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THE TECHNIQUE OF MONOLATERAL COMBINED EPIDURAL-SPINAL ANESTHESIA

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Relevance. The Modified CSEA with single spinal needle firstly was described by P.Kumar [1]. The monolateral spinal anaesthesia was firstly described by Tanasichuk M. A., Schultz E. A., Matthews, J. H. et al. [2]. According to the literature, there are several methods of monolateral spinal anesthesia (MSA) such as suggested by the authors: Koryachkin V. A., V. I. Strashnov, A. A. Khryapa, D.A. Shelukhin, T.I. Dumpis «Odnostoronnyaya spinalna anestheziya»[3], such as suggested by the authors: "Spinalna anesteziya u travmatologichnih hvorih visokogo riziku: perevagi unilateralnoi tehnyaki z vikororistaniyam gipobarichnih rozchiniv." Y.P. Kuchin, Glumcher F.S. et al.// BIl, znebolyuvaniya i intensivna terapiya [4].

The technique of anesthesia involves the puncture of the subarachnoid space of the patients lying on the side prior to surgery, and then a local anesthetic hyperbaric solution was slowly injected into the subarachnoid space. This led to the fact that the local anesthetic fell down in the cerebrospinal fluid under the action of gravity and was located only on one side of the subarachnoid space along the spinal cord, which blocked the pain and motor sensitivity only on one side.

Another MSA technique is based on the application of bupivacaine hypobaric solution, in which the puncture is made to the patient laying on the side opposite of the intended operation. After the injection, due to its hypobaric properties, local anesthetic blocked pain and motor sensitivity on operated side. The authors noted that unilateral spinal anesthesia was accompanied by less disruption of central hemodynamics and respiration due to sympathetic blockade only on one side.

The disadvantages and dangers of MSA techniques can be the fact that they are made with usual needles for spinal anesthesia, which do not allow to determine the location of the needle tip in the subarachnoid space toward the midline. During the process of puncture, a needle may deviate from the midline, there are no objective criteria for the location of the needle tip within the subarachnoid space, which is especially important in MSA, in which local anesthetic should be distributed along the spine on one side only and cause adequate block of pain and physical sensitivity. This MSA technique is associated with greater risk of neurological complications, due to the fact that the unknown depth of insertion and the direction of needle in the subarachnoid space. Then there is a high probability of damage to the neural structures, blood vessels of both subarachnoid and front/rear epidural space. There is a high probability of receiving inadequate unilateral spinal and mosaic anesthesia as a result of random insertion of the needle and local anesthetic on the opposite side. This MSA technique requires wide experience and high qualification of anesthesiologist. On the other hand, the MSA technique with the use of hypobaric local anesthetic solution requires to produce a local anesthetic dilution with bidistilled water for injection to reduce the baricity of initial local anesthetic. The large dilution of the local anesthetic leads to a reduction of its working concentration, which reduces the quality of the blockade and its effectiveness. As a result, and it was noted by the authors of the method, the frequency of inadequate blockade was higher in comparison with the MSA with the use of a hyperbaric solution of local anesthetic.

However, in the last decade there is implemention of special insulated needles for electroneurostimulation (next ENS). The use of needles for ENS facilitates and speeds up the search of the nerve plexus and major nerves. This allows providing blockades with the least amount of complications – Pashchuk A. Y.[5], Rathmell James P. Neal Joseph M., Viscomi Christopher M.[6], The use of ENS during MSA formed the basis for the development of our new technique of unilateral spinal anesthesia [7,8].

The purpose of the study: to develop the technique of unilateral combined epidural spinal anesthesia (CMESA), which would be more efficient, safer and economically compared to already known techniques.

MATERIALS AND METHODS

The study was carried out with the permission of the Ethical Committee of Semey State Medical University. The study involved 19 patients divided into 2 groups. In the 1st control group which included 12 patients at the age of 21 to 55. There were 10 men, 2 women. In the 2d group, with MCESA there were 7 patients at the age of 22 to 57. There were 5 men, 2 women. The profile of the surgery patients comprised vascular surgery and trauma who underwent operative treatment for femoral-popliteal bypass grafting, thrombectomy, varicose veins of the lower extremities, and the removal of osteosynthesis. In the control group a standard needle for spinal anesthesia with sizes from 22 to 25 G was used. In the main group there were used special insulated needles for ENS - Stimuplex 22G, special device for ENS - Stimuplex-HNS-12 (B. Braun) and Pajunk (Germany). All patients had

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the puncture of the subarachnoid space in a sideways position, on the side of the surgery.

The MCESA technique with electroneurostimulation.

All patients was placed in position on the side of the surgery. Intravenous line was secured in forearm with 18-20G intravenous cannula and monitoring of non-invasive blood pressure, SpO2 were established. For 15-20 minutes, all the patients were hydrated with 5-10 ml/kg of 0.9% sodium chloride solution, ringer solution before providing the spinal block. The punction of Dura mater, if the patient showed a motor response and felt irritation with electric current on the side of the upcoming surgery, we injected a full dose of a local anesthetic hyperbaric solution in amount of 7.5-10 mg of 0.5% bupivacaine slowly without barbotage or aspiration for 100-120 seconds. Slow speed of injection minimizes mixing of local anaesthetic with cerebro-spinal fluid and thus facilitates unilateral block. In main group with strict aseptic precautions, puncture of epidural space and subarachnoid space was made at level LII-LIII or LIII-LIV by needle Stimuplex 22G, connected to the ENS device, with the loss of resistance test made with 2 ml syringe with air. After puncturing the ligamentum flavum, with the loss of resistance test, we injected 10 ml 0,5% bupivacaine to the epidural space. After that, turned on the electroneurostimulator and continued moving needle towards dura mater.

After puncturing the Dura mater, if the patient's lower extremities received motor response and felt irritation with electric current on the side of the upcoming surgery, we injected a full dose of a local anesthetic in amount of 5-7.5 mg of 0.5% hyperbaric bupivacaine slowly without barbotage or aspiration in 100-120 seconds. Slow speed of injection minimizes mixing of local anaesthetic with cerebro-spinal fluid and thus facilitates unilateral block.

After injection, all patients of 1-st and 2 group were remained in the lateral position for 18-20 minutes for better fixation of a local anesthetic on the nervous structures, before turning supine.

At the moment of puncturing dura mater, depending on the degree of deviation of the needle and its location towards the median line, we received a clear motor response and subjective sensation of electrical stimulation that allow the anesthesiologist to determine the location of the needle tip towards the midline and depending on its location, then we turned the bevel in the required direction and injected a local anesthetic. On the other hand, if there was not the above feeling of irritation with electric current and motor response on the intended side, it meant that the needle tip was placed wrong.

For example, if the location of the needle tip was in the midline or above it, we turned bevel into the side of the operated limb and injected local anesthetic. In cases when the needle tip was located on the side of the planned operation, depending on the level of the puncture, the severity of lordosis of the spine, and body and position of the patient on the operating table, we turned bevel either cranially or caudally and injected the full dose of local anesthetic.

In the control group, MSA was injected by usual needles for spinal anesthesia.

RESULTS OF RESEARCH AND DISCUSSION

Hemodynamic parameters of the patients in a control group after the onset of anesthesia were unidirectional and accompanied with a decrease of arterial pressure by 11.5%, for patients of the main group - by 10.5%. Duration of MCESA was 248,5±5,6 min., duration of MSA was 158,8±3,4 min.

The frequency of intraoperative complications was higher for patients of the 1st group compared to the second group. Thus, 2 (16,6%) patients of the control group experienced the hypotension below 80 mm of mercury after the onset of anesthesia, 1 (8,3%) - nausea and 1 (8,3%) - vomiting. In the main II group, 1 (8,3%) patients experienced the hypotension below 80 mm of mercury, 1 (8,3%) - nausea.

It should be noted that hypotonia for the 1st group patients occurred much faster and required a lot of efforts for its correction, in comparison with II group patients.

2(16,6%) group I patients and 1(8,3%) group II patients had post dural puncture headache. There were not complications developed by our MCESA technique.

Thus, we were first to do MCESA, using special insulated needles for ENS, in particular Stimuplex – 22G with of 80 mm, which allow to determine the moment of puncturing dura mater and the location of the tip in the subarachnoid space of the spinal cord towards midline, according to the received motor response and sensation of the irritation of lower extremities with an electric current. The possibility to determine the localization of the needle tip in the subarachnoid space toward the midline, which is determined by the electric current stimulation and motor response, allow to predict success of the ongoing MCESA and almost 100% probability of injection of local anesthetic into the subarachnoid space after the injection of local anesthetic into epidural space and to have high-quality unilateral combined epidural spinal anesthesia. This technique provided the possibility to correct the direction of injection of the local anesthetic, by turning the bevel in the desired direction, according to the location of the needle tip in the subarachnoid space. MCESA with ENS increased the quality and efficiency of the unilateral spinal anesthesia and helped to reduce the number of complications.

This technique allowed to reduce the amount of local anesthetic injected into the subarachnoid space of the spinal cord by 2 times, due to a more precise identification of the place of its injection, compared to the conventional MSA techniques. This technique opens broad prospects for the MSA application for surgical patients who have been shown surgery on one side. This was particularly important for immunocompromised patients whose routine spinal anesthesia may be accompanied by severe disturbances of hemodynamics and respiration. In the case of any neurological complications (paresis, palsy, etc.), you can clearly see the relationship between produced puncture of the subarachnoid space, the location of the needle tip inside of it during the anesthesia and the resulting neurological deficits.

The MCESA with ENS technique, developed by us, formed the basis for the development of a new method of spinal anesthesia. As a result of the studies, we obtained a prepatent for the invention of NIIS of the Republic of Kazakhstan.

Research transparency

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Declaration about financial and other relations

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Conflict of interest

The authors state that there is no conflict of interest.

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