

Efficiency of Patient-Controlled Epidural Anesthesia after Lower Limb Joint Replacement Surgery

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Abstract

At present, there are many drugs and method of anesthesia, each has its advantages and disadvantages. The aim of anesthesia is not only to eliminate suffering and create psychological comfort, but also to improve the quality of life, accelerate postoperative functional rehabilitation, reduce the incidence of complications. The problem of postoperative pain treatment is relevant both in our country and abroad. According to literary sources, 30–75% of patients suffer from severe pain in the postoperative period. Today there is a great number of research, recommendations and guidelines for postoperative anesthesia. (Volchkov V.A., Kovalev S.V., Kubynin A.N. Modern aspects of postoperative anesthesia (literature review)//Bulletin of St. Petersburg University. Medicine. 2018. V. 13. Issue 3. p. 245-270).

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Introduction

The study results of postoperative pain level after various surgical procedures are of special interest. (Ovechkin A. M. Postoperative pain: state of the problem and current trends in postoperative pain management// Regional anesthesia and treatment of acute pain. 2015. V. IX, No. 2. p. 29-39.)¹ In particular, after orthopedic interventions. An effective method of postoperative analgesia is preemptive analgesia (PEA) combined with use of local anesthetics and various adjuvants. The main drugs for PEA are represented by solutions of local long-acting anesthetics in low concentration, providing analgesia without motor blockade. Narcotic analgesics and adrenergic drugs are most often used as adjuvants. (Yousef A. A., Atef A. M., Awais W. M. Comparison of fentanyl versus meperidine as supplements to epidural clonidine-bupivacaine in patients with lower limb orthopedic surgery under combined spinal epidural anesthesia//BMC Anesthesiol. 2015. Oct. 14. No. 15. p. 146-155.) (Bell R. F., Dahl J., Moore R. et al.

Perioperative ketamine for acute postoperative pain// Cochrane Database Syst Rev. 2015. Jul. 2(7). p. 344–348.)²

High-tech analgesia method include regional analgesia/anesthesia and patient-controlled analgesia. Patient-controlled analgesia (PCA) or on-demand analgesia is an alternative to the traditionally used analgesic “for cause” or planned analgesic².

According to this procedure, the patient himself, by pre-prescribed doses, administers the analgesic using a programmable syringe perfusor³. Anesthesia is achieved as a result of repeated injections of small analgesic doses⁴. When in pain, the patient titrates analgesic administration, evaluates its effect and determines the most acceptable level of pain⁵. The working principle of PCA is easily understood by patients. As the pain increases, the patient, by pressing the control unit button, titrates a bolus dose of analgesic until the desired effect is achieved⁶.

PCA has several advantages over traditional administration of analgesics. It ensures effective analgesia according to patient's individual needs; quick desired effect; reduction of time of the patient without analgesia; stable analgesic concentration in blood plasma. Besides, when PCA is applied, it is possible to save medical personnel time, decrease the incidence of side effects and shorten their treatment in hospital.²

Therefore, the purpose of our study was to evaluate PCA efficiency after orthopedic surgery for prosthetics of lower limb joints.

Material and Research Method

The study was performed in 34 patients aged from 65 to 90 years (average age was 78 ± 8 years) with a physical status of ASA 3 or higher. Patients were hospitalized in the traumatology department of TMA clinic with a diagnosis of: Coxarthrosis; Gonarthrosis. All patients had a concomitant pathology: coronary heart disease - 25, hypertension - 27, atherosclerosis - 28, chronic bronchitis - 19, peptic ulcer - 10. Patients underwent orthopedic surgery: 20 patients - hip replacement, 14 patients - knee replacement.

All examined patients were divided into 2 groups. In the 1st group ($n = 15$), postoperative analgesia was performed traditionally by administration of opioid analgesics (morphine or promedol) by the patient's request. In the 2nd group of patients ($n = 19$), postoperative analgesia was performed using "Accumate -1100. Electronic PCEA. Electronic PCA" Device. 0.25% solution of longocain, 5 ml, was fractionally injected into the epidural catheter by a patient every 4 hours. During 24 hours after surgery. The study and control groups of patients were comparable in age, volume and surgery duration.

P.R. Bromage scale was used to evaluate the motor blockade. Postoperative analgesia was evaluated using a visual analogue scale (VAS), hemodynamic parameters (heart rate, SBP, BR,) SatO₂, stress hormone cortisol and glucose in blood plasma. Hemodynamic parameters were measured at the following stages: 1 - initially, before analgesia, 2 - in 20 minutes after analgesic administration, 3 - in 24 hours after surgery.

The obtained results were processed using parametric statistics method using Statistica 6 program. Data were presented as mean (M) with standard deviation and evaluated using Student's t-test. Differences were considered significant at $p < 0.05$.

Results and Discussion

Before analgesia in patients of both groups, respiratory and hemodynamic parameters were almost identical. As can be seen in the following table 1, all patients experienced severe pain (more than 7 points according to VAS) before analgesia, which was clinically accompanied by tachycardia, moderate hypertension and rapid breathing.

In the 1st group, introduction of standard analgesia decreased in pain severity. Parenteral administration of narcotic analgesics has often proved to be insufficiently effective for pain relief, although pain intensity was higher than 4 points according to VAS, which is an indication for administration of opiates. However, use of drugs in this group was associated with quite a large number of complications and side effects (hypotension - 2, decreased saturation - 3, bradypnea - 1), which are more often observed in elderly patients (over 80 years old). At the same time, postoperative nausea and vomiting were more often recorded in the group ($n = 6$). Nearly 30% of patients in the group suffered from adverse reactions.

In the 2nd group, where PCA was used, not a single case of severe pain was recorded, the lowest levels of pain syndrome were observed. Mild motor blockade (1-2 Bromage points) was observed in 3 patients of the group and ($p = 0.5$). Motor blockade occurred in the first 12 hours after surgery and resolved after the patient increased intervals of using the patient's control unit. Epidural anesthesia, in terms of risk/benefit ratio is not less efficient. The main disadvantages of neuraxial analgesia are represented by arterial hypotension ($n = 2$), acute urinary retention ($n = 1$), post lumbar puncture syndrome ($n = 2$). No other adverse events, typical of neuraxial blockade, including infectious ones, were recorded.

As a result of the postoperative analgesia study with use of PCEA, no statistically significant changes in hemodynamic system indicators and a decrease in systolic and diastolic pressure were observed (see Table 1). Also, in contrast to the control group, in the study group of patients, cardiac depression with a decrease was not recorded. It may be due to the patient's selection of the optimal analgesic dose, when, upon reaching the comfort state in the first hours after the surgery, patients maintained this state at an individual level.

In our studies, all patients did not suffer from severe pain. In study groups, there was not a single case of complications associated with side effects of drugs or anaesthesia during the hospitalization period.

Table 1: Indicators of hemodynamics, respiration and pain syndrome severity

Indicators	Group 1			Group 2		
	Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3
	128.5±5.7	119.5±5.4	120.5±5.2	126.7±5.2	123.5±5.7	121.5±5.3
ABP mm Hg	85.6±5.3	81.6±5.1	81.4±5.3	84.5±5.1	84.1±5.3	83.1±5.1
Heart rate, bpm	86.8±7.4	78.8±7.4	73.8±3.4	85.8±8.0	74.8±7.4	71.8±4.4
BR/min	18.6±2.4	14.6±2.4	14.6±2.4	18.5±2.6	16.6±2.5	15.6±2.5
Sat O ₂ , %	98.3±1.5	96.3±1.5	97.3±1.5	98.1±1.7	98.3±1.8	99.3±0.6
VAS, points	7.4±1.3	3.6±1.8	3.5±1.5	7.2±1.9	1.5±0.5	1.2±0.2
Cortisol, n/mol/l	186.1±51.1	184.5±49.1	178.1±43.1	186.2±52.1	149 ± 43.1	145.3±32.1
Glucose, mmol/l	6.1±1.3	4.26±0.4	4.3±0.3	6.2±1.5	4.09±0.3	4.04±0.1

Analysis of the analgesic effect study results showed, that in the postoperative period, using patient-controlled epidural analgesia (PCEA), a clear tendency to a decrease in cortisol and glycemia levels was observed, which was not the case with the control group. The decrease in cortisol is due to nociception interruption in the lesion, because there is no activation of hypothalamo-pituitary-adrenal axis (HPAA). The humoral pathway is a direct entry of inflammatory mediators into the blood and HPAA activation. The blood glucose level is almost the same, with a slight fluctuation, indicating HPAA deactivation.

The results of studies, performed to evaluate PCA efficiency, showed that analgesia shall be started as early as possible. In patients, who started PCA for mild pain (at rest), good results were observed more often by 30 %, than in patients with severe pain. Inadequate analgesia is observed in 15% of patients, when PCA was used for severe or unbearable pain. At the same time, if PCA started with absent or slight pain at rest, inefficient analgesia was observed in only 3% (p is less than 0.05) of patients. Analgesic action starts 20-30 minutes earlier, as no time is spent for a doctor's permission and a nurse's injection.

The patient-controlled analgesia is a method that makes it possible, depending on the analgesic to be administered, in 82-95% of patients to select an efficient individual dose and control pain.

Thus, PCA method provides adequate analgesia according to the patient's individual needs.

Conclusions

1. PCEA is a reliable way to provide analgesia in the postoperative period with total arthroplasty of lower limb joints.
2. The use of prolonged analgesia in low-concentrated solutions of local anesthetics provides sufficient hemodynamic stability and preservation of motor activity of lower limbs. Advantages of the method are as follows: rapid analgesia, bypasses gastrointestinal tract is not involved, patient-controlled, programmable.
3. Epidural analgesia with extended infusion provides reliable nociceptive protection, use of low concentrations of local anesthetics prevents motor disorders. As a result, early activation of patients is possible even with use of epidural analgesia.

Ethical Clearance: No ethical approval is needed.

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Conflict of Interest: Nil

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