ORIGINAL ARTICLE

THE COMPARATIVE EFFECTIVENESS OF ERECTOR SPINE PLANE BLOCK AND PARAVERTEBRAL BLOCK FOR EARLY REHABILITATION AFTER TOTAL HIP ARTHROPLASTY

DOI: 10.36740/WLek202208212

Vitaliy Kolomachenko[1,2]
[1]KHARKIV MEDICAL ACADEMY OF POSTGRADUATE EDUCATION, KHARKIV, UKRAINE
[2]KHARKIV REGIONAL TRAUMA HOSPITAL, KHARKIV, UKRAINE

ABSTRACT

The aim: To evaluate the effectiveness of erector spine plane block vs lumbar paravertebral block for early rehabilitation after total hip arthroplasty.

Materials and methods: The study included 60 ASA II–III patients (female/male = 35/25) aged 41-82 years, undergone total hip arthroplasty under spinal anesthesia. The patients randomly divided into two groups (n=30 in each) according to postoperative regional analgesia technique: paravertebral block (PVB) and erector spine plane block (ESPB). The time interval to meet three criteria: adequate analgesia (<4 points of VAS), opioid-free period longer than 12 h, and possibility to cover walking 30 m distance without time restriction was analyzed. We also analyzed opioid requirement postoperatively.

Results: The time interval to meet the three criteria after surgery was shorter to 9.4 h for patients in PVB group 36.3 h 95% CI 31.8 to 40.8 h than for patients in ESPB group 45.7 h 95% CI 40.1 to 51.3 h, (p = 0.016). During the first 24 h after surgery the total dose of nalbuphine per patient was significantly higher in ESPB group (10.7 95% CI 7.0 to 14.3) compared to PVB group (6.3 95% CI 3.7 to 9.0).

Conclusions: The paravertebral block and erector spine plane block provide quite effective pain relieve in patients undergone total hip arthroplasty (<4 points of VAS). PVB has more opioid-preserving effect than ESPB. The paravertebral block is superior to erector spine plane block for early rehabilitation after total hip arthroplasty (the time required for patients to meet the three criteria was shorter PVB than ESPB).

KEY WORDS: rehabilitation, total hip arthroplasty, paravertebral block, erector spine plane block

Wiad Lek. 2022;75(8 p2):2010-2013

INTRODUCTION

Total hip arthroplasty is one of the most common and successful surgical interventions in the world nowadays. The effective perioperative pain control is critical for successful rehabilitation and postoperative recovery after hip arthroplasty. Early rehabilitation after arthroplasty shortens the time to meet the criteria for discharge, reduces the duration of hospital stay and improves quality of patients` life [1]. The debate about the optimal method of analgesia for this operation has been going on for many decades [2,3]. However, the quality of postoperative pain control after hip arthroplasty often remains insufficient, and there is no agreement on the preferred method of analgesia. The prolonged peripheral regional blocks should be used as a component of multimodal analgesia for patients with total arthroplasty, but the optimal technique that would provide maximum analgesia without motor blockage for preserved patient`s mobility is still not established [4].

The prolonged paravertebral block (PVB) in LIII is quite effective, but it should be used with caution in patients with hypocoagulation and cachexia due to kidney injury especially in cases of right side blockage. In addition, PVB is very often accompanied by weakness of the quadriceps of the thigh, which impairs the patient's physical activity and does not contribute to its safety during verticalization [5].

The erector spine plane block (ESP) is a newer regional analgesic technique [6], which has been described for many types of surgery, including total hip arthroplasty [7]. Because the ESP block is not associated with quadriceps weakness [8], this allows the administration of a local anesthetic at any time, regardless of the patient's physical activity, and may therefore improve the quality of patient`s rehabilitation. With the advent of new regional techniques that seem safer, there is a need to compare their impact on the speed and quality of physical recovery after hip arthroplasty.

THE AIM

The aim of the study was to evaluate the effectiveness of erector spine plane block vs to lumbar paravertebral block for early rehabilitation after total hip arthroplasty.

MATERIALS AND METHODS

The study was provided at Kharkiv Regional Trauma Hospital in 2019-2020 and included 60 ASA II–III patients

Table I. The demographic data of patients and surgery duration in both groups.

Data	Groups		P level (PVB vs ESPB)
	PVB (n=30)	ESPB (n=30)	
Age, years, m ± σ	64.2 ± 10.9	64.7 ± 9.6	0.493[1]
Gender (male/female), n	13/17	12/18	0.793[2]
Height, cm, m ± σ	168.0 ± 10.8	167.6 ± 8.0	0.114[1]
Body mass, kg, m ± σ	91.2 ± 18.1	88.1 ± 17.2	0.806[1]
Body mass index, kg/m^2, m ± σ	32.3 ± 6.3	31.4 ± 6.6	0.838[1]
Surgery duration, min, m ± σ	88.8 ± 8.5	89.3 ± 8.1	0.790[1]

Note: [1] – Student`s t-test, [2] – criterion χ2

Table II. Time to reach the three criteria after surgery (adequate analgesia (<4 points of VAS), opioid-free time longer than 12 h, ability to overcome a walking distance of 30 meters without time restrictions) and the need for optoids.

Data	Groups		P level (PVB vs ESPB)
	PVB (n=30)	ESPB (n=30)	
Time to meet three criteria, h, Me [25%; 75%]	32.5 [26.0 – 47.0]	46.0 [34.0 – 54.0]	0.016[1]
Nalbuphine dose during the first 24 h after surgery, mg, Me [25%; 75%]	5.0 [0 – 10]	10.0 [0 - 20.0]	0.110[1]
Nalbuphine dose during the next postoperative days, mg, Me [25%; 75%]	0 [0 – 0]	0 [0 – 10]	0.270[1]
Number of patients not-needing opioids for the first postoperative day, n (%)	15 (50)	11 (36.7)	0.297[2]
Number of patients not-needing opioids for the next postoperative days, n (%)	17 (56.7)	12 (40)	0.196[2]

Note: [1] – Mann-Whitney U-test, [2] – criterion χ2

(female/male = 35/25) aged 41-82 years, undergone elective primary total hip arthroplasty. The informed consent to participate in the study was received prior to inclusion in the study from the patients. A positive conclusion on compliance with the principles of the Declaration of Helsinki, the Council of Europe Convention on Human Rights and Biomedicine, ICH GCP and relevant laws of Ukraine was received from the Commission on Bioethics of Kharkiv Medical Academy of Postgraduate Education (Protocol №3, March 22, 2019, chaiman Prof. MA Georhyants). The patients randomly divided into two groups (n=30 in each) according to postoperative regional analgesia technique: paravertebral block (PVB) and erector spine plane block (ESPB). In all patients spinal anesthesia was provided for total hip arthroplasty. The G26 spinal needle was placed intrathecally in paramedian approach in L3-L4 in patients in side position with upper positioning of surgery side. 12 mg (2.4 ml) of isobaric 0.5% bupivacaine was injected. In PVB group immediately after spinal anesthesia performed the paravertebral space was punctured using "loss of resistance" technique with a set Perifix 401 («BBraun», Germany) in L3 level on the operated side with the injection of 20 ml 0.25% bupivacaine, followed by catheterization to a depth of 4 cm. In group ESPB immediately after similar spinal anesthesia performed erector spine plane block was provided using the technique described in a recent experimental study [Elsharkawy H, Bajracharya GR, El-Boghdadly]. We identified transverse processes of L2-L3 in the parasagittal plane using a high-frequency linear or low-frequency convex sensor (Sonoscanner U-Lite, France). Tuohi needle (Perifix 401, BBraun, Germany) was inserted in-plane between the transverse processes L2-L3 and 20 ml 0.25% bupivacaine was injected for hydrodissection of muscle from the transverse processes and the spread in the ESP space, followed by catheterization to a depth of 4 cm.

Postoperatively in both groups, 20 ml 0.25% bupivacaine was injected through the catheter every 8 hours during the three postoperative days. In all patients 8 mg lornoxicam was administered twice intravenously 30 min before the surgery started and in 12 h after the end of surgery. In addition, 1 g acetaminophen was used 30 min before the end of surgery and 6 h after the surgery. In cases of pain intensity above 4 cm according to 10-cm visual analoqual scale (VAS), 10 mg nalbuphine was administered intramuscularly. We did not use any wound or periarticular infiltration of local anesthetics.

The patients were encouraged to engage in early physical activity, they were allowed to walk on orthopedic support walkers, or on crutches with a load on the operated limb

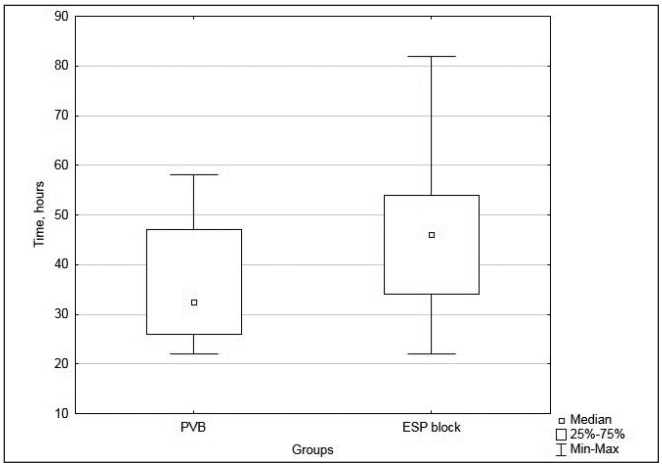

Fig. 1. Time interval to meet three criteria in two groups, hours.

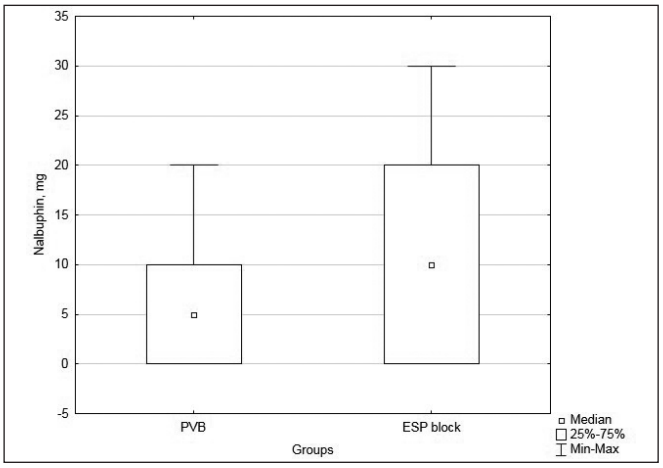

Fig. 2. The total dose of nalbuphine per patient (mg) during the first 24 h after surgery in two groups.

70% from the first postoperative day. The time required for patients to meet the three criteria was assessed, namely: adequate analgesia (<4 points of VAS), opioid-free time longer than 12 h, ability to overcome a walking distance of 30 meters without time restrictions. The countdown started from the end of the operation.

The results were analyzed at the next stages: in the first postoperative morning, midday and evening in 1-3 postoperative days. The need in opioid was calculated: nalbuphine dose in mg and number of patients needing opioids postoperatively.

Statistical analysis of the results was performed using a standard Microsoft Excel 2013 package, which is freely available and using a demo version of IBM SPSS 19.0 software. The analysis of the studied parameters for the normality of the distribution was performed by the Shapiro-Wilk test. The descriptive statistics of normally distributed data were presented as mean and standard deviation ($M \pm \sigma$), and non-normally distributed data were presented as median and interquartile range Me [25%; 75%] or percentage (%) and 95% confidence intervals were calculated where appropriate.

Estimate of statistic difference in comparable groups conducted using unpaired Student's t-criterion, in case of normal distributions, if the distribution didn't match to the normal law, we were used Mann-Whitney U test. Comparison of qualitative indicators was carried out according to the criterion χ^2. Differences were considered significant at the level of statistical significance $p < 0.05$.

RESULTS

The patients of two groups did not differ in terms of demographic data and surgery duration (table I).

In the first 24 hours after surgery, three criteria were not met in any group. In the next 24 hours, in both groups, patients had adequate pain control and could cover a distance of more than 30 meters. But the time interval to meet the three criteria after surgery was shorter to 13.5 h for patients in PVB group (32.5 [26.0 – 47.0] h) than for patients in ESPB group (46.0 [34.0 – 54.0] h) and the intergroup difference was statistically significant ($p = 0.016$, Mann-Whitney U-test) (Fig. 1). Analysis of this criterion showed that the time to achieve it is significantly shorter in patients of the PVB group 36.3 h 95% CI 31.8 to 40.8 h, than in patients ESPB group 45.7 h 95% CI 40.1 to 51.3 h.

During the first 24 h after surgery, 50% of patients in PVB group did not need additional opioid administration due to pain intensity above 4 points of VAS. While in ESPB group 36.7% of patients did not need additional opioid analgesia (fig.2). The intergroup difference did not reach the statistical significance ($p= 0.297$, criterian χ^2). But the total dose of nalbuphine per patient was significantly higher in ESPB group (10.7 95% CI 7.0 to 14.3) compared to PVB group (6.3 95% CI 3.7 to 9.0).

During the next postoperative days the same tendency was seen in opioid need. In PVB group 56.7% of patients did not need additional opioid administration, while in ESPB group the part of such patients was 40% (table II).

DISCUSSION

Early mobilization is one of the priorities in the management of patients after total hip replacement. The rate of recovery after hip arthroplasty, in addition to orthopedic factors, is affected by adequate pain control. Regional anesthesia provides effective anesthesia and analgesia in the perioperative period [9]. Patients after such surgery have many options for pain relief. But it is very important that adequate analgesia is not accompanied by a restriction in the physical activity of patients, which requires further study in this area to determine the optimal technique for perioperative pain control. Paravertebral block at the lumbar level can be used as component of multimodal analgesia, reducing the need in opioid analgesics and improving early recovery [10]. PVB supplies unilateral analgesia, and the level of motor blockage can be effectively controlled changing the local anesthetic concentration. Moreover, safety of regional blocks increased with ultrasound guidance. The ESPB became more popular from the

first publication about this technique in 2016 [8]. ESPB is performed for different types of surgical procedures in thoracic, abdominal surgery as well as for orthopedic surgery including hip arthroplasty. But most of these publications report about case series, and mainly they use single-short technique of ESPB. A few studies compared ESPB with another regional methods in terms of clinical efficacy and safety [11].

We compared ESPB with PVB and confirmed that ESPB provides effective alternative analgesia compared to PVB for early postoperative period after total hip arthroplasty allowing the physical activity of patients for early rehabilitation. We analyzed the readiness of patients to meet criteria, which are appropriate for self-care activity. When reaching such criteria patients do not need additional care from medical personnel or relatives.

CONCLUSIONS

The paravertebral block and erector spine plane block provide quite effective pain relieve in patients undergone total hip arthroplasty (<4 points of VAS). PVB has more opioid-preserving effect than ESPB. The paravertebral block is superior to erector spine plane block for early rehabilitation after total hip arthroplasty (the time required for patients to meet the three criteria was shorter PVB than ESPB).

REFERENCES

1. Guerra M.L., Singh P.J., Taylor N.F. Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: A systematic review. Clin Rehabil. 2015;29(9):844–54.
2. Johnson R.L., Kopp S.L., Burkle C.M. et al. Neuraxial vs general anaesthesia for total hip and total knee arthroplasty: a systematic review of comparative-effectiveness research. Br. J. Anaesth. 2016;116(2):163-176.
3. Greimel F., Maderbacher G., Zeman F. et al. No Clinical Difference Comparing General, Regional, and Combination Anesthesia in Hip Arthroplasty: A Multicenter Cohort-Study Regarding Perioperative Pain Management and Patient Satisfaction. J Arthroplasty. 2017;32(11):3429-3433.
4. Bugada D., Bellini V., Lorini L.F., Mariano E.R. Update on selective regional analgesia for hip surgery patients. Anesthesiol Clin. 2018;36(3):403–15.
5. Kolomachenko V. Ranni pislyaoperatsiyni uskladnennya ta nebazhani yavischa pislya endoprotezuvannya kulshovogo sugloba: vpliv metodiv anesteziyi ta analgeziyi [Early postoperative complications and adverse effects after hip arthroplasty: the influence of anesthetic and analgesic techniques]. Kharkiv surgical school. 2018;3-4(90-91):12-17. (In Ukrainian)
6. Forero M., Adhikary S.D., Lopez H. et al. The erector spinae plane block: A novel analgesic technique in thoracic neuropathic pain. Reg Anesth Pain Med. 2016;41(5):621–7.
7. Singh S., Ranjan R., Lalin D. A new indication of erector spinae plane block for perioperative analgesia is total hip replacement surgery: A case report. Indian J Anaesth. 2019;63(4):310–1.
8. Tsui BCH, Fonseca A, Munshey F, et al. The erector spinae plane (ESP) block: A pooled review of 242 cases. J Clin Anesth. 2019;53:29–34.
9. Jakobsson J., Johnson M.Z. Perioperative regional anaesthesia and postoperative longer-term outcomes. F1000Research. 2016;5:F1000. doi:10.12688/f1000research.9100.1.
10. Kolomachenko V. Vpliv metodiv znebolyuvannya na rannyu reabilitatsiyu patsientiv pislya endoprotezuvannya kulshovogo sugloba [Influence of pain relief management on early patents rehabilitation after total hip replacement]. Orthopaedics, Traumatology and Prosthetics. 2018;1:53-58. (In Ukrainian)
11. Taketa Y., Irisawa Y., Fujitani T. Comparison of ultrasoundguided erector spinae plane block and thoracic paravertebral block for postoperative analgesia after video-assisted thoracic surgery: A randomized controlled non-inferiority clinical trial. Reg Anesth Pain Med. 2019;45(1):10–5.

ORCID and contributionship:
Vitaliy Kolomachenko: 0000-0003-4740-091X[A-F]

Conflict of interest:
The Author declare no conflict of interest.

CORRESPONDING AUTHOR
Vitaliy Kolomachenko
Kharkiv Medical Academy of
Postgraduate Education
58 Amosova st., 61171 Kharkiv, Ukraine
tel: +380508440888
e-mail: vitaliykolomachenko@gmail.com

Received: 13.06.2021
Accepted: 29.06.2022

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article