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PRACA ORYGINALNA
ORIGINAL ARTICLE

COMPARATIVE ANALYSIS OF THE METHODS OF ANESTHETIC MAINTENANCE IN PATIENTS WITH DIABETES WITH THE SYNDROME OF DIABETIC FOOT REQUIRING OPERATIVE INTERVENTION

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ABSTRACT

Introduction: In the present article we draw a comparison between such types of regional anesthesia (RA) as unilateral spinal anesthesia (USA), traditional spinal anesthesia (SA) and block anesthesia of peripheral nerve trunk (block anesthesia of sciatic nerve (BASN) on the side of operative intervention) during surgical treatment of patients with the syndrome of diabetic foot.

The aim of the article is to compare effectiveness, reliability and safety of such methods of RA as unilateral and traditional spinal anesthesia, as well as block anesthesia of sciatic nerve on the side of operative intervention.

Materials and methods: 96 patients with the syndrome of diabetic foot, who received treatment in the department of purulent surgery, were examined. All patients underwent operative interventions of varying degrees of complexity depending on the nature and seriousness of damage degree of extremities, in terms of RA types under investigation. Effectiveness of regional block anesthesia, the time when anesthesia takes effect, duration and deepness were evaluated.

Results: It should be noted that USA, as a variant of pain management during operations of foot, provides the most adequate level of surgical pain management in comparison with the other types of anesthesia. During block anesthesia of sciatic nerve more than half of patients are not provided with 100% surgical analgesia, which can lead to additional medicamentous analgesedation. According to the results obtained, pain sensitivity in patients after BASN is reliably higher than in patients after USA and SA in all stages of the study.

Conclusions: RA is the main method of choice during operations on foot in comparison with the methods of general anesthesia. Unilateral spinal anesthesia is carried out with the use of smaller amount of anesthetic than traditional spinal anesthesia and block anesthesia of peripheral nerve trunk, which significantly reduces sympathectomy area and leads to the stable hemodynamic during the peri-operative period.

KEY WORDS: regional anesthesia, unilateral spinal anesthesia, diabetes, syndrome of diabetic foot

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INTRODUCTION

Diabetic foot syndrome (DFS) is the most difficult late complication of diabetes mellitus. This pathology, which in half of cases ends with amputation of one or both extremities, occurs in about 80% of patients 15-20 years after the onset of a diabetes disease [1]. Every fourth patient suffering from a carbohydrate metabolism disorder is in the risk group of DFS development [2]. Diabetic foot syndrome is one of the main causes of disability and mortality in diabetics [3,4].

The main task of anesthetic support surgery is adequate anesthesia [5]. The risk of perioperative complications increases by accompanied: coronary artery disease, heart failure, cardiac arrhythmias, hypertension, renal failure, mitral and aortic stenosis, and history of stroke. The risk may be due to obesity, difficulties in the respiratory tract, the full stomach, the position of the patient on the abdomen, and so on.

Sympathetic blockade has not been still identified in the pain treatment of DFS patients. Changes in peripheral circulation during regional anesthesia caused by artificial sympathectomy are manifested by vasoplegias with accompanying slowing of microcirculatory blood flow. As a result of the blockade of paravertebral sympathetic trunks [6,7] the microcirculation improves, the total peripheral vascular resistance (TPVS) decreases, the venous redelivery to the heart increases, which decreases pre- and post-loading.

The myocardium works in more comfortable conditions (the type of circulation in the conditions of regional anesthesia is normodynamic, in contrast to endotracheal anesthesia, where the type of circulation, as a rule, is hyperdynamic) [8]. Due to this the renal blood circulation, cerebral perfusion, pulmonary gas exchange improves. The manifestations and frequency of arterial hypotension, bra-

dycardia, postoperative urinary retention become reduced, and the motor activity recovers faster [9,10].

The following advantages of using regional anesthesia in patients with DFS can be distinguished [11,12]:

- a) the possibility of maintaining a normal diet;
- b) the absence of the need for correction of the usual schemes of insulin therapy;
- c) high adequacy of anesthesia during surgery;
- d) minimization of catabolic response of an organism to surgical aggression with limitation of hyperglycemic reaction;
- e) reduction of intra- and postoperative blood loss;
- e) decrease in the number of pulmonary artery thromboembolism (PATE);
- g) decrease in the number of deep vein thromboses;
- h) effective postoperative analgesia;
- i) opioid-preserving effect;
- k) decrease in the number of intra- and postoperative complications.

THE AIM

To compare the effectiveness, reliability and safety of such methods of regional anesthesia as one-sided and traditional spinal anesthesia, as well as blockade of the sciatic nerve on the side of surgical intervention.

MATERIALS AND METHODS

96 patients diagnosed with diabetes mellitus, DFS, who were treated at the 3rd city hospital in Zaporizhia, in the Department of Purulent Surgery from 2017 to 2018, were examined. Patients were divided into 3 groups (32 patients in each), depending on the method of analgesia:

Group 1 - patients operated under unilateral spinal anesthesia conditions;

Group 2 - patients operated under the conditions of traditional spinal anesthesia;

Group 3 - patients operated under conditions of blockade of the sciatic nerve.

Inclusion criteria:

1. Necessity of operative treatment;
2. Different forms of complicated DFS in patients with diabetes type 2;
3. Stable condition of the patient, which allows conducting a differential approach to treatment;

The criteria for not including in the study were:

1. Type 1 diabetes;
2. Patients with DFS, stage 1 and 4 classified by CZE (Uzhhorod 2012);
3. Patients on hemodialysis.

All patients underwent surgical intervention of varying degrees of complexity, depending on the nature and degree of damage to the lower extremity, in conditions of the types of regional anesthesia we study.

The age of patients included in the study was 39-86 years, the average age of patients was $62,72 \pm 9,19$ years. In each group, 50% of male and female patients were respectively.

Most patients had accompanying pathology of varying degrees and stages (Table 1).

PATIENTS' PAIN RELIEF PROTOCOL DEPENDING ON THE GROUP

Group 1: Before performing a unilateral spinal anesthesia, a solution of crystalloids in a volume of 6-8 ml / kg is dripped to the patient intravenously. The patient is in Fowler's position, lying on the side (on the side of the operative limb). After a 3-fold treatment of the place of the anticipated puncture $L_{II}-L_{III}$ 70% with the solution of ethanol, a puncture of the subarachnoid space with a needle G-25 with an aperture directed downwards (towards the operative limb) is performed, and a solution of bupivacaine is given in a dose of 10 mg. The rate of anesthetics injection is 0,5 ml / min. The control of the rate of anesthetic injection was carried out: directly – by the apparatus of ultrasound (Doppler mode), indirectly – by using a three-way tap for 2-ml syringe, with 1 ml of air and in their combination. At the place of the puncture, an aseptic bandage was applied to the skin. The patient's turn for operative intervention was performed in 20 minutes. The proposed technique avoids the development of a bilateral blockade in the vast majority of cases and provides adequate anesthetic support. The risk of development of possible complications is minimized. Control of hemodynamic parameters during the surgical intervention is indicative of the fact that the blood pressure, pulse and oxygen saturation values are within normal limits and do not require medical correction.

Group 2: Prior to the performance of spinal anesthesia, the patient was given infusion therapy with crystalloids in the volume of 8 - 10 ml / kg dripped intravenously. The patient is in a position lying on the side, in some cases, in the sitting position (given anatomical features, overweight). After a 3-fold treatment of the puncture site with a 70% ethanol solution at the level of $L_{III}-L_{IV}$ or $L_{II}-L_{III}$, a puncture was performed. After the appearance of cerebrospinal fluid in the needle's lumen the patient was injected 2,5 - 3 ml of a hyperbaric solution of 0,5% bupivacaine. At the place of the puncture, on the skin, was applied aseptic bandage. During the operation, constant monitoring of hemodynamic parameters was carried out. With a decrease in systolic blood pressure below 85 mm Hg. and diastolic below 60 mm Hg. hemodynamics was corrected medically and by infusion of colloids and crystalloids to normalize the indicators.

Group 3: The blockade of the sciatic nerve was carried out at a point which is 5 cm in the perpendicular drawn from the middle of the line connecting trochanter major and spina iliaca posterior superior, skin was anesthetized prior in aseptical conditions and subcutaneous tissue was anesthetized by solution of lidocaine 0,5% - 10,0 ml. The puncture was carried out with a long needle at the indicated point till appearance of paresthesia and after aspiration a 30 ml of 0,25% - 0,5% anesthetic solution was injected perineuronally. At the place of the puncture, the aseptic bandage was applied to the skin. If surgical intervention is performed on the foot, then this type of anesthesia is enough

Table I. The structure of concomitant pathology in the examined patients, n (%).

Concomitant pathology	Groups of patients					
	1		2		3	
	number	%	number	%	number	%
Coronary artery disease	29	91	30	94	28	88
Hypertonic disease, stage 2-3	26	81	25	78	23	72
Postinfarction cardiosclerosis	3	9	1	3	2	6

Table II. Duration of the intra- and post-operative period (M±m).

Indicator	Group of investigated patients			P 1-2	P 1-3
	1	2	3		
Duration of operation, min.	48,44±9,54	49,53±11,24	41,25±8,13		
Duration of anesthesia, min.	161,09±6,93	139,53±10,50*	163,13±8,68	0,00	0,31
Regression of anesthesia, min.	198,75±8,80	174,56±11,54*	212,34±28,48*	0,00	0,01

*p<0,05

to provide adequate surgical pain relief. At the place of the puncture, the aseptic bandage was applied to the skin. In the course of surgery, patients in this group did not require a medical correction of hemodynamic parameters. The values of blood pressure, heart rate, blood saturation with oxygen were within normal limits.

METHODS OF PATIENT'S EXAMINATION

The effectiveness of the regional block, its time of occurrence, duration and depth were evaluated. The intensity of the pain was determined using the standard visual analog scale (VAS). The estimation of the sensory blockade was performed in points (E. Lanzet al., 1979). The estimation of motor blockade was also performed in points (P.R. Bromage, 1976). For statistical data processing was used descriptive statistics (Excel), Student's t-test.

RESULTS AND DISCUSSION

On the basis of the estimation of the sensory blockade level of the operative limb, we demonstrate in Table II the duration of adequate surgical anesthesia, and when combined with the level of motor blockade less than 3 points, the calculated time of anesthesia "regression" (time from the beginning of the anesthesia to the beginning of the restoration of the sensitivity in the operated limbs), depending on the method of analgesia of patients. Significant differences were not found only when comparing the duration of anesthesia in 1 and 3 groups, in all other cases, the results are reliable (p < 0.05). During the 3 subsequent postoperative days, patients of all the study groups were given anesthesia by intramuscular injection of analgesics.

The controlled level of glucose concentration (presented in Table III) in patients who underwent operative foot intervention in regional anesthesia conditions indicates the beneficial effects of this anesthetic method on carbohydrate metabolism

and diabetes mellitus in the postoperative period, since patients retain normal diet and supplementary insulin therapy schemes are not needed. There was no significant difference in glucose levels from the method of regional anesthesia (p > 0,05 in all groups). In the first postoperative day, the level of glucose decreased in the 1st group by 28,3%, in the 2nd - by 22,2%, in the 3rd group - by 19,7%. At the 3rd postoperative day, glucose levels decreased by 6,8% in group 1, by 5% in the 2nd group and by 7,2% in the third group of patients.

It should be noted that unilateral spinal anesthesia, as an option for pain relief in operations on the foot, has the most adequate level of surgical anesthesia compared with other types of regional anesthesia that we used in our work, as shown in the Table IV by measuring of pain sensitivity on the VAS (Visual Analogue Scale). During the 4 and 10 hours of anesthesia, the effect of unilateral spinal anesthesia and spinal anesthesia is almost the same (p > 0,05), however, after 4 hours, after the onset of anesthesia, the pain is felt less in patients after the unilateral spinal anesthesia by almost 50%.

In performance of the sciatic nerve blockade, more than half of the patients do not receive 100% of surgical analgesia, which can lead to additional medical analgesedation. From the obtained results it can be seen that the pain sensitivity in patients after sciatic nerve blockade is significantly higher than in patients after unilateral spinal anesthesia and spinal anesthesia at all stages of the study (p < 0,05).

CONCLUSIONS

1. Regional anesthesia is the main method of choice in operations on the foot in comparison with the methods of general anesthesia regarding to the high risk of the patients with DFS on ASA scale and the many concomitant pathologies associated with the underlying disease (diabetes mellitus).
2. The postoperative period in patients who underwent a foot operation in conditions of regional anesthesia is

Table III. Blood glucose ($M \pm m$).

Indicator	Group of investigated patients			p1-2	p1-3
	1	2	3		
Before operation	10,93±2,77	11,33±4,13	10,24±3,72		
1 day after operation	7,84±1,91	8,81±2,64	8,23±2,30	0,10	0,46
3 days after operation	7,31±1,65	8,37±2,92	7,64±2,14	0,08	0,50

Table IV. Pain sensitivity in the operated foot on the VAS ($M \pm m$).

Indicator	Group of investigated patients			p 1-2	p 1-3
	1	2	3		
1 hour of anesthesia	0,00±0,00	0,00±0,00	0,84±0,68*		0,00
4 hours of anesthesia	0,19±0,40	0,34±0,48	1,03±0,59*	0,16	0,00
10 hours of anesthesia	2,53±0,67	2,65±0,83	2,91±0,82*	0,51	0,04

* $p < 0,05$

not complicated by a violation of the normal diet, which does not require additional correction of the standard mode of insulin therapy.

- Unilateral spinal anesthesia is subjectively perceived by patients better than traditional spinal anesthesia.
- Unilateral spinal anesthesia is performed with smaller volumes of anesthetic than traditional spinal anesthesia and blockade of the peripheral nerve trunk.
- In the performance of the sciatic nerve block, part of the patients does not receive 100% of surgical analgesia, which may lead to additional medical analgesedation.

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Conflict of interest:

The Authors declare no conflict of interest.

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