https://doi.org/10.23873/2074-0506-2024-16-1-10-20

Transversus abdominis plane block as a component of anesthesia in kidney transplantation

A.V. Shabunin[1,2], E.P. Rodionov[1,2], P.A. Drozdov✉[1,2], A.A. Malyshev[1,2], B.A. Smolev[1], A.A. Efanov[1], S.A. Fedorishchev[1], R.I. Malashenko[1], S.A. Astapovich[1], E.A. Lidzhieva[2]

[1]City Clinical Hospital n.a. S.P. Botkin, 52-nd Botkinskiy Dr., Moscow 125284 Russia;

[2]Russian Medical Academy of Continuous Professional Education, 2/1 Bldg. 1 Barrikadnaya St., Moscow 125993 Russia

✉Corresponding author: Pavel A. Drozdov, Cand. Sci. (Med.), Head of the Organ and/or Tissue Transplantation Department, City Clinical Hospital n.a. S.P. Botkin; Associate Professor of the Department of Surgery, Russian Medical Academy of Continuous Professional Education, dc.drozdov@gmail.com

Abstract

Aim. *To evaluate the safety and efficacy of the transversus abdominis plane block in kidney transplantation from deceased donor.*

Material and methods. *The first stage included a retrospective comparative analysis of the results using the transversus abdominis plane block in renal transplantation. Group I (n=30) included patients who underwent transversus abdominis plane block after kidney transplantation; in comparative group II (n=58) the TAP-block wasn't performed. We assessed the daily requirement for trimeperidine on the first day after kidney transplantation. The second stage was a prospective randomized placebo-controlled study. The patients were randomly divided into 2 groups with respect to whether the transversus abdominis*

plane block was provided with an active drug, or placebo was used; so the sodium chloride 0.9% was injected into the transversus abdominis plane i.e. in the intermuscular fascial plane between the internal oblique and transversus abdominis muscle in patients of Group III (n=31), and a local anesthetic was injected in patients of Group IV (n=34). The daily requirements for trimeperidine, tramadol were assessed as well as the pain severity according to visual analogue scale at 1, 6, 12, 24 hours after surgery, the incidence of adverse events in the gastrointestinal tract; and several laboratory parameters (cortisol, interleukin-1, interleukin-6) related to pain syndrome were analyzed.

Results. *As a result of pseudorandomization, 17 cases were included in each of the two retrospective stage groups, which were comparable in terms of patients' main characteristics (p>0.05). The daily requirement for trimeperidine in the transversus abdominis plane block group (Group I) was lower than in the comparison group with a trend toward statistical significance (p=0.07). The median daily dose of trimeperidine in Group III (placebo control) was 59.5 mg (interquartile range: 51.5–72.0), which was higher than in Group IV (45.5 mg; interquartile range: 38.5–62.0) (p=0.039). The postoperative pain severity assessed by visual analogue scale was also statistically significantly higher in group III at the timepoint of 12 hours after surgery, making 4.0 points (interquartile range: 2.5–5.0) versus 1.5 points (interquartile range: 0.5–2.5) in group VI (p=0.015). There were no differences between the groups in pain severity at 1, 6, and 24 hours after surgery. The daily requirement for tramadol was also statistically significantly higher in Group III, amounting to 50 mg (interquartile range: 0–100) versus 0 (interquartile range: 0–55 mg) in the active drug Group IV (p=0.045).*

Conclusion. *Our study showed that the use of the transversus abdominis plain block was safe and effective, yielding encouraging results, which*

demonstrated a clinically significant reduction in the need for opioid analgesics and in the incidence of adverse events in the postoperative period after transversus abdominis plane block which contributes to the early activation of patients. Therefore, further studies are needed to improve the package of multimodal perioperative analgesia after kidney transplantation.

Keywords: regional anesthesia, kidney transplantation, transversus abdominis plane block, pain

Conflict of interest. The authors declare no conflict of interest

Financing The study was performed without external funding

For citation: Shabunin AV, Rodionov EP, Drozdov PA, Malyshev AA, Smolev BA, Efanov AA, et al. Transversus abdominis plane block as a component of anesthesia in kidney transplantation. *Transplantologiya. The Russian Journal of Transplantation.* 2024;16(1):10–20. (In Russ.). https://doi.org/10.23873/2074-0506-2024-16-1-10-20

BMI, body mass index
BP, blood pressure
CI, confidence interval
GI, gastrointestinal tract
IQR, interquartile range
MLV, mechanical lung ventilation
NSAID, non-steroidal anti-inflammatory drug
OR, odds ratio
RRT, renal replacement therapy
KT, kidney transplantation
SBP, systolic blood pressure
TAP block, transversus abdominis plane block
US, ultrasound
VAS, Visual Analogue Scale

Introduction

Kidney transplantation (KT) is the best treatment for patients with end-stage chronic kidney disease without absolute contraindications to this intervention [1]. Today, the strategy of early ambulation of patients after major surgical interventions is recognized as the most effective,

since it leads to a statistically significant reduction in the risk of developing postoperative complications [2–3]. Severe pain syndrome, characteristic of surgical interventions in the abdominal region, including kidney transplantation, can significantly limit the patient's activity after surgery. The postoperative pain management in kidney transplant recipients is a key problem associated with the changed pharmacokinetics of opioid analgesics in patients with end-stage chronic kidney disease, which can lead to an increase in the incidence of adverse events. [4]. Non-steroidal anti-inflammatory drugs in high doses can have a negative effect on the graft function, which is especially critical in the early post-transplant period [5–6]. In this regard, the implementation of regional anesthesia techniques into clinical practice may be a promising trend that is relevant for nephrotransplantology.

One of the most suitable techniques for regional anesthesia seems to be transversus abdominis plane (TAP) block [7–8]. For the first time, the technique of the transversus abdominis plane block was developed in 1999 by Dr. A.N. Rafi, an anesthesiologist from Ireland [9]. In the classical version, the technique application did not require ultrasound (US) visualization, since the Petit's triangle was used as an anatomical landmark. Alternate techniques include an ultrasound-guided access to the interfascial plane where the parietal sensory branches of the spinal nerves pass (Th VI–XII) along the mid-axillary line between the iliac crest and the costal margin, as well as a subcostal access. Currently, the vast majority of anesthesiologists perform this block under ultrasound navigation, which improves the quality and safety of the block [10–12].

In the world literature over the recent 5 years, we have not found a large number of reports on the use of the transversus abdominis plane block for kidney transplantation. However, a number of studies demonstrate the high efficiency and safety of this technique, which

certainly confirms the promise of its use in the field of KP [13]. Today, in our clinic, this technique has become an integral component of combined anesthesia in abdominal surgery. In this regard, we initiated a study to investigate its safety and efficacy in KT.

Material and methods

At the initial stage of the study, the first experience of using the transversus abdominis plane block in KT was studied retrospectively by a comparative analysis. From July 2018 to August 2020, 98 isolated KTs from posthumous donors were performed in the Organ and/or Tissue Transplantation Department of the City Clinical Hospital n.a. S.P. Botkin. Of these, 30 patients had the transversus abdominis plane block performed before KT (group I); the remaining patients (n=58) received no additional regional anesthesia they formed a retrospective comparison group II. Patients were excluded from the study (n=10) if at least one of the following criteria was present: the need for revision within 48 hours after KT, increasing graft bed hematoma, allergy to a local anesthetic, and an unsatisfactory ultrasound navigation by the anesthesiologist. At the retrospective stage of this study, we assessed the daily requirements for trimeperidine on the first day after KT and compared them between the groups.

At the second stage, we initiated a prospective, randomized, placebo-controlled study to comparatively analyze the safety and efficacy of the transversus abdominis plane block in KT. Randomization was performed using the envelope method. The exclusion criteria were identical to those used for the retrospective stage of the study. Thus, group III (placebo control) consisted of 31 patients who were injected with a 0.9% sodium chloride solution when performing a TAP block; 34 kidney transplant recipients were randomized into group IV, who underwent a TAP block using a local anesthetic. We analyzed the daily

requirements for trimeperidine, tramadol, the pain intensity assessments on a visual analogue scale (VAS) 1, 6, 12, and 24 hours after surgery, the incidence of adverse events from the gastrointestinal tract (GIT), and a number of laboratory parameters characteristic of pain syndrome (blood levels of cortisol, interleukin-1 and interleukin-6); and we compared them between the groups.

Protocol of anesthesia for kidney transplantation and postoperative management of the patient on the 1st day

The kidney transplantation surgery, postoperative management of recipients and administration of immunosuppressive therapy were performed according to standard protocols, in accordance with the National Clinical Guidelines [14]. In all cases, the ureteroneocystoanastomosis was performed with the placement of an internal ureteral stent. Patient condition was monitored in accordance with the Harvard Standard (continuous two-lead electrocardiography with automated ST segment analysis, blood pressure (BP) measurement at least every 5 minutes, capnometry, thermometry, measurement of arterial blood saturation, plethysmography, analysis of the inhaled and exhaled gas percentage composition, tightness control of breathing circuit and the main parameters of mechanical lung ventilation (ALV); TOF monitoring to assess neuromuscular transmission and the invasive blood pressure monitoring were also obligatory performed. Anesthetic management ensured combined endotracheal anesthesia, which included: premedication with fentanyl at a dose of 3–4 mcg/kg, induction with propofol (1.5–2.5 mg/kg), and myoplegia with the administration of rocuronium bromide (0.9 mg/kg). The anesthesia course was accompanied by the sevoflurane inhalation in an oxygen-air mixture at a minimum alveolar concentration (MAC) corresponding to the patient's age, and a

fractional intravenous administration of fentanyl. If episodes of hypotension developed during general anesthesia, norepinephrine was used to maintain adequate graft perfusion in doses of 0.02–0.2 mcg/kg/min to achieve a systolic blood pressure (SBP) of at least 100 mm Hg.

Upon completion of the surgical phase, provided the patient was in a stable condition, the patient was awakened in the Operating Room and transferred to the Intensive Care Unit. On the first postoperative day, nausea and vomiting were controlled with ondansetron. The tactics of postoperative analgesia were “on demand”, no baseline medications were prescribed, administering paracetamol, a non-steroidal anti-inflammatory drug (NSAID) in a VAS assessment of up to 3, tramadol in a VAS assessment of 3 or more, and trimeperedin, if they turned ineffective. In case of severe hyperkalemia, a conservative pharmacological therapy was undertaken, including the infusion of sodium chloride, glucose-insulin mixture, sodium bicarbonate, calcium gluconate, and furosemide administration. In case of severe hypervolemia or ineffectiveness of conservative therapy for hyperkalemia, a session of renal replacement therapy (RRT) was performed with a reduced amount of anticoagulants infused in blood or without them.

Transversus abdominis plane block technique

In all cases included in this study, the transversus abdominis plane block was performed after the anesthesia induction immediately before the skin incision on the surgical side. Under the ultrasound guidance in three layers of muscles: the external and internal oblique abdominal muscles, and the transverse abdominal muscle were identified in the mesogastric region along the mid-axillary line. After this, a puncture of the external and internal oblique muscles was performed, and the local anesthetic ropivacaine 0.2% in a volume of 20 ml was injected into the

interfascial plane between the internal oblique and transverse abdominal muscles, using a 22G spinal needle.

When the technique was correctly applied, the ultrasonography demonstrated a typical divergence of the interfascial plane according to the lens type. To verify the position of the needle, it may be necessary to inject 1-2 ml of 0.9% sodium chloride solution followed by local anesthetic. The puncture is performed at an acute angle, and in patients with a thick layer of muscle and pronounced subcutaneous fat, the angle can reach up to 90°.

Statistical analysis

Statistical processing and analysis of data were performed using IBM SPSS Statistics software, version 26 for Microsoft Windows (USA). To compare two groups of quantitative parameters, given the small sample size, the Mann–Whitney U test was used regardless of the type of distribution. Comparison of qualitative data was made using Pearson's χ^2 test or Fisher's exact test with determination of the odds ratio (OR) and 95% confidence interval (CI), as well as the strength of association between the studied variables by using the Cramer's V value. Pseudorandomization was performed using SPSS Statistics, v. 26, by using a pseudorandomization method with a match tolerance 0.1. Differences were considered statistically significant at $p<0.05$, and a trend toward statistical significance was defined as $p<0.1$.

Results

In group I (control), the median age of recipients was 54 (IQR: 25–68) years, the median body mass index (BMI) was 28 (IQR: 19–31) kg/m^2. There were 14 men (24.1%) and 40 women (75.9%). Median surgery duration was 240 minutes (IQR: 180–300). In group II (TAP block), the median age of recipients was 49 (IQR: 19–54) years, the

median BMI was 22 (IQR: 18–26) kg/m^2. There were 11 men (36.7%) and 19 women (63.3%). Median surgery duration was 205 minutes (IQR: 120–230). Statistically significant differences between the groups were recorded in the age of the recipients (p=0.03), BMI (p=0.01), and the surgery duration (p<0.001). The mean daily requirement for trimeperidine was 58.5 (IQR: 51.0–68.5) mg in group I, 59.0 (IQR: 50.5–71.0) mg in group II. No statistically significant differences were found (p=0.563). However, given the presence of statistically significant differences in key outcome parameters between the groups, we performed pseudorandomization according to quantitative parameters: recipient age, recipient BMI, and the surgery duration. The groups resulting from the pseudorandomization included 17 cases each and were comparable in principal characteristics (p>0.05). The daily requirement for trimeperidine in the TAP blockade group was lower than in the comparison group, but without reaching the level of statistical significance (p=0.07). The results of the first stage of the study before and after pseudorandomization are presented in Table. 1.

Table 1. Results of a retrospective study of the transversus abdominis plane block efficacy in kidney transplantation

Parameter	Before pseudorandomization			After pseudorandomization		
	Group I (n=58)	Group II (n=30)	p	Group I (n=17)	Group II (n=17)	p
Daily requirement for trimeperidine (mg)	58.5 (IQR: 51.0–68.5)	59.0 (IQR: 50.5–71.0)	0.563	61.0 (IQR: 45.5–80.0)	57.5 (IQR: 42.0–75.5)	0.07
Age of recipients (years)	54 (IQR: 25–68)	49 (IQR: 19–54)	0.03	52 (IQR: 23–70)	51 (IQR: 20–65)	0.43
BMI of recipients (kg/m^2)	28 (IQR: 19–31)	22 (IQR: 18–26)	0.01	24 (IQR: 21–35)	24 (IQR: 22–31)	0.61
Surgery duration (min)	240 (IQR: 180–300)	205 (IQR: 120–230) min	<0.001	220 (IQR: 200–280)	210 (IQR: 180–260) min	0.15

In group III, the median age of recipients was 51 (IQR: 19–65) years, the median BMI was 22 (IQR: 18–28) kg/m^2. There were 13 men (21.3%) and 18 women (78.7%). The median surgery duration was 201 (IQR: 149–243) minutes. In group IV, the median age of recipients was 50 (IQR: 21–67) years, the median BMI was 21 (IQR: 18–26) kg/m^2. There were 14 men (41.2%) and 20 women (58.8%). The median surgery duration was 218 (IQR: 153–266) minutes. There were no statistically significant differences in the baseline characteristics ($p>0.05$). The mean daily dose of trimeperidine in group III (placebo control) was 59.5 (IQR: 51.5–72.0) mg, which was statistically significantly higher than in group IV 45.5 (IQR: 38.5–62.0) mg ($p=0.039$). The intensity of postoperative pain syndrome was also statistically significantly higher in the comparison group at the third stage 12 hours after surgery: 4.0 (IQR: 2.5–5.0) points by VAS versus 1.5 (IQR: 0.5–2.5) points by VAS in the TAP blockade group ($p=0.015$). There were no statistically significant differences between the groups in the severity of pain syndrome at 1, 6, and 24 hours after surgery. The majority of recipients from both the main group (22/31; 70.1%) and the comparison group (26/34; 76.5%), in addition to complaints of pain in the surgical area, also complained of significant discomfort in the bladder area. The daily requirement for tramadol was statistically significantly higher in group III 50 (IQR: 0–100) mg versus 0 (IQR: 0–55) mg in the main group IV ($p=0.045$). Unfortunately, we found no statistically significant differences in the incidence of adverse events in the gastrointestinal tract (nausea/vomiting) ($p=0.324$). They occurred in 10/34 (29.4%) recipients of the main group, and in 13/31 (41%) of the comparison group. Similarly, no statistically significant differences were recorded for laboratory markers of pain ($p>0.05$). No complications associated with the implementation of the transversus abdominis plane block were identified in any of the groups

(p=1). A detailed analysis of the results obtained at the second prospective stage of the study is presented in Table. 2.

Table 2. Results of the second stage of assessing the transversus abdominis plane block efficacy in kidney transplantation in a randomized placebo-controlled trial

Parameter	Group IV (TAP block) n=34	Group III (placebo control) n=31	p
Daily requirement for trimeperidine (mg)	45.5 (IQR: 38.5–62.0)	59.5 (IQR: 51.5–72.0)	0.039
Daily requirement for tramadol (mg)	0 (IQR: 0–55)	50 (IQR: 0–100)	0.045
Nausea, vomiting (%)	10/34 (29.4%)	13/31 (41%)	0.324
Pain severity by VAS: – 1 hour – 6 hours – 12 hours – 24 hours	 3.0 (IQR: 2.5–5.5) 2.0 (IQR: 1.5–3.5) 1.5 (IQR: 0.5–2.5) 0 (IQR: 0–2.5)	 3.5 (IQR: 3.0–6.0) 2.5 (IQR: 1.5–3.0) 4.0 (IQR: 2.5–5.0) 0.5 (IQR: 0–2.5)	 0.15 0.54 0.015 0.43
Discomfort in the bladder area	26/34 (76.5%)	22/31 (70.1%)	0.76
Blood level of cortisol before surgery (Nmol/L)	321 (IQR: 265–444)	282 (223–450)	0.09
Blood level of cortisol on the 1st day after surgery (Nmol/L)	396 (IQR: 215–638)	320 (IQR: 155–782)	0.34
Blood cortisol level on the 2nd day after surgery (Nmol/L)	180 (IQR: 109–295)	203 (IQR: 134–327)	0.54
Blood level of Interleukin-6 before surgery (Pg/mL)	9420 (IQR: 24–22618)	9830 (IQR: 48–45128)	0.63
Blood level of Interleukin-6 on the 1st day after surgery (Pg/mL)	32 (IQR: 23–41)	48 (IQR: 34–112)	0.73
Blood level of Interleukin-6 on the 2nd day after surgery (Pg/mL)	36 (IQR: 28–70)	32 (IQR: 25–68)	0.32
Technical success of block by an anesthesiologist: – perfect – satisfactory	 28/31 (90.3%) 3/31 (9.7%)	 30/34 (88.2%) 4/34 (11.7%)	 0.86 0.92
TAP-block-related complications	0	0	1

Discussion

Analyzing world literature data and our own experience, we can make a clear conclusion that the inclusion of an additional component of regional anesthesia in the complex of multimodal perioperative analgesia for KT is a promising way to improve early post-transplant results. The transversus abdominis plane block is one of the simplest and most effective methods of regional anesthesia. However, as already mentioned, the relevance of its use in KT has not been determined to the full. In a randomized study, N.M. Freir et al. studied the efficacy of TAP blockade in 65 kidney transplant recipients [15]. The authors found no statistically significant differences in the need for morphine either intraoperatively or on the 1st postoperative day. However, it is worth noting that in this study, TAP block was performed according to the original technique described by Dr. Rafi rather than with ultrasound guidance.

Indeed, having a portable ultrasound machine at the disposal of the anesthesiologist is now a standard practice in modern surgical centers. In particular, its use significantly increases the safety of puncture of the main veins. Similarly, visualization of the transversus abdominis plane in M-mode at ultrasonography can increase the efficacy and safety of regional anesthesia. Thus, in a double-blind randomized study by S. Mohammadi et al. [10], an ultrasound-guided TAP block was performed in all patients, and its use was associated with a statistically significant reduction in opioid requirements during the first 24 hours of the postoperative period.

An important question, still without an obvious answer, is the optimal moment to perform a TAP block. On the one hand, performing a block before surgery may seem preferable within the concept of preemptive analgesia, as it could theoretically lead to a lower need for opioids administered intraoperatively. On the other hand, the

retroperitoneal access to the iliac vessels used for kidney transplantation involves crossing the entire thickness of the muscle layer and, accordingly, “depressurization” of the transversus abdominis plane. In our practice, we have repeatedly noticed the leakage of anesthetic into the wound during access, which can limit the analgesic efficacy of the block and/or complicate the surgery.

We found the answer to this question in the meta-analysis by P.M. Singh et al. [4], which results indicated a clear advantage of preoperative TAP block in reducing the intra- and postoperative need for opioids. In this regard, at the stage of implementing this technique into clinical practice, we decided to perform the block 15 minutes before the skin incision for the necessary resorption of the solution and the blockade coming to effect.

In our study, TAP block led to a statistically significantly lower need for narcotic analgesics in the postoperative period ($p=0.039$). However, we did not obtain statistically significant differences in the incidence of the common side effects of opioids: nausea and vomiting ($p=0.324$). Most likely, this was due to a small number of patients in the groups. In addition, it is worth noting that postoperative opioid administration was not always justified by pain associated with the surgical wound. The majority of patients (more than 70%) complained of severe discomfort in the bladder area, which indirectly characterized regional analgesia as being effective, since that discomform was most likely due to the presence of a urinary catheter and an internal ureteral stent graft. This could have a significant impact on the severity of pain syndrome, as well as on the need for analgesics. There were no differences between groups in this parameter. Thus, the TAP block had no analgesic efficacy against urinary catheter/ureteral stent- related discomfort.

Most likely, performing the epidural anesthesia could have relieved our patients from both the pain associated with the wound and the discomfort caused by the ureteral stent. However, its implementation may be associated with an unjustified high risk of developing fatal complications associated with pharmacologically caused failure of the hemostatic system. Kidney transplant recipients often require hemodialysis in the early postoperative period. Administration of heparin after insertion of an epidural catheter can lead to irreversible consequences [16]. At least two more potentially effective methods of regional anesthesia have been described in the world literature: erector spinae plane (ESP) [17, 18] and quadratus lumborum (QL) block [19, 20]. Their use in KT has been little studied to date, but their safety and better analgesic efficacy compared to TAP block have been proven in other abdominal surgical interventions. Accordingly, we have also implemented these interventions into our clinical practice and are currently studying their efficacy in a comparative study.

Conclusion

We obtained encouraging results that demonstrated clinically significant reductions in the need for opioid analgesics and the incidence of adverse events in the postoperative period when performing a transversus abdominis plane block, which contributes to the early ambulation of patients. However, our study нав limitations in the form of severe patient complaints of discomfort in the bladder area, which requireв pain relief with opioid analgesics. Most likely, the pain was associated with the presence of a stent in the ureter and the presence of a urinary catheter. Therefore, further studies are needed to improve the complex of multimodal perioperative analgesia and introduce new techniques after kidney transplantation.

Based on our results we can make the following conclusions:

- The ultrasound-guided transversus abdominis plane block is a safe procedure characterized by a low risk of complications and a high level of technical success (more than 90%).
- Performing a transversus abdominis plane block before kidney transplantation allows a statistically significant reduction in the need for trimeperidine (p=0.039), tramadol (p=0.045), and the intensity of pain syndrome (p=0.015) on the first postoperative day.

References

1. Chadban SJ, Ahn C, Axelrod DA, Foster BJ, Kasiske BL, Kher V, et al. KDIGO clinical practice guideline on the evaluation and management of candidates for kidney transplantation. *Transplantation.* 2020;104(4S1):S11–S103. PMID: 32301874 https://doi.org/10.1097/TP.0000000000003136

2. Mancel L, Van Loon K, Lopez AM. Role of regional anesthesia in Enhanced Recovery After Surgery (ERAS) protocols. *Curr Opin Anaesthesiol.* 2021;34(5):616–625. PMID: 34325463 https://doi.org/10.1097/ACO.0000000000001048

3. Brindle M, Nelson G, Lobo DN, Ljungqvist O, Gustafsson UO. Recom-mendations from the ERAS Society for standards for the development of enhanced recovery after surgery guidelines. *BJS Open.* 2020;4(1):157–163. PMID: 32011810 https://doi.org/10.1002/bjs5.50238

4. Singh PM, Borle A, Makkar JK, Trisha A, Sinha A. Evaluation of transversus abdominis plane block for renal transplant recipients – a meta-analysis and trial sequential analysis of published studies. *Saudi J Anaesth.* 2018;12(2):261–271. PMID: 29628838 https://doi.org/10.4103/sja.SJA_598_17

5. Chiasson JM, Fominaya CE, Gebregziabher M, Taber DJ. Long-inflammatory drug interaction: implications of changes in renal function associated with concurrent use. *J Clin Pharmacol*. 2018;58(11):1443–1451. PMID: 29799625 https://doi.org/10.1002/jcph.1264

6. Desai N, El-Boghdadly K, Albrecht E. Epidural vs. transversus abdominis plane block for abdominal surgery – a systematic review, meta-analysis and trial sequential analysis. *Anaesthesia*. 2021;76(1):101–117. PMID: 32385856 https://doi.org/10.1111/anae.15068

7. Danilo J, Philip P. (eds.) *Regional nerve blocks in anesthesia and pain therapy: imaging-guided and traditional techniques*. 3d ed. Cham: Springer International Publishing; 2022. https://doi.org/10.1007/978-3-030-88727-8

8. Rafi AN. Abdominal field block: a new approach via the lumbar triangle. *Anaesthesia*. 2001;56(10):1024–1026. PMID: 11576144 https://doi.org/10.1046/j.1365–2044.2001.02279–40.x

9. Soltani Mohammadi S, Dabir A, Shoeibi G. Efficacy of transversus abdominis plane block for acute postoperative pain relief in kidney recipients: a double-blinded clinical trial. *Pain Medicine*. 2014;15(3):460–464. PMID: 24330449 https://doi.org/10.1111/pme.12311

10. Tran DQ, Bravo D, Leurcharusmee P, Neal JM. Transversus abdominis plane block: a narrative review. *Anesthesiology*. 2019;131(5):1166–1190. PMID: 31283738 https://doi.org/10.1097/ALN.0000000000002842

11. Qin C, Liu Y, Xiong J, Wang X, Dong Q, Su T, et al. The analgesic efficacy compared ultrasound–guided continuous transverse abdominis plane block with epidural analgesia following abdominal surgery: a systematic review and meta-analysis of randomized controlled

trials. *BMC Anesthesiol.* 2020;20(1):52. PMID: 32111162 https://doi.org/10.1186/s12871-020-00969-0

12. Zheng C, Yang H, Yang L, Luo J, Xiong B. The effect of transversus abdominis plane block in kidney transplantation: a systematic review and meta-analysis. *Urol Int.* 2023;107(6):608–616. PMID: 37231953 https://doi.org/10.1159/000529804

13. Russian public organization of transplantologists “Russian Transplant Society”. *Kidney transplantation, the presence of a transplanted kidney, death and rejection of the kidney transplant. Clinical recommendations.* Moscow; 2020. (In Russ.).

14. Freir NM, Murphy C, Mugawar M, Linnane A, Cunningham AJ. Transversus abdominis plane block for analgesia in renal transplantation: a randomized controlled trial. *Anesth Analg.* 2012;115(4):953–957. PMID: 22763899 https://doi.org/10.1213/ANE.0b013e3182642117

15. Tawfic QA, Bellingham G. Postoperative pain management in patients with chronic kidney disease. *J Anaesthesiol Clin Pharmacol.* 2015;31(1):6–13. PMID: 25788766 https://doi.org/10.4103/0970-9185.150518

16. De Cassai A, Bonvicini D, Correale C, Sandei L, Tulgar S, Tonetti T. Erector spinae plane block: a systematic qualitative review. *Minerva Anestesiol*. 2019;85(3):308–319. PMID: 30621377 https://doi.org/10.23736/S0375–9393.18.13341–4

17. Liheng L, Siyuan C, Zhen C, Changxue W. Erector spinae plane block versus transversus abdominis plane block for postoperative analgesia in abdominal surgery: a systematic review and meta–analysis. *J Invest Surg.* 2022;35(9):1711–1722. PMID: 35848431 https://doi.org/10.1080/08941939.2022.2098426

18. Liu X, Song T, Chen X, Zhang J, Shan C, Chang L, et al. Quadratus lumborum block versus transversus abdominis plane block for postoperative analgesia in patients undergoing abdominal surgeries: a systematic review and meta–analysis of randomized controlled trials. *BMC Anesthesiol.* 2020;20(1):53. PMID: 32122319 https://doi.org/10.1186/s12871-020-00967-2

19. Kolacz M, Mieszkowski M, Janiak M, Zagorski K, Byszewska B, Weryk-Dysko M, et al. Transversus abdominis plane block versus quadratus lumborum block type 2 for analgesia in renal transplantation: a randomised trial. *Eur J Anaesthesiol.* 2020;37(9):773–789. PMID: 32175985 https://doi.org/10.1097/EJA.0000000000001193

Information about the authors

Aleksey V. Shabunin, Academician of the Russian Academy of Sciences, Prof., Dr. Sci. (Med.), Head Physician, City Clinical Hospital n.a. S.P. Botkin; Head of the Department of Surgery, Russian Medical Academy of Continuous Professional Education, https://orcid.org/0000-0002-0522-0681, shabunin-botkin@mail.ru

20%, study concept and design, approval of the final version of the manuscript

Evgeniy P. Rodionov, Cand. Sci. (Med.), Anesthesiologist-Intensivist of the Highest Qualification Category, Head of the Anesthesiology and Intensive Care Centre, City Clinical Hospital n.a. S.P. Botkin; Associate Professor at the Department of Anesthesiology and Emergency Medicine, Russian Medical Academy of Continuous Professional Education, http://orcid.org/0000-0002-1865-2114, dr.rodionov@gmail.com

20%, study concept and design, manuscript writing and editing

Pavel A. Drozdov, Dr. Sci. (Med.), Head of the Organ and/or Tissue Transplantation Department, City Clinical Hospital n.a. S.P. Botkin; Associate Professor at the Department of Surgery, Russian Medical Academy of Continuous Professional Education, https://orcid.org/0000-0001-8016-1610, dc.drozdov@gmail.com

15%, organization of the treatment process at the Transplantation Department, the study concept and design, writing and editing the manuscript

Anatoly A. Malyshev, Cand. Sci. (Med.), Anesthesiologist-Intensivist of the Highest Qualification Category, Head of the Anesthesiology and Intensive Care Department No. 62, City Clinical Hospital n.a. S.P. Botkin; Assistant at the Department of Anesthesiology and Emergency Medicine, Russian Medical Academy of Continuous Professional Education, http://orcid.org/0000-0001-9191-6169, malyshevaa@botkinmoscow.ru

15%, organization of the treatment process at the Transplantation Department, the study concept and design, writing and editing the manuscript

Boris A. Smolev, Anesthesiologist-Intensivist of Anesthesiology and Intensive Care Department No. 62, City Clinical Hospital n.a. S.P. Botkin, https://orcid.org/0009-0007-1059-6660, smolevboris@yandex.ru

5%, treatment of in-hospital patients, writing the text, patients' follow-up over time

Andrey A. Efanov, Anesthesiologist-Intensivist of Anesthesiology and Intensive Care Department No. 62, City Clinical Hospital n.a. S.P. Botkin http://orcid.org/0000-0002-7348-0303, dc.efanov@gmail.com

5%, treatment of in-hospital patients, writing the text, patients' follow-up over time

Sergey A. Fedorishchev, Anesthesiologist-Intensivist of Anesthesiology and Intensive Care Department No. 62, City Clinical Hospital n.a. S.P. Botkin http://orcid.org/0009-0007-8867-7786, fedorishev-serzh89@mail.ru

5%, treatment of in-hospital patients, writing the text, patients' follow-up over time

Roman I. Malashenko, Anesthesiologist-Intensivist of Anesthesiology and Intensive Care Department No. 62, City Clinical Hospital n.a. S.P. Botkin, http://orcid.org/0009-0003-7451-0740, romimalacco@gmail.com

5%, treatment of in-hospital patients, writing the text, patients' follow-up over time

Sergey A. Astapovich, Residency-training Surgeon of the Surgical Clinic, City Clinical Hospital n.a. S.P. Botkin, https://orcid.org/0000-0001-7774-1892, astsergej99@gmail.com

5%, forming a patient database, data collection and statistical processing of material

Elza A. Lidzhieva, Residency-training Surgeon at the Department of Surgery, Russian Medical Academy of Continuous Professional Education, https://orcid.org/0000-0003-1120-5450, lidjieva99@mail.ru

5%, data collection and statistical processing of material

The article was received on October 4, 2023;
approved after reviewing November 11, 2023;
accepted for publication December 27, 2023