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**CHOICE OF ANESTHESIA METHOD FOR TRANSFORAMINAL
ENDOSCOPIC DISCECTOMY (TFED)**

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Transforaminal endoscopic discectomy (TFED) is a modern effective method of removing symptomatic hernias in the lumbar spine that cause therapeutically resistant pain syndromes. It gained its popularity due to its safety and minimally invasiveness. To avoid injury to the nervous system, this operation must be performed with the patient's clear consciousness. Combined anesthesia (CA), which combines a local anesthetic with an opioid analgesic and epidural anesthesia (EA), are alternative methods of anesthesia, which allows to maintain adequate speech contact between the surgeon and the patient.

Goals and objectives. Compare the efficacy and side effects of CA and EA during TFED.

Materials and methods. The study included 32 patients operated on for herniated intervertebral discs in the lumbar spine during the period 2019-2020. The patients' age was from 24 to 58 years (43 ± 9.8). Among them there were 22 women (68.75%), men - 10 (31, 25%). In 5 cases (15.6%), TFED was performed at the L3L4 level, in 10 cases (31.2%) at the L4L5 level and in 17 cases (52.2%) at the L5S1 level. All patients were

divided into 2 groups: a group with combined anesthesia (CA group) and a group with epidural anesthesia (EA group). The first group included 14 (43.75%) patients, the second - 18 (56.25%) patients. Transforaminal endoscopic discectomy was performed according to the standard Maxmorespine® technique. The results of surgical treatment were determined according to the MacNab criteria. The severity of pain syndrome was assessed according to the visual analogue scale (VAS). The following time frames were chosen: before the intervention, intraoperatively, 1 hour after the intervention and 7 days after the operation. Statistical data were processed by the Statistica-10 program. Side effects such as nausea, vomiting, muscle weakness, dysuria, and arterial hypotension were evaluated. Complications in the form of damage to the meninges and neural structures were taken into account.

Results and discussion. There were no complications in both groups. All patients were discharged from the hospital in satisfactory condition the next day after the operation. According to MacNab criteria, all patients were treated with good (56.25%) and excellent (43.75%) outcomes. The analysis shows that in the EA group the level of intraoperative analgesia was significantly higher, which ultimately resulted in a higher degree of satisfaction with anesthesia in patients. A similar pattern was observed when comparing the severity of postoperative pain. In the EA group, two patients (11%) had transient muscle weakness in the lower extremities, which we regarded as a result of prolonged action of epidural anesthesia in conditions of insufficiently correct sensory-motor separation. 5 patients (28%) in the CA group had complaints of nausea and vomiting, the probable cause of which was a side effect of opioids. Dysuric phenomena were not registered in any of the groups.

Conclusions. EA, in our opinion, is preferable to CA for TFED in the lumbar spine. It has a great analgesic effect and is devoid of the side effects of opioids.

Key words: transforaminal endoscopic discectomy, combined anesthesia, epidural anesthesia, efficacy, side effects

Introduction

Percutaneous transforaminal endoscopic discectomy (TPED), performed under local anesthesia, has been gaining popularity in recent years due to improved endoscopic imaging and increased patient needs for minimally invasive procedures [1-3]. The safety and effectiveness of this method of removing lumbar disc hernias has been confirmed by several randomized studies [4-8]. In addition, the indications for TFED have been successfully expanded in the case of recurrent extrusions, spinal stenoses, foraminal and extraforaminal protrusions [3,9-13]. Compared to "open" operations, TFED has the advantages of a smaller skin incision and soft tissue trauma, a reduction in the time of surgery, a decrease in intraoperative blood loss and postoperative complications [2,6-8]. The use of local anesthesia for endoscopic discectomy is recommended in order to avoid damage to the spinal roots [8,14,15]. Local anesthesia allows patients to be alert during surgery. Thus, the surgeon has a verbal communication with the patient and can correct his actions while working on neural structures. However, clinical observations show that some patients experience quite pronounced pain during the operation, especially for such stages as the installation of a working port, radiculolysis, removal of large sequestered fragments. In addition, one report contained information that due to severe pain caused by the manipulation of the surgeon, the intervention had to be stopped [8]. For these reasons, the use of exclusively local anesthesia remains controversial. The most widely used method of combined anesthesia (CA), which is a combination of intramuscular

injection of 10 mg of morphine and local anesthesia with 1% lidocaine. Having proven itself functionally well, this method has a negative side, manifested in the form of such side effects of opioids as nausea and vomiting. Another important method of pain relief, which assumes a clear consciousness of the patient during the intervention, is epidural anesthesia (EA). Reasonable choice of anesthetic and control of the sensory sphere helps to prevent pain and, at the same time, to maintain the motor function of the lower limbs. In addition to being easier to control, this type of pain relief avoids the negative effects of opioids. Literary information comparing different methods of anesthesia during SPED is rather scarce [16], so we decided to conduct our study.

Goals and objectives.

To compare the effectiveness of various types of anesthesia during the surgical treatment of transforaminal endoscopic discectomy. Assess the unwanted side effects of each of these methods.

Materials and methods

The study included 32 patients operated on for herniated intervertebral discs in the lumbar spine during the period 2019-2020. The patients' age was from 24 to 58 years (43 ± 9.8). Among them there were 22 women (68.75%), men - 10 (31.25%). In 5 cases (15.6%) TFED was performed at the L3L4 level, in 10 cases (31.2%) at the L4L5 level and in 17 cases (52.2%) at the L5S1 level. All patients were divided into 2 groups: a group with combined anesthesia (CA group) and a group with epidural anesthesia (EA group). The first group included 14 (43.75%) patients, the second - 18 (56.25%) patients (Fig. 1, Fig. 2).

	Combined anesthesia group (CA)	Epidural Anesthesia Unit (EA)
Male	4	6
Female	10	12

Fig. 1. Distribution of patients by sex in the groups of combined (CA) and epidural anesthesia (EA).

Level	Combined anesthesia group (CA)	Epidural Anesthesia Unit (EA)
L3L4	2	3
L4L5	4	6
L5S1	8	9

Fig. 2. Distribution of patients according to the level of operated intervertebral disc hernias in the groups of combined (CA) and epidural anesthesia (EA).

The inclusion criteria for the study were as follows: 1). clinically significant disc hernia of one lumbar-motor segment (LMS); 2). therapeutically resistant radicular syndromes such as sciatica, positive Lasegue symptom, segmental sensory and / or movement disorders; 3). confirming additional research methods (MRI); 4). more than 6 weeks of unsuccessful conservative treatment. The following exclusion criteria were selected: 1). congenital and acquired malformations of the spine, including scoliosis, sacralization, lumbarization, non-closure of the vertebral arches; 2). previous operations on the same LMS, including recurrent extrusions; 3). polysegmental LMS lesion, when there were 2 or more-disc hernias; 4). non-discogenic stenosis of the spinal canal; 5). spondylolisthesis and LMS instability; 6). cauda equina syndrome; 7). sequestered disc hernias with pronounced cranial or caudal migration.

In the CA group, 10 mg of morphine hydrochloride was injected intramuscularly 30 minutes before the operation. After placing the patient in the prone position and preoperative marking, the skin was infiltrated at the site of the intended incision with 1% lidocaine solution in an amount of 2-3 ml. Then an 18G needle, 10 cm long, was inserted to anesthetize the access trajectory, also with 1% lidocaine in an amount of 8-10 ml. After reaching the superior articular process, 2-3 ml of 1% lidocaine solution was used to anesthetize the facet joint. In the EA group, the epidural space was

punctured with a Tuohy needle by interlaminar access 2 segments above the operation level (Fig. 3).



Figure 3. An epidural catheter was placed and secured with adhesive tape on the patient's back. The black arrow marks the place of catheter insertion (L2-L3 level), the white arrow - the level of the operation (L4-L5).

Initially, 3 ml of 1% lidocaine solution was injected as a trial. After 5-7 minutes, making sure that the anesthetic was not injected intrathecally, a 0.25% ropivacaine solution was added. The volume of the latter was adjusted until sensory-motor separation was achieved. Transforaminal endoscopic discectomy was performed according to the standard Maxmorespine® technique [5] (Fig. 4).

Patient satisfaction with the results of surgical treatment was determined according to the MacNab criteria. The severity of pain syndrome was assessed according to the visual analogue scale (VAS). The following time frames were chosen: before the intervention, intraoperatively, 1 hour after the intervention and 7 days after the operation. Statistical data were processed by the Statistica-10 program.

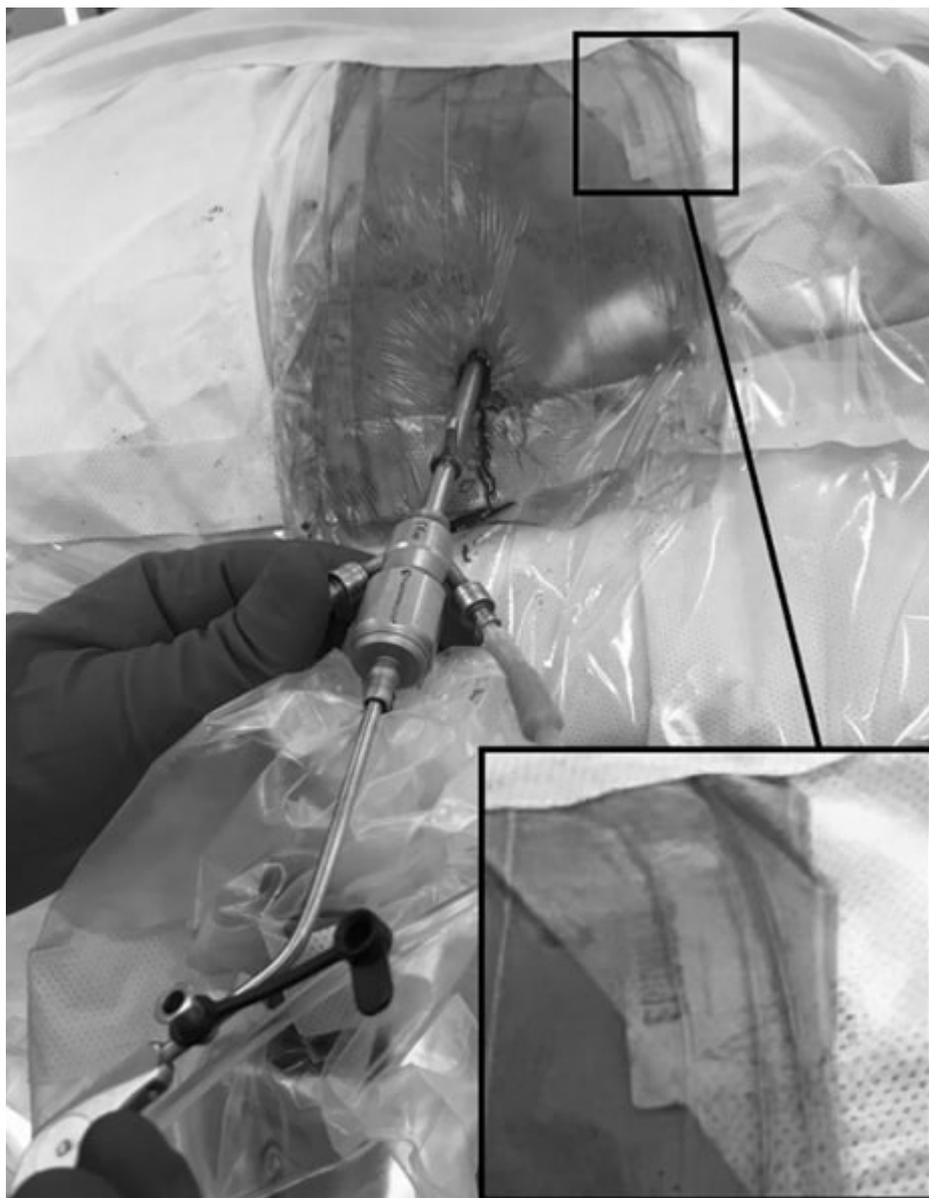


Figure 4. Stage of the TFED operation: the working port is located paravertebrally, an endoscope with discectomy nippers is inserted into it. Bottom right - the site of the epidural catheter.

Results and discussion

There were no complications during the intervention. All patients were discharged from the hospital in satisfactory condition the next day after the operation. According to the MacNab criteria, all patients were treated with good (56.25%) and excellent (43.75%) outcomes. Before the intervention, most patients rated their pain sensations as “severe, sometimes

intolerable”, from 6 to 9 according to the VAS (average 7.5 ± 1.07). During the follow-up visit to the clinic seven days later, many patients had no pain at all, or were described as "light, transient", from 0 to 1 according to VAS (on average, 0.56 ± 0.5). The analysis shows that there were no significant differences in the level of pain before surgery and one week after it was performed in both groups. Significant differences were observed in the degree of intraoperative and early (1 hour) postoperative analgesia (Fig. 5, Fig. 6).

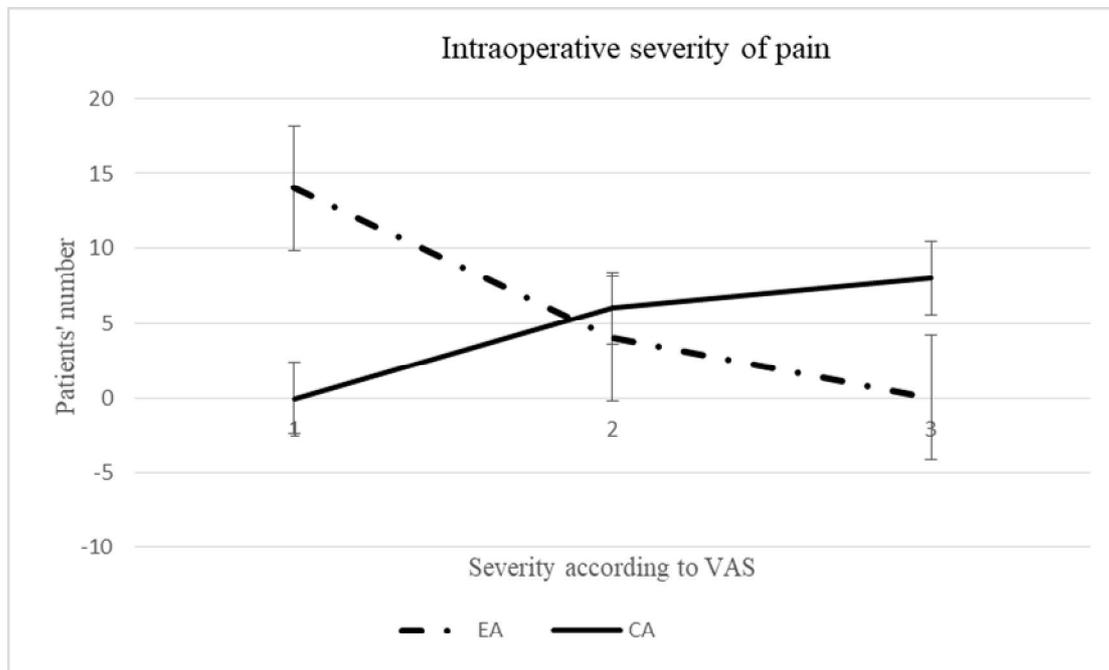


Figure 5. Intraoperative severity of pain in the groups of combined (CA) and epidural anesthesia (EA). The vertical lines represent the standard error.

Comparing the data obtained, we can confidently state that in the EA group the level of intraoperative analgesia was significantly higher, which ultimately resulted in a higher degree of satisfaction with anesthesia in patients (Fig. 7).

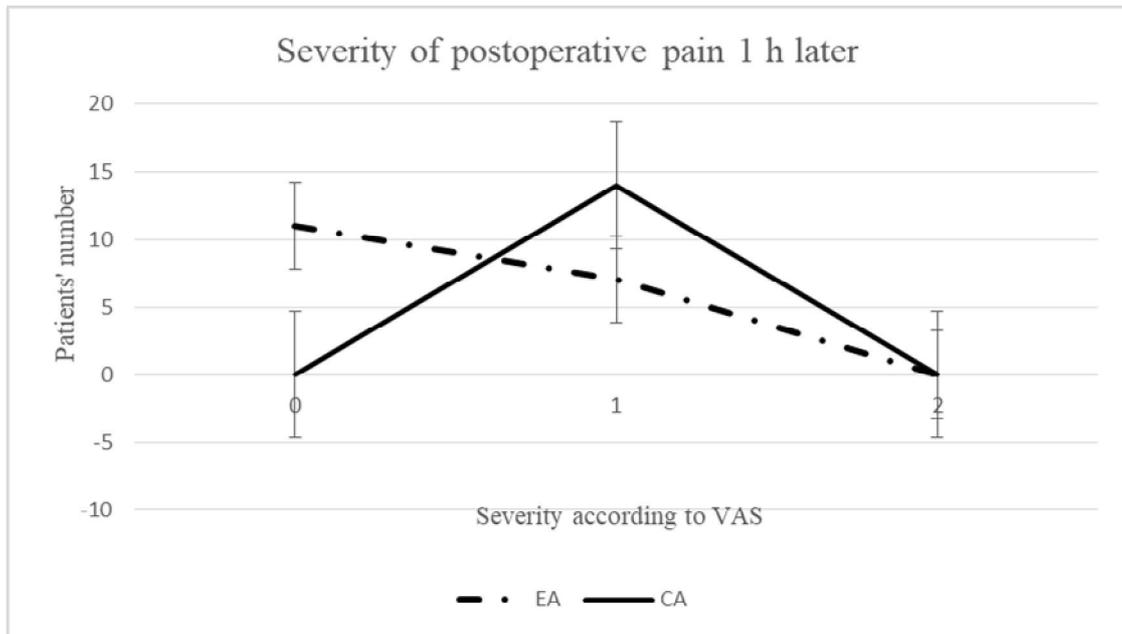


Figure 6. The severity of postoperative pain in the groups of combined (CA) and epidural anesthesia (EA). The vertical lines represent the standard error.



Figure 7. General view of the operating room during SPED using EA. The patient's eloquent gesture and a smile on her face indicate an adequate level of analgesia.

A similar pattern was observed when comparing the severity of postoperative pain. In the EA group, two patients (11%) had transient muscle weakness in the lower extremities, which we regarded as a result of prolonged action of epidural anesthesia under conditions of insufficiently correct sensory-motor separation. 5 patients (28%) in the CA group had complaints of nausea and urge to vomit, the probable cause of which was a side effect of opioids. Dysuric phenomena were not registered in any of the groups. Overall, the study confirms that both methods of anesthesia perform reasonably well for surgical pain. The search for effective analgesia continues and, ultimately, should increase patient satisfaction and reduce treatment costs without compromising its quality [17]. In this regard, the mechanism of pain management is extremely important for the implementation of TFED. Local anesthesia has the advantage of being easier to administer and less risk of potential complications. However, its effectiveness in reducing intraoperative pain is significantly lower. Low concentrations of ropivacaine in the epidural space can effectively prevent surgical pain while maintaining the motor function of the lower extremities, which is extremely important for maintaining verbal contact between the surgeon and the patient. But EA is more difficult and time-consuming to conduct, has a greater risk of potential complications, which include damage to the dural sac, arterial hypotension, and urinary retention. In addition, the duration of postoperative bed rest in the case of EA is slightly longer. Opioids are most commonly used to block intraoperative pain [18]. However, morphine has side effects such as nausea and vomiting, which should certainly be taken into account. It should be emphasized that intraoperative pain during SPED has several peaks. The first of them occurs during the formation of the canal in the facet joint by the burs and the installation of the working port. The second is associated with irritation of the root at the time of hernia removal [19]. Most of the patients who were

dissatisfied with the operation under the CA pointed precisely to these aspects. The use of EA made it possible to successfully overcome the aforementioned peaks of pain. The absence of pain during key points in instrument positioning reduces the need for repeat fluoroscopy. Thus, the operation time and the dose of radiation exposure are reduced. This is especially true given the recommendations of the International Commission on Radiological Protection (ICRP) for specialists working with the appropriate equipment [20]. As a result, the formally longer time required for the EA is leveled out according to the overall results of the operation. It should also be noted that an excessive amount of lidocaine injected into the facet joint in CA can easily anesthetize the spinal root. As a result, the patient loses the ability to control his sensations when neural structures are irritated, adequate verbal contact with the surgeon is disturbed, and the likelihood of root injury increases.

Conclusions

Epidural anesthesia, in our opinion, is preferable for transforaminal endoscopic discectomy in the lumbar spine. It has a greater analgesic effect in comparison with combined anesthesia and is devoid of the side effects of opioids. If EA is performed by an experienced specialist, the risk of potential complications is minimized. This does not increase the total operation time, and the radiation load decreases.

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