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RATE AND STRUCTURE OF COMPLICATIONS IN SPINE SURGERY

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The risk of intraoperative and postoperative complications after spinal surgery still remains in the hospital-acquired conditions of any hospital. The methods for performing spinal surgery in children and adults are developing and constantly improving. A significant number of constructions for performing spinal surgery are created by leading manufacturers. The frequency of local and systemic surgical complications has not decreased. Knowing the rate and structure spinal surgery complications can expand the ability to predict and prevent them, which is important for medical science and practice. The presented review of literature addressed the current state of knowledge on spinal surgery complications.

Keywords: spinal surgery, intraoperative complications, postoperative complications.

ЧАСТОТА И СТРУКТУРА ОСЛОЖНЕНИЙ ПРИ ОПЕРАЦИЯХ НА ПОЗВОНОЧНИКЕ

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Риск развития осложнений, развивающихся как интраоперационно, так и после хирургических вмешательств на позвоночнике, сохраняется в условиях любого лечебно-профилактического учреждения, где осуществляются такие вмешательства. В настоящее время на высоком уровне и для взрослых больных и для детей разработаны и совершенствуются методы спинальной хирургии. Ведущими производителями создано значительное количество конструкций для проведения операций на позвоночнике. Однако частота местных и общих осложнений в спинальной хирургии не имеет устойчивой тенденции к снижению. Поэтому знание частоты и структуры местных и общих осложнений, развивающихся при операциях на позвоночнике, способствует расширению возможностей прогнозирования и профилактики такого вида компликаций, что особенно актуально для медицинской науки и практики. Представленный обзор литературы позволяет сориентироваться в состоянии этого вопроса на сегодняшний день.

Ключевые слова: спинальная хирургия, интраоперационные осложнения, послеоперационные осложнения.

According to some authors, among the causes of disability orthopedic and traumatological pathology is second only to cardiovascular disease [1-3].

Degenerative and dystrophic spine diseases (DDSD) firmly hold the first and second places in adults, comprising 40% of all orthopedic illnesses, whereas among the elderly and senile patients, these are observed in 95%–98% of all observations [4]. In addition, it was noted that in the older age groups, surgeries performed for spinal stenosis are in the first place among the interventions performed for diseases and deformities of the dorsal spine [5].

In the working population, DDSD can cause complete loss of labor capacity [6-8]. In the USA, approximately 0.2% of the total population, including newborns, has a spinal curvature of

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over 30°, which acts as an indication for surgical treatment [9].

Surgery for spinal deformities represents the most complex procedures in orthopedics. Currently, the population of the Russian Federation is approximately 150 million [9]. Significant number of patients requires specialized spinal surgery. In the USA (with a population of approximately 300 million), approximately 500,000 need surgical treatment for spinal diseases. Extrapolating these figures to the Russian population, there may be 250,000 patients who require spinal surgery [9]. Compared to approximately 4,000 vertebrologists in the USA, the Russian Federation has are no more than 30 such specialists [10].

It is also widely recognized that surgical treatment is the most optimal treatment for spinal pathology because of poor responsiveness to conservative treatment. For the same reason, in the available literature, there are only few publications relating to complications in spinal surgeries, whereas there is sufficient information available from Western Europe, the USA, and Southeast Asia.

In the Russian Federation, surgical interventions for correcting spinal deformities have become more common since the beginning of the 21st century. During this period, the national project "Health" was actively implemented. Accordingly, the Government of the Russian Federation had planned, developed, and implemented appropriate targeted programs supported with funding from both federal and regional budgets and territorial funds of compulsory health insurance [11, 12]. This facilitated an annual increase in the number of surgical interventions aimed at correcting spinal deformities. Tens of thousands of patients throughout the country received high-tech medical care.

In Russia, more than one million people seek medical care every year for intense back pain syndrome [13]. The financial costs for treating patients requiring surgical correction of the spine amount to billions of dollars in the developed countries, such as Western Europe, the USA, and Japan). Annually, approximately 90 billion US dollars is spent on the diagnosis and treatment of patients with spinal diseases, and the economic losses because of the decline in labor productivity amount to approximately 20 billion US dollars [14].

In recent years, there has been a steady increase in surgical interventions for correcting spinal deformities [15]. In the USA, from 2000 to 2009, surgical procedures performed for DDSD increased by more than 1/3rd and has been growing both because of rapid increase in the elderly population and adoption of broader indications for surgical treatment [13].

Currently, there are no accurate statistical data for Russia in the literature. To date, data on the number of surgical interventions performed for spinal deformities have been difficult to obtain because national registries on spinal surgery are not maintained in all countries. However, there is information from the USA, where more than 300,000 surgical interventions are annually performed for spondylosyndesis [16].

Currently, a high-level technique for surgical interventions on the spine has been developed. Leading manufacturers, mainly from the USA and Western Europe, have created a significant number of designs for spinal surgeries. However, the frequency of surgical complications after similar surgeries has not demonstrated a steady decrease [17-22]. The frequency of various complications in spinal surgery remains quite high—9%–33% [9, 19, 23, 24]. Complications after surgical interventions on the spine are encountered more often in adults than in children [7, 25, 26]. The incidence of complications is higher in smokers and in patients with a high body mass index or diabetes mellitus along with several other precipitating factors [27-31].

The volume of blood loss during spinal surgeries depends on several factors, including the duration of surgery, state of bone mineral density, and extent of the zone of spondylosyndesis. During the surgical correction of idiopathic scoliosis, the average volume of blood loss amounts to 20%–40% of the circulating blood volume (CBV) [32].

Some researchers believe that neuromuscular forms of scoliosis are the most unfavorable in terms of intraoperative blood loss, which is explained by the considerable extent of the zone of spondylosyndesis [33]. Surgical treatment of neuromuscular scoliosis is accompanied by an average blood loss of approximately 50% of the CBV, but cases with loss of more than 90% of the CBV have also been described [34].

During surgical interventions on the spine, several authors have identified provoking factors affecting the volume of blood loss; these include the type of anesthetic support, use of muscle relaxants,

increase in intra-abdominal pressure, and nature of hemodynamics [35, 36].

Fatal outcomes after surgical interventions on the spine may result from acute coronary insufficiency, pulmonary embolism, pneumonia, and sepsis. The frequency of fatal outcomes in surgical interventions on the spine varies from 0.1% to 2.0% [18, 37-40]. The primary causes for fatal outcomes in young and middle-aged patients with spinal deformities are cardiovascular and respiratory insufficiencies [9, 24].

The risk of complications during and after surgical intervention is higher in older age groups because of the presence of a concomitant pathology that causes low functional reserves in them. Diseases such as arterial hypertension, diabetes mellitus, chronic pyelonephritis, and rheumatoid arthritis are present, on an average, in 55% of the elderly and senile patients [41].

On an average, complications after surgical interventions on the spine occur in more than 50% of the patients aged ≥75 years; these complications include surgical site infection (SSI, 10.5%), urinary tract infection (10%), postoperative pneumonia (8%), pulmonary embolism (2.6%), and acute myocardial infarction (2.5%). In the elderly and senile patients, complications include acute urinary retention (12.5%), intestinal obstruction (5.3%), acute renal failure (2.6%), superficial wound infection (2.6%), and postoperative delusions (17.5%) [18, 41].

Cardiovascular complications in spinal surgery are observed both during the intervention and early postoperative period [17]. Several factors affect cardiac activity, including pre-existing coronary artery disease, different types of arrhythmias, left ventricular hypertrophy and dysfunction, and valvular heart disease.

Cardiovascular complications during the early postoperative period occur in 1.7%–4.5% of the cases [38, 42].

During spinal surgeries, postoperative deep vein thromboses of the lower limbs are observed in 1.8%–6.7% of the cases [43, 44]. To prevent thromboembolic complications, ultrasound dopplerography of the lower limbs, compression knitwear, patient positioning without abdominal compression during surgery, anticoagulant administration, and early activation in the postoperative period are recommended [9].

Statistical data on the number of pulmonary complications after spinal surgeries widely vary from 1.8% to 64% [45, 46]. This may be because of differences in the interpretation of respiratory complications by different investigators. For example, Jules-Elysee et al. (2004) considered changes revealed by radiographic examination of lungs as pulmonary complications even in the absence of clinical signs [45]. According to these authors, the number of cases of respiratory complications reaches 64%. Karadimas et al. (2008) considered it appropriate to classify pneumonia (1.8%) as a pulmonary complication [38]. Other authors consider complications such as pulmonary edema, pneumonia, and atelectases as respiratory [18, 42]. In these studies, incidences of pulmonary complications after spinal surgeries ranged from 1.8% to 23%.

Risk factors for the development of pulmonary complications are considered to be smoking, prescription of muscle relaxants during anesthesia, and intraoperative damage to the pleura and lung tissue [47, 48]. After the surgical correction of spinal deformities, respiratory functions improve in most cases.

The incidence of neurological complications after spinal surgery is relatively small (0.5%–2.0%) with severe lesions involving impaired pelvic function, complete damage to the spinal cord, and paraplegia around 0.07%–0.3% [37]; some authors [49] have considered these as major neurological complications, whereas the transient impairment of motor and sensory functions has been considered as minor [50].

Reames et al. (2011) reported 19,260 surgical interventions for scoliosis in pediatric practice [40]. The incidence of neurologic complications was 0.8%. Another study reported data on 108,419 spinal surgeries in adult patients, during which 1,064 neurological complications (1%) were observed [39]. According to these investigators, the incidence of fatal outcomes was 0.18%.

The results of spinal surgeries are assessed based on the presence or absence of postoperative complications; there are methods for evaluating functional results and quality of life [51-53].

Increased surgical treatments for spinal pathology have increased the number of complications associated with this surgery. Most often (up to 12%), infectious complications such as infected hematoma, superficial suppuration, marginal necrosis of the wound, intermuscular and paravertebral phlegmons

and abscesses, and osteomyelitis are noted; non-infectious complications such as instability of the metal implant, debris syndrome, osteolysis, and metallosis are also noted [18, 54, 55].

One of the most common, unfavorable complications of spinal surgery is SSI. Cases of local purulent-inflammatory complications significantly worsen the outcomes of treatment and increases its duration and cost [56-58]. The frequency of SSI in spinal surgeries is 0.7%–20.0% [19, 31, 59-62]. Deep SSI occurs less frequently than superficial SSI and amounts to 0.5%–3.5% [27, 63-65].

Early complications are those that develop within 1 month after the surgery, whereas late complications are those that develop more than 1 month after the surgery [9].

During spinal surgery, local non-infectious complications such as pseudarthrosis, instability or fracture of the metal implant, protrusion of the implant under the skin, kyphotic deformity above the fixation level, and degenerative changes in the lower pole are often noted [24, 55].

Bonnevialle et al. (2012) consider SSI to be unsuccessful and disputable and recommend the combination of all local complications (both infectious and non-infectious), not related to bacterial contamination, into a broad category of wound healing problems [66].

After spinal surgeries, hematomas are observed in 0.8%–5.6% of the cases; several researchers consider this complication after surgical intervention as a precursor of suppurative complications [44].

Thus, data on the incidence and structure of complications in spinal surgery presented in the literature are ambiguous. In Russia and abroad, new surgical methods and modern types of anesthetic and resuscitation supports have been developed and the number of surgical interventions on the spine has been constantly increasing. In the Russian Federation, an effective legal framework was created (within the framework of the priority national project "Health" and modernization of health care), which provided a real opportunity to increase the availability and quality of high-tech, expensive medical care to the population [67, 68]. However, complications are encountered in every unit that deals with spinal surgery.

Analysis of data from literature reveals that complications after spinal surgery have attracted the interest of several researchers. There is a wide spectrum of these complications, their causes are varied, and they undoubtedly affect the functional status and quality of life of patients. The prognosis of complications in spinal surgeries is possible, which depends on the experience of vertebrologists in most cases.

In general, when analyzing data of domestic and foreign literature, it is obvious that the incidence of complications in spinal surgeries remains quite high without a steady tendency to decrease in any country [19, 59, 69]. Prevention of these complications is possible by creating systems for their prognosis and prevention. However, there have been only few publications that have provided such data on spinal surgery [54, 70, 71].

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