DOI: https://doi.org/10.17816/RA624428

Current methods of perioperative analgesia for arthroscopic anterior cruciate ligament reconstruction: a literature review

Danil V. Gorelov[1], Andrey V. Babayants[1, 2], Alexei M. Ovechkin[3]

[1] Yudin City Clinical Hospital, Moscow, Russia;
[2] Federal Research and Clinical Center of Intensive Care Medicine and Rehabilitology, Moscow, Russia;
[3] Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russia

ABSTRACT

Arthroscopic knee joint surgery is becoming routine in modern orthopedics. Its advantages include minimal invasiveness, lower infection risk, and early rehabilitation. Despite the minimized surgical trauma, the postoperative period after some arthroscopic operations involving cruciate ligament surgery occurs with relatively severe pain syndrome. This warrants the search for novel pain relief methods for patients that meet all modern trends. This review presents data from randomized clinical studies and meta-analyses on the use of various anesthesias in arthroscopic cruciate ligament repair and discusses methods of prolonged postoperative analgesia. The limited number of studies on this issue and lack of systematic recommendations require prospective studies.

Keywords: arthroscopy; anterior cruciate ligament reconstruction; anesthesia; peripheral nerve block; spinal anesthesia; regional anesthesia; local anesthesia; general anesthesia.

To cite this article:
Gorelov DV, Babayants AV, Ovechkin AM. Current methods of perioperative analgesia for arthroscopic anterior cruciate ligament reconstruction: a literature review. *Regional anesthesia and acute pain management*. 2024;18(1):5–16. DOI: https://doi.org/10.17816/RA624428

Received: 11.12.2023 **Accepted:** 31.01.2024 **Published Online:** 13.02.2024

DOI: https://doi.org/10.17816/RA624428

Актуальные методы периоперационного обезболивания при артроскопической пластике крестообразных связок: обзор литературы

Д.В. Горелов[1], А.В. Бабаянц[1, 2], А.М. Овечкин[3]

[1] Городская клиническая больница им. С.С. Юдина, Москва, Россия;
[2] Федеральный научно-клинический центр реаниматологии и реабилитологии, Москва, Россия;
[3] Первый Московский государственный медицинский университет им. И.М. Сеченова (Сеченовский Университет), Москва, Россия

АННОТАЦИЯ

Артроскопические операции на коленном суставе активно выполняют в современной ортопедической практике. Их явными преимуществами являются малоинвазивность, меньший риск инфицирования и ранняя реабилитация. Несмотря на минимизированную операционную травму, послеоперационный период после некоторых артроскопических операций, включающих пластику крестообразных связок, протекает с достаточно выраженным болевым синдромом. Это обусловливает необходимость поиска новых адекватных, отвечающих всем современным тенденциям методов обезболивания пациентов. В обзоре представлены данные рандомизированных клинических исследований и метаанализов, посвящённых использованию различных вариантов анестезии при артроскопической пластике крестообразных связок, рассмотрены методы продлённой послеоперационной аналгезии. Недостаточное число исследований и отсутствие систематизированных рекомендаций требуют проведения проспективных исследований по этому вопросу.

Ключевые слова: артроскопия; артроскопическая пластика передней крестообразной связки; анестезия; блокада периферических нервов; спинальная анестезия; регионарная анестезия; местная анестезия; общая анестезия.

Как цитировать:
Горелов Д.В., Бабаянц А.В., Овечкин А.М. Актуальные методы периоперационного обезболивания при артроскопической пластике крестообразных связок: обзор литературы // Регионарная анестезия и лечение острой боли. 2024. Т. 18, № 1. С. 5–16. DOI: https://doi.org/10.17816/RA624428

Рукопись получена: 11.12.2023 **Рукопись одобрена:** 31.01.2024 **Опубликована онлайн:** 13.02.2024

BACKGROUND

Arthroscopic surgery is one of the most common orthopedic techniques used in patients with disorders of the medial knee joint compartment primarily due to its low risk of complications and early rehabilitation. More than 1 million knee arthroscopies are performed worldwide each year [1]. According to Salzler et al. [2], the complication rate in this type of intervention is 4.7% for more than 90 thousand knee arthroscopies, with the highest percentage of complications in posterior (20%) and anterior cruciate ligament (9%) surgeries. In other arthroscopies, the complication rate ranges between 2.8 and 7.6%. Among the total pool, surgical (0.77%) and infectious (0.84%) complications are the most common, while anesthetic complications are the rarest (0.22%) [2]. According to European studies, the complication rate varies between 1% and 5% [3, 4]. The available evidence makes it clear that arthroscopic cruciate ligament surgeries are the most technically difficult, with a more complicated postoperative course.

Anesthetic support of patients during arthroscopic surgeries is still a matter of discussion. Anesthesiologists opt for beneficial strategies based on the patient's condition and the specific type of surgical intervention. Such strategies can vary from general and neuraxial anesthesia to conduction and even local anesthesia [5, 6]. First of all, the choice of method depends on the treatment strategy. In recent decades, there have been clear trends towards a shift from inpatient to outpatient arthroscopic operations, which require anesthesia types to discharge a patient on the same day without any health risks [7].

In the context of postoperative pain management, it is well established that peripheral nerve blocks, in addition to standard multimodal analgesia, can reduce opioid use and related complications, as well as total postoperative complications. Unfortunately, this practice is not universally followed, not only because of the need for additional training of anesthesiologists in peripheral nerve blocks but also due to the increasing technical and financial burden on medical institutions.

AIM

Our aim was to search for current methods of perioperative analgesia for patients undergoing arthroscopic cruciate ligament surgeries.

SEARCH METHODOLOGY

A search in databases and electronic libraries like PubMed (MEDLINE), Google Scholar, eLibrary, and Central Scientific Medical Library of Russia was carried out for publications in Russian and English using the following keywords: "arthroscopy," "knee arthroscopy," "arthroscopic cruciate ligament reconstruction," "anesthesia in arthroscopy," "conduction anesthesia," and "peripheral nerve block". A total of 305 publications were identified, of which the following were included in this review: meta-analyses (*n*=9), systematic reviews (*n*=11), and randomized controlled studies (*n*=37). Case reports, studies of anesthesia in pediatric patients, studies with a small (<15 patients) sample size, and abstracts were excluded.

DISCUSSION

Innervation of the knee joint

Afferent innervation of the knee joint is provided by the articular branches of 2 groups of nerves. The anterior group includes branches of the femoral, saphenous, and common peroneal nerve. The capsule and ligaments of the anteromedial and anterolateral knee are innervated by articular branches arising from the muscular branches, in particular nerves innervating the vastus medialis and vastus lateralis muscles, respectively. The anteromedial part of the capsule is also innervated by the infrapatellar branch of the saphenous nerve, while the anterolateral part is innervated by the lateral articular and recurrent peroneal nerves, which arise from the common peroneal nerve. The posterior group of nerves includes branches of the tibial (dorsal articular nerve) and obturator nerves that innervate the posterior parts of the joint capsule, including proprioceptive innervation of soft tissue structures [8, 9].

Types of anesthesia for arthroscopic cruciate ligament reconstruction

Taking into account modern requirements for early rehabilitation of patients (preserved muscle tone of the limbs, early mobilization, and appropriate analgesia to perform graduated exercise), general (GA), neuraxial, conduction, and even local anesthesia are actively used. Each type of anesthesia is discussed in detail below.

With recent advances and minimization of the side effects of anesthetics, GA is now widely used in arthroscopic operations. No other type of anesthesia can provide such safety, control, surgeon's comfort, or early mobilization and discharge of patients as GA. Back in 1997, Dahl et al. [10] in their study that involved 91 patients demonstrated that GA used for arthroscopy shortened the "start anesthesia to ready for surgery" and "patient in the operating room" times. The psychological comfort of the patient, which can improve treatment outcomes, is an unquestionable advantage of this procedure. In 2022, Wesam et al. [6] in their prospective study that

included 121 patients confirmed that GA with short-acting anesthetics provided greater patient satisfaction and faster discharge from the clinic. Nevertheless, the intraoperative use of opioids alone for analgesia and postoperative pain management according to a standard multimodal analgesia protocol (including non-steroidal anti-inflammatory drugs, paracetamol, and opioids used as needed) do not cover all the pain management needs of patients, particularly in such traumatic surgeries as arthroscopic cruciate ligament (ACL) reconstruction. Prabhakar et al. [11] noted that this leads to an increased need for opioids in the postoperative period, prolonged hospitalization, adverse reactions (nausea, vomiting, constipation, urinary retention, pruritus, depression of consciousness, etc.), delayed functional recovery and low patient satisfaction with the quality of treatment.

There are 2 types of neuraxial anesthesia: spinal (SA) and epidural (EA). Previously, EA has been widely used in arthroscopic surgeries because it meets all anesthesia requirements for knee arthroscopies and provides long-term postoperative pain relief. In 1993, Parnass et al. [12] demonstrated this in the study that included 260 patients who underwent arthroscopic knee surgery, of which 79 patients had EA and 181 patients had GA. The authors noted that pain was less frequent in the EA group compared to the GA group (24.1 *vs*. 49.7%). Similar changes were observed for postoperative nausea and vomiting (8.9 *vs*. 32%, respectively). Despite the minimal rate of serious complications, as demonstrated by Kang et al. [13] (out of 5 083 cases with EA, complications were recorded in 69 patients [1.36%]), the use of EA for analgesia in modern practice is limited by possible complications [14, 15], availability of safer methods of peripheral nerve block and an increase in the number of patients taking antiplatelet and anticoagulant agents (including relatively young patients). Epidural catheter placement can also prolong hospitalization; it requires particular perioperative thromboprophylaxis (if necessary), and leads to additional risks, including the risk of infections.

The use of SA in domestic anesthesiology during operations on the lower extremities has become a kind of gold standard. Its technical simplicity, low cost, versatility, and quick effect determine anesthesiologist's preference for SA [16]. Various options for the SA technique have been proposed, for example, as in Nair et al. [17] publication. In their review of 15 randomized clinical trials (1 248 patients), the authors found that unilateral SA using low-dose hyperbaric bupivacaine led to the earliest discharge of patients compared to higher doses or bilateral block. Some authors propose to add adjuvants to SA. For example, Demiraran et al. [18] suggested adding morphine, and Merivirta et al. [19] suggested adding clonidine, both with good results. Spinal headache, transient neurological syndrome [20], motor block, and severe postoperative pain during block reversal overshadow the use of SA in both outpatient and inpatient practice, as well as reduce patient satisfaction with anesthesia quality. Andrés-Cano et al. [21] studied complications in the early postoperative period in 342 patients who underwent ACL reconstruction under SA. The authors demonstrated that pain not controlled by analgesics was the most common complication (6.7% of total complications). As with EA, antiplatelet and anticoagulant therapy and infectious complications should be taken into account when using SA.

With the development and increasing availability of high-tech devices in the operating room, including neurostimulation systems and ultrasound imaging devices, conduction anesthesia is now of particular interest. Special equipment makes it easier to find the target nerve structures, reduces the rate of complications associated with neural blocks, and simplifies training of specialists in new methods of peripheral nerve blocks. A well-executed block eliminates the need for opioids and other pain medications during the early postoperative period. For example, selective femoral and sciatic nerve block in 402 patients (Zhang et al. [22]) provided excellent working environment for the surgeon, as well as earlier spontaneous urination and more efficient postoperative analgesia. Based on this, the authors suggested using this block as an alternative to unilateral SA. In their study, Montes et al. [23] arrived at a similar conclusion. At the same time, as previously stated, modern orthopedic practice requires the earliest possible patient mobilization, which cannot be achieved if an 8 to 12-hour nerve block is used. Peripheral nerve blocks that spare motor function of the lower limb, such as adductor canal block, genicular nerve block, and tibial and peroneal block, do not provide optimal surgical conditions, while the complex innervation of the knee joint and variability of the anatomical origin of nerves determine a high rate of unsuccessful peripheral blocks, as reported in the meta-analyses conducted by Vorobeichik et al. [24] and Sehmbi et al. [25].

The significant role of local infiltration analgesia (LIA) in arthroscopic knee surgery is well established. In low-traumatic arthroscopic operations, LIA performed by the operating surgeon can reduce the operation cost and speed up the intervention, with comparable characteristics to other types of anesthesia, which require an anesthesiologist. Yasir et al. [26] conducted a retrospective analysis of 433 knee arthroscopies under LIA and intra-articular anesthesia to assess perioperative pain levels. The average VAS scores during port placement and the procedure were 1.8 and 0.9, respectively, without any complications associated with LIA. Outpatient low-traumatic arthroscopic interventions benefit from local anesthesia. However, cruciate

ligament reconstruction is a more complex and traumatic operation, which requires additional extra-articular access and intervention on bone structures, so limiting analgesia to only local infiltration with anesthetics does not cover all the patient's needs for intraoperative pain relief. Due to the well-established local anesthetics' toxicity toward chondrocytes, they cannot be used intra-articularly in arthroscopic practice. In their study, Noyes et al. [27] observed chondrolysis after intra-articular pump infusion of bupivacaine (both 0.5% and 0.25% solution), with extensive knee joint chondrolysis.

Considering the above, it is clear that there is a lack of systematic approach to choosing the type of anesthesia for knee arthroscopy, in particular for cruciate ligament arthroplasty. Anesthesiologists prefer one type of anesthesia over another based on their beliefs, capabilities, and a specific clinical situation. It may be due to the heterogeneity of literature data on specific types of anesthesia, which often require further study [24, 28–30], as well as a lack of specific recommendations in arthroscopic surgery [31].

Postoperative analgesia options

Currently, the generally accepted method of routine postoperative pain relief is multimodal analgesia with cyclooxygenase inhibitors, opioid analgesics, etc. [32]. Wunsch et al. [33] found that 79–82% of patients undergoing various knee arthroscopies received opioids postoperatively, which primarily indicates the highly traumatic nature of ACL reconstruction surgery, as well as the insufficient analgesic effect of other drugs used for pain relief. To address this issue regional analgesia techniques were introduced.

The peripheral nerve block, including femoral nerve block (FNB), has long been considered the mainstay of postoperative pain relief in ACL reconstruction [24]. It is not unexpected since researchers, including Tetzlaff et al. [34], demonstrated that the dermatomes of the femoral nerve are primarily affected during major knee surgeries. Current data regarding the effectiveness of FNB in ACL repair are contradictory [35, 36]. For example, studies of cumulative opioid consumption in the first 24 hours after surgery in patients who were additionally provided with FNB for postoperative analgesia (Guirro et al. [37], Frost et al. [38] and Matava et al. [39]; the latter two studies compared FNB and LIA) did not show any significant differences compared with the control group. On the contrary, Peng et al. [40] and Williams et al. [41] reported a statistically significant reduction in opioid consumption with the addition of FNB. During the period of 24 to 48 hours after surgery, the same authors (Williams and Frost) did not find a significant difference in opioid consumption compared to the control group [38, 41]. As for the severity of pain reported by the patients, Guirro et al. [37], Matava et al. [39], and Peng et al. [40] used VAS scores and reported no significant clinical effect of FNB, with a notion by Peng [40] that the intensity of pain at rest within 1 hour after surgery was lower in the FNB group compared to the control group (4.0 *vs*. 5.6, respectively). There is also mention of a rebound increase in pain after the FNB subsides compared to the no-FNB group [42]. In contrast, Wulf et al. [43] claim more effective postoperative pain relief compared to placebo, but note persistent motor blockade within 4 hours after surgery, regardless of the local anesthetic dose used, including 0.2% ropivacaine. A combination of sciatic nerve block and FNB could cover the entire target area of innervation and reduce opioid consumption but would not provide early mobilization of patients and rebound pain prevention [44].

Therefore, the review of the above studies does not indicate any significant advantages of FNB in patients undergoing ACL reconstruction [24]. The effects of adding FNB range from no improvement in pain relief [37] to modest benefits in terms of reduction in opioid consumption [40, 41]. FNB combined with LIA does not provide an additional analgesic effect, although these techniques are effective if used separately [38, 39]. These findings are consistent with the results of other studies conducted in patients undergoing knee arthroplasty [45]. Certain concerns are related to possible weakness of the quadriceps femoris muscle [46, 47], which may extend beyond the early postoperative period, and neurological deficits observed in 1.94% of cases [48].

The heterogeneity of results may be explained by the use of different donor sites for tendon harvesting (depending on surgeon preference and clinical situation), as well as by the complex innervation of the knee joint, which includes many articular and cutaneous sensory nerves located in the capsule and overlying tissues. Acute pain is usually related to the incision site, the femorotibial tunnel and the graft site, which is partially overlapped by the femoral nerve innervation area, but with a hamstring graft, for example, it will not be sufficient [49, 50].

In this context, the already mentioned LIA can be considered as the method of choice defined as surgeon-directed infiltration of subcutaneous fatty tissue, periarticular tissues, and the donor zone of the graft, extending to the terminal articular branches of the sciatic, femoral and obturator nerves [51, 52]. Unlike knee arthroplasty, where the injection sites and the drug used for LIA are clearly defined [53], the infiltration zone in knee arthroscopy is not standardized since this technique is relatively new. Despite this, a systematic review that included 11 randomized clinical trials (Yung et al. [54])

demonstrated satisfactory clinical results after LIA: a decrease in the total consumption of analgesics, the need for additional analgesia, and better control of postoperative pain within 24 hours. However, in most of the studies included in the meta-analysis by Yung et al., the researchers also performed an intra-articular injection of a local anesthetic without monitoring long-term functional outcomes, which, considering possible chondrotoxicity, renders such practice doubtful in modern orthopedics [27]. The use of LIA without an intra-articular anesthetic injection is discussed by Abdallah et al. [55]. In their study, they intraoperatively combined GA with LIA and postoperatively with multimodal opioid-free analgesia (strong recommendation, moderate level of evidence, the Society for Ambulatory Anesthesia of Canada).

It does not depend on the type of graft whether a local anesthetic can be used or not, which allows for a more selective analgesic effect depending on the clinical situation. An undoubted advantage is that LIA is not associated with weakness of the quadriceps femoris muscle. Thus, we can conclude that this technique is an excellent option for postoperative analgesia, minimizing the potential complications of anesthetics. However, local anesthetic infiltration points shall be standardized to prevent poor-quality procedure.

The adductor canal block (ACB) is a predominantly sensory block that targets the distal branches of the femoral nerve (particularly the saphenous nerve). Depending on the area, a different effect can be achieved: the higher the block, the more likely the nerve innervating the vastus medialis muscle will be blocked, which will not only block the terminal articular branches of this nerve but also cause a motor block of the quadriceps muscle. When a block is made in the lower third of the thigh, only the saphenous nerve is blocked, which makes it different from the femoral nerve block [28, 56].

This block has been reported to be effective after ACL reconstruction, with analgesia similar to that of FNB but without muscle weakness [57]. El Ahl et al. [28] obtained additional data on the analgesic component after comparing FNB and ACB in 128 patients undergoing ACL repair. The authors found that the ACB group had significantly higher VAS pain intensity scores (at 18 and 24 hours) and higher postoperative opioid consumption. Similar data on muscle weakness in the lower extremities were obtained in a study by Chisholm et al. [57].

The previously mentioned Society for Ambulatory Anesthesia of Canada summarized that ACB can be used in ambulatory patients undergoing ACL reconstruction in combination with multimodal analgesia due to less muscle weakness; however, the Society noted that the level of evidence for this recommendation is weak [55]. As mentioned above, the rationale for this approach is related to the complex innervation of the knee joint. Stebler et al. [58] went further by comparing ACB and LIA in 52 patients undergoing ACL reconstruction and found no differences in postoperative opioid consumption, VAS pain intensity at rest and movement, muscle weakness of the lower extremity, and the effect of techniques on early and late functional outcomes. A positive effect of the combined use of both methods on intra- and postoperative opioid consumption is reported by Xie et al. [59], with few limitations related to the objective control of the ACB effect and a limited sample size.

CONCLUSION

Compliance with the ERAS (Enhanced Recovery After Surgery) strategy, including sufficient and high-quality postoperative analgesia, is the key to success in outpatient and inpatient treatment of cruciate ligament disorders. Based on the obtained data, there are currently no gold standard or clear recommendations for the perioperative management of patients undergoing ACL reconstruction. The findings suggest that multimodal systemic analgesia is not sufficient to cover all postoperative pain management needs of patients. Considering the current information on the subject under discussion, the most adequate intraoperative method of anesthesia/analgesia for ACL reconstruction seems to be the combined GA that allows early patient mobilization. To provide better intra- and postoperative pain relief, peripheral nerve blocks should be additionally used. It is important to choose an appropriate method of the peripheral nerve block for the specific type of surgery and the nature of the graft. It seems advisable to the authors to reserve the technique of combined femoral and sciatic nerve block for exceptional clinical cases when GA cannot be performed. Despite the conflicting data, the authors agree that it is logical to perform peripheral nerve blocks as distally as possible. A combination of ACB and LIA seems a promising method of postoperative pain relief; however, inconsistent and limited data necessitate further research on this method.

ADDITIONAL INFORMATION

Funding source. Not specified.

Competing interests. The authors declare that they have no competing interests.

Author's contribution. D.V. Gorelov, A.V. Babayants, A.M. Ovechkin — literature review, collection and analysis of literary sources, preparation and writing of the text of the article.

REFERENCES

1. Kim S, Bosque J, Meehan JP, et al. Increase in outpatient knee arthroscopy in the United States: a comparison of National Surveys of Ambulatory Surgery, 1996 and 2006. *J Bone Joint Surg Am*. 2011;93(11):994–1000. doi: 10.2106/JBJS.I.01618

2. Salzler MJ, Lin A, Miller CD, et al. Complications after arthroscopic knee surgery. *Am J Sports Med*. 2014;42(2):292–296. doi: 10.1177/0363546513510677

3. Reigstad O, Grimsgaard C. Complications in knee arthroscopy. *Knee Surg Sports Traumatol Arthrosc*. 2006;14(5):473–477. doi: 10.1007/s00167-005-0694-x

4. Hagino T, Ochiai S, Watanabe Y, et al. Complications after arthroscopic knee surgery. *Arch Orthop Trauma Surg*. 2014;134(11):1561–1564. doi: 10.1007/s00402-014-2054-0

5. Casati A, Cappelleri G, Aldegheri G, et al. Total intravenous anesthesia, spinal anesthesia or combined sciatic-femoral nerve block for outpatient knee arthroscopy. *Minerva Anestesiol*. 2004;70(6):493–502.

6. Wesam K, Jraisat I, Harahsheh H, et al. Spinal, Epidural, and General Anesthesia for Knee Joint Arthroscopy: Diversity, Equity, and Inclusion — Comparison Study. *Anesth Essays Res*. 2022;16(2):181–186. doi: 10.4103/aer.aer_93_22

7. Leathers MP, Merz A, Wong J, et al. Trends and demographics in anterior cruciate ligament reconstruction in the United States. *J Knee Surg*. 2015;28(5):390–394. doi: 10.1055/s-0035-1544193

8. Gilev MV, Gvozdevich VD, Volokitina EA, et al. *Anatomy of the knee joint: training manual*. Ekaterinburg: UGMU; 2016. (In Russ.)

9. Horner G, Dellon AL. Innervation of the Human Knee Joint and Implications for Surgery. *Clin Orthop Relat Res*. 1994;(301):221–226. doi: 10.1097/00003086-199404000-00034

10. Dahl V, Gierløff C, Omland E, Raeder JC. Spinal, epidural or propofol anaesthesia for out-patient knee arthroscopy? *Acta Anaesthesiol Scand*. 1997;41(10):1341–1345. doi: 10.1111/j.1399-6576.1997.tb04655.x

11. Prabhakar A, Mancuso KF, Owen CP, et al. Perioperative analgesia outcomes and strategies. *Best Pract Res Clin Anaesthesiol*. 2014;28(2):105–115. doi: 10.1016/j.bpa.2014.04.005

12. Parnass SM, McCarthy RJ, Bach BR Jr, et al. Beneficial impact of epidural anesthesia on recovery after outpatient arthroscopy. *Arthroscopy*. 1993;9(1):91–95. doi: 10.1016/s0749-8063(05)80351-2

13. Kang XH, Bao FP, Xiong XX, et al. Major complications of epidural anesthesia: a prospective study of 5083 cases at a single hospital. *Acta Anaesthesiol Scand*. 2014;58(7):858–866. doi: 10.1111/aas.12360

14. Ovechkin AM, Politov ME, Morozov DV. Neurological complications of regional anesthesia. *Regional Anesthesia and Acute Pain Management*. 2018;12(1):6–14. doi: 10.17816/RA42856

15. Neal JM, Deck JJ, Kopacz DJ, Lewis MA. Hospital discharge after ambulatory knee arthroscopy: A comparison of epidural 2-chloroprocaine versus lidocaine. *Reg Anesth Pain Med*. 2001;26(1):35–40. doi: 10.1053/rapm.2001.9852

16. Casati A, Fanelli G, Danelli G, et al. Spinal anesthesia with lidocaine or preservative-free 2-chlorprocaine for outpatient knee arthroscopy: a prospective, randomized, double-blind comparison. *Anesth Analg*. 2007;104(4):959–964. doi: 10.1213/01.ane.0000258766.73612.d8

17. Nair GS, Abrishami A, Lermitte J., Chung F. Systematic review of spinal anaesthesia using bupivacaine for ambulatory knee arthroscopy. *Br J Anaesth*. 2009;102(3):307–315. doi: 10.1093/bja/aen389

18. Demiraran Y, Yucel I, Akcali GE, et al. Adding intrathecal morphine to unilateral spinal anesthesia results in better pain relief following knee arthroscopy. *J Anesth*. 2008;22(4):367–372. doi: 10.1007/s00540-008-0648-9

19. Merivirta R, Kuusniemi K, Jaakkola P, et al. Unilateral spinal anaesthesia for outpatient surgery: a comparison between hyperbaric bupivacaine and bupivacaine-clonidine combination. *Acta Anaesthesiol Scand*. 2009;53(6):788–793. doi: 10.1111/j.1399-6576.2009.01955.x

20. Freedman JM, Li DK, Drasner K, et al. Transient neurologic symptoms after spinal anesthesia: an epidemiologic study of 1,863 patients. *Anesthesiology*. 1998;89(3):633–641. doi: 10.1097/00000542-199809000-00012. Erratum in: *Anesthesiology*. 1998;89(6):1614.

21. Andrés-Cano P, Godino M, Vides M, Guerado E. Postoperative complications of anterior cruciate ligament reconstruction after ambulatory surgery. *Rev Esp Cir Ortop Traumatol*. 2015;59(3):157–164. doi: 10.1016/j.recot.2014.09.001

22. Zhang L, Tong Y, Li M, et al. Sciatic-femoral nerve block versus unilateral spinal anesthesia for outpatient knee arthroscopy: a meta-analysis. *Minerva Anestesiol*. 2015;81(12):1359–1368.

23. Montes FR, Zarate E, Grueso R, et al. Comparison of spinal anesthesia with combined sciatic-femoral nerve block for outpatient knee arthroscopy. *J Clin Anesth*. 2008;20(6):415–420. doi: 10.1016/j.jclinane.2008.04.003

24. Vorobeichik L, Brull R, Joshi G, Abdallah FW. Evidence Basis for Regional Anesthesia in Ambulatory Anterior Cruciate Ligament Reconstruction: Part I — Femoral Nerve Block. *Anesth Analg*. 2019;128(1):58–65. doi: 10.1213/ANE.0000000000002854

25. Sehmbi H, Brull R, Shah UJ, et al. Evidence Basis for Regional Anesthesia in Ambulatory Arthroscopic Knee Surgery and Anterior Cruciate Ligament Reconstruction: Part II: Adductor Canal Nerve Block-A Systematic Review and Meta-analysis. *Anesth Analg*. 2019;128(2):223–238. doi: 10.1213/ANE.0000000000025707

26. Shaukat Y, Malik E, El-Khateeb H, Koeweiden E. The role of local anaesthesia in knee arthroscopy. *J Orthop*. 2013;10(4):193–195. doi: 10.1016/j.jor.2013.06.003

27. Noyes FR, Fleckenstein CM, Barber-Westin SD. The Development of Postoperative Knee Chondrolysis After IntraArticular Pain Pump Infusion of an Anesthetic Medication. *J Bone Joint Surg Am*. 2012;94(16):1448–1457. doi: 10.2106/JBJS.K.01333

28. El Ahl MS. Femoral nerve block versus adductor canal block

for postoperative pain control after anterior cruciate ligament reconstruction: A randomized controlled double blind study. *Saudi J Anaesth*. 2015;9(3):279–282. doi: 10.4103/1658-354X.154708

29. Espelund M, Fomsgaard JS, Haraszuk J, et al. Analgesic efficacy of ultrasound-guided adductor canal blockade after arthroscopic anterior cruciate ligament reconstruction: a randomised controlled trial. *Eur J Anaesthesiol*. 2013;30(7):422–428. doi: 10.1097/EJA.0b013e328360bdb9

30. Tan M, Law LS, Gan TJ. Optimizing pain management to facilitate Enhanced Recovery After Surgery pathways. *Can J Anesth*. 2015;62(2):203–218. doi: 10.1007/s12630-014-0275-x

31. Anger M, Valovska T, Beloeil H, et al. PROSPECT guideline for total hip arthroplasty: a systematic review and procedure-specific postoperative pain management recommendations. *Anaesthesia*. 2021;76(8):1082–1097. doi: 10.1111/anae.15498

32. Ovechkin AM, Bayalieva AZ, Ezhevskaya AA, et al. Postoperative analgesia. Guidelines. *Annals of Critical Care*. 2019;(4):9–33. doi: 10.21320/1818-474X-2019-4-9-33

33. Wunsch H, Wijeysundera DN, Passarella MA, Neuman MD. Opioids prescribed after low-risk surgical procedures in the United States, 2004–2012. *JAMA*. 2016;315(15):1654–1657. doi: 10.1001/jama.2016.0130

34. Tetzlaff JE, Andrish J, O'Hara J Jr, et al. Effectiveness of bupivacaine administered via femoral nerve catheter for pain control after anterior cruciate ligament repair. *J Clin Anesth*. 1997;9(7):542–545. doi: 10.1016/s0952-8180(97)00141-4

35. Astur DC, Aleluia V, Veronese C, et al. A prospective double blinded randomized study of anterior cruciate ligament reconstruction with hamstrings tendon and spinal anesthesia with or without femoral nerve block. *Knee*. 2014;21(5):911–915. doi: 10.1016/j.knee.2014.06.003

36. Mall NA, Wright RW. Femoral nerve block use in anterior cruciate ligament reconstruction surgery. *Arthroscopy*. 2010;26(3):404–416. doi: 10.1016/j.arthro.2009.08.014

37. Guirro UB, Tambara EM, Munhoz FR. Femoral nerve block: assessment of postoperative analgesia in arthroscopic anterior cruciate ligament reconstruction. *Braz J Anesthesiol*. 2013;63(6):483–491. doi: 10.1016/j.bjane.2013.09.001

38. Frost S, Grossfeld S, Kirkley A, et al. The efficacy of femoral nerve block in pain reduction for outpatient hamstring anterior cruciate ligament reconstruction: a double-blind, prospective, randomized trial. *Arthroscopy*. 2000;16(3):243–248. doi: 10.1016/s0749-8063(00)90047-1

39. Matava MJ, Prickett WD, Khodamoradi S, et al. Femoral nerve blockade as a preemptive anesthetic in patients undergoing anterior cruciate ligament reconstruction: a prospective, randomized, double-blinded, placebo-controlled study. *Am J Sports Med*. 2009;37(1):78–86. doi: 10.1177/0363546508324311

40. Peng P, Claxton A, Chung F, et al. Femoral nerve block and ketorolac in patients undergoing anterior cruciate ligament reconstruction. *Can J Anaesth*. 1999;46(10):919–924. doi: 10.1007/BF03013124

41. Williams BA, Kentor ML, Vogt MT, et al. Reduction of verbal pain scores after anterior cruciate ligament reconstruction with 2-day continuous femoral nerve block: a randomized clinical trial. *Anesthesiology*. 2006;104(2):315–327. doi: 10.1097/00000542-200602000-00018

42. Okoroha KR, Keller RA, Marshall NE, et al. Liposomal bupivacaine versus femoral nerve block for pain control after anterior cruciate ligament reconstruction: a prospective randomized trial. *Arthroscopy*. 2016;32(9):1838–1845. doi: 10.1016/j.arthro.2016.05.033

43. Wulf H, Löwe J, Gnutzmann KH, Steinfeldt T. Femoral nerve block with ropivacaine or bupivacaine in day case anterior crucial ligament reconstruction. *Acta Anaesthesiol Scand*. 2010;54(4):414–420. doi: 10.1111/j.1399-6576.2009.02200.x

44. Harbell MW, Cohen JM, Kolodzie K, et al. Combined preoperative femoral and sciatic nerve blockade improves analgesia after anterior cruciate ligament reconstruction: a randomized controlled clinical trial. *J Clin Anesth*. 2016;(33):68–74. doi: 10.1016/j.jclinane.2016.02.021

45. Gudmundsdottir S, Franklin JL. Continuous adductor canal block added to local infiltration analgesia (LIA) after total knee arthroplasty has no additional benefits on pain and ambulation on postoperative day 1 and 2 compared with LIA alone. *Acta Orthop.* 2017;88(5):537–542. doi: 10.1080/17453674.2017.1342184

46. Luo TD, Ashraf A, Dahm DL, et al. Femoral nerve block is associated with persistent strength deficits at 6 months after anterior cruciate ligament reconstruction in pediatric and adolescent patients. *Am J Sports Med.* 2015;43(2):331–336. doi: 10.1177/0363546514559823

47. Swank KR, DiBartola AC, Everhart JS, et al. The effect of femoral nerve block on quadriceps strength in anterior cruciate ligament reconstruction: a systematic review. *Arthroscopy*. 2017;33(5):1082.e1–1091.e1. doi: 10.1016/j.arthro.2017.01.034

48. Widmer B, Lustig S, Scholes CJ, et al. Incidence and severity of complications due to femoral nerve blocks performed for knee surgery. *Knee.* 2013;20(3):181–185. doi: 10.1016/j.knee.2012.11.002

49. Feller JA, Webster KE, Gavin B. Early post-operative morbidity following anterior cruciate ligament reconstruction: patellar tendon versus hamstring graft. *Knee Surg Sports Traumatol Arthrosc.* 2001;9(5):260–266. doi: 10.1007/s001670100216

50. Tran DQ, Clemente A, Finlayson RJ. A review of approaches and techniques for lower extremity nerve blocks. *Can J Anaesth.* 2007;54(11):922–934. doi: 10.1007/BF03026798

51. Kristensen PK, Pfeiffer-Jensen M, Storm JO, Thillemann TM. Local infiltration analgesia is comparable to femoral nerve block after anterior cruciate ligament reconstruction with hamstring tendon graft: a randomised controlled trial. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(2):317–323. doi: 10.1007/s00167-013-2399-x

52. Gi E, Yamauchi M, Yamakage M, et al. Effects of local infiltration analgesia for posterior knee pain after total knee arthroplasty: comparison with sciatic nerve block. *J Anesth.* 2014;28(5):696–701. doi: 10.1007/s00540-014-1793-y

53. Bauer MC, Pogatzki-Zahn EM, Zahn PK. Regional analgesia techniques for total knee replacement. *Curr Opin Anaesthesiol.* 2014;27(5):501–506. doi: 10.1097/ACO.0000000000000115

54. Yung EM, Brull R, Albrecht E, et al. Evidence Basis for Regional Anesthesia in Ambulatory Anterior Cruciate Ligament Reconstruction: Part III: Local Instillation Analgesia — A Systematic Review and Meta-analysis. *Anesth Analg*. 2019;128(3):426–437. doi: 10.1213/ANE.0000000000002599

55. Abdallah FW, Brull R, Joshi GP; Society for Ambulatory Anesthesia (SAMBA). Pain management for ambulatory arthroscopic anterior cruciate ligament reconstruction: evidence-based recommendations from the society for ambulatory anesthesia. *Anesth Analg.* 2019;128(4):631–640. doi: 10.1213/ANE.0000000000003976

56. Manickam B, Perlas A, Duggan E, et al. Feasibility and efficacy of ultrasound-guided block of the saphenous nerve in the adductor canal. *Reg Anesth Pain Med.* 2009;34(6):578–580. doi: 10.1097/aap.0b013e3181bfbf84

57. Chisholm MF, Bang H, Maalouf DB, et al. Postoperative analgesia with saphenous block appears equivalent to femoral nerve block in ACL reconstruction. *HSS J.* 2014;10(3):245–251. doi: 10.1007/s11420-014-9392-x

58. Stebler K, Martin R, Kirkham KR, et al. Adductor canal block versus local infiltration analgesia for postoperative pain after anterior cruciate ligament reconstruction: a single centre randomised controlled triple-blinded trial. *Br J Anaesth.* 2019;123(2):e343–e349. doi: 10.1016/j.bja.2019.04.053

59. Xie Y, Sun Y, Lu Y. Effect of Adductor Canal Block Combined with Local Infiltration Analgesia on Postoperative Pain of Knee Arthroscopy Under General Anesthesia: A Randomized Controlled Trial. *Pain Ther.* 2023;12(2):543–552. doi: 10.1007/s40122-023-00482-5

СПИСОК ЛИТЕРАТУРЫ

1. Kim S., Bosque J., Meehan J.P., et al. Increase in outpatient knee arthroscopy in the United States: a comparison of National Surveys of Ambulatory Surgery, 1996 and 2006 // J Bone Joint Surg Am. 2011. Vol. 93, N 11. P. 994–1000. doi: 10.2106/JBJS.I.01618

2. Salzler M.J., Lin A., Miller C.D., et al. Complications after arthroscopic knee surgery // Am J Sports Med. 2014. Vol. 42, N 2. P. 292–296. doi: 10.1177/0363546513510677

3. Reigstad O., Grimsgaard C. Complications in knee arthroscopy // Knee Surg Sports Traumatol Arthrosc. 2006. Vol. 14, N 5. P. 473–477. doi: 10.1007/s00167-005-0694-x

4. Hagino T., Ochiai S., Watanabe Y., et al. Complications after arthroscopic knee surgery // Arch Orthop Trauma Surg. 2014. Vol. 134, N 11. P. 1561–1564. doi: 10.1007/s00402-014-2054-0

5. Casati A., Cappelleri G., Aldegheri G., et al. Total intravenous anesthesia, spinal anesthesia or combined sciatic-femoral nerve block for outpatient knee arthroscopy // Minerva Anestesiol. 2004. Vol. 70, N 6. P. 493–502.

6. Wesam K., Jraisat I., Harahsheh H., et al. Spinal, Epidural, and General Anesthesia for Knee Joint Arthroscopy: Diversity, Equity, and Inclusion — Comparison Study // Anesth Essays Res. 2022. Vol. 16, N 2. P. 181–186. doi: 10.4103/aer.aer_93_22

7. Leathers M.P., Merz A., Wong J., et al. Trends and demographics in anterior cruciate ligament reconstruction in the United States // J Knee Surg. 2015. Vol. 28, N 5. P. 390–394. doi: 10.1055/s-0035-1544193

8. Гилев М.В., Гвоздевич В.Д., Волокитина Е.А., и др. Анатомия коленного сустава: уч. пос. Екатеринбург: УГМУ, 2016.

9. Horner G., Dellon A.L. Innervation of the Human Knee Joint and Implications for Surgery // Clin Orthop Relat Res. 1994. N 301. P. 221–226. doi: 10.1097/00003086-199404000-00034

10. Dahl V., Gierløff C., Omland E., Raeder J.C. Spinal, epidural or propofol anaesthesia for out-patient knee arthroscopy? // Acta Anaesthesiol Scand. 1997. Vol. 41, N 10. P. 1341–1345. doi: 10.1111/j.1399-6576.1997.tb04655.x

11. Prabhakar A., Mancuso K.F., Owen C.P., et al. Perioperative analgesia outcomes and strategies // Best Pract Res Clin Anaesthesiol. 2014. Vol. 28,N 2. P. 105–115. doi: 10.1016/j.bpa.2014.04.005

12. Parnass S.M., McCarthy R.J., Bach B.R. Jr., et al. Beneficial impact of epidural anesthesia on recovery after outpatient arthroscopy // Arthroscopy. 1993. Vol. 9, N 1. P. 91–95. doi: 10.1016/s0749-8063(05)80351-2

13. Kang X.H., Bao F.P., Xiong X.X., et al. Major complications of epidural anesthesia: a prospective study of 5083 cases at a single hospital // Acta Anaesthesiol Scand. 2014. Vol. 58, N 7. P. 858–866. doi: 10.1111/aas.12360

14. Овечкин А.М., Политов М.Е., Морозов Д.В. Неврологические осложнения регионарной анестезии // Регионарная анестезия и лечение острой боли. 2018. Т. 12, № 1. С. 6–14. doi: 10.18821/1993-6508-2018-12-1-6-14

15. Neal J.M., Deck J.J., Kopacz D.J., Lewis M.A. Hospital discharge after ambulatory knee arthroscopy: A comparison of epidural 2-chloroprocaine versus lidocaine // Reg Anesth Pain Med. 2001. Vol. 26, N 1. P. 35–40. doi: 10.1053/rapm.2001.9852

16. Casati A., Fanelli G., Danelli G., et al. Spinal anesthesia with lidocaine or preservative-free 2-chlorprocaine for outpatient knee arthroscopy: a prospective, randomized, double-blind comparison // Anesth Analg. 2007. Vol. 104, N 4. P. 959–964. doi: 10.1213/01.ane.0000258766.73612.d8

17. Nair G.S., Abrishami A., Lermitte J., Chung F. Systematic review of spinal anaesthesia using bupivacaine for ambulatory knee arthroscopy // Br J Anaesth. 2009. Vol. 102, N 3. P. 307–315. doi: 10.1093/bja/aen389

18. Demiraran Y., Yucel I., Akcali G.E., et al. Adding intrathecal morphine to unilateral spinal anesthesia results in better pain relief following knee arthroscopy // J Anesth. 2008. Vol. 22, N 4. P. 367–372. doi: 10.1007/s00540-008-0648-9

19. Merivirta R., Kuusniemi K., Jaakkola P., et al. Unilateral spinal anaesthesia for outpatient surgery: a comparison between hyperbaric bupivacaine and bupivacaine-clonidine combination // Acta Anaesthesiol Scand. 2009. Vol. 53, N 6. P. 788–793. doi: 10.1111/j.1399-6576.2009.01955.x

20. Freedman J.M., Li D.K., Drasner K., et al. Transient neurologic symptoms after spinal anesthesia: an epidemiologic study of 1,863 patients // Anesthesiology. 1998. Vol. 89, N 3. P. 633–641. doi: 10.1097/00000542-199809000-00012. Erratum in: Anesthesiology. 1998. Vol. 89, N 6. P. 1614.

21. Andrés-Cano P., Godino M., Vides M., Guerado E. Postoperative complications of anterior cruciate ligament reconstruction after ambulatory surgery // Rev Esp Cir Ortop Traumatol. 2015. Vol. 59, N 3. P. 157–164. doi: 10.1016/j.recot.2014.09.001

22. Zhang L., Tong Y., Li M., et al. Sciatic-femoral nerve block versus unilateral spinal anesthesia for outpatient knee arthroscopy: a meta-analysis // Minerva Anestesiol. 2015. Vol. 81, N 12. P. 1359–1368.

23. Montes F.R., Zarate E., Grueso R., et al. Comparison of spinal anesthesia with combined sciatic-femoral nerve block for outpatient knee arthroscopy // J Clin Anesth. 2008. Vol. 20, N 6. P. 415–420. doi: 10.1016/j.jclinane.2008.04.003

24. Vorobeichik L., Brull R., Joshi G., Abdallah F.W. Evidence Basis for Regional Anesthesia in Ambulatory Anterior Cruciate Ligament Reconstruction: Part I — Femoral Nerve Block // Anesth Analg. 2019. Vol. 128, N 1. P. 58–65. doi: 10.1213/ANE.0000000000002854

25. Sehmbi H., Brull R., Shah U.J., et al. Evidence Basis for Regional Anesthesia in Ambulatory Arthroscopic Knee Surgery and Anterior Cruciate Ligament Reconstruction: Part II: Adductor Canal Nerve Block-A Systematic Review and Meta-analysis // Anesth Analg. 2019. Vol. 128, N 2. P. 223–238. doi: 10.1213/ANE.0000000000025707

26. Shaukat Y., Malik E., El-Khateeb H., Koeweiden E. The role of local anaesthesia in knee arthroscopy // J Orthop. 2013. Vol. 10, N 4. P. 193–195. doi: 10.1016/j.jor.2013.06.003

27. Noyes F.R., Fleckenstein C.M., Barber-Westin S.D. The Development of Postoperative Knee Chondrolysis After IntraArticular Pain Pump Infusion of an Anesthetic Medication // J Bone Joint Surg Am. 2012. Vol. 94, N 16. P. 1448–1457. doi: 10.2106/JBJS.K.01333

28. El Ahl M.S. Femoral nerve block versus adductor canal block for postoperative pain control after anterior cruciate ligament reconstruction: A randomized controlled double blind study // Saudi J Anaesth. 2015. Vol. 9, N 3. P. 279–282. doi: 10.4103/1658-354X.154708

29. Espelund M., Fomsgaard J.S., Haraszuk J., et al. Analgesic efficacy of ultrasound-guided adductor canal blockade after arthroscopic anterior cruciate ligament reconstruction: a randomised controlled trial // Eur J Anaesthesiol. 2013. Vol. 30, N 7. P. 422–428. doi: 10.1097/EJA.0b013e328360bdb9

30. Tan M., Law L.S., Gan T.J. Optimizing pain management to facilitate Enhanced Recovery After Surgery pathways // Can J Anesth. 2015. Vol. 62, N 2. P. 203–218. doi: 10.1007/s12630-014-0275-x

31. Anger M., Valovska T., Beloeil H., et al. PROSPECT guideline for total hip arthroplasty: a systematic review and procedure-specific postoperative pain management recommendations // Anaesthesia. 2021. Vol. 76, N 8. P. 1082–1097. doi: 10.1111/anae.15498

32. Овечкин А.М., Баялиева А.Ж., Ежевская А.А., и др. Послеоперационное обезболивание. Клинические рекомендации // Вестник интенсивной терапии им. А.И. Салтанова. 2019. № 4. С. 9–33. doi: 10.21320/1818-474X-2019-4-9-33

33. Wunsch H., Wijeysundera D.N., Passarella M.A., Neuman M.D. Opioids prescribed after low-risk surgical procedures in the United States, 2004–2012 // JAMA. 2016. Vol. 315, N 15. P. 1654–1657. doi: 10.1001/jama.2016.0130

34. Tetzlaff J.E., Andrish J., O'Hara J. Jr., et al. Effectiveness of bupivacaine administered via femoral nerve catheter for pain control after anterior cruciate ligament repair // J Clin Anesth. 1997. Vol. 9, N 7. P. 542–545. doi: 10.1016/s0952-8180(97)00141-4

35. Astur D.C., Aleluia V., Veronese C., et al. A prospective double blinded randomized study of anterior cruciate ligament reconstruction with hamstrings tendon and spinal anesthesia with or without femoral nerve block // Knee. 2014. Vol. 21, N 5. P. 911–915. doi: 10.1016/j.knee.2014.06.003

36. Mall N.A., Wright R.W. Femoral nerve block use in anterior cruciate ligament reconstruction surgery // Arthroscopy. 2010. Vol. 26, N 3. P. 404–416. doi: 10.1016/j.arthro.2009.08.014

37. Guirro U.B., Tambara E.M., Munhoz F.R. Femoral nerve block: assessment of postoperative analgesia in arthroscopic anterior cruciate ligament reconstruction // Braz J Anesthesiol. 2013. Vol. 63, N 6. P. 483–491. doi: 10.1016/j.bjane.2013.09.001

38. Frost S., Grossfeld S., Kirkley A., et al. The efficacy of femoral nerve block in pain reduction for outpatient hamstring anterior cruciate ligament reconstruction: a double-blind, prospective, randomized trial // Arthroscopy. 2000. Vol. 16, N 3. P. 243–248. doi: 10.1016/s0749-8063(00)90047-1

39. Matava M.J., Prickett W.D., Khodamoradi S., et al. Femoral nerve blockade as a preemptive anesthetic in patients undergoing anterior cruciate ligament reconstruction: a prospective, randomized, double-blinded, placebo-controlled study // Am J Sports Med. 2009. Vol. 37, N 1. P. 78–86. doi: 10.1177/0363546508324311

40. Peng P., Claxton A., Chung F., et al. Femoral nerve block and ketorolac in patients undergoing anterior cruciate ligament reconstruction // Can J Anaesth. 1999. Vol. 46, N 10. P. 919–924. doi: 10.1007/BF03013124

41. Williams B.A., Kentor M.L., Vogt M.T., et al. Reduction of verbal pain scores after anterior cruciate ligament reconstruction with 2-day continuous femoral nerve block: a randomized clinical trial // Anesthesiology. 2006. Vol. 104, N 2. P. 315–327. doi: 10.1097/00000542-200602000-00018

42. Okoroha K.R., Keller R.A., Marshall N.E., et al. Liposomal bupivacaine versus femoral nerve block for pain control after anterior cruciate ligament reconstruction: a prospective randomized trial // Arthroscopy. 2016. Vol. 32, N 9. P. 1838–1845. doi: 10.1016/j.arthro.2016.05.033

43. Wulf H., Löwe J., Gnutzmann K.H., Steinfeldt T. Femoral nerve block with ropivacaine or bupivacaine in day case anterior crucial ligament reconstruction // Acta Anaesthesiol Scand. 2010. Vol. 54, N 4. P. 414–420. doi: 10.1111/j.1399-6576.2009.02200.x

44. Harbell M.W., Cohen J.M., Kolodzie K., et al. Combined preoperative femoral and sciatic nerve blockade improves analgesia after anterior cruciate ligament reconstruction: a randomized controlled clinical trial // J Clin Anesth. 2016. N 33. P. 68–74. doi: 10.1016/j.jclinane.2016.02.021

45. Gudmundsdottir S., Franklin J.L. Continuous adductor canal block added to local infiltration analgesia (LIA) after total knee arthroplasty has no additional benefits on pain and ambulation on postoperative day 1 and 2 compared with LIA alone // Acta Orthop. 2017. Vol. 88, N 5. P. 537–542. doi: 10.1080/17453674.2017.1342184

46. Luo T.D., Ashraf A., Dahm D.L., et al. Femoral nerve block is associated with persistent strength deficits at 6 months after anterior cruciate ligament reconstruction in pediatric and adolescent patients // Am J Sports Med. 2015. Vol. 43, N 2. P. 331–336. doi: 10.1177/0363546514559823

47. Swank K.R., DiBartola A.C., Everhart J.S., et al. The effect of femoral nerve block on quadriceps strength in anterior cruciate ligament reconstruction: a systematic review // Arthroscopy. 2017. Vol. 33, N 5. P. 1082.e1–1091.e1. doi: 10.1016/j.arthro.2017.01.034

48. Widmer B., Lustig S., Scholes C.J., et al. Incidence and severity of complications due to femoral nerve blocks performed for knee surgery // Knee. 2013. Vol. 20, N 3. P. 181–185. doi: 10.1016/j.knee.2012.11.002

49. Feller J.A., Webster K.E., Gavin B. Early post-operative morbidity following anterior cruciate ligament reconstruction: patellar tendon versus hamstring graft // Knee Surg Sports Traumatol Arthrosc. 2001. Vol. 9, N 5. P. 260–266. doi: 10.1007/s001670100216

50. Tran D.Q., Clemente A., Finlayson R.J. A review of approaches and techniques for lower extremity nerve blocks // Can J Anaesth. 2007. Vol. 54, N 11. P. 922–934. doi: 10.1007/BF03026798

51. Kristensen P.K., Pfeiffer-Jensen M., Storm J.O., Thillemann T.M. Local infiltration analgesia is comparable to femoral nerve block after anterior cruciate ligament reconstruction with hamstring tendon graft: a randomised controlled trial // Knee Surg Sports Traumatol Arthrosc. 2014. Vol. 22, N 2. P. 317–323. doi: 10.1007/s00167-013-2399-x

52. Gi E., Yamauchi M., Yamakage M., et al. Effects of local infiltration analgesia for posterior knee pain after total knee arthroplasty: comparison with sciatic nerve block // J Anesth. 2014. Vol. 28, N 5. P. 696–701. doi: 10.1007/s00540-014-1793-y

53. Bauer M.C., Pogatzki-Zahn E.M., Zahn P.K. Regional analgesia techniques for total knee replacement // Curr Opin Anaesthesiol. 2014. Vol. 27, N 5. P. 501–506. doi: 10.1097/ACO.0000000000000115

54. Yung E.M., Brull R., Albrecht E., et al. Evidence Basis for Regional Anesthesia in Ambulatory Anterior Cruciate Ligament Reconstruction: Part III: Local Instillation Analgesia — A Systematic Review and Meta-analysis // Anesth Analg. 2019. Vol. 128, N 3. P. 426–437. doi: 10.1213/ANE.0000000000002599

55. Abdallah F.W., Brull R., Joshi G.P.; Society for Ambulatory Anesthesia (SAMBA). Pain management for ambulatory arthroscopic anterior cruciate ligament reconstruction: evidence-based recommendations from the society for ambulatory anesthesia // Anesth Analg. 2019. Vol. 128, N 4. P. 631–640. doi: 10.1213/ANE.0000000000003976

56. Manickam B., Perlas A., Duggan E., et al. Feasibility and efficacy of ultrasound-guided block of the saphenous nerve in the adductor canal // Reg Anesth Pain Med. 2009. Vol. 34, N 6. P. 578–580. doi: 10.1097/aap.0b013e3181bfbf84

57. Chisholm M.F., Bang H., Maalouf D.B., et al. Postoperative analgesia with saphenous block appears equivalent to femoral nerve block in ACL reconstruction // HSS J. 2014. Vol. 10, N 3. P. 245–251. doi: 10.1007/s11420-014-9392-x

58. Stebler K., Martin R., Kirkham K.R., et al. Adductor canal block versus local infiltration analgesia for postoperative pain after anterior cruciate ligament reconstruction: a single centre randomised controlled triple-blinded trial // Br J Anaesth. 2019. Vol. 123, N 2. P. e343–e349. doi: 10.1016/j.bja.2019.04.053

59. Xie Y., Sun Y., Lu Y. Effect of Adductor Canal Block Combined with Local Infiltration Analgesia on Postoperative Pain of Knee Arthroscopy Under General Anesthesia: A Randomized Controlled Trial // Pain Ther. 2023. Vol. 12, N 2. P. 543–552. doi: 10.1007/s40122-023-00482-5

AUTHORS INFO

*** Danil V. Gorelov,** MD, anesthesiologist-resuscitator;
address: 4 Kolomensky Driveway, 115446, Moscow, Russia;
ORCID: 0000-0001-9554-2942;
eLibrary SPIN: 7893-4040;
e-mail: GorelovD.V@yandex.ru

Andrey V. Babayants, MD, Cand. Sci. (Medicine), associate professor;
ORCID: 0000-0003-3072-3237;
eLibrary SPIN: 2603-9728;
e-mail: babayants@gmail.com

Alexei M. Ovechkin, MD, Dr. Sci. (Medicine), professor;
ORCID: 0000-0002-3453-8699;
eLibrary SPIN: 1277-9220;
e-mail: ovechkin_alexei@mail.ru

* Corresponding author / Автор, ответственный за переписку

ОБ АВТОРАХ

*** Горелов Данил Владимирович,** врач анестезиолог-реаниматолог;
адрес: Россия, 115446, Москва, Коломенский пр-д, д. 4;
ORCID: 0000-0001-9554-2942;
eLibrary SPIN: 7893-4040;
e-mail: GorelovD.V@yandex.ru

Бабаянц Андрей Валерьевич, канд. мед. наук, доцент;
ORCID: 0000-0003-3072-3237;
eLibrary SPIN: 2603-9728;
e-mail: babayants@gmail.com

Овечкин Алексей Михайлович, д-р мед. наук, профессор;
ORCID: 0000-0002-3453-8699;
eLibrary SPIN: 1277-9220;
e-mail: ovechkin_alexei@mail.ru