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EVALUATION OF THE EFFICACY OF PARAVERTEBRAL BLOCKADE AS A COMPONENT OF COMBINED ANESTHESIA IN THE SURGICAL TREATMENT OF PULMONARY CANCER

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The aim. *The paper evaluates the effectiveness of implemented combined anaesthesia (inhalation with paravertebral blockade) in comparison with inhalation anaesthesia (IA) and total intravenous anaesthesia (TVA) at the stages of surgery and the early postoperative period in the surgical treatment of cancer lungs.*

Methods. The study involved 60 patients with an average age of 55±5.6 years, physical status ASA II–III, who underwent open surgical interventions in the scope of frontal or pneumonectomy or resection of part of the lung. Patients were divided into 3 groups depending on the method of anaesthetic support at the stage of anaesthesia maintenance: I (n=20) – combined anaesthesia was used; II (n=20) – IA with sevoflurane; III (n=20) – TVA. In addition, the leading indicators of central hemodynamics were studied; oxygen saturation (SaO_2), CO_2 ET (concentration of CO_2 in exhaled air), cortisol level, and indicators of acid-base status were determined. The effectiveness of analgesia in the early postoperative period was assessed using a visual analogue scale (VAS) at 10 control stages. Fasting intensity was recorded after waking up, after extubation, after 1 h. after surgery, on the first day after surgery every 3 h. and once a day from the 2nd day for 5–6 days.

Results. The studied clinical and laboratory indicators indicated an adequate course of the applied type of anaesthesia. In the dynamics of pain syndrome (PS) in the postoperative period, a gradual subjective increase of pain syndrome was noted until the 3rd day, including a decrease in pain on the 4th - 6th day. It was established that when using combined anaesthesia, a less significant level of PS, according to VAS, was noted compared to inhalation anaesthesia and the use of TVA.

Conclusions. Combined anaesthesia (inhalation with PVB) can more effectively prevent the development of post-thoracotomy pain syndrome (PTPS) compared to TVA and IA in the surgical treatment of lung cancer

Keywords: combined anaesthesia, total intravenous anaesthesia, inhalation anaesthesia, post-thoracotomy pain syndrome

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1. Introduction

According to the WHO, oncopathology is one of the leading causes of death in adults and children worldwide [1]. According to forecasts, the incidence and mortality from cancer will constantly increase significantly in economically developed and developing countries [2]. In 2019, malignant neoplasms (MN) were first registered in Ukraine in 1.2 million patients, occupying second place in the spread of oncopathology among all European countries [3]. At the same time, according to official world statistics among all oncopathology, lung cancer ranks first in terms of prevalence [4, 5] and mortality [6], reaching more than 15.0 % in the structure of the entire world cancer and up to 21.0 % of the total world mortality from MN [7]. Most MN is amenable to surgical treatment, and up to 80.0 % receive anesthesiological support during diagnostic, therapeutic or palliative interventions. Scientists worldwide continue to develop and improve anesthesiological and surgical treatments for oncopathology. In recent years, anesthesiology has tended to reduce the use of narcotic analgesics in the perioperative period due to unwanted incidents, especially in elderly patients and obese people. When carrying out surgical treatment of lung cancer, a significant problem is the choice of the type of anesthesiological support due to the need to overcome the so-called PTPS. On this occasion, a significant study (20 thousand patients) in the UK found that 30.0–40.0 % of patients develop PTPS after surgical treatment of MN of the lungs and oesophagus [8]. At the same time, for a long time, the "gold standard" of anaesthesia during surgical interventions on the lungs remained epidural anaesthesia and analgesia; But, in recent years, most scientists have preferred paravertebral blockade (PVB) as an alternative and safer anesthesiological method [8], which can prevent the development of PTPS. The postoperative benefits of PVB are primarily to reduce the

frequency of severe vomiting, hypotension and the need for analgesics [9]. Other randomized trials comparing the results of epidural anaesthesia and PVB indicated that PVB is more effective in reducing respiratory complications and risks of developing PTPS and, in the first few hours after surgery provides equivalent analgesia [10], without determining a significant difference in the development of acute pain and 30-day mortality and hospital duration of such patients [8] and can provide good anaesthesia at all stages surgical treatment. Adequate anaesthesiologic support for traumatic oncological surgical interventions is essential in reducing the risk of incidents during the perioperative period and early rehabilitation of such patients.

The aim of the research. Evaluate the effectiveness of the introduced conjugated anaesthesia (PVB with inhaled anaesthesia with sevoflurane) in preventing the development of PTPS compared to its level after IA and TBA in the surgical treatment of lung cancer.

2. Materials and methods of the research

The study was carried out based on the KnP "Regional Center of Oncology" from 2019 to 2022.

The study involved 60 patients with an average age of 55±5.6 years, physical status under ASA II–III, who underwent open surgery for the volume of forehead or pneumonectomy, or resection of a part of the lung. Patients were divided into 3 groups depending on the method of anaesthesiology at the stage of maintaining anaesthesia: I (n=20) – used conjugated anaesthesia (inhalation with sevoflurane with PVB); II (n=20) – inhalation anaesthesia with sevoflurane; III (n=20) – total intravenous anaesthesia.

Induction of anaesthesia in all groups of patients was standardized: fentanyl (0.002 mg/kg), propofol (2 mg/kg), muscle relaxation – atracurium-novo at a dosage of 0.5–0.6 mg/kg; maintenance of general relaxation throughout the operation with a perfusor at a dosage of 0.3–0.5 mg/kg/hour. The use of inhaled sevoflurane anaesthetic was carried out in conditions of low-current artificial ventilation by the General Electric Carestation 620 apparatus (USA) with a gas analyzer with an assessment of the depth of anaesthesia according to BIS monitoring indicators and bolus intravenous administration of fentanyl of 0.05–0.1 mg at the traumatic stages of the operation. PVB was performed under aseptic conditions in the patient's position lying on the opposite side of the surgical intervention using ultrasound navigation with the LOGICQe apparatus. After verification of the thoracic paravertebral space, a puncture was performed at the level of Th4-Th5, and a 0.25 % solution of longocaine was administered in a volume of 15–20 ml of bolus with an aspiration test. Studied hemodynamic indicators were systolic (BP_{sys}), diastolic (BP_{diast}), medium (MBP), pulse pressure and heart rate (heart rate). Oxygen saturation (SaO_2), CO_2 ET (CO_2 concentration in exhaled air), cortisol level as an indicator of stress and pain reaction and indicators of acid-base state were determined. Evaluation of the effectiveness of anaesthesia in the early postoperative period was carried out using a 100-mm visual-analogue scale (VAS) at 10 control stages.

Statistical processing was carried out using the Statistica 6.0 for Windows application package; Student's t-criterion estimated the reliability of the difference. The difference in values was recognized as reliable at $p<0.05$.

The study was carried out with the approval of the Bioethical Commission of KhMAPE (Protocol No. 1 of 28.02.2020). All patients gave informed consent to the study following the requirements of the Helsinki Declaration of the World Medical Association "Ethical principles of medical research with human participation as an object of study" (edition of 01.10.2008)

3. Research results

Based on the data obtained, an adequate intraoperative course of the applied conjugate anaesthesia (inhalation with PVB) and the intensity of PS patients after surgery for lung MN were determined depending on the type of anaesthesiology (Table 1).

Table 1

Dynamics of subjective manifestations of PTPS of VAS examined patients, cm

Groups	Stages of the study										
	Awakening	Extubation	hours				day				
			1	3	12	24	2nd	3rd	4th	5th	6th
I	0	1.4± 0.3*#	1.5± 0.4*#	2.7± 0.2*#	2.9± 0.4*#	3.5± 0.7*#	3.5± 1.1*^#	3.1± 0.7*#	2.1± 0.9#	1.8± 0.2*#	1.2± 0.2#
II	0	2.1± 0.1^	2.3± 0.1^	3.2± 0.1^	3.8± 0.2^	5.2± 0.2^	4.8± 0.2^	4.5± 0.2^	3.4± 0.9	2.1± 0.6	1.6± 0.2
III	0	2.5± 0.1	2.8± 0.1	3.7± 0.2	4.8± 0.2	5.8± 0.1	5.9± 0.5	5.0± 0.1	4.1± 0.3	3.3± 0.3	2.4± 0.9

*Notes: the probability of differences p < 0.05 * – compared with the group of combined anaesthesia with inhalation; ^ – compared to the groups of inhalation anaesthesia and TBA; # – compared to the group of coupled anaesthesia with TBA*

When comparing the manifestations of PS intensity, the comparative effectiveness of all applied anesthesiology methods with a significant probable advantage of using inhaled PVB supply was determined. Thus, it was stated that the PS level when using conjugated anaesthesia was observed at a less significant level (1.4±0.3 cm) after extubation compared to IA (2.1±0.1 cm) and the use of TBA (2.5±0.1 cm) with a significant difference $p_{1-2}<0.05$; $p_{1-3}<0.05$. Furthermore, in dynamics at all time intervals, a gradual subjective increase in the level of BS in all anaesthesia groups was recorded with the potential ad-

vantage of the method of combined anaesthesia compared to IA and TBA (p>0.05).

The advantage of conjugated anaesthesia for lower VAS pain values compared to IA and TBA was determined. So, PS levels in 1st hour after surgery, 1.5±0.4 cm were observed in patients of group I, compared with groups II and III, where the PS level was 2.3±0.1 cm and 2.8±0.1 cm, respectively (p_{1-2}<0.05; p_{1-3}<0.05). In the 3rd hour after surgery, there was an increase in PS in patients of group I (2.7±0.2 cm), but it was lower compared with patients of groups II and III of the study (3.2±0.1 cm and 3.7±0.2 cm, respectively) (p_{1-2}<0.05; p_{1-3}<0.05). After 12 hours, PS in patients of group I is registered at 2.9±0.4 cm and smaller than in groups II and III – 3.8±0.2 cm and 4.8±0.2 cm, respectively (p_{1-2}<0.05; p_{1-3}<0.05).

An increase in VAS PS levels was stated by day 4 with probably better anaesthesia when using conjugated anaesthesia compared to IA and TBA: 2nd day – PS level in patients of group I was 3.5±1.1 cm compared to PS patients of groups II and III, where it was recorded at 4.8±0.2 cm and 5.9±0.5 cm, respectively (p1–2<0.05; p1–3<0.05); 3rd day – VAS PS level was 3.1±0.7 cm in patients of group I compared to GROUP II and PS II – 4.5±0.2 cm and 5.0±0.1 cm, respectively (p1–2<0.05; p1–3<0.05).

From the 4th day until the end of our observation, there was a gradual decrease in the intensity of PS with the same advantage of inhalation + PVB technique, as opposed to IA and TBA. Thus, the level of BS on the 4th day of the study was observed 2.1±0.9 cm in patients of group I, compared with groups II and III, where the level of PS was 3.4±0.9 cm and 4.1±0.3 cm, respectively (p_{1-2}< 0.05; p_{1-3}<0.05). PS on the 6th day decreased to 1.2±0.2 cm in patients of group I, while the PS level in patients of groups II and III was 1.6±0.2 cm and 2.4±0.9 cm, respectively (p_{1-2}< 0.05; p_{1-3}<0.05) (Table 1).

4. Discussion of research results

The data we obtained utterly coincide with the results of other world studies, which stated the advantage of the quality of recovery on the 1st and 2nd days after surgery for PVB compared to general anaesthesia [11]. Other studies [12] prove fewer manifestations of VAS pain after 2 hours, 4 hours, 8 hours, 12 hours and 24 hours after surgery with PVB compared to general anaesthesia. Also, the advantage of the PVB anaesthesia technique is stated by the Feng C. et al. [13] meta-analysis carried out, according to which the VAS when using PVB pain intensity was significantly lower [average difference =–0.68; 95.0 % confidence interval: –1.04 – –0.33; z = 3.80; p = 0.0001] compared to general anaesthesia.

We registered a gradual subjective increase in the level of PS by the 3rd day, including a decrease in pain on the 4th – 6th day. In addition, it was found that when using conjugated anaesthesia, there was a less significant level of BS on a visual analogue scale (VAS) compared to inhalation anaesthesia and total intravenous anaesthesia.

Study limitations. The sample of patients was small, and the population did not include elderly or obese patients.

Prospects for further research. In further studies, it is planned to increase the contingent of investigated operated patients with the determination of the possible influence of many factors (type of anaesthesia, surgery, essential and concomitant pathology) on the risks of incidents in the perioperative period and early rehabilitation of such patients. The lack of substantiated research on this issue leaves a wide field for study.

5. Conclusions

Thus, a comparison of the level of postoperative anaesthetic effect of the applied conjugated anaesthesia (PVB + sevoflurane) with TBA and IA after traumatic oncological surgical interventions for lung cancer was established:

1. Combined anaesthesia (inhaled with PVB) is capable of more likely to effectively prevent the development of PTPS compared to TBA and IA in the surgical treatment of lung cancer.

2. The study in the dynamics of BS showed a gradual subjective increase in all types of anaesthesia from the moment after surgery to the 3rd day, including a decrease in pain on the 4th– 6th day with a probable advantage in the group of combined anaesthesia.

3. It was stated that when using conjugated anaesthesia, there was less pain in patients than in IA and TBA.

Conflict of interests

The authors declare that they do not have a conflict of interest concerning this study, including financial, personal nature, authorship or other nature, which could affect the study and its results presented in this article.

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