The results of treatment of patients after median sternotomy

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Abstract. Median sternotomy is known as a major surgical approach in coronary bypass surgery. As the number of patients after surgical revascularization increases, we can see an increase in the incidence of severe complications associated with poststernotomy wound. An urgent task is to improve the postoperative treatment of these patients. Here in this paper we describe the developed method of analgesia and prevention method of inflammatory complications in patients after median sternotomy (invention application number 2014104048, priority as of 2/04/2014). We studied 55 patients with diagnosis of coronary artery disease in the period from 2012 to 2014.The median age for men was 56.1 ± 6.6 years, for women - 59.3 ± 5.9 years. All patients underwent median sternotomy. Coronary artery bypass grafting from the internal mammary artery. On-pump aorta-coronary bypass grafting with cold cristalloid cardioplegia. Depending on the method of drainage placing and on the treatment used in the postoperative period, patients were divided into 2 groups. There were no significant differences between groups by gender, age, nature of comorbidity. During the study we found the greatest efficiency of the developed method in drainage removal from the anterior mediastinum and the pericardial cavity in patients without pain symptoms or discomfort. Application of the developed method of analgesia and prevention of inflammatory complications after median sternotomy allows for effective postoperative analgesia, reduces the amount of exudative inflammatory complications and excludes additional financial costs of the treatment.
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Introduction

Coronary artery disease takes the first place among all cardiovascular diseases - 49.3% [1, 8, 9]. Direct myocardial revascularization is known to be the most effective method to treat patients with CAD [1, 3, 5].

Median sternotomy is the most common surgical approach in cases of coronary artery bypass in Russia and in the world [1, 3, 11, 12]. With an increasing number of patients undergoing myocardial revascularization surgery, the number of patients with serious complications associated with poststernotomy has also increased [10, 13, 14].

Despite the modern advances in antibiotic therapy, immune and surgical technologies, the incidence of complications after median sternotomy such as mediastinitis varies from 0.4 to 5% [1, 3, 5].

According to some authors the cost of treating patients with complications after median sternotomy is about 500 thousand dollars a year [14].

Performing a median sternotomy and thoracic surgery is always accompanied by pain in the postoperative period. This pain is caused by a series of physiological changes that can affect functions of most organs and systems of organs. Intramuscular administration of narcotic analgesics is a normal method of postoperative analgesia. This kind of anesthesia is often characterized by a high risk associated with possible development of a number of side effects which can considerably deteriorate the postoperative period [2, 4, 6, 7].

Creation and implementation of new methods of pain relief and prevention of inflammatory complications after median sternotomy would improve the treatment of patients with cardiovascular diseases and respiratory diseases. All the above listed indicates an urgency of this problem.

The aim of our study was to improve the results of surgical treatment of patients after median sternotomy by applying the developed method of analgesia and prevention of inflammatory complications.

Material and methods

The work was performed in accordance with the guidelines of the research program developed in the Federal State Educational Institution of Higher Professional Education "Ulyanovsk State University" at the Department of Surgery.

The study is retrospective, prospective, exploratory. The study covers 2012-2014 years. The number of enrolled patients - 55.

The inclusion criteria were as follows: age - 18 years and older, male and female gender, coronary artery disease, median sternotomy, cardiopulmonary bypass, coronary artery bypass surgery.

The exclusion criteria were as follows: age - under 18 years, acute cerebrovascular accident.

This paper presents the results of examination and surgical treatment of patients with CAD hospitalized in the State Health Care Institution "Regional Clinical Hospital" of Ulyanovsk in the period from 2012 to 2014 years.

In order to achieve the objectives we used clinical and laboratory, radiological and statistical methods.

The laboratory studies included complete blood count, calculation of leukocyte intoxication index (LII) by the formula of BA Race.

In order to estimate the intensity of postoperative pain, we used visual analogue pain scale (VAS). It consisted of 11 points from 0 - no pain, 1-3 - mild pain, 4-6 - moderate pain, 7-9 - severe pain, 10 - "the worst pain you can ever imagine". This scale is the most convenient to use in practice and is well understood by most people [6, 7].

The level of saturation of peripheral blood was determined by laboratory method when the patients were in the ICU for 2 days after the surgery. Such moments as extubation and removal of drainage were marked as the most stressful.

All patients underwent median sternotomy. Coronary artery bypass grafting from the internal mammary artery. On-pump aorta-coronary bypass grafting with cold cristalloid cardioplegia.

Depending on the method of drainage placing and on the treatment used in the postoperative period, patients were divided into 2 groups. There were no significant differences between groups by gender, age, nature of comorbidity, and the volume of the primary surgery.

Group 1 - 30 patients. Drainage of the anterior mediastinum and the pericardial cavity was performed, osteosynthesis of the sternum by Z-shaped caproic monofilament sutures "MedInzh". These patients received a standard therapy: pain-relief drugs (promedol), antibiotic therapy (cefotaxime).

Group 2 - 25 patients. Drainage of the anterior mediastinum and the pericardial cavity, sternum osteosynthesis by Z-shaped caproic monofilament sutures "MedInzh". According to the developed method of therapy (invention application number 2014104048, priority as of 2/04/2014), after suturing the sternum, we placed a plastic multi-aperture catheter on its front surface through the skin counterpuncture (hole). On the background of the basic treatment similar to that performed in group 1 of patients that included pain-relief drugs (promedol), antibiotic therapy (cefotaxime), we also administered 2 ml of topical anesthetic procaine 0.25% for pain relief every 6 hours and antibiotic gentamicin 80 mg every 8 hours for over 3 days.

The method was performed as follows. After on-pump surgical revascularization performed through a median sternotomy, we placed mediastinal and pericardial drainage. Then after suturing the sternum we placed a plastic multi-aperture catheter on its front surface through the skin counterpuncture (hole), making a step back for 1.0-2.0 cm from the lower edge of the wound, between the outputs of the drainage tubes. Distal part of the catheter with cannula (external aperture of the catheter) is fixed by suturing to the skin by non-absorbable sutures (Figure 1, Figure 2).

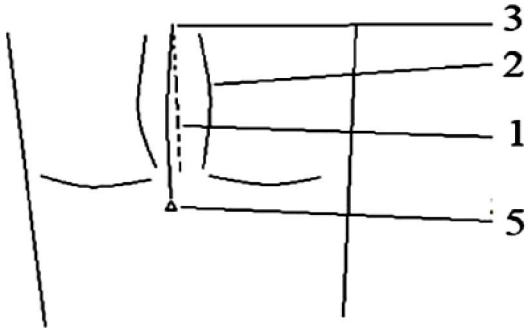

Figure 1. Surgical wound in the chest after suturing the sternum: 1 - sternum after suturing, 2 - skin (edge of the surgical wound), 3 - proximal part of the catheter with the inner aperture, 5 - distal part of the catheter

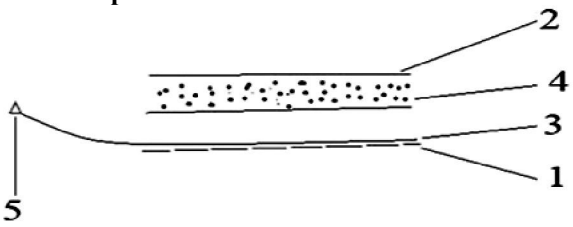

Figure 2. Side view, in section: 1 - sternum after suturing, 2 - skin (edge of the surgical wound), 3 - proximal part of the catheter with the inner aperture, 4 - subcutaneous fat, 5 - distal part of the catheter

All patients gave informed voluntary consent for the surgery and the treatment in the postoperative period.

Statistical analysis was performed using the software package Statistica 6. When comparing the obtained parameters, we used the Student's t-test for independent samples and paired x2 test. We considered statistically significant differences of at least 95% based on the Bonferroni correction for multiple comparisons.

Study results and discussion

In the second group of subjects we revealed a high degree of pain relief in patients from the first to 5th days after surgery (Table 1). The most obvious effect of anesthesia in the second group of patients was almost complete absence of pain, discomfort on

drainage removal from the anterior mediastinum and pericardial cavity on the 2nd day: visual analog pain scale (VAPS) – 2.9 ± 0.6, if compared with the patients of the first group – VAPS – 6.6 ± 0.9.

The postoperative anesthesia using the proposed method in patients after a median sternotomy reduces the intensity of pain (VAPS) twice as compared with the conventional analgesia methods.

Table 1. Evaluation of analgesia using a visual analog pain scale

After surgery (days)	Group of patients n = 55	
	Group 1 (n = 30) Points by visual analog pain scale	Group 2 (n = 25) Points by visual analog pain scale
1st day	4.8 ± 0.8	2.7 ± 0.9 •
2nd day	4.0 ± 0.8	2.5 ± 0.8 •
Period of drainage removal	**6.6 ± 0.9**	**2.9 ± 0.6 •**
3rd night	3.9 ± 0.8	1.9 ± 0.5 •
4th day	3.5 ± 0.8	1.5 ± 0.5 •
5th day	3.1 ± 0.7	1.5 ± 0.5 •

Note. • - intergroup differences were significant (p <0.05).

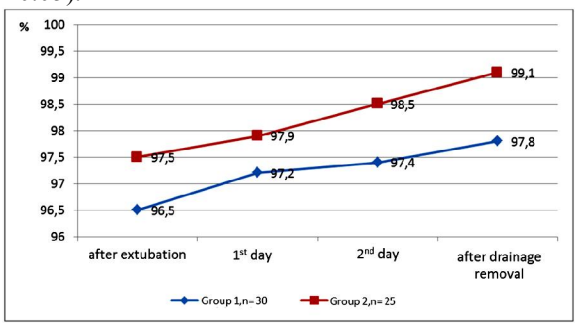

Figure 3.Indicators of blood oxygen saturation in dynamics

The lowest oxygen saturation was recorded immediately after extubation and in the 1 day after the surgery. Considerable and statistically significant (p <0.05) difference in oxygen saturation of peripheral blood was revealed during and after removal of the pericardial and anterior mediastinal drainage. It is probably caused by a significant difference in the same part of the pain at this stage in the presented groups (Figure 3.).

According to the results of laboratory tests on the 8th day after operation in subjects of group 2, the values of total white blood cell count and erythrocyte sedimentation rate were considerably lower. These indicators clearly characterize the activity of inflammatory reactions in the early postoperative period (table 2).

Table 2. Laboratory parameters of blood

Day	Group of patients n = 55					
	Group 1, n = 30			Group 2, n = 25		
	ESR, mm/h	Leu, 10x9	LII	ESR, mm/h	Leu, 10x9	LII
before the operation	13.1 ± 7.9	8.4 ± 1.9	1.3 ± 0.4	12.3 ± 6.0	8.0 ± 1.7 •	1.1 ± 0.3 •
2nd day	25.6 ± 12.3	14.0 ± 5.6	3.1 ± 1.0	24.2 ± 4.4	12.5 ± 2.7	3.4 ± 1.1 •
8th day	37.6 ± 11.6	11.3 ± 2.9	1.8 ± 0.6	22.2 ± 3.5 •	8.7 ± 1.8 •	1.6 ± 0.3

Note. • - intergroup differences were significant (p <0.05).

The number of early postoperative complications in groups was as follows: seroma or suppuration of postoperative wound - in 7 (23.3%) patients from the first group, no patients in the second group (Table 3).

Table 3. Structure of early postoperative complications in the studied patients

Postoperative complications	Group of patients, n = 55	
	Group 1, n = 30	Group 2, n = 25
Seroma or suppuration of postoperative wound	7 (23.3%)	-

Patients who developed seromas or suppuration required separating of the wound edges (Fig. 4.) and further long-term treatment similar to those performed in suppurative complications followed by the placing of secondary sutures, which led to a significant increase in postoperative bed-days and additional financial costs (Table 4). There were not lethal outcomes in either group.

Table 4. Duration of stay in a surgical hospital

Bed-days	Group of patients, n = 55	
	Group 1, n = 30	Group 2, n = 25
general	20.9 ± 5.5	15.5 ± 3.2 •
before operation	7.7 ± 4.6	5.5 ± 3.4
after operation	13.1 ± 3.6	10.1 ± 0.9 •

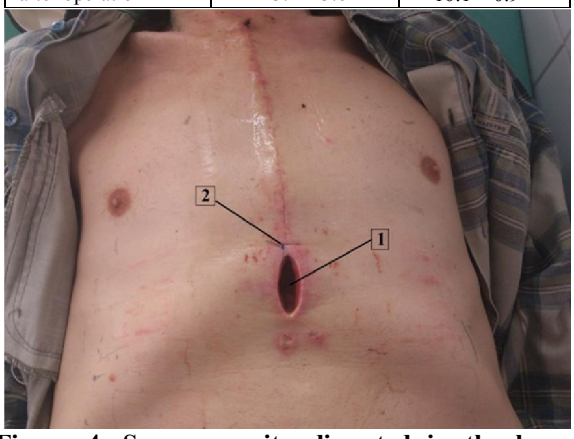

Figure 4. Seroma cavity dissected in the lower third of the wound on the 9th day after the surgery: 1 - seroma cavity, 2 - fixing skin suture.

Note. • - intergroup differences were significant (p <0.05).

Thus, the analysis of the incidence of early postoperative complications showed that in the second group the proposed method not only provides effective pain relief, but also is effective in the prevention of the inflammatory complications of the postoperative wound (Figure 5).

Placing the catheter in the surgical wound for analgesics administering has several advantages: ease of technical execution, constant monitoring of the patient's condition isn't required, which is necessary for epidural analgesia.

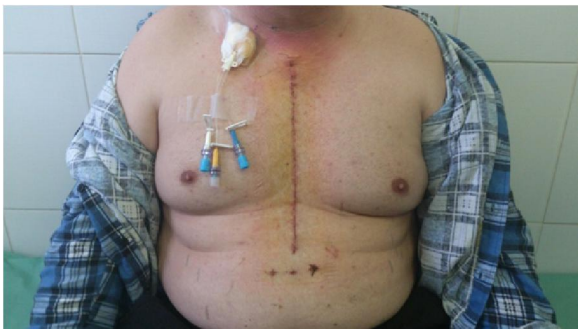

Figure 5. 7th day after the surgery, healing by primary intention

Conclusions

1. The proposed method of postoperative anesthesia in patients after median sternotomy decreases pain intensity twice compared to conventional analgesia.

2. The developed method of pain relief in patients after median sternotomy can reduce the number of complications in the postoperative wound.

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