensatory mechanisms, high lethality and multiple complications [51,61].

The clinical picture of polytrauma depends on the severity of the traumatic disease, due to a combination of general and local changes occurring in the body as a result of the injury, as well as on pathological and adaptive reactions.

Pathogenetic classification of the course of traumatic disease:

I. The stage of acute reaction of an organism on a trauma (shock), this stage corresponds to the early period of post-traumatic shock and shock and can be considered as an induction of a multiple organ dysfunction syndrome (MODS). This period lasts from several hours to 2 days from the moment of injury.

II. Early period of symptoms and complications (post-shock or intermediate period), characterized by the initial phase of MODS, impaired or stable work of individual organs, lasting from 3 to 7 days.

III. The late period of symptoms and complications begins after the 7th day and is distinguished by complications that determine the prognosis and outcome of the disease.

IV. The rehabilitation period is characterized by a complete or incomplete recovery [49].

The first stage - traumatic shock – characterized by the syndrome of perfusion insufficiency (acute hemodynamics disorder) in response to severe mechanical damage and blood loss.

The second stage is accompanied by the development of the MODS symptoms -violation of the function of organs and systems. At this stage, dysfunction of multiple organs is caused by a systemic inflammatory reaction in response to organic injury. Its severity depends on the severity of the trauma.

The third stage - the late period of the appearance of signs of traumatic disease, in the optimal course of which the functions of damaged organs and tissues are restored, reparative processes are carried out. Some patients at this stage develop dystrophic changes and sclerotic processes in the affected organs as well as secondary disorders of their functions, and develop various complications such as

abscesses, phlegmons, osteomyelitis, thrombophlebitis and sepsis. This period can last for several months and requires special treatment.

The fourth stage of traumatic disease rehabilitation ends with a full or incomplete recovery (disability) [49,50,54].

Among young people, i.e., of working age, associated injuries take first place in the list of causes of death [68]. Therefore, it stands out not only as one of the most significant subjects in the field of health care, but it is also socially important on Republican level, since the society spends a huge amount of funds every year on the treatment and rehabilitation of polytrauma survivors. For example: developed countries spend at least 2% of health care funds per year on the treatment of polytrauma patients [59].

Cases when it can be assumed that the patient has received polytrauma (3. Muller, 2005):

- in the cases of death of the driver or a person sitting next to them in a car accident;
- if the person flew out of a car;
- if the deformation of the car is more than 50 cm;
- if the victim is trapped under a heavy object;
- a traffic collision at high speed;
- pedestrian or cyclist hit by a car;
- falling from height over 3 meters;
- in cases of various explosions;
- when left under fine-grained sand-like materials [20].

The social meaning of a polytrauma is not only measured by the level of mortality, but also depends on the large number of persons with incapacity, and it is 6-10 times higher than in the case of isolated injuries. [16,17,2].

According to a report by the Institute for Health Metrics and Evaluation (IHME), about 5 million patients who sustain polytrauma each year worldwide may become disabled in the future [62].

20-25% of all the victims pass away at the prehospital level (within 2 hours), and another 20% - in the intensive care unit (lasting 3 days), so during the period of transfer to the specialized department remain only 55-60% of them, and 15-20% stay temporarily or permanently disabled.

The above data show that the majority of victims die from polytrauma in the pre-hospital level, so the overall mortality rate is directly related to the quality and timeliness of emergency care.

Sustainably organized and high-quality care plays an important role, and can also reduce the secondary and tertiary peaks that die from multiple injuries. According to the World Health Organization, 20 out of 100 lethal cases from accidents can be avoided if full medical care is provided on the place of incident [58,64].

The importance of the rule of "golden hour".

According to the common rule of the "golden hour" if the prompt medical treatment is not provided during the first hour after trauma, critically injured person will lose their chance for survival; if help is provided during the first 18 minutes, then the human's chance of staying alive will increase by 15%; and if the patient is treated during the first 9 minutes after trauma, the possibility will rise by 90%. According to statistics, if the victim receives first aid within 30 minutes, complications will be reduced by half. [34].

All this demonstrates the importance of providing early and full medical care. But victims usually are left alone

("temporarily isolated") right after a car crash, so life-threatening situations are resolved with the help of the accident participants and witnesses. However, the majority of the population is not ready to provide first aid.

The quality of provided medical care depends on several components:

- First aid at the place where an incident has happened
- First immediate assistance given by ambulance brigade
- Transporting to hospital
- Quality of medical help in hospital

Effects of polytrauma. Most of multiple trauma survivors have a decline in quality of life, as there are restrictions in the movements of the affected joints and feeling of discomfort in the area of broken bones associated with changing weather conditions. [65,66]. The majority of patients with polytrauma have to change their previous professions and jobs, which results in growth of work incapacity till 75% [32,35,69]. As experience shows, full recovery of patients with multiple lesions is rare. The reason is - the quality of their real life has not been fully investigated so far. [36].

Polytrauma affects different fields of humans' life, reducing quality of physical, mental, cognitive and social existence. [22]. It is because such injuries most often affect limb and pelvic bones, which is 55-82% of all cases. [22,47,40,41,70]. Consequences of these kind of lesions are the first item in disability structure, as long as their treatment is pretty difficult. Although operations were performed on time and properly, in some situations the results are not encouraging [57,60].

Polytrauma can originate from high energy effects. As a rule, these are transport (motorcycle and car crashes, railroad accidents, etc.) and heavy industrial injuries, for example: being compressed by heavy industrial materials, falling from tall buildings; criminal injuries like bullets, knife injuries, explosions, etc. [15,26, 28,14], there are also acts of suicide. A strong damage factor leads to two or more severe traumas in various body systems and fractures of bones. These are severe open and closed traumatic brain injury (TBI), injuries of the thoracic and abdominal cavity organs, and musculoskeletal system. Among the lesions involving musculoskeletal system the most severe ones are pelvic and limb fractures [21,33,42], and their frequency is increasing every year [1]. The results of treatment of such fractures do not bring relief as treatment of single broken bone does [40]. Since such fractures disrupt microcirculation associated with damage not only to the bones, but also to soft tissues and blood vessels at the site of the injury, this condition results in inefficient treatment [13].

The combination of abdominal, thoracic, and bone fracture injuries, severe bleeding, microbial contamination of wounds, and traumatic shock are the basis for a high percentage of complications. This situation reveals a high level of lethality and disability among individuals who have multiple traumas [39].

Osteomyelitis often develops due to local osteonecrosis and deep bone circulation disorders [31]. Incidence of local complications after polytrauma were found to increase in 2-3 times, as well as complications from bone fractures [42].

In polytraumatized people with open bone fractures there is a 31% of wound suppuration states, and 11.7% of cases end in osteomyelitis [43]. As a result, consolidation slows down or bones do not heal, this leads to the rise in the amount of people with disabilities during the first year after the accident [7,43].

In recent years the incidence of complications in patients with multiple traumas has been increasing. The reason for this is a disturbance in central hemodynamics. Polytrauma is accompanied by hemorrhage, so it is followed by blood vessels' spasm [25]. As there is a tissue metabolism disorders, immune reactivity of the body sharply decreases, leading to the development of infectious complications [3, 27, 4,18].

Range of PT complications associated with infections is wide. It includes complications after thoracic, abdominal, neurological, urological, traumatological and other different surgical operations (festering wound, abscess, phlegmon, etc.) as well as common complications such as tracheobronchitis, pneumonia, thrombophlebitis, cystitis, ascendant pyelonephritis, meningoencephalitis, sepsis and so on [67].

In addition to infectious diseases, which impede people from being discharged from hospital and from successfully going through the rehabilitation process, there is a large group of non-infectious diseases, involving: anemia occurring after trauma, fat embolism, phlebothrombosis and pulmonary embolism, acute peptic ulcer of the gastrointestinal tract, hemopleuritis. To eliminate the above mentioned complications, the doctor should use all the available resources as efficiently as possible. This is the reason why recovery of polytraumatized patients lasts for so long [67]. The effectiveness of treatment depends not only on expensive medicines and equipment used for diagnostic and therapeutic purposes, but also on well-coordinated work of specialists. Because when a person with polytrauma gets to hospital, the traumatologist starts taking actions to restore the musculoskeletal system, meanwhile the surgeon is dealing with damages of the abdominal and chest organs, but the patient at the same time may die from respiratory failure arising from brain injury [48].

Treatment of polytrauma sufferers and prevention of complications require specialized medical care [29, 30]. And carrying out of such manipulations is possible only in the multidisciplinary hospitals having all the necessary tools and doctors [12,67].

Conclusion

Having analyzed the data given in literary sources, it can be noticed that intensive development of technical and building branches provoke growth of amount of polytrauma not only in our country but also all over the world. The leading reason of traumas are MVC. Although patients with polytrauma remain alive, many of the consequences persist and lead to temporary or permanent disability. According to the rule of "golden hour", the sooner a patient receives definitive care, the higher is the likelihood that medical and surgical treatment will prevent their death. Therefore, in the future this requires the development of an effective plan aimed at preventing injuries, timely provision of high-quality medical care to polytrauma survivors, and work towards reducing the level of mortality and disability.

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