

## Case Report

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# Pericapsular Nerve Group Block of the Hip Joint After Arthroplasty

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**ABSTRACT** We report a case of postoperative pain relief in a patient after total cement arthroplasty of the right hip joint in the early postoperative period.

Pericapsular nerve group block (PENG-block) of the hip joint was suggested to provide adequate pain relief and reduce the risk of postoperative complications.

This clinical case shows an example of effective pain relief in a patient in the early postoperative period after reconstructive plastic restoration of the right hip joint, performed for a fracture of the femoral neck. Severe pain syndrome, restriction of movements, forced position and volume of surgical intervention are risk factors for the development of thromboembolic complications. According to the literature, the incidence of thromboembolic complications after total cemented hip arthroplasty varies from 9.3 to 20.7%. Our observation indicates that pericapsular block of the hip joint is an effective method of pain relief in the early postoperative period after total hip replacement.

**Keywords:** regional anesthesia, pericapsular block, total arthroplasty

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ASIS - anterior superior iliac spine  
AIIS - anterior inferior iliac spine  
CPOT - Critical-Care Pain Observation Tool  
FA - femoral artery  
GIT - gastrointestinal tract  
IPE - iliopubic eminence  
NSAIDs - non-steroidal anti-inflammatory drugs  
PENG - Pericapsular Nerve Group  
PT - psoas tendon  
SFV - superficial femoral vein  
TA - total arthroplasty  
VAS - visual analogue scale

## INTRODUCTION

Total arthroplasty (TE) is the replacement of the hip joint with an artificial endoprosthesis. The operation is performed after ineffectiveness of conservative methods of treatment, the presence of persistent pain and prolonged dysfunction of the joint. In order to prevent the risks of postoperative complications and reduce intraoperative blood loss, a classic direct anterior approach or a minimally invasive technique with anterolateral or posterolateral approaches is often used. There are several types of fixation of endoprostheses: cementless, cement, combined [1].

The first day after surgery for patients is the most risky for the development of adverse events. It is necessary to choose adequate anesthesia, start preventing complications and preparing the patient for physiotherapy exercises. Effective pain relief is an important initial stage of therapy.

In most cases, severe pain after surgical interventions on the hip joint is a predictor of delayed recovery of patients, delays mobilization and increases the risk of thromboembolic complications, as a result of which the patient's stay in the hospital is lengthened [2].

To date, the standard of pain management after hip arthroplasty is multimodal analgesia, the basis of accelerated recovery (*fast-track*) [3], as well as preemptive analgesia with the help of, as a rule, opioids, paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) [4].

However, the use of opioids in early postoperative pain management is not the treatment of choice for acute pain [5], and the well-established efficacy of NSAIDs in patient analgesia correlates with higher doses with serious complications such as upper gastrointestinal (GI) bleeding (40–50% of cases) [6-9] and its lower parts (30-40% of cases) [10-12], which require endoscopic or surgical hemostasis. The use of prolonged epidural analgesia in postoperative pain relief can have a number of complications: arterial hypotension, epidural hematoma, impossibility of early rehabilitation, while prolonged femoral nerve block is unjustified [13]. In this regard, the search for the optimal method of anesthesia is relevant in traumatology of the hip joint.

Pericapsular nerve group block (PENG-block) is a relatively new method in pain relief of patients after hip arthroplasty in the early postoperative period [14, 15], which has proven to be a “lifeline” in regional anesthesia of the hip joint, especially in elderly and senile patients.

**The aim** of our observation is to evaluate the effectiveness and safety of analgesia by the PENG-block method after hip arthroplasty, to identify the advantages of this method relative to the standard ones, and to improve the patient's quality of life after surgery.

### Clinical observation

Patient A., 80 years old, female, was hospitalized at the N.V. Sklifosovsky Research Institute for Emergency Medicine in October, 2021. Height 163 cm, weight 59 kg. Upon admission, she complained of pain in the right hip joint.

The X-ray showed a fracture of the femoral neck (Fig. 1).

Upon further examination, duplex scanning of the veins of the lower extremities was performed, which revealed non-occlusive thrombosis of the superficial femoral vein on the right without reliable signs of flotation.

Given the severe pain syndrome in the area of the right hip joint and the unfavorable prognosis of fracture union with conservative treatment, it was decided to perform a total cement arthroplasty of the right hip joint (Fig. 2).



Fig. 1. X-ray of a fracture of the right femoral neck before surgery (31B2 according to the AO classification)



Fig. 2. X-ray of the right hip joint of the patient after total cement arthroplasty

The operation was performed on the 2<sup>nd</sup> day after the injury and admission to the N.V. Sklifosovsky Research Institute for Emergency Medicine: "Total cement arthroplasty of the right hip joint under spinal anesthesia of 15 mg ropivacaine. A 14 cm long incision was made in the upper third of the right thigh along the anterior outer surface.

In the early postoperative period, pain intensity was assessed as score 7 according to the VAS scale, and score 6 points according to the CPOT (*Critical-Care Pain Observation Tool*) scale. The patient was anesthetized: pericapsular block of the hip joint (*PENG-block*) with 0.5% solution of ropivacaine (10.0 ml).

Under aseptic conditions, under local anesthesia with 2.0 ml of 0.5% ropivacaine solution, under ultrasonic (US-) navigation with a linear transducer, after detecting anatomical landmarks (Fig. 3) and obtaining a negative aspiration sample, local anesthetic was infiltrated under the tendon of the lumbar muscle (Fig. 4). Aseptic bandage. In 30 minutes, a satisfactory sensory-motor block was obtained. Stable hemodynamics: blood pressure (BP) 123/72 mm Hg, heart rate (HR) 76 bpm, blood oxygen saturation 98%. After anesthesia was performed, pain was assessed as score 1 according to the VAS scale, and score 2 according to the CPOT scale.

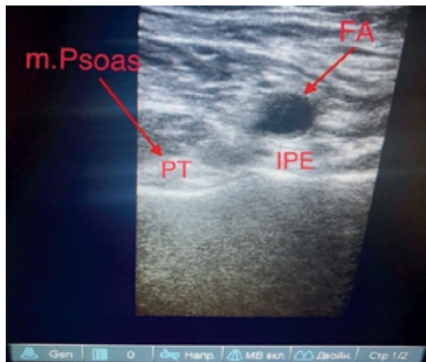


Fig. 3. Ultrasound landmarks for regional anesthesia of nerve groups innervating the capsule of the hip joint using a linear transducer

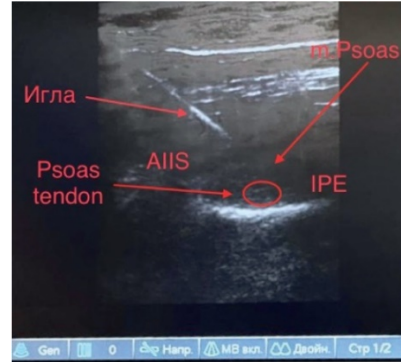


Fig. 4. Anesthesia of the hip joint capsule using ultrasound

The results of laboratory analyzes dated October 26, 2021 after the PENG-block was performed did not reveal significant findings. X-ray of the right hip joint dated October 27, 2012: the position of the endoprosthesis is - satisfactory.

On October 27, 2021, the patient began to engage in physiotherapy exercises. Two days after the operation, she sat down in bed with her legs dangling, and got up by the bed with the help of a walker.

Starting from October 27, 2021, she received ketorolac tablets, 10 mg 2 times a day.

After surgery, until the moment of discharge, the wound was without signs of inflammation, and the pain was moderate (VAS score 0-1, CPOT score 0-1), which allowed the patient to comfortably carry out rehabilitation.

On November 02, 2021, on the 7<sup>th</sup> day after the operation, the patient was discharged for outpatient treatment in a satisfactory condition, without postoperative complications and pain. The total time spent in the hospital was 10 bed-days.

## DISCUSSION

PENG-block was first described by *Laura Giron-Arengo et. al.* (2018) in work "*Pericapsular Nerve Group (PENG) block for Hip Fracture*". This technique of analgesia has an opioid-sparing effect and minimizes the risk of developing any complications.

The main sources of innervation of the capsule of the hip joint are the branches of the obturator and femoral nerves from the lumbar plexus (*Nn. Obturatorius et femoralis* from *Plexus lumbalis*) and the sciatic nerve from the sacral plexus (*n. Ischiadicus* from *Plexus sacralis*).

Ultrasound landmarks for pericapsular block of the hip joint (PENG-block) are the anterior superior iliac spine (ASIS), the anterior inferior iliac spine (AIIS), iliopubic eminence (IPE) and femoral artery (FA). The aim of the technique is to detect PT (*psoas t.*) followed by infiltration of a local anesthetic (ropivacaine solution 0.5%–10.0 ml) under the tendon of the psoas muscle.

The analysis of the studies showed that there were no complications when performing pericapsular block of the hip joint. The mobility of the operated limb is significantly improved, which significantly speeds up the recovery of the patient [15].

Ultrasound guidance with a linear transducer made it possible to safely and accurately spread the local anesthetic (0.5% solution of ropivacaine, 10.0 ml) under the m. psoas tendon.

Since the elderly patient had a high risk of postoperative complications, it can be assumed that this method of anesthesia is the optimal method of choice. The main role is given to reducing the dosage of local anesthetics (10.0 ml of a 0.5% solution of ropivacaine, 50 mg), increasing the quality of the analgesic effect and maintaining movements in the operated lower limb as much as possible.

PENG-block shows its effectiveness in pain relief after hip arthroplasty with preservation of lower limb mobilization.

It should be understood that knowledge of the mechanisms of pain development is a utilitarian approach to the choice of postoperative pain relief. In this clinical observation, analgesia was selected using the PENG-block method taking into account the pathogenetic treatment of pain, rather than symptomatic, which ensures a positive result of analgesic therapy [16]. It was decided to abandon the analgesic ladder of the World Health Organization (WHO) due to its significant shortcomings [17].

In the early postoperative period after hip arthroplasty, any passive or forced movements in the hip joint are contraindicated for the patient, which was also taken into account when choosing the method of anesthesia. PENG-block is performed in the supine position and does not require additional physical activity from the patient.

Opioid analgesics cause activation of neurons in the dorsal horns of the spinal cord, increasing pain sensitivity, causing postoperative hyperalgesia at high doses [18] and can cause mental and psychiatric impairment in elderly patients. The use of a local anesthetic makes it possible to block the pain impulse at the stage of transmission through the nociceptive system, which ensures the overlap of the transition to the stages of modulation, perception with the need to use opioid analgesics and psychotropic drugs.

With nociception, there is a single mechanism of regulation and response in order to transfer information to the cortical analyzer about the nature of the nociceptive effect. The goal of adequate postoperative analgesia is to eliminate nociceptive neuropathic pain.

In patients after hip arthroplasty, early postoperative analgesia using PENG-block under ultrasound guidance can provide adequate pain relief with preservation of movements in the lower limb on the side of surgery, which corresponds to the fast-track strategy. Currently, studies in the field of anesthesia of patients using the method of pericapsular block of the hip joint are isolated. In this regard, the present clinical observation reflects the importance of studying the current topic in the future, both in practical and scientific terms.



Fig. 5. Innervation of the areas of the hip joint capsule

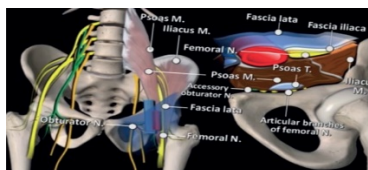


Fig. 6. Vascular, nervous, muscular landmarks for ultrasound navigation



Fig. 7. Bone landmarks for ultrasound navigation

## CONCLUSIONS

1. The presented observation of the treatment of a patient with a fracture of the femoral neck showed the effectiveness of PENG-block in pain relief after total cemented hip arthroplasty in the early postoperative period.

2. The advantage of this technique is the exclusion of narcotic analgesics, the use of a local anesthetic and the minimum amount of non-steroidal anti-inflammatory drugs, and as a result, effective pain relief and rapid rehabilitation in the postoperative period.

## REFERENCES

1. Broshyura dlya patsientov s endoprotezirovaniem tazobedrennogo sustava . Available at: <https://gc-cmt.ru/content/broshyura-dlya-pacientov-s-endoprotezirovaniem-tazobedrennogo-sustava> [Accessed Nov 30, 2021]. (In Russ.)
2. Pascarella G, Costa F, Del Buno R, Pulitano R, Strumia A, Piliago C, et al. Impact of the pericapsular nerve group (PENG) block on postoperative analgesia and functional recovery following total hip arthroplasty: a randomized, observer-masked, controlled trial. *Anaesthesia*. 2021;76(11):1492–1498. PMID: 34196965 <https://doi.org/10.1111/anae.15536>
3. Ferrata P, Carta S, Fortina M, Scipio D, Riva A, Di Giacinto S. Painful hip arthroplasty: definition. *Clin Cases Mineral Bone Metab*. 2011;8(2):19–22. PMID: 22461810
4. Kurganskiy AV, Khrapov KN. Approaches too Post-operative Pain Relief During Total Knee and Hip Replacement. *Messenger of Anesthesiology and Resuscitation*. 2018;15(4):76–85. (In Russ.) <https://doi.org/10.21292/2078-5658-2018-15-4-76-85>
5. Dalury D, Lieberman J, MacDonald S. Current and innovative pain management techniques in total knee arthroplasty. *J Bone Joint Surgery*. 2011;93(20):1938–1943. PMID: 22012532 <https://doi.org/10.2106/JBJS.9320ic1>
6. Ovechkin AM. Postoperative pain: the state of problem and current trends in postoperative analgesia. *Regional Anesthesia and Acute Pain Management*. 2015;9(2):29–39 (In Russ.).
7. Shostak NA, Ryabkova AA, Savelyev VS, Malyarova LP. Gastrointestinal hemorrhages as complications of gastropathies associated with intake of nonsteroid anti-inflammatory drugs. *Terapevticheskiy arkhiv*. 2003;78(5):70–73. (In Russ.).
8. Evseev MA. NPVP–indutsirovannyye gastroduodenal'nye yazvy, oslozhnennyye krvotekheniem. Lektsiya. *Medical Journal of the Russian Federation*. 2006;(15):1099–1107. (In Russ.).
9. Gelfand BR, Protzenko DN, Babayants AV, Karateev AE. Upper Gastrointestinal Tract Acute Bleeding: From Epidemiology to the Conservative Therapy Concept Formation. *Infektsii v khirurgii*. 2013;11(4):11–17.
10. Harirforoosh S, Asghar W, Jamali F. Adverse Effects of nonsteroidal antiinflammatory drugs: an update of gastrointestinal, cardiovascular and renal complications. *J Pharm Pharm Sci*. 2013;16(5):821–847. <https://doi.org/10.18433/j3vw2f> PMID: 24393558
11. Sostres C, Gargallo C, Lanas A. Nonsteroidal anti-inflammatory drugs and upper and lower gastrointestinal mucosal damage. *Arthritis Res Ther*. 2013;15Suppl (Suppl 3):S3. PMID: 24267289 <https://doi.org/10.1186/ar4175>
12. Maiden L, Thjodleifsson B, Seigal A, Bjarnason II, Scott D, Birgisson S, et al. Long-term effects of nonsteroidal anti-inflammatory drugs and cyclooxygenase-2 selective agents on the small bowel: a cross-sectional capsule enteroscopy study. *Clin Gastroenterol Hepatol*. 2007;5(9):1040–1045. PMID: 17625980 <https://doi.org/10.1016/j.cgh.2007.04.031>
13. Adebayo D, Bjarnason I. Is non-steroidal anti-inflammatory drug (NSAID) enteropathy clinically more important than NSAID gastropathy? *Postgrad Med J*. 2006;82(965):186–191. PMID: 16517800 <https://doi.org/10.1136/pgmj.2005.039586>
14. Zagrekov VI. Regional anesthesia for total hip arthroplasty. *Regional Anesthesia and Acute Pain Management*. 2013;7(4):5–13. (In Russ.).
15. Allard C, Pardo E, de La Jonquiere C, Wyniecki A, Soulier A, Faddoul A, et al. Comparison between femoral block and PENG block in femoral neck fractures: A cohort study. *PLoS One*. 2021;166(6):e0252716. PMID: 34086782 <https://doi.org/10.1371/journal.pone.0252716>
16. Mazurov VI, Belyaeva IB. The Role of IL 6 in the Formation of the Pathogenetic Mechanisms of Rheumatoid Arthritis. *Poliklinika*. 2019;(3):42–47. (In Russ.).
17. Vargas-Schaffer G. Is the WHO analgesic ladder still valid? Twenty-four years of experience. *Can Fam Physician*. 2010;56(6):514–517. PMID: 20547511
18. Karellov AE. Modern concepts of pain mechanisms. *Russian Journal of Anaesthesiology and Reanimatology*. 2020;(6):88–95. (In Russ.). <https://doi.org/10.17116/anaesthesiology202006187>

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