Review

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Traumatological Aspect of Polytrauma Treatment for Elderly and Senile Patients

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ABSTRACT The conducted analysis of Russian and foreign literature sources showed that the problem of diagnostics and treatment of polytrauma in elderly and senile patients is still relevant. The main discussion point is the high mortality rate in this group of patients. Although at this level of the medicine's evolution, an active approach to the treatment offered to such patients is applicable, the mortality rate in this group of patients remains much higher than in the group of patients under 65. The priority here is to study the difficulties of diagnosing injuries in elderly and senile patients with polytrauma. Also, a fundamental issue is the development of an effective algorithm for the surgical treatment of injuries, taking into consideration age-related changes, the presence of concomitant pathology and an increased risk of complications in patients of this age group.

Keywords: polytrauma, elderly, polymorbidity

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WHO — World Health Organization
RTA — road traffic accident
PMMA — polymethyl methacrylate
MOF— multiple organ failure
RDS — respiratory distress syndrome
ASLS — Angular Stable Locking system
DCO — Damage control orthopedics
DCR — Damage control resuscitation
ISS — Injury severity score

INTRODUCTION

Every year the relevance of the problem of polytrauma management in elderly and senile people is growing. This is due to an increase in the proportion of older people among the population. According to the age classification of the World Health Organization (WHO), elderly age is 60-74, senile age is 75-89 and long-livers are after 90. According to the United Nations, a demographic aging of the population is taking place over time. At the moment, there are 29.0 elderly and senile residents per 100 people of working age in Europe, in the United States of America - about 25.9; while in 1950 there were 12.1 and 12.7 people, respectively [1]. This trend can also be traced in the Russian Federation. According to the Federal State Statistics Service for 2020, 36.3 million people of retirement age live in Russia [2]. This is more than 27% of the total population of the Russian Federation. By 2036, this figure is projected to increase to 37.0 million people [3].

The WHO identifies several factors contributing to population aging. First of all it is an increase in average life expectancy. This is facilitated by the socio-economic development of countries, income growth of the population. With the development of countries and the improvement of medical provision, the probability of death in childhood and young age significantly decreases, the probability of death in elderly and senile age increases [4].

A significant number of older people maintain an active lifestyle: they go for walks and shopping, go in for sports, drive cars, the number of working pensioners is increasing. Elderly people remain able to work until senile age. This is due to changes in working conditions.

At the moment, physical activity when performing any work is decreasing, the need for intellectual work is increasing. At the beginning of 2020, according to the Federal State Statistics Service, the number of working pensioners was 8.2 million [5]. Over the past 5 years, the number of people over working age in the share of those employed has increased from 8.5 to 9.6%.

Given the continuing social and professional activity, the risk of injury in elderly and senile people is increasing. In particular, they often become victims of road traffic accidents (RTA), falls from height. Thus, according to *Kocuvan S.*, in the study of injuries among this category of the population, 43 out of 117 patients included in the study were injured as a result of an accident, 27 patients - when falling from a height of more than 3 meters [6]. This data is confirmed by a study by *Richmond T.S.*: among all individuals of elderly and senile age, 27.2% were injured in a RTA [7]. But even a low-energy fall at home can result in serious injury. In the same study, *Kocuvan S.* gives the following data: in 47.9% of cases, elderly people were injured through low-energy falls [6].

Over the past decades, many methods of diagnosis and management of polytraumatized patients have been proposed. Despite the increasing relevance of this problem, there are many issues in this area that need to be addressed. The purpose of this review is to evaluate modern algorithms for the diagnosis and treatment of musculoskeletal injuries in geriatric patients. To do this, we analyzed domestic and foreign literature published over the past 15 years, where these issues are considered.

MATERIAL AND METHODS

Taking into account the growth in the number of patients receiving severe injuries, the number of publications devoted to this topic is naturally increasing. Searching for the keyword "*polytrauma*" in the PubMed database, we found 17,488 publications in the last 10 years. Whereas in the previous 40 years, only 19,523 works were published. There are much fewer researches devoted to polytrauma in elderly and senile people: in the period from 1980 to 2020, 13 125 studies were published. About half of them (6,148 works) were published in the last decade.

To write this literature review, we selected studies devoted to the problems of diagnosis and treatment of elderly and senile patients with multiple injuries of solid organs and body systems. We also used articles touching upon some aspects of polytrauma in this category of individuals, such as statistical data on elderly and senile people living in a certain territory, comorbid conditions in people of this group, and some others. Since our research group specializes in traumatology and orthopedics, it was decided to exclude articles describing the problems of anesthetic management for this group of patients. From the remaining articles, we selected those that were available in full-text version.

As a result, 74 works were included in the study, 1 work in German, 10 works in Russian and 63 in English.

The analysis of such a vast topic as polytrauma in elderly and senile patients cannot be carried out in isolation from such important problems as chronic diseases and multimorbidity of this group of people, therefore, this article devotes a significant place to this aspect.

CHRONIC DISEASES AND THEIR INFLUENCE ON INJURIES AMONG ELDERLY AND SENILE PEOPLE

According to the study by *M. Van den Akker*, in men aged 40-59, several chronic diseases are diagnosed in 33.6% of cases, while in the 60-79-year-old group - in 60.9% of cases, and in the group over 80 - in 74.2% of cases [8].

According to the research by *L.B. Lazebnik et al.*, conducted in 2007, the number of chronic diseases in people aged 60–65 is 5.2 ± 1.7; 66–70 years old: 5.4 ± 1.4; 71–75 years old: 7.6 ± 1.7; 76–80: 5.8 ± 1.6; 81–85: 5.8 ± 1.8; 86–90: 4.4 ± 1.6; in centenarians of 91–95 years: 3.2 ± 0.5 [9]. According to *A.A. Blazhenko et al.*, one

or more concomitant diseases occur in 81.5% of elderly and senile patients with severe injuries [10]. The presence of comorbidities negatively affects the early results of polytrauma treatment and its outcomes. *L.I. Dvoretskiy* (1997) argues that the features of the course of chronic diseases in elderly and senile people include nonspecific manifestation of symptoms of diseases, a high frequency of complications [11].

Cummings S.R. considers osteoporosis and osteopenia to be the main reasons for the increased incidence of bone fractures in elderly and senile people [12]. Osteoporosis is defined as a metabolic bone disease characterized by decline in bone mass, impaired micro-architectonics of bone tissue. Osteopenia is a condition in which bone mineral density and bone mass are low. In the Russian Federation, according to *G.A. Melnichenko*, among people over 50 years old, osteoporosis occurs in 34% of women and in 27% of men, osteopenia is detected in 43% and 44%, respectively, as well as 24% of women and 13% of men aged 50 years and older have previously had at least one low-energy fracture [13].

Pioli G. calls osteoporosis a socially significant disease, since against its backdrop, even in case of low-energy trauma, multiple fractures of the skeletal bones can occur causing a high level of invalidity, disablement and mortality in elderly and senile people [14]. According to the United States Department of Health, among the 10 million people with osteoporosis, about 1.5 million cases of bone fractures are reported each year [15]. In the UK, according to statistics cited by *Van Staa T.P.*, every second woman and every fifth man with osteoporosis has some kind of skeletal fracture [16].

In 2002, *Susman M. et al*. showed that with age, irreversible changes in the walls of cerebral vessels occur, the vessels become more susceptible to external influences, which increases the risk of damage to cerebral vessels, intracranial hemorrhages and strokes [17].

According *to Bulger E.M. et al.,* the lung tissue is also gradually replaced by fibrous tissue, therefore, the elasticity of the lung tissue and the vital capacity of the lungs decrease, the chest becomes rigid, the cartilage becomes more fragile, and the risk of chest trauma increases [18].

PECULIARITIES OF THE CIRCUMSTANCES OF INJURIES AMONG INDIVIDUALS OF ELDERLY AND SENILE AGE

High-energy trauma plays an important role as a cause of injuries in elderly and senile people. According to *Giannoudis P.V. et al*. RTA and falls from a height of more than 2 meters occur with the same frequency both in the group of young and middle-aged patients and among the elderly [19]. However, the risk of severe injury when falling from a height of less than 2 meters in elderly and senile patients is significantly higher than in young patients (31% versus 8%).

Many scientists call low-energy falls one of the most common mechanisms of injury in older people. In 2002 *Richmond T.S. et al.* conducted a retrospective study and found that patients over 65 are more likely to receive severe injuries when falling on a flat surface (23.9%) [7].

In their study of 25,304 patients published in 2018, *Rob de Vries et al.* confirmed that, unlike young and middle-aged people, older people are more likely to be seriously injured when falling from a bicycle (17% versus 21%) or due to a low-energy fall (13% versus 43%) [20].

Lee H.S. et al. noted that the risk of accidental falls in older people is very high. Thus, one third of patients over 65 years old report one fall per year, among patients over 75 years old, falls occur in 60% of cases [21]. Accordingly, the risk of fractures increases even when falling from a small height. Thus, according to the results of *Atwell S.E.,* up to 10% of falls lead to serious injuries [22].

In their 2005 research *Demitriades D. et al.* revealed a pattern: with the same mechanism of injury, elderly and senile people receive more severe injuries than those of younger age [23]. According to their data, when falling from a height of 15 feet in a group of patients over 65 years old, 43.2% had an Injury Severity Score (*ISS*) of more than 15. In patients in the age group of 15–55 years old, an *ISS* of more than 15 was found in only 18.2% of people.

INFLUENCE OF CHRONIC DISEASES ON THE PROCESS OF POLYTRAUMA TREATMENT FOR ELDERLY AND SENILE PATIENTS

The presence of several concomitant diseases in elderly and senile people often does not allow the same approach to treatment of their musculoskeletal injuries as to the treatment of young patients. Cardiovascular diseases are the most common in the population of the older age group. According to *Zhou B. et al*., there were 1.13 billion people with hypertension in 2015 [24]. With age, the number of older people with hypertension increases. Thus, according to *Chow C.K. et al*., 26.2% of the population under 50 suffer from arterial

hypertension, and among patients over 50 years of age, arterial hypertension is common in 53.3% of cases [25].

In their 2016 study, *A.A. Blazhenko. et al.* showed that among all elderly patients with multiple injuries who suffered from chronic diseases, 56.81% had chronic diseases of the cardiovascular system [10]. With long-term arterial hypertension and other cardiovascular problems, the resistance of the vascular wall increases, and the contractility of the heart muscle decreases. According to *Braun B.J. et al*. all these conditions may affect the body's adequate response to traumatic effects [26].

Another common disease affecting the treatment for polytrauma patients of older age groups is diabetes mellitus. According to *Held F.P.* the prevalence of diabetes mellitus is about 6-10% among the adult population, and among the elderly it ranges from 8.9 to 16% [27]. Disruptions in glucose metabolism in the human body lead to many complications, such as micro- and macroangiopathy, retinopathy, neuropathy, nephropathy, etc. According to the American Diabetes Association, elderly and senile people with diabetes mellitus have a higher risk of premature death and complications after injury. These data are confirmed by the study by *Tebby J. et al.* (2014) [28]. In their research, scientists showed that mortality in the group of elderly and senile patients with diabetes mellitus is significantly higher than in those without it (32.4% versus 12.9%). Also, the most frequent complications in trauma patients suffering from diabetes mellitus are of infectious nature, such as wound suppuration, deep soft-tissue infections. Thus, according to *Aderinto J. et al.,* in the postoperative period, wound suppuration developed in 17% of patients, while in patients without concomitant diabetes mellitus - only in 9% [29]. In a study by *Lynde M.J. et al.* (2012), among patients with diabetes mellitus, inconsistency and suppuration of the postoperative wound amounted to 20.51%, while in the group of patients without diabetes mellitus - 7.47% [30].

It can be concluded from the above, that people of the older age group suffering from diabetes mellitus are not only subject to more frequent traumatization, but also the course of their injury-related disorder is more severe than in the absence of diabetes mellitus.

According to *Held F.P.*, among the respiratory tract diseases in elderly and senile people, chronic bronchitis of various etiologies, bronchial asthma, chronic obstructive pulmonary disease are most common [27]. These diseases alone and in combination with other chronic disorders can significantly worsen the prognosis of survival for patients with severe injuries. According to *Braun B.J. et al*., chronic lung diseases occur in 20% of elderly and senile people [26]. Against this backdrop, such important indicators as vital capacity and pulmonary distensibility decrease, tissue oxygenation is reduced and, accordingly, the body of a geriatric patient cannot adequately respond to post-traumatic hypoxia, the risk of respiratory distress syndrome (RDS) increases.

Obesity is one of the main problems of the 21st century, including among the elderly. According to the WHO, there were more than 650 million obese people around the world in 2016 [31]. Some studies by *Neville A.L. et al*. revealed a direct correlation between obesity and mortality in patients with severe trauma [32]. The mortality rate among obese patients is 2 times higher than among patients with normal weight (32% versus 16%). Also, in the group of patients with obesity, the syndrome of multiple organ failure (MOF) develops much more often (13% versus 3% in patients with a normal body mass index). Based on the results of this study, *Neville A. L. et al*. identified independent risk factors for death among patients with polytrauma. These were obesity, the age of the victims over 55 years old, as well as severe head trauma and lung contusion.

Given the presence of many chronic diseases, elderly and senile patients may take several drugs at the same time. *Johnell K. et al.* (2007) found that geriatric patients receive on average 6.2 ± 3.7 drugs per person [33]. In the period from 1988 to 2010, the median of the amount of drugs consumed by this age group in the United States doubled (from 2 to 4), and the share of elderly people taking more than 5 drugs at the same time, tripled - from 12.8 to 39.0% [34]. Consequently, the frequency of adverse reactions in the elderly is progressively increasing, and the risk of their development in people over the age of 65 is 4 times higher than that in the adult population [35].

Impairment of the physiological and metabolic homeostasis of the body after trauma depletes the body's functional reserves, leading to disruption of the functioning of organ systems. Given the presence of many chronic diseases in elderly and senile people, administration of a large amount of drugs, the risk of complications and death is significantly higher than that in younger patients. Thus, according to *De Vries R.*, hospital mortality in elderly and senile people was twice as high as in younger patients (19.8% versus 9.6%)

[36]. *Giannoudis P.V.* shared similar data: mortality among people over 65 was also higher (42% versus 20%), and the risk of developing MOF and RDS was also higher (28% versus 24% and 30% versus 22%, respectively) [19].

TRAUMATOLOGIST'S DIAGNOSTIC AND TREATMENT TACTICS FOR POLYTRAUMA GERIATRIC PATIENTS

For the first time, polytrauma in elderly and senile people was studied by *Oreskovich M.R. et al*. in 1984. The researchers assessed such factors influencing mortality in polytrauma patients over 70 years old as the mechanism of injury, damaged areas of the body, the *ISS*, and others. According to the results of the assessment, the mortality rate was 15%. Moreover, 88% of the surviving patients were unable to return to their previous standard of living [37].

Understanding the anatomical and physiological changes that occur during the aging of the body is essential for identifying the characteristic injuries in elderly and senile people, and also significantly affects the provision of medical care. Also, the features of the course of pathophysiological processes in polytrauma play a significant role. According to *Sokolov V.A.,* the resuscitation stage is characterized by the presence of certain symptom complexes that significantly affect the outcome, among both young and elderly patients [38]. In his practical guide for doctors (2006) *Sokolov V.A.* especially emphasizes a similar (for both young and elderly patients) picture of the course of hemorrhagic shock, respiratory depression of central origin in traumatic brain injuries and damage to the external breathing apparatus in case of chest trauma, RDS, disseminated intravascular coagulation syndrome. 3 days after injury, according to *Sokolov V.A.*, infectious complications come to the fore. At the specialized clinical stage, the main thing is the treatment of complications that developed at the resuscitation stage of treatment, and also reconstructive surgeries on the musculoskeletal system. Scientific publications pay close attention to this important aspect.

DIAGNOSTICS

When searching for information, we did not find data on the use of special algorithms for diagnosing polytrauma in elderly patients. It should be then concluded that at the moment the corresponding paradigms have not been developed and used in practice, and standard methods of diagnosis and treatment have been used.

It should be noted that, according to the study by *De Vries R.,* 73.7% of all patients over 65 years old who were admitted to hospital with polytrauma had received head injury. In 40.8% of patients on admission, the Glasgow Coma Scale was less than 8 [36]. In these cases, there is practically no possibility of full collection of anamnesis. It is not possible to find out whether certain laboratory parameters are the body's response to trauma or associated with chronic diseases. These circumstances significantly complicate the choice of a diagnostic and treatment algorithm for elderly and senile patients.

At the moment, the most effective diagnostic approach is whole-body computed tomography. This test allows specialists to evaluate all the vital anatomical areas of the body at once, and also to abandon other screening methods, reducing the examination time. According to *Huber-Wagner S. et al.*, computed tomography has a high sensitivity and specificity for determining life-threatening injuries [39].

One of the most dangerous complications in geriatric patients is sepsis. A literature review conducted in 2009 by *Pfeifer R. et al*. showed that sepsis is the main cause of late death in polytrauma patients [40]. More than 30 biological markers are used for the early diagnosis of sepsis. *Ciriello V. et al*. conducted a scientific study in 2013, and came to the conclusion that the most acceptable marker for the diagnosis of sepsis is procalcitonin [41].

TRAUMATOLOGIST'S TACTICS FOR POLYTRAUMA GERIATRIC PATIENTS

Over the past few decades, many doctors and scientists have been studying the problem of treating multiple injuries in elderly and senile people. However, the conclusions reached by the researchers are often contradictory. To date, there has been no clearly regulated algorithm of action for the treatment of this group of patients. Many doctors are guided by their own personal experience.

The issues of diagnostics and treatment of victims who have received severe injuries are constantly being reviewed, new protocols and paradigms for the treatment of this group of patients are proposed. Thus, in the 1970s, when this problem became relevant, researchers, in particular *Wolff G. et al.*, tended to refuse surgical interventions for this group of patients, since their condition was considered too severe for surgery [42]. Limb

fractures were stabilized by skeletal traction. The patients were in this position until doctors considered them stable enough for osteosynthesis. However, in the long term, this approach proved to be ineffective, since mortality among those patients remained high.

In 1982 *Goris R.J. et al.* in their study showed that early fracture stabilization in combination with artificial ventilation allows doctors not only to provide full patient care, but also reduces the risk of complications and death [43].

Among all the victims who participated in the presented study, one death was recorded in the groups where early osteosynthesis was performed, in contrast to the group of patients in which conservative treatment of fractures was carried out or fracture fixation was performed in the long-term period, where the mortality rate was 42%. However, the authors in their study indicated that a significant increase in mortality in the latter group of patients is largely associated with a higher average age and more severe condition in this group of patients, and not with the time of surgery.

Bone L.D. et al., in a study carried out in 1989, showed that with early stabilization of fractures in patients with multiple injuries, complications developed in 16 patients, while with delayed intervention, 50 patients showed some complications [44]. In their studies, *Behrman S.W.* (1990) and *Charash W.E.* (1994) confirmed the position of *Goris R.J*. *Behrman S. W*. also found that the risk of respiratory complications in case of delay in surgery for more than 48 hours significantly increases in the age group of patients over 50 years old and among patients with ISS> 35 [45].

Charash W.E. et al. found out that mortality among victims with chest trauma combined with long-bone fractures who underwent early and delayed osteosynthesis differs insignificantly (4% versus 8%). However, the percentage of complications is significantly higher (16% in the early fixation group, 56% in the group where the fracture was fixed 48 hours after injury). Hospital-acquired pneumonia was the most frequent complication, which developed in 48% of cases [46]. This led to the introduction of the Early Total Care (*ETC*) approach which involved early operative stabilization of long bone and pelvic fractures.

Due to the increase in the number of seriously injured patients, researchers have accumulated enough data to analyze and comprehensively study the problem. Some researchers proved in their publications that early osteosynthesis of long bones in polytrauma patients of any age is unsafe and can also lead to complications and increase the risk of death in this group. Thus, in 1994 *Fakhry S.M. et al*. conducted a study in which they showed that regardless of age, final osteosynthesis in the first 24 hours after injury leads to death in 8.5% of cases, however, conservative treatment or postponing the surgery for more than 4 days also increases the risk of death (39% and 7, 1%, respectively) [47]. *Reynolds M.A. et al.* shown that after locking nail osteosynthesis of femoral fractures on the first day after injury, the mortality rate of patients with multiple injuries was 5.7%. While there were no deaths among the victims who underwent osteosynthesis later than the first day after injury [48].

The work of *Giannoudi M*. showed that the Damage Control Orthopedics (*DCO*) algorithm remains relevant in the treatment of patients in critical condition and with a high risk of death. *DCO* prevents the development of systemic inflammatory response, thereby reducing the risk of RDS and MOF [49]. This approach, according to the research by *Giannoudis P.V*., may have extended indications for the treatment of multiple injuries in patients over 65 years old, since the physiological reserves of the body are significantly reduced in elderly and senile people [50].

Despite the advantages of using *DCO*, the mortality rate among the population over 65 is still high. In a study by *Newell M.A. et al*., conducted in 2010, mortality rate among young and middle-aged patients for whom the DCO algorithm was used was 12.5%, while in the group of elderly patients it was 42.9% [51].

Early operative stabilization of long bone and pelvis fractures help avoid complications in the long term. *Zuckerman J.D. et al*. calculated that postponing surgery for 2 days or more doubles the risk of death during the first year after surgery [52]. *Sexon S.B. et al.* found that among practically healthy elderly patients who underwent osteosynthesis of the femur within the first 24 hours after hospital admission the risk of death is lower than in case of delayed surgery [53]. However, according to research by *Fröhlich M. et al.,* conducted in 2014 among patients with three or more chronic diseases, surgery, on the contrary, increases the risk of death [54].

Resuscitation guidelines are an integral part of the management of severely injured patients. In 2007, the military surgeon *Holcomb J.B.* proposed a new therapeutic paradigm, referred to as the Damage Control

Resuscitation (DCR) [54]. Its fundamental principle is the timely detection and prevention of pathological conditions such as acidosis, hypothermia and coagulopathy. The so-called "Death Triad" develops against a background of massive bleeding. DCR offers massive transfusion therapy, controlled blood pressure lowering, and all the advantages of Damage Control Surgery (*DCS*).

Over the past decades, while studying the problems of polytrauma treatment in elderly and senile patients, additional information has appeared which makes it possible to change the approach to their treatment. Thus, in 2016 *Braun B.J. et al.* in their review showed that a combination of *ISS* > 25, *Glasgow coma score* less than 7, comorbidities, complications and age are predictors of unsatisfactory outcome [26].

Blazhenko A.N. et al. proposed an algorithm for dynamic control of injuries in elderly and senile patients with polytrauma [55]. They developed criteria to objectify the possibility of performing the stages of surgical treatment in accordance with the *DCO* concept. These criteria were homeostasis indicators (erythrocytes, hemoglobin, total protein, albumin, lactate, and prothrombin time), the changes in which most closely correlate with the onset of death in severely traumatized patients over the age of 60. During their research, the authors managed to reduce mortality by 9.6%, using these criteria in the preoperative preparation of patients.

In almost all of the above studies, the group of elderly and senile victims is not separated from young and middle-aged patients. The authors propose the same treatment paradigms for all patient groups. Although in the works by *Sexon S.B. and Braun B.J.,* there is a clear correlation between the patient age and the risk of poor outcome [26, 53]. Among all the treatment paradigms we found, only in the study by *A.N. Blazhenko* geriatric patients were singled out into a separate group and an algorithm for preoperative planning and the sequence of surgical interventions in this group of patients was proposed [55]. It means that at the moment there are no generally accepted algorithms for the treatment of elderly and senile patients with severe injuries, which contribute to a significant reduction in mortality.

TRAUMATOLOGICAL TECHNIQUES FOR ELDERLY AND SENILE PATIENTS

Fractures of limb bones are more common in the elderly than in the population of young people. This is due to changes in bone structure, a decrease in bone mass, and the development of osteoporosis with age [56]. In this group of patients, not only the possibility of a fracture increases, but also fractures are of a more complex nature. Comminuted fractures are common due to increased bone fragility. This greatly complicates the repositioning and fixation of such fractures.

Considering this and a number of other factors, such as somatic and mental status of the elderly contingent, the slowing down of reparative processes in the body, the approach to the treatment of such patients should be special. Fixators used in osteosynthesis for patients with osteoporosis must be more resistant to stress in order to be able to achieve stronger fixation, despite poor bone quality and slow bone-healing process. In his review of the literature, *Miranda M.A.* showed the advantage of using angle-stable locking plates in comparison with non-locking plating system [57].

Management of pathological fractures of the proximal femur in elderly patients is the most studied issue. According to *Switzer J.A. et al*. femoral fractures in elderly patients occur in 18.9% of cases [58].

There are many fixation systems for intertrochanteric and subtrochanteric fractures. Currently, the most common are cephalomedullary and cephalocondylar nails. They help achieve complete fixation of the fracture. According to *Carulli S. et al.,* intramedullary fixation devices compared with extramedullary systems, such as *Sliding hip screw* (SHS) and *Dynamic Hip Screw* (DHS), allow in almost all cases in the early postoperative period to restore full support on the limb, reduce surgery duration and postoperative pain syndrome [59].

There is a risk of lag-screw cutout when utilizing these devices. According to *Buykdogan K.,* in 10.5% of operated patients, the implant is "pulled out" from the bone [60]. To prevent this type of complications, perforated helical-shaped femoral neck blade is augmented with polymethylmethacrylate (PMMA) cement.

According to *Kammerlander C. et al.* PMMA acts as a "grout" as it locks the bone and implant together and reduces the risk of cut-out effect. Also *Unger S. et al*. suggested using augmentation of implants with PMMA cement in osteosynthesis of the humerus head, which allows strengthening the fixation of screws in the bone and prevents their eruption [61].

The Angular Stable Locking system (*ASLS*) has been developed to block intramedullary nails. According to *Wähnert D. et al*., *ASLS* provides a tighter fixation of the implant in the bone, even in severe osteoporosis [62, 63].

The decision on the method of patient treatment is made in each case by the doctor individually, depending on the nature of the fracture and the somatic condition of the patient. We can conclude that there has been still no sufficient evidence base as to what kind of treatment method is indicated for the elderly patient with a certain type of fracture.

OUTCOMES OF POLYTRAUMA TREATMENT IN ELDERLY AND SENILE PATIENTS

According to *Oreskovich M.R. et al.,* up to 88% of patients over 70 years after the hospital stage of treatment were unable to return to their previous lifestyle [37]. Similar data were shown by *Richmond T.S. et al*. in 2002. Although the mortality rate in their study was 10%, only 52.2% of the surviving patients were discharged home. 25.4% of patients required constant care from nursing services, 19.6% needed further rehabilitation in specialized hospitals [7].

The mortality rate in elderly and senile patients who have undergone polytrauma is several times higher than the mortality rate among people under 65 years of age. In the study by *Rob de Vries et al*., published in 2018, mortality in the group of elderly patients was 19.8%, while in young patients it was 9.6% [20]. According to *Grossman M.D*., among the affected older age groups, the mortality risk in polytrauma increases by 6.8% every year [64].

There has been still disagreement among scientists about the structure of causes of death in elderly patients. *Bergeon E. et al*. made a comparison among polytrauma patients which included chest injuries. The researchers concluded that the risk of death in patients over 65 was 5 times higher than in young and middle-aged people with the similar injury [65].

Bulger E.M. et al. showed that with each rib fracture, mortality in elderly patients increases by 19% [18]. *Giannoudis P.V. et al*. (2009) indicate RDS (34%) and MOF (35%) as the main causes of death [49]. Whereas in the Russian study by *A.A. Blazhenko. et al*. (2016), progressive cerebrovascular insufficiency after concomitant head injury is called the main cause of death [10]. According to their data, this complication was the cause of death in 57.8% of cases.

CONCLUSION

The problem of treating polytrauma elderly patients is in the process of being researched; over the past few decades, a large number of studies have been carried out. As a result of our analysis of modern data, it can be concluded that there are many problems that need to be solved. The main one is high mortality in the group of patients over 65 years old with polytrauma. At this stage of the progression of medicine, an active approach to their treatment is relevant. Doctors have become more likely to make a choice in favor of surgical treatment of elderly and senile patients. Mortality in this group remains several times higher than in the group of patients under 65 years of age. However, as indicated above, in the literature we studied, there are no clear algorithms for diagnosis and treatment of this group of patients.

This means that a priority direction is the study of diagnostic problems of injuries in elderly and senile people with polytrauma. Also, a fundamental issue is the development of an effective paradigm for the surgical treatment of injuries, taking into account age-related changes, the presence of concomitant pathology and an increased risk of complications in patients of this age group.

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