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Use of levobupivacaine in carotid endarterectomy

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Abstract

Background. *Anesthesia for carotid endarterectomy can be used as a combined endotracheal anesthesia, regional anesthesia, and also a combination of combined endotracheal anesthesia with regional anesthesia. Studies have shown that the combination of endotracheal anesthesia with regional anesthesia significantly reduces the need for analgesics after surgery, and the use of levobupivacaine as a local anesthetic reduces the incidence of adverse events.*

Objective. *To compare the advantages and disadvantages of the combined anesthesia (the combination of endotracheal with regional anesthesia) and the regional anesthesia with sedation using levobupivacaine.*

Material and methods*. In a prospective single-center study, patients were allocated into 2 groups. In group 1 (n=40), a general anesthesia was performed using desflurane in combination with the regional anesthesia of the superficial cervical plexus. In group 2 (n=40), a*

blockade of the superficial cervical plexus and deep cervical plexus was achieved. Levobupivacaine was used as a local anesthetic in both groups.

Results. *The study showed a significantly ($p<0.05$) greater number of intraoperative hypertension (BPsys more than 170 mm Hg) episodes in patients of group 1 making 10(25%) versus 4(10%) in group 2, and the presence of hypotension defined as blood pressure less than 90 mm Hg in 5 (12.5 %) patients of group 1 during surgery. In addition, tachycardia (heart rate > 90 beats per minute) was significantly ($p<0.05$) more often recorded in group 1: in 8 patients (20%) versus 4 (10%) in group 2. In both groups 1 and 2, adverse events were noted: pain in the intervention area in 4 (10%) patients of group 2, positional discomfort in 3 (7.5%) patients of group 2, sensation of shortness of breath and anxiety in 1 (2.5%) patient of group 2, postoperative nausea in 3 (7.5%) patients of group 1, and postoperative vomiting in 2 (5%) patients of group 1. The time spent in the operating room was significantly longer ($p<0.05$) in group 1 than in group 2: 110±15 minutes versus 75±12, respectively.*

Conclusion. *Regional anesthesia reduces the patient's time in the operating room, but the presence of "operating room effect" reduces patient satisfaction compared to general anesthesia in combination with regional anesthesia. Levobupivacaine is effective and safe for both the isolated regional anesthesia and as a component of the combined endotracheal anesthesia for carotid endarterectomy.*

Keywords: regional anesthesia, carotid endarterectomy, blockade of the superficial and deep cervical plexus, levobupivacaine

Conflict of interests Authors declare no conflict of interest

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BP, blood pressure
CEA, carotid endarterectomy
CETA, combined endotracheal anesthesia
HR, heart rate
RA, regional anesthesia
TCO, transcranial cerebral oximetry
VAS, Visual Analogue Scale

Introduction

Carotid endarterectomy (CEA) is one of the most common surgical interventions in vascular surgery. So, at the N.V. Sklifosovsky Research Institute of Emergency Medicine more than 400 such operations are annually performed. Carotid artery surgery is essentially a low-traumatic surgical procedure and is not associated with significant pain, hypovolemia, or massive blood loss. Currently, during carotid artery surgery, combined endotracheal anesthesia (CETA), regional anesthesia (RA), and a combination of CETA and RA are used [1, 2]. A number of researchers argue that CEA performed under regional rather than general anesthesia has an advantage, since an “awake” patient is the “gold standard” for monitoring cerebral function [3–5]. Moreover, according to the literature, the percentage of RA in the overall structure of pain relief during CEA, ranges from 6 to 74% and only in some clinics reaches 99%. This wide variation is largely due to established preferences in the centers, and no clear advantages or disadvantages of a particular method of anesthesia. The combination of CETA with RA allows a statistically significant reduction in the need for the use of analgesics in the perioperative period [6–11].

In recent years, there has been a growing interest in the use of levobupivacaine as a local anesthetic for RA. Literature data support the

safety of the pharmacological profile of levobupivacaine compared to bupivacaine, as the incidence of various adverse outcomes with the latter is higher than with levobupivacaine. The successful use of levobupivacaine in obstetrics, gynecology, orthopedic practice, abdominal surgery, ophthalmology, as well as comparison of the effects of levobupivacaine, bupivacaine, and ropivacaine showed that levobupivacaine is not inferior in efficacy to other local anesthetics, while having less cardio- and neurotoxicity than its dextrorotatory isomer bupivacaine [12–14].

The objective was to compare the advantages and disadvantages of combined anesthesia: combined endotracheal anesthesia with regional anesthesia and regional anesthesia with sedation achieved using levobupivacaine.

Material and methods

The prospective pilot single-center study included 80 patients who were allocated into two groups.

Inclusion criteria:

- Elective carotid endarterectomy
- Adult patients under 80 years of age

Exclusion criteria:

- Refusal of the proposed type of anesthesia
- Acute stroke
- Inflammatory changes in the area of the proposed puncture
- History of allergy to local anesthetics.

In group 1 (n=40), general anesthesia was performed using desflurane in combination with regional anesthesia of the superficial

cervical plexus. Nerve block anesthesia was performed in the operating room with a 0.5% levobupivacaine solution of (no more than 50 mg) after tracheal intubation, under sterile conditions using ultrasound navigation.

In group 2 (n=40), the blockade of the superficial cervical plexus (subcutaneous fatty tissue along the posterior edge of the sternocleidomastoid muscle) and deep cervical plexus (prevertebral space, at the level of C2–C4) was performed with a levobupivacaine solution. The total dose of 0.5% local anesthetic solution did not exceed 150 mg. In group 2, after a skin incision and the carotid artery exposure, an additional block of the carotid sinus nerve, being a branch of the glossopharyngeal nerve, was performed. Heart rate, SpO_2, and transcranial cerebral oximetry (TCO) were monitored. A reduction in TCO of less than 50% was considered critical, which was an indication for using an intraoperative shunt.

In group 2, for the purpose of sedation, dexmedetomidine was administered intravenously at a loading dose of up to 1 mcg/kg/h for 10 minutes; during surgery, a maintenance dose of the drug of 0.2–0.4 mcg/kg/h was used. The depth of sedation was maintained at level 3-4 of Ramsay sedation scale throughout the procedure. The Montreal Cognitive Assessment scale was used to assess cognitive function before and after surgery.

The operating room “occupancy” time, satisfaction with anesthesia, adverse events, complications, the number of days the patient spent in hospital, and cognitive status were recorded. When comparing patients between the study groups by gender, age and the presence of concomitant pathology, no statistically significant differences were revealed (Table 1).

Table 1. Patient characteristics by gender and age

Parameter	CETA + RA (n=40)	RA (n=40)	R
Age, years	69 (66;73)	71 (68;74)	>0.05
Men/women, %	28/12 70/30	31/9 77/13	>0.05

Statistical analysis

Statistical data processing and analysis were performed in the Statistics program for Microsoft Windows software (USA). Results are presented as means ± standard deviation for normal distribution, or medians and percentiles (25%;75%) for non-normal distribution. To compare changes in quantitative variables between different groups, the Mann–Whitney U test was used. Comparisons of qualitative data were performed using Pearson's χ^2 test or Fisher's exact test. Differences were considered statistically significant at $p<0.05$, and a trend toward statistical significance was defined as $p<0.1$.

Results

In our study, all patients underwent surgery and were discharged from the hospital; there was no statistically significant difference in the hospital length of stay (the discharge on the 5^{th} day).

During surgery, the cerebral oximetry parameter, when clamping the carotid artery, neither decreased lower than 50%, nor and there were indications for the use of an intraoperative shunt in any of the patients included in the study. In the postoperative period, narcotic analgesics were not used, and the pain level assessed by VAS did not exceed 5 points.

In group 1, there were recorded hypotension episodes in 5 cases (12.5%) during the induction anesthesia with blood pressure lower than 90 mm Hg, and the tachycardia episodes and significant hypertension in 10 patients (25%) with blood pressure over 170 mmHg and heart rate

exceeding 90 beats per minute when performing tracheal extubation (Table 2).

Table 2. Intraoperative hemodynamic changes and postoperative complications

Characteristic	CETA + RA (n=40)	RA (n=40)	p
Intraoperative shunt	0	0	>0.05
Episodes of hypotension: $BP_{systolic}$ lower 90 mm Hg	5 (12.5%)	0	<0.05
Episodes of hypertension: $BP_{systolic}$ more than 170 mm Hg	10 (25%)	4 (10%)	<0.05
Episodes of tachycardia	8 (20%)	4 (10%)	<0.05
Transient cerebrovascular accidents	1 (2.5%)	1 (2.5%)	>0.05
Hematoma in the area of surgery	5 (12.5%)	2 (5%)	<0.05

In group 2, patients were breathing spontaneously and were fully accessible to contact.

Adverse events noted in patients during surgery are presented in Table 3.

Table 3. Adverse events and patient satisfaction with anesthesia

Characteristic	CETA + RA (n=40)	RA (n=40)
Complaints of pain during surgical intervention	–	4 (10%)
Shortness of breath sensation and anxiety	–	1 (2.5%)
Position discomfort	–	3 (7.5%)
Nausea	3 (7.5%)	–
Vomiting	2 (5%)	–
Completely satisfied (would prefer this type of anesthesia for repeat surgery)	38 (95%)	32 (80%)

In one case, the patient complained of a feeling of air shortage; anxiety and restlessness appeared, and therefore, a conversion to general anesthesia was undertaken. The most likely cause was the distribution of anesthetic into the phrenic nerve area.

Thus, complaints of pain in the surgical area were registered in 4 patients (10%), a feeling of discomfort due to an uncomfortable position were reported by 3 patients (7.5%) of the 2^{nd} group.

In the 1st group of patients, the postoperative period was accompanied by nausea in 3 patients (7.5%) and vomiting in 2 (5%).

Narcotic analgesics were not used in the postoperative period, the pain level did not exceed 5 points by VAS.

In the CETA group, 38 patients (95%) were completely satisfied with anesthesia; in group 2, 32 patients (80%) were satisfied (see Table 3).

The reasons for dissatisfaction with CETA were postoperative nausea and vomiting, and transient cerebrovascular accidents (Tables 2, 3).

The reasons for dissatisfaction with RA were intraoperative pain in 4 patients, intraoperative discomfort and stress in 3 patients, and intraoperative breathing problems in 1 patient (see Table 3).

In the CETA group, 38 patients (95%) would prefer the same type of anesthesia if another surgical intervention was necessary. In group 2, 32 patients (80%) would prefer RA in case of reoperation (Table 3). The difference in preferences was statistically significant ($p<0.05$).

We assessed the time spent by the patient in the Operating Room, which was statistically significantly 31.8% shorter in group 2 (70±12 min) than in group 1 (110±15 min) ($p<0.05$).

There was no statistically significant difference ($p>0.05$) between the groups in the hospital length of stay: 6±1 days in group 1 and 5±1 in group 2, or in the level of cognitive impairment identified using the Montreal Cognitive Assessment scale (Figure).

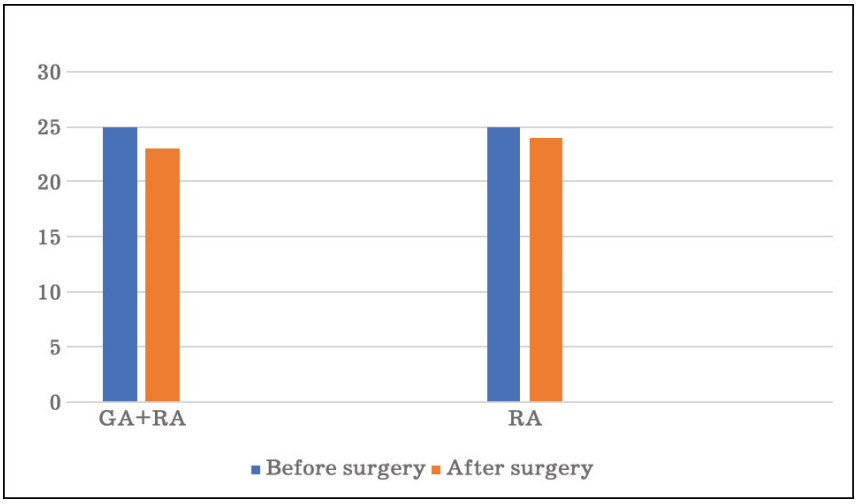

Figure. The assessment of cognitive impairment by using the Montreal Cognitive Assessment (MoCA) test

Discussion

One of the main disadvantages of RA is the development of adverse events that require an urgent conversion to general anesthesia during surgery, which in our study was required in 2.5% of cases. That might be caused both the impact of certain stages of surgical intervention (loss of consciousness when the carotid artery is clamped, the need for bypass surgery and associated complications) [9, 11], and the regional anesthesia (insufficient blockade, blockade of the phrenic nerve or vocal cords, systemic toxicity of local anesthetics, airway obstruction, accidental subarachnoid injection) [11]. In our series, only one case required the conversion of anesthesia, which did not cause technical difficulties. Meantime, severe cardiovascular concomitant diseases are the main factors influencing the choice of regional anesthesia. Thus, we previously presented our own successful experience of using RA during CEA in a patient with a low ejection fraction [15]. Another advantage of RA is the reduction in the time length of patient's staying in the operating room, which is of no small importance for a large number of operations. At the same time, we avoid potential complications of a tracheal

intubation, including hemodynamic changes, which were statistically significantly more often recorded in group 1.

Overall, the patient survey showed that satisfaction with anesthesia was higher in the group of general anesthesia plus RA. The main causes of dissatisfaction were postoperative nausea and vomiting among the patients of the 1st group, and a certain positional discomfort of in the intraoperative period, pain, stress from being present at one's own operation, cough and difficulty swallowing in the 2nd group. As previous studies show, a personalized approach takes on leading importance when choosing anesthesia for CEA. The widespread implementation of ultrasound navigation into the practice of anesthesiologists has significantly increased the efficacy of the RA use [4, 9, 12].

Levobupivacaine worked well for CEA in both groups. This is confirmed by the use of narcotic analgesics in group 1 only during the induction anesthesia. Moreover, the pain level assessed by VAS was lower than 5 points in the postoperative period. As recent studies have shown, levobupivacaine has less toxicity compared to bupivacaine and is not inferior in analgesic effect to ropivacaine [13, 16].

In some cases, we associate the pain complaints with certain individual anatomical features, for example, high bifurcation of the carotid artery, and/or cross innervation.

Conclusion

The use of regional anesthesia during carotid endarterectomy in patients with severe concomitant pathology helps to avoid the risks of developing possible complications when performing combined endotracheal anesthesia. In both cases, the effective local anesthetic is levobupivacaine.

Levobupivacaine use as a local anesthetic has confirmed its good analgesic properties and decreased the required total amount of narcotic analgesics during and after surgery.

In conclusion we should state the following:

- Regional anesthesia statistically significantly reduces (by 1.6 times, $p < 0.05$) the patient's stay in the operating room and helps to avoid potential adverse events of combined endotracheal anesthesia during carotid endarterectomy.
- Patient satisfaction with the general anesthesia combined with regional anesthesia is 15% higher than that with regional anesthesia.

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