

Modified Epidural Analgesia in Patients with Ischemic Heart Disease

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Abstract

Epidural analgesia (EA) is one of the best measures for prevention of patient's stress during surgical operation. But arterial hypotension during EA may cause potentially hazardous situations. The effects of different types of EA on haemodynamics have been investigated during analgesia in 84 patients with ischemic heart disease. All patients were haemodynamically and ECG monitored. Cardiac performance, cardiac output, acid-base state before, during and after operation were studied. It has been shown that introduction of local analgesic (LA) into epidural space (ES) with gradual increase of volume and concentration allowed us to achieve a sufficient quality of anesthesia with minimal haemodynamic changes

Key words: Epidural analgesia, Ischemic heart disease, Haemodynamics.

Introduction:

The use of epidural blockade technique is becoming a more popular means of anesthesia for patients with heart disease^{1,2}. It is generally agreed and widely taught that well performed EA offers major advantages to such patients^{3,4}. EA has exerted minimal influence on acid-base balance and metabolism, it has provided long-term postoperative analgesia and has diminished the use of narcotic analgesics^{5,6}. But EA may cause arterial hypotension due to interruption of sympathetic regulation especially in old patients and in patients with cardiovascular disorders⁷. The blockade of upper thoracic segments is accompanied by pharmacological denervation of heart sympathetic fibers⁶. It is characterized by negative inotropic and chronotropic effects^{8,9}. EA entailed peripheral resistance reduction, venous tone lowering, venous stagnation and changes in blood distribution to relaxed muscles and to skin^{10,11}. Different attempts

were undertaken to decrease negative influence of epidural blockade on haemodynamic state such as preliminary volume replacement, vasopressor addition to the solution of LA, vasoactive therapy, using infusion pump^{7,12}. All these measures have usually prevented extensive haemodynamic changes during anesthesia, but hypotension is still and remains to be a troublesome problem of EA.

We advise administration of LA solution into epidural space with gradual increase of volume and concentration to obtain sufficient quality of analgesia with minimal haemodynamic changes.

Materials and Methods:

This study was undertaken according to guidelines laid down by the Local Ethical Committee.

The patients were fully informed and agreed to the investigation procedures. The investigated group consisted of 84 patients (54 men, 30 women), they all underwent elective surgery due to hip-fractures and

urological disorders (ureterolithotomy) with an average age of 58 years (range 40 to 79). The patients were divided into two groups randomly, each group consisted of 42 patients in order to study the effects of analgesia. The two groups were compared by sex, age, weight and physical status (ASA). All baseline measurements were taken before EA. The results were within normal limits and without significant differences between the two groups.

All patients received EA without any additional sedation. Epidural catheter was inserted at the appropriate vertebral interspace (L2-3 for hip-fracture operations and Th 9-10 for urological operations). The 19-gauge Teflon catheter was inserted into the epidural space through the Touhy needle, using standard technique, and placed at the appropriate site.

We used 1% & 2% Lidocaine and 0.005% Fentanyl to perform EA in both groups. Puncturing and catheterisation of epidural space was performed 30-40 minutes before the operation. Soon after LA introduction the patients were positioned in the supine horizontal, lateral or Fowler's position for attainment of the predominant LA spread in the desirable direction in ES (Epidural Space).

The scheme of Lidocaine administration in the first group was as follows: initial dose – 0.25 mg/kg of 1% solution; after 3 minutes - 0.5 mg/kg of 1% solution; then 0.5 mg/kg, of 2% solution after another 3 minutes; and after that 1 mg/kg of 2% solution and so on to the development of an adequate level of analgesia (total dose of 6-8 mg/kg).

In the second group Lidocaine was introduced by traditional way: test-dose (80 mg 2% solution) and in 5 minutes the main dose (6-10 mg/kg). For the acceleration of blockade in both groups Fentanyl (1-2 ml 0.005%) was added to initial dose in ES14.

Doses of LA and Fentanyl were determined individually for each patient, taking into account his/her

condition, presence of concomitant diseases, height, weight, effect of analgesia and the changes of arterial pressure values. Dermatome level of anesthesia was determined by pin-prick evaluation.

We evaluated latency and duration of action in both groups. Functional characteristics such as systolic blood arterial pressure (sBP), heart rate (HR), mean blood arterial pressure (MAP) were measured in both groups. The metabolic status was assessed by blood gas analysis and humeral values. The regional blood flow was assessed by photoplethysmography, and haemodynamics was assessed with integral cardiography by M.I. Tischenko with ECG.

Central venous pressure (CVP) was determined by means of a water manometer. The anesthesia level and adequacy were evaluated by external respiration parameters. Tidal volume (TV), respiration rate (RR) and vital capacity (VC) were measured before and after EA, taking into account the patients psychoemotional status.

The patient's sensations of blockade were performed by a special questionnaire. The blockade was ranked as complete, incomplete or failed. The statistical processing of data was performed by Student's t-test with difference being considered significant at $p < 0.05$.

Result:

In both groups good segmental analgesia was developed. None of the patients complained of pain during and for a while after surgery.

Group 1 was characterized by minimal functional motor impairment and haemodynamic alterations. In group 2 motor block developed in 68% of cases. There was no significant difference in dermatome level of anesthesia in both groups.

Table 1 is showing duration of latent and active periods of EA for the two groups of the patients. As we can see in table 1, the time of analgesia on-set and blockade duration was depending upon the type of EA. Modified

EA has had a little longer duration of latent period and the same duration of active period.

As can be seen from the table the mean values of the parameters immediately before surgery have not shown a considerable difference in the groups. The difference in the BP between the two groups was significant ($p < 0.005$) throughout the study. In the 1st group BP and mBP have decreased slightly after anesthesia development and have returned to control value in 20-30 minutes, while in the 2nd group, BP has decreased significantly during EA and continued to decrease for 1.5 hours. The 2nd group was characterized by a marked decrement in stroke volume and cardiac index ($p > 0.005$). In 2nd group there was necessity for rapid volume replacement (more than 1000 ml) for 23 patients and 3 patients have received vasoactive drugs.

In the 1st group in 2 patients ST-segment depression was developed and in 1 patient supraventricular extrasystoles were observed. In the 2nd group in 10 patients ST segment depression developed and in one patient ST-segment elevation was observed and in one patient nodal rhythm was developed.

The analysis of photoplethysmograms brought us to a conclusion that both types of EA led to enhancement of blood flow in the upper and lower limbs. This result might be mainly to the arterial and capillary dilatation.

The study of humoral and metabolic characteristics in both groups showed that the initial and postoperative mean values of adrenocorticotrophic hormone and cortisol displayed just a slight difference in both groups ($p > 0.05$).

Plasma sodium, potassium and ionised calcium concentrations and arterial pH remained stable during the whole perioperative period in both groups of the patients.

Discussion:

It is very important for anesthetists to be aware of the possible problems which may occur in perioperative period in patients with concomitant cardiac diseases in

order to prevent the potential serious cardiac problems¹⁵. The patient during operation and in the postoperative period should be kept under deep analgesia so the nociceptive stimuli do not provoke an outpouring of catecholamines in the event when adrenergic blockade is incomplete. But for the good or excellent analgesic effect there is no necessity to use a great amount of concentrated solution of LA. The nerve cell membrane can interact only with such quantity of LA which needs to create threshold block. With the excess, in the best case, the effect is only prolonged^{18,19}. It is known that fast injection of analgesic drug into epidural space causes acceleration of EA onset²⁰, but it is often accompanied by incomplete anesthesia¹⁷. The speed of injection has a small influence on prolonging the time of EA²¹. With use of low concentration solutions of LA sympathetic blockade with preservation of motor activity is being provided^{16,22}.

The method of EA with the development of resistance to LA is based on introduction of anesthetic solution into epidural space with gradual increase of volume and concentration. It allows to use more effective minimal dose of LA for creation of a threshold block. Thus, one can reach a sufficient quality of anesthesia with minimal haemodynamic changes. In this case the blockade is grown slowly, with the attainment of a complete analgesia by using a minimal amount of LA. The homeostatic mechanisms responsible for control of blood pressure and heart rate will have enough time for gradual adaptation to cardiovascular changes associated with blockade of sympathetic nervous system namely efferent fibres. As a rule, such modified type of EA is characterized by minimal functional motor impairment.

Conclusion:

In elderly patients with ischemic heart disease this type of modified EA is the technique of choice due to decreased risk of cardiovascular system disturbances.

This method has been used routinely in our clinical practice and we are satisfied with the results. Modified EA has reduced the depression of cardiovascular system associated with sympathetic blockade and has allowed the avoidance of extensive haemodynamic alterations during surgery. It can be used successfully as an analgesic measure for patients with impaired cardiovascular reserves.

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Table 1: Onset, duration, total dosage of Lidocain with respect to type of EA

Patient Group	Onset,Min	Duration, Min	Dose mg/kg	Quality of Analgesia*
1	18±2.01	98±22.3	7.1±1.3	3.5
2	16±2.2	104±17.4	8.9±2.1	3.7

* - According to analgesia scale table, ref. N-7, p.74.

Table 2: Changes in functional parameters at respective of type of EA (M±t)

	Group 1			Group 2		
	Before operation	During operation	After operation	Before operation	During operation	After operation
HR per min	71±0.9	69±1.1	68±1.5	73±2.4	65±2.3	63±2.41
MAP(mm Hg)	89.2±3.8	86.0±1.6	88.6±3.9	93.4±4.0	79.6±4.0	74.2±3.2
CI, l/min/m ²	3.41±0.1	3.3±0.1	3.29±0.1	3.3±0.16	2.69±0.13	2.58±0.08
CVP (mm H ₂ O)	83.1±8.2	77.8±20.1	75.2±8.3	87.1±5.9	75.3±14.7	62.5±10.4
BE	+ 1.0±0.35	- 0.5±0.18	+ 0.5±0.15	+1.5±0.12	-2±0.35	+1.0±0.35
pH	7.4±0.1	7.4±0.15	7.39±0.08	7.41±0.05	7.39±0.08	7.4±0.1
RR per min	17±2.1	16.8±3.1	16.4±3.2	17.1±1.3	16.8±2.9	16.2±3.4
TV ml	598±121.1	572±138.4	558±112.3	612±124.5	580±118.4	540±116.4

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