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The Role of Unilateral Spinal Anesthesia in Orthopedic Procedures in Elderly Patients

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Annotation. In patients in need of orthopedic surgery, it is very important and necessary to consider such patients during surgery and postoperative care, due to the significant anesthetic risk associated with significant aging and high comorbidity. In order to use anesthesia correctly, it is first necessary to have sufficient knowledge about intraoperative treatment (care) with possible complications in vital organs, adequate preoperative preparation, minimal physiological disturbances and side effects.

Key words: orthopedic surgery, hip fractures, degenerative-dystrophic diseases, syndrome.

One of the most important and necessary features of modern surgery and anesthesiology is minimal postoperative discomfort and pain, as well as early onset and rehabilitation [77], [124]. According to relatively recent studies, progress in anesthesia and analgesia may affect outcomes after surgery [148], [131].

Currently, neuroaxial aesthesia techniques are increasingly used in orthopedic surgical procedures. Compared to general anesthesia, local anesthesia has many advantages, such as the patient being conscious during the surgical procedure, spontaneous breathing, respiratory protective reflexes, and postoperative analgesic preparation. Neuroaxial anesthesia can reduce or eliminate preoperative physiological stress reactions while reducing surgical complications and improving outcome. [156]. Despite the widespread use of this method, hypotension that occurs during neuroaxial anesthesia is still a serious problem. Of course, the prevention of these and other complications is far more beneficial than treating them. Therefore, for many years, rapid research has been conducted to minimize them (reducing the dose of local anesthetics administered intrathecally, the use of adjuvant drugs, unilateral SA, predinfusion, etc.).

Hip fractures and degenerative-dystrophic diseases of the ankle joints accompanied by severe pain syndrome are serious diseases that are common, especially in elderly and senile patients [141; 1374]. This aspect is one of the main problems of the public health system due to their high morbidity and mortality rates [50; s.1573-1579, 49; Pp. 364-370]. The prediction of these cases depends on the quality of co-morbidities and perioperative care [123; 483-489, pp. 129; 1738-1743-b].

According to the literature, fractures of the femur and shin bones are the leading causes of long tuberous bone injuries (8.1 to 61.5%) [97; 39-44, 103, 107-b; 131-136-b]. The number of cases of fractures of the proximal part of the femur is increasing year by year all over the world [21; 289-294-b]. In the elderly, fractures of the proximal portion of the femur often determine the issue of predicting patient life expectancy. However, these cases are more common in women than in men, and statistically, osteoporosis occurs at a relatively early age in women during longevity [37; 24 b.]. According to WHO, in 90% of cases in elderly and senile patients, these fractures occur against the background of osteoporosis. The risk of fracture of the proximal part of the femur increases with age (aging) in these people: at the age of 50 - 1.8%, at the age of 60 - 4%, at the age of 70 - 18%, at the age of 90 - 24% [150; 91-96-b].

It is known that the age of the patient, the level of self-care, and the presence of concomitant pathology are factors that lead to possible death after an injury. Thus, the mortality rate due to conservative

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treatment in the first year after injury is 60–80%, and 50% of such patients were in a position to be able to self-care before injury [70; 788-795, 199-b].

Surgical treatment includes rapid activation of the patient, restoration of his ability to stand up (ie, stand up), self-care (will), and trophic changes in the skin (bed sores), thromboembolic complications, pulmonary bronchial infection, decompensation of previously compensated organ failure reduces the risk of developing complications. Dystrophic-degenerative diseases also have a negative impact on elderly patients. Degenerative diseases of the musculoskeletal system are among the leading causes of disability, especially among the elderly, in the world. It is projected that by 2050, the proportion of the population over the age of 60 will be more than 20% of the world's population, and about 15% of them will suffer from osteoarthritis to varying degrees. However, one-third of these patients remain disabled. To date, total endoprosthesis has been recognized as the most effective method of treating severe osteoarthritis, which not only relieves pain syndrome, but also significantly improves quality of life. In cases where conservative measures are ineffective, joint replacement surgery has already become a common way for the treatment of severe stages of degenerative joint disease, and their number will only increase rapidly in the future.

The degree to which the problem has been studied. According to the literature, fractures of the femur and shin bones are the leading causes of long tibial bone injuries (8.1 to 61.5%) [97; 39-44, 103, 107-b; 131-136-b]. The number of cases of fractures of the proximal part of the femur is increasing year by year all over the world [21; 289-294-b].

The aim of the study: to study the effectiveness and safety of different USA options in elderly patients who undergo ankle arthroplasty surgery and to develop criteria for a differential approach to their selection..

Research objectives

1. A comprehensive study of the circulatory system and hemostasis, including the evaluation of the preoperative and postoperative periods in the process of total endoprosthesis of the ankle joints in terms of safety and effectiveness of anesthesia and anesthesia in elderly patients, ie

a) During unilateral spinal anesthesia (n = 20).

Research methods.

ECG recording and monitoring; Measurement (monitoring) of heart rate with the possibility of source selection (ECG, SpO2); Arrhythmia registration and automatic recording; Measurement (control) of the degree of oxygen saturation of capillary blood (pulsoximetry); non-invasive continuous monitoring of central hemodynamic parameters using impedance cardiography; to determine the level of the stress hormone "cortisol" in the blood.

Unilateral spinal anesthesia techniques are described in detail in the "Research Materials and Methods" section.

The patients were kept in a supine position for 20 minutes and then placed on their backs with their heads slightly raised. We selected an intrathecal injection dose of 7.5 mg of hyperbaric solution of 0.5% bupivacaine for unilateral spinal anesthesia as a relatively widely recommended dose without combination with intrathecal administration of fentanyl (sufentanil). Further reduction of the dose of local anesthetic (intrathecal administration of 0.5% hyperbaric solution of 4 mg and 6 mg of bupivacaine), taking into account the data from studies in the available literature, has also been reported in cases of unilateral spinal anesthesia failure and [23; 45-54-b], indicates that the blocks are insufficient.

The level of sensor blocking was assessed using the Pin Prink test. The engine block was evaluated using a modified Bromage scale. All 20 patients were given a crystalloid (Ringer's lactate) solution (predinfusion) at a rate of 5-6 ml / kg / h. Dormicum 1.5 mg and fentanyl 40 mcg were given intravenously 35-45 minutes before surgery.

Using the YuM-300 resuscitation-surgical monitor, heart rate, blood pressure, systolic blood pressure, central hemodynamic parameters and ECG were monitored continuously during the surgical stages and in the immediate postoperative period.

The inclusion of patients over 65 years of age in this group was identified as a criterion for involvement in the study.

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A total of 20 elderly and elderly patients were operated on in this (I) group. A total of 14 patients underwent pelvic arthroplasty and 6 patients underwent total knee arthroplasty.

3.1.1. The results obtained

The following table shows the demographic data of patients in this group who underwent surgery under unilateral spinal anesthesia (USA).

19.4% of the patients we studied were operated on with the USA. In this group, patients over 70 years of age or close to old age predominated (40.6%). The trophic status of the patients was satisfactory. Concomitant diseases were atherosclerotic changes, hypertension, coronary cardiosclerosis, circulatory failure with arrhythmias, pneumosclerosis, pulmonary emphysema, respiratory failure, varicose veins of the legs, and hormonal disorders with NYHA grade II-III UIC.

Demographic characteristics of patients (n = 20).

Indicators				Value
Age/years				71,3 ± 3,1
Gender, m/f				7/13
BMI (kg/м^2)				29,5 ± 1,9
Place of the operation, left/right				8/12
Charlson Comorbidity Index	Less than 4			5 (25 %)
	Less than 5			7 (35 %)
	⩾ 6			8 (40 %)

The following are data from clinical analysis of blood in this group of patients before and after surgery.

Results of general blood tests of patients who underwent surgery under the USA (n = 20)

Indicators	USA (n=20)		
	Before operation	After operation	P
Erythrocytes, 10^{12}/л	4,28 ± 0,12	3,86 ± 0,07	< 0,05
Hemoglobin, g/l	13,9 ± 0,3	11,8 ± 0,6	< 0,05
Hematocrit, %	43,7 ± 0,20	40,7 ± 1,4	< 0,05
Leukocytes, 10^9 /l	5,49 ± 0,23	6,94 ± 0,28	< 0,05
Neutrophils, 10^9/l	3,27 ± 0,21	3,88 ± 0,31	> 0,05
Lymphocytes, 10^9/l	1,71 ± 0,27	1,43 ± 0,14	> 0,05

Almost all peripheral blood parameters and hematocrit were within physiological norms. However, given the chronic pain syndrome and age that occur before hospitalization in all patients in this group, here we can talk about the role of initial hemoconcentration (blood transfusion). An increase in leukocytes in the blood after surgery by 32.5% (P <0.05) was accepted as an aseptic inflammatory process resulting from the underlying pathology without clinical signs (in response to the general inflammatory process).

Indications of hemostasis in patients before and after surgery.

Indicators	USA (n = 20)		
Platelets, 10^9/l	195,7 ± 5,0	182,4 ± 6,7	< 0,05
Prothrombin time, sec	11,2 ± 0,8	12,8 ± 0,5	> 0,05
APTT, sec	31,2 ± 0,3	37,8 ± 0,2	> 0,05

Hemostasis in patients in this group showed activation of the blood coagulation system both before and after surgery. Thus, fibrinogen, although it is within the physiological norm, but the approach of its

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stable values to the upper limit of the norm can be interpreted as the activation of the coagulation component of hemostasis. This was confirmed by prothrombin time and partially activated thromboplastin time (APTT), whose initial values were 20.4 and 16.8% lower than the minimum values of the norm, and this showed a change in the direction of hypercoagulation of plasma coagulation factors. This required the addition of low molecular weight heparins (enoxiparin) in the care of patients.

The table shows the mean values of systemic hemodynamics and pulse oximetry in group I patients who underwent surgery under the USA.

SpO2 and systemic hemodynamics before and during USA (n = 20).

Indicators	Surgery and postoperative stages						
	Result	Beginning of the operation	Joint implantation	End of operation	30 mins	60 mins	120 mins
BP, systolic	155,4 ± 2,9	147,1 ± 2,8	145,3 ± 1,7^{x}	146,5 ± 3,7	148,4 ± 3,8	158,5 ± 3,4	145,3 ± 3,4
BP, diastolic	78,5 ± 4,6	79,4 ± 3,1	81,3 ± 3,1	82,8 ± 4,4	84,5 ± 3,2	87,2 ± 3,1	75,2 ± 3,4
MAP	104,1 ± 3,7	101,9 ± 2,9	92,4 ± 2,6	104,0 ± 4,0	105,8 ± 3,4	110,9 ± 3,2	100,2 ± 3,2
Heart rate	90,1 ± 2,0	87,3 ± 1,7	85,3 ± 2,2	87,1 ± 2,2	94,2 ± 2,1	84,8 ± 3,2	84,7 ± 2,2
CVP	7,6 ± 0,4	7,4 ± 0,3	8,1 ± 0,4	8,3 ± 0,3	8,8 ± 0,5^{x}	8,1 ± 0,6	8,2 ± 0,4
SpO_2, %	90,1 ± 0,4	92,3 ± 0,5^{x}	91,7 ± 0,6	92,2 ± 0,5^{x}	91,2 ± 0,4	91,3 ± 0,3	91,7 ± 0,4

Note: x - r <0.05 relative to initial values.

Average indicators describe the USA as an anesthesia with more stable hemodynamic properties. We noted that in the most traumatic phase of surgery, BP was the lowest compared to all other stages of the study. Thus, if at the beginning of the operation the systolic BP was 5.4% lower than the initial data (p> 0.05), at the joint implantation stage this difference was 6.5% (p <0.05). As for diastolic BP and MAP, they were relatively stable at all stages of the operation, and the same can be said about CVP and SpO2. Although there was a tendency to slow heart rate at the beginning of surgery and during joint implantation, however, the heart rate later was at the level of age-specific features.

In a more detailed analysis of the USA period (anesthetic delivery) and before surgery and implantation of joint components, the dynamics of BP and MAP were as follows.

Age-related indications of CG in the early stages of surgical practice in patients.

Indicators	Age	N of patients	Stages of the operation		
			Result	Beginning	Joint implantation
Shock index, ml/m^2	67 - 75	12	30,0 ± 1,0	27,4 ± 0,4	28,6 ± 0,6 ^{x}
	76 - 84	8	24,2 ± 0,8	23,2 ± 0,6 ^{x}	21,4 ± 0,5 ^{x}
Heart index, l/m^2	67 - 75	12	2,70 ± 0,03	2,39 ± 0,04	2,44 ± 0,03 ^{x}
	75 - 84	8	2,18 ± 0,05	2,02 ± 0,03	1,82 ± 0,04^{x}
TPVR dyn×c×cm $^{-5}$	67 - 75	12	1632,9 ± 108,4	1811,5 ± 154,9	1606,9 ± 121,9 ^{x}
	76 - 84	8	2031,2 ± 102,3	2145,2 ± 109,9	2142,6 ± 141,4^{x}

Note: x - r <0.05 relative to initial values.

The data presented once again show a significant difference in central hemodynamic parameters in the early stages of surgery, depending on age and comorbidity. Thus, if in the third stage of the study in patients aged 67-75 years the heart index decreased by 4.7% (p <0.05), in patients aged 76-84 years it decreased by

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11.6% (p <0.05). In patients aged 67–75 years, the decrease in cardiac index at the same stage of the study was 9.7%, while in the large group it was reduced to 16.6% without compensation for tachycardia. As for total vascular peripheral resistance, it increased by 10.9% before the start of surgery in patients aged 67–75 years and returned to baseline in stage III, compared to 5.6% and 5.4% in relatively elderly patients, respectively. % (p <0.05). The gradual administration of 3-4 mg of isoket (perlinganite) under pulse and BP control helped to reduce the overall vascular peripheral resistance and open the periphery, reduce subsequent loading, and bring it closer to the required values. Thus, the actual values of total vascular peripheral resistance initially in this group were 2890.8 ± 170.1 din × s × cm-5 from the corresponding values (3145.9 ± 102.4 din × s × cm-5), which was higher by 10.4% (p <0.05). The total vascular peripheral resistance at the stage of joint implantation averaged 3734.5 ± 112.7 din × s × cm-5, from the required values. That was higher by 8.5% (3446.1 din × s × cm-5)

High levels of sympathetic regulation of the circulatory system in the elderly and the senile in this group were also affected by vegetative index indicators, which were +24 at the initial level and recorded a positive +15.7 at the end of the operation.

We were interested in the fact that in the USA, 0.5% bupivacaine at a dose of 7.5 mg of a local anesthetic resulted in more lasting sensory and motor blocks. In the USA, engine block duration averaged 117.5 ± 6.1 minutes. We explain this fact by the high concentration and duration of exposure of the unilateral dose of bupivacaine in the USA.

In 2 (9.6%) patients in this group, bilateralization of the process occurred without affecting the effectiveness of anesthesia. A dose of 7.5 mg of bupivacaine was found to be very effective in the USA in terms of relative hemodynamic stability. Perioperative instability in the patients involved in the study was associated with cardiovascular effects of neuroaxial blockade due to aging and comorbidities. Therefore, its prevention is mainly based on limiting the cardiovascular effects of neuroaxial blockade. The efficacy of such low doses has been reported by a number of authors (Kayamm et al., 2004; Khatouf M. et al., 2005). [87; 591-596-b, 90; 249-254-b].

The total blood loss in this group of patients was 6.5 ml / kg, in the case of total pelvic arthroplasty - 5.8 ml / kg and in the case of total knee arthroplasty - 6-8 ml / kg. The volume of infusion solutions administered to patients in this group was 24.6 ml / kg, and the volume of infused (transfused) erythrocyte mass was 3.45 ml / kg.

The preoperative time was 47.7 + 6.1 minutes, which was the USA technique itself, with a long stay in the supine position and a slow achievement of the surgical level (Th11).

The average duration of the operation was close to 2 hours. Recovery time of cognitive functions was relatively fast and short.

The table below shows the total amount of anesthetics, opiates, nonsteroidal anti-inflammatory drugs, adjuvants, and vasopressors consumed during the operation in Group I patients who underwent surgery in the USA.

Conclusion.

Neuroaxial anesthesia is often used in traumatology and orthopedic surgery in elderly patients with a high comorbid background. Decreased compensatory mechanisms of the cardiovascular system in the elderly significantly increase the risk of developing arterial hypotension in the sympathetic block caused by neuroaxial anesthesia [119; 44-48-b].

Satisfactory hemodynamic stability can be achieved during spinal anesthesia by reducing the area of the spinal block. Continuous spinal anesthesia and unilateral spinal anesthesia have been suggested when low doses of local anesthetic are used. The study of hemodynamic status and homeostasis parameters in the elderly patients operated under unilateral spinal anesthesia, as well as the identification of its side effects, served as the goal of our study.

An effective way to prevent hemodynamic disturbances in NA conditions is to optimize anesthesia depending on the condition of the autonomic nervous system. Simple measurement of the vegetative index allows to identify patients with a predominance of sympathetic type of vegetative tone, which should be included in the risk group during NA, which requires a differential approach in the choice of method of anesthesia.

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