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Multimodal Opioid-Sparing Approach to Postoperative Anesthesia as one of the ERAS Protocol Components

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Abstract **The aim** of the study was to evaluate the efficiency of multimodal opioid-sparing anesthesia as a component of the protocol for accelerated recovery of emergency patients operated on for peritonitis of various etiologies. **Background.** Multimodal opioid-sparing pain therapy is the main component of the concept of patients accelerated recovery after various surgical interventions. Adequate pain relief in the postoperative period, based on the principle of multimodal analgesia, promotes early recovery of gastrointestinal peristalsis, reduction of stress response of the body, reduction of the frequency of delirium and cognitive impairment in the postoperative period, early recovery of patients. **Material and methods.** 203 patients who were treated at the Republican Research Centre of Emergency Medicine with a diagnosis of peritonitis in the period from 2021 to 2022 were examined. The patients were divided into 2 groups: Control group (n=101), who did not use the ERAS protocol and Main group (n=102), who used components of accelerated recovery protocol in the perioperative period and multimodal opioid-sparing technology of postoperative anesthesia. **Results.** The use of regional technologies under the control of ultrasound navigation as part of multimodal analgesia in emergency patients with peritonitis allowed to reduce the time of the first requirement of anesthesia by 35%, to improve the quality of anesthesia by more than 50%, the duration of anesthesia by more than 2.5 times, which was confirmed by studies of subjective pain assessment indicators on a visual-analog scale. The consumption of narcotic analgesics was noted in the group with the use of opioid-sparing anesthesia technology with a basis consisting of regional anesthesia methods by 67%. **Conclusion.** Systemic multimodal analgesia was used in both study groups which was supplemented by regional analgesia in the group using the protocol of accelerated recovery after surgery. Accordingly, the reduction in the consumption of narcotic analgesics marked an early recovery of intestinal motility, a decrease in intestinal paresis, which in turn contributed to the early activation of patients, a decrease in delirium manifestations, a decrease in the duration of staying in ICU and hospital stay.

Keywords Systemic multimodal analgesia, Opioid-sparing therapy, Postoperative pain, Regional anesthesia

1. Introduction

Multimodal opioid-sparing pain therapy is the main component of the concept of patients accelerated recovery after various surgical interventions [1]. Anesthesia of patients after emergency surgical interventions requires a great deal of skill and knowledge from the anesthesiologist, since the individual characteristics of the patient, the state of the body vital functions, the existing water-electrolyte and acid-base disorders must be taken into account. Postoperative pain, analgesia and recovery are factors that cannot be ignored [2]. Adequate pain relief in the postoperative period, based on the principle of multimodal analgesia, promotes early recovery of gastrointestinal peristalsis, reduction of stress response of the body, reduction of the frequency of delirium and cognitive impairment in the postoperative period, early recovery of patients [3,4]. Multimodal analgesia implies opioid-sparing therapy based on the use of regional methods of anesthesia in combination with paracetamol, NSAIDs. Anesthesia of patients should be personalized, patient-oriented, taking into account the trajectory of pain syndrome in the postoperative period [5,6].

The aim of the study was to evaluate the efficiency of multimodal opioid-sparing anesthesia as a component of the protocol for accelerated recovery of emergency patients operated on for peritonitis of various etiologies.

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2. Material and Methods

203 patients who were treated at the Republican Research Centre of Emergency Medicine with a diagnosis of peritonitis in the period from 2021 to 2022 were examined. The patients were divided into 2 groups: Control group (n=101), who did not use the ERAS protocol and Main group (n=102), who used components of accelerated recovery protocol in the perioperative period and multimodal opioid-sparing technology of postoperative anesthesia. The

mean age of the patients was 42.1 ± 17.6 years. There were 155 (76.4%) men and 48 (23.6%) women. Patients with acute gangrenous appendicitis were 61 (30%) of the total number of patients. Diffuse purulent-fibrinous peritonitis was observed in 25 (12.3%) patients, local purulent peritonitis was detected in 36 (17.7%) patients. Patients with gastric and duodenal ulcer complicated by perforation were 142 (70%) from the total number of patients (n=203). Of these, diffuse fibrinous-purulent peritonitis was detected in 40 (19.7%) patients, and diffuse serous-fibrinous peritonitis was observed in 102 patients, which was 50.2% of the total number of patients.

Appendectomy from McBurney's access was performed in 9 (4.4%) cases, appendectomy by laparoscopic access was performed in 44 (1.7%) patients, appendectomy with laparotomy access was performed in 8 (4%) cases. In peptic ulcer of the duodenum and stomach, complicated by perforation, laparoscopic suturing of the perforated hole was performed in 73 cases (36%). Suturing of the perforating hole by laparotomy was performed in 62 (30.5%) patients, stomach resection by Billrot-II by laparotomic access was performed in 7 (3.4%) cases out of the total number of patients.

All patients were performed surgery under general combined anesthesia. The majority of patients in both groups – 47.2% (n=96) corresponded to ASA Class III. Patients corresponding to ASA Class II made up 40% (n=81), ASA Class IV -12.8% (n=26). Scheme of anesthesia: induction in anaesthesia - propofol 2 mg/kg, arduan 0.08-0.1 mg/kg, fentanyl 3 μg/kg. Maintenance of anesthesia - isoflurane 2-2.5 vol% (MAC 1-1.2), fentanyl 2 μg/ kg /hour, arduan according to indications of TOF monitoring (3-4 points). The anesthesia regimen in the main group was supplemented with the use of acytomenophen (paracetamol) 1000 mg and ketoprofen 100 mg as components of multimodal analgesia. At the end of the surgical intervention for postoperative anesthesia, patients of the main group with median-median laparotomy were performed TAP (Transversus abdominis plane block) under the control of ultrasound on both sides with a solution of local anesthetic Bupivacini 0.25% 20 ml on each side with the addition of 4 mg dexamethasone as an adjuvant of local anesthetic. Patients with McBurney access for appendectomy were performed a unilateral TAP block on the right with a solution of local anesthetic Bupivacini 0.25% 20 ml with the addition of 4 mg dexamethasone. During laparoscopic surgical intervention, anesthesia of the trocar injection site was performed with a local anesthetic. Postoperative pain relief was supplemented with NSAIDs and paracetamol. Narcotic analgesics were used as needed. The patients of the control group were performed multimodal anesthesia technology without the use of regional anesthesia methods.

The evaluation of pain and the quality of anesthesia in the postoperative period was carried out on the basis of a visual - analog scale (VAS). The time of the first analgesic requirement, the number of narcotic analgesics used, the analysis of the presence of intestinal paresis depending on the number of narcotic analgesics used were also calculated. Statistical analysis was carried out using the StatTech v. 3.0.7 program (developed by Stattech LLC, Russia).

3. Results

Studies conducted in the postoperative period revealed that the time to first analgesic requirement in the control group was 2.73 ± 1.97 hours, which was significantly earlier by 34.5% (p<0.001) than in patients of the main group, where this indicator was 4.18 ± 0.59 hours (Tab.1).

Table 1. Indicator of the Time to first analgesic requirement

Group	Time to first analgesic requirement (h p/oper)			p
	M ± SD	95% ДИ	n	
Control group	2.73 ± 1.97	2.34 – 3.12	101	< 0.001*
Main group	4.18 ± 0.59	4.06 – 4.30	102	

Note: * – differences in indicators are statistically significant (p<0.05)

The VAS pain assessment before the start of anesthesia revealed that the control group patients felt pain equivalent to 7.30 ± 0.93 points, which corresponded to very severe pain. Patients of the main group felt pain equal to 3.14 ± 0.70 points, which corresponded to moderate pain according to the VAS. Such a significant difference (p<0.001) (method used: Welch's t-test) in pain sensations between groups, equal to 43%, is due to the fact that in the main group one of the regional methods of anesthesia was used at the end of surgery (Tab.2).

Table 2. VAS score before anesthesia

Group	VAS before anesthesia (points)			p
	M ± SD	95% CI	n	
Control group	7.30 ± 0.93	7.11 – 7.48	101	< 0,001*
Main group	3.14 ± 0.70	3.00 – 3.28	102	

Note: * – differences in indicators are statistically significant (p<0.05)

Table 3. VAS analgesia score 30 min after anesthesia

Group	VAS через 30 min after anesthesia (points)			p
	M ± SD	95% CI	n	
Control group	4.62 ± 0.90	4.45 – 4.80	101	< 0.001*
Main group	1.82 ± 0.57	1.71 – 1.94	102	

Note: * – differences in indicators are statistically significant (p<0.05)

Anesthesia in the control group at this stage of pain relief was performed with narcotic analgesic morphine 10 mg + NSAIDs ketoprofen 100 mg + paracetamol 1000 mg. And anesthesia in the main group was performed by NSAIDs ketoprofen 100 mg and paracetamol 1000 mg. 30 minutes after anesthesia, pain indicators in the control group decreased by 36.7%, averaging 4.62 ± 0.90 points, which corresponded to moderate pain. In the main group, the VAS pain index decreased by 42%, making up 1.82 ± 0.57 points,

which corresponded to mild pain. According to the data obtained, when assessing pain by VAS 30 minutes after anesthesia in comparison between the groups, we found statistically significant differences equal to 60.6% (p<0.001) (method used: Welch's t-test) (Tab.3).

Pain sensations in patients of the control group 2 hours after anesthesia were 40% lower in compare with the previous stage of the study, amounting to 2.75 ± 0.79 points, which corresponded to mild pain according to the VAS. Pain sensations in the main group also tended to decrease by 40% compared with the previous stage. It made up 1.09 ± 0.29 points, which corresponded to the absence of pain according to VAS. A comparative analysis of pain sensations by VAS between the groups revealed a significant difference of 60%, which was statistically significant (p<0.001) (Tab.4).

Table 4. VAS analgesia score 2 hours after anesthesia

Group	VAS 2 hours after anesthesia (points)			p
	M ± SD	95% CI	n	
Control group	2.75 ± 0.79	2.60 – 2.91	101	< 0.001*
Main group	1.09 ± 0.29	1.03 – 1.14	102	

Note: * – differences in indicators are statistically significant (p<0.05)

There was again an increase in the pain index for VAS to 6.21 ± 1.13 points in the control group 5 hours after anesthesia which corresponded to severe pain and required additional administration of a narcotic analgesic. Compared to the previous stage, this indicator increased by 55.7% in the control group. This indicator practically did not change in the main group remaining within 1.20 ± 0.40 points, which corresponded to the absence of pain by VAS. A comparative analysis of pain sensations between patients of both groups revealed a significant difference (p<0.001) equal to 80.6% (Tab.5).

Table 5. VAS analgesia score 5 hours after anesthesia

Group	VAS 5 hours after anesthesia (points)			p
	M ± SD	95% CI	n	
Control group	6.21 ± 1.13	5.98 – 6.43	101	< 0.001*
Main group	1.20 ± 0.40	1.12 – 1.27	102	

Note: * – differences in indicators are statistically significant (p<0.05)

At all stages of the study in the postoperative period, there was a significant tendency to reduce pain in patients of the Main group, where opioid-sparing technology of multimodal anesthesia based on regional methods of anesthesia was used. The duration of anesthesia in the group with the use of adapted ERAS components was 4.5 ± 0.8 hours. Subsequent pain sensations in this group did not require the use of a large and repeated amount of narcotic analgesics. The duration of anesthesia in the Control group was 2.8 ± 0.4 hours, which was 50% shorter than in patients of the Main group. Subsequent sensations of pain in patients of this group corresponded to severe pain according to VAS and required additional administration of narcotic analgesics (Fig.1).

When analyzing the amount of narcotic analgesics consumption, it was revealed that the use of regional anesthesia methods in the multimodal analgesia scheme significantly reduced the consumption of narcotic analgesics by 67% and statistically significant differences were revealed (p < 0.001) (method used: Welchs' t–test) (Fig.2).

We analyzed the presence of intestinal paresis depending on the amount of narcotic analgesics used. The analysis revealed the dependence of intestinal paresis development on the number of narcotic analgesics used. We identified statistically significant differences (p = 0.013) (method used: Student's t–test) (Tab.6).

Table 6. Analysis of the relationship between the amount of narcotic analgesics and the development of intestinal paresis

Index	Categories	Number of narcotic analgesics (ampoules)			p
		M ± SD	95% CI	n	
Intestinal paresis	Absence of intestinal paresis	2 ± 1	2 – 2	100	0.013*
	Presence of intestinal paresis	3 ± 1	2 – 3	61	

Note: * – differences in indicators are statistically significant (p<0.05)

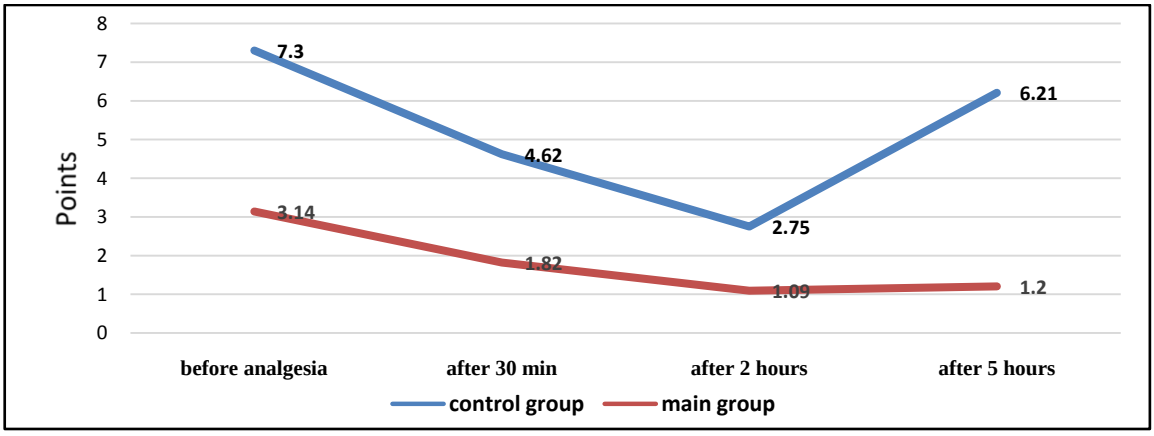

Figure 1. Dynamics of the indicator of anesthesia quality and duration according to VAS at the study stages

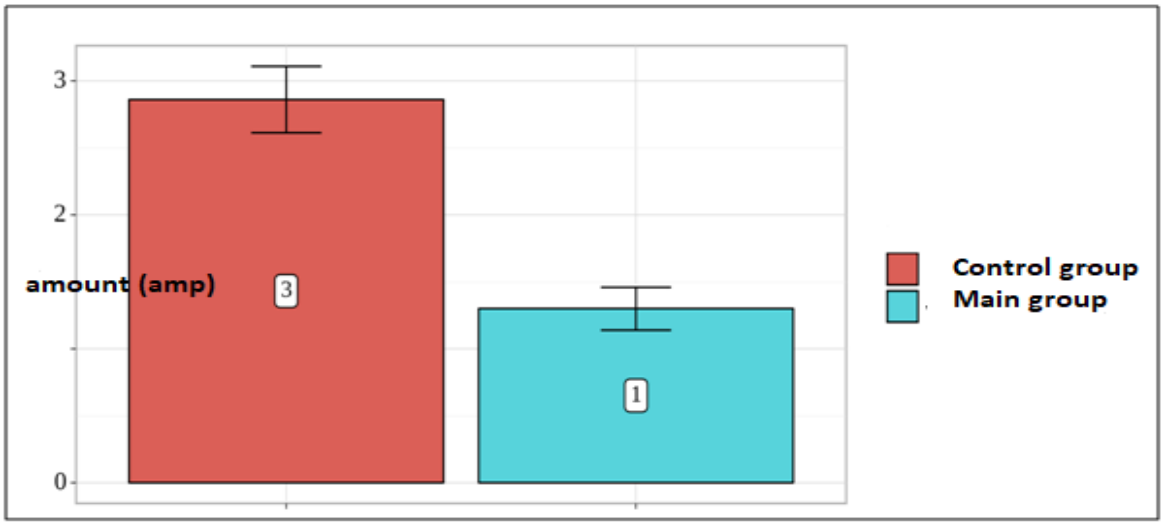

Figure 2. Comparative analysis of the requirement for narcotic analgesics in the postoperative period

4. Conclusions

Systemic multimodal analgesia was used in both study groups which was supplemented by regional analgesia in the group using the protocol of accelerated recovery after surgery.

Accordingly, the reduction in the consumption of narcotic analgesics marked an early recovery of intestinal motility, a decrease in intestinal paresis, which in turn contributed to the early activation of patients, a decrease in delirium manifestations, a decrease in the duration of staying in ICU and hospital stay.

The consumption of narcotic analgesics was noted in the group with the use of opioid-sparing anesthesia technology with a basis consisting of regional anesthesia methods by 67%.

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