

DIAGNOSTIC AND TREATMENT METHODS

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THE EFFECTIVENESS OF THE INTRODUCTION OF A SYSTEM FOR THE PREVENTION OF STERNAL COMPLICATIONS IN CARDIAC SURGERY

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The aim of the study. To evaluate the results of the introduction of a system for the prevention of sternal infectious complications at the Federal Center for Cardiovascular Surgery in Khabarovsk in comparison with the traditional method of cardiac surgery.

Materials and methods. The authors conducted a comparative analysis of two treatment groups of cardiac surgery patients operated with sternotomy median access. The first group, 2712 patients operated according to the traditional method (2016-2018); the second group of patients, 2991 people, were treated using the method of prevention of sternal infectious complications (2019-2021). Attention was paid to the performance of bimammary bypass surgery, which is one of the leading risk factors for complications, while performing this type of bypass surgery increased in the second group.

Results. As a result of the introduction of systemic prevention of complications during cardiac surgery, the number of superficial complications, such as divergence of wound edges, skin necrosis, osteomyelitis of the sternum significantly decreased from 1.18 ± 0.207 to $0.43 \pm 0.120\%$ ($t=3.11$), there was also a tendency to decrease deep complications, namely sternomediastinitis - from 0.55 ± 0.142 to $0.23 \pm 0.088\%$ ($t=1.90$).

Conclusion. The introduction of a system for the prevention of sternal complications in the work of cardiac surgeons during median sternotomy has reduced the incidence of postoperative sternomediastinitis and superficial complications. Therefore, in order to reduce infectious complications after cardiac surgery, it is advisable to introduce systemic prevention of sternal infection more widely into clinical practice.

Keywords: cardiac surgery, infectious complications, postoperative sternomediastinitis, thoracic surgery.

Introduction. The problem of postoperative sternomediastinitis and sternal osteomyelitis is urgent for all countries of the world where cardiac surgery is performed. Infectious complications of the anterior chest after this type of surgery range from 0.3% to 6.9% [1, 8]. Postoperative sternomediastinitis is not a short-term complication but it significantly

worsens the course of the clinical case [7; 9], increases the early in-hospital mortality to 7% compared to patients without inflammatory changes in the sternum (1,8%) [4,5].

The cost of treatment of deep postoperative sternal infection is excessively high, [6], reaching up to \$500,000 in specialized centers of the USA [10], which even with an infection rate of less than 1% is quite an impressive cost for any state.

Risk factors for the development of postoperative sternomediastinitis differ and are divided into preoperative, intraoperative, and postoperative [2]. Prevention of these complications makes it possible to reduce the incidence of postoperative sternomediastinitis in patients under consideration [3].

The aim of the study. To study the effectiveness of the infection prevention system introduced in cardiac surgical operations in Khabarovsk Federal Centre of Cardiovascular Surgery. Materials and methods. The analysis of treatment of two groups of cardiac surgical patients operated on by median sternotomy in Khabarovsk Federal Centre of Cardiovascular Surgery was carried out using a continuous method. The first group of 2,712 patients was operated on before the introduction of systemic prevention of postoperative complications (from 2016 to 2018); while the second group of 2,991

patients were operated on after the introduction of the above-mentioned system of prevention of post-operative complications (from 2019 to 2021). Concomitant somatic pathologies in the first group of patients that have been operated on were represented by diabetes mellitus (in 472 patients), by chronic obstructive pulmonary disease (in 141), obesity (in 678), atrial fibrillation (in 224), and chronic kidney disease (in 115 patients). The number of the same concomitant somatic pathologies in the second group of patients constituted respectively 408, 307, 735, 255 and 159 patients. Statistical processing of the data was carried out by variance analysis with calculation of the coefficient of contingency (chi-square); represented in Table 1.

In the two groups studied, statistical significance for qualitative indicators was determined using chi-square value (χ^2) taking into account the pairing of rows and columns; while for quantitative indicators it was determined with a Student's test. Qualitative indicators were considered statistically significant based on conjugation tables; whereas for quantitative indicators, the results were considered statistically significant at $p < 0.05$.

The direct method of standardization was used to analyze the somatic pathology in the two studied groups of patients operated on with transsternal longitudinal access.

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Table 1

Comparative characteristics of concomitant somatic pathology in patients undergoing cardiac surgery

Indicators	Patients operated before the introduction of systemic prevention of postoperative complications (n=2 712)	Patients operated after the introduction of systemic prevention of postoperative complications (n=2 991)	The conjugacy indicator (χ^2)
Concomitant pathology in general:	1630	1864	3.72
The first group of pathology:	472	408	15.58
Diabetes mellitus	472	408	15.58
The second group of pathology	1158	1456	20.47
Obstructive pulmonary disease	141	307	50.38
Fatness	678	735	0.14
Chronic kidney disease	115	159	3.52
Atrial fibrillation	224	255	0.14

Table 2

The frequency of infectious complications depending on the presence of concomitant somatic pathology in patients after cardiac surgery

Indicators	Patients with complications before the introduction of systemic prevention (n=74)	Patients with complications after the introduction of systemic prevention (n=45)	The conjugacy indicator (χ^2)
Concomitant pathology in general:	74	45	37.65
The first group of pathology:	18	9	12.17
Diabetes mellitus	18	9	12.17
The second group of pathology	56	36	58.93
Obstructive pulmonary disease	8	4	94.55
Fatness	21	14	6.34
Chronic kidney disease	19	14	14.27
Atrial fibrillation	8	4	5.56

To make the general comparison of the two studied groups of patients having different structure of concomitant somatic pathology more objective, Fisher's criterion was additionally applied.

The age of the patients of the first and second groups was comparable and constituted 62.8 ± 7.4 and 62.8 ± 8.7 years old respectively.

To reduce postoperative complications of an infectious nature after cardiac surgery using transsternal access, systemic prevention based on the principles Vogt PR, (2019) [14] was developed.

The leading factors in the systemic prevention of the development of postoperative complications were exclusion of iodine-containing solutions, preservation of the attachment of the xiphoid process to the surrounding soft tissues, exclusion of wax to stop bleeding, performing skeletonization of the internal thoracic artery during bypass surgery, suturing the sternum with Z-shaped USP7 monofilament sutures (Steelex Sternum Set), and

early activation of patients in the postoperative period. At the same time, systemic antibiotic prophylaxis was used for cardiac patients that have been operated on (first dose before surgery; with the second dose being administered in case

the operation lasted more than 6 hours).

The groups under study were analyzed in a continuous chronological order; the groups included all patients operated on consecutively in the two three-year periods studied. At that, spe-

Table 3

Postoperative complications in the observed patients during cardiac surgery before and after the introduction of systemic prevention

Indicators	Complications		Statistical significance of indicators
	Before the introduction of the prevention system (n=2 712)	After the introduction of systemic prevention (n=2 991)	
Postoperative complications, including:	1.73 $\pm$ 0.25%	0.67 $\pm$ 0.15%	t=3.65. p<0.05
divergence of wound edges, skin necrosis, osteomyelitis of the sternum	1.18 $\pm$ 0.21 %	0.43 $\pm$ 0.12 %	t=3.11. p<0.05
sternomediastinitis	0.55 $\pm$ 0.14%	0.23 $\pm$ 0.09%	t=1.90. p>0.05

cial emphasis was placed on bimammary coronary artery bypass, the performance of which has increased 10-fold in the last three years - from 57 to 582 surgical interventions.

47 and 20 patients with infectious complications after cardiac operations performed at Khabarovsk Federal Center of Cardiovascular Surgery were admitted for treatment to the Thoracic Surgery Department of the Khabarovsk Regional Clinical Hospital №1 named after Prof. S.I. Sergeev in 2016-2018 and 2019-2021 respectively. The analysis of concomitant pathologies in the patients admitted to the Regional Clinical Hospital №1 showed that the number of cases of somatic diseases per patient was 1.57 and 2.25 in the first and in the second study groups respectively.

The incidence of infectious postoperative complications depending on somatic pathology is shown in Table. 2.

Discussion and results. Diabetes mellitus characterized by an increased risk of developing infectious complications occurred 27% more often (which is of statistical importance) in the first group of patients studied as compared with the second group or $17,40 \pm 0,73\%$ vs. $13,64 \pm 0,63\%$, $p < 0,001$. The second group of somatic pathologies (chronic obstructive pulmonary disease, obesity, chronic kidney disease and atrial fibrillation) leading to the development of hypoxia in organs and tissues, prevailed in patients of the second group, $p < 0,001$. In the meantime, the patients with the second group of somatic pathology show a meaningful ($p < 0,001$), almost 2-fold increase in the number of those having chronic obstructive pulmonary disease: $10,28 \pm 0,55\%$ vs. $5,20 \pm 0,43\%$ respectively. The proportion of patients with chronic kidney disease in the second study group was higher than in the first group of operated patients ($t = 1,91$): $5,32 \pm 0,41$ and $4,24 \pm 0,39\%$ respectively, $p > 0,05$. Other risk factors for the development of complications due to concomitant pathology in both groups of patients were not significant, with obesity constituting $24,57 \pm 0,79$ and $25,00 \pm 0,83\%$ respectively, and atrial fibrillation - $8,53 \pm 0,51$ and $8,26 \pm 0,53\%$ respectively.

However, using a direct standardization method it was found that differences in the incidence of somatic pathology in the compared groups did not affect the rate of postoperative complications, the standardized rate of complications being 4.7% and 2.4% in the first and the second group of patients respectively.

The change in the structure of somatic pathology among patients with postoper-

ative infectious complications admitted to Clinical Hospital №1 arouses a certain concern. The incidence of diabetes mellitus in 2019-2021 as compared to 2016-2018 did not change significantly - 38.3% and 45.0% respectively ($p > 0,05$). Postoperative complications were more common in patients with chronic kidney disease and obesity ($p < 0,05$) in the last three years - from 2019 to 2021 - as compared with the 2016-2018 period. Chronic obstructive pulmonary disease, cardiogenic pathology in the form of atrial fibrillation in both groups of patients admitted to Clinical Hospital №1 with postoperative infectious complications occurred equally often and remained at almost the same level of 17.02% and 20.00% respectively.

The incidence of inflammatory complications after cardiac surgery performed by sternotomy approach in the second group of patients under study decreased by 80% to $2,41 \pm 0,36\%$ ($p < 0,001$) in contrast to the corresponding indicator in the first group of patients - $4,54 \pm 0,52\%$. This trend which is especially typical for patients with the second group of somatic pathology ($p < 0,001$) did not change in patients with diabetes mellitus.

The authors believe that the introduction of a method of systemic prevention during cardiac surgery turned out to be a significant factor in reducing the incidence of postoperative complications during surgical treatment of the category of patients under consideration which does not depend on the nature of the noted somatic pathology with Fisher's criterion equaling 37.65, that is higher than the significant value according to the critical values of χ^2 at $p < 0,001$ (10.83).

As a result of the introduction of systemic prevention of cardiac surgery complications at the Federal Center of Cardiovascular Surgery in Khabarovsk, the number of infectious complications of median sternotomy after cardiac surgery decreased significantly by 2.6-fold from $1,73 \pm 0,25$ to $0,67 \pm 0,15\%$ ($p < 0,001$). The number of superficial complications, such as wound dehiscence, skin necrosis, and sternal osteomyelitis, decreased by 2.7-fold from $1,18 \pm 0,21$ to $0,43 \pm 0,12\%$ ($t = 3,11$, $p < 0,001$). There was a trend towards a decrease in deep infectious complications ($t = 1,92$; $p > 0,05$), namely sternomediastinitis - from $0,55 \pm 0,14$ to $0,23 \pm 0,09\%$ (Table 3).

It should be noted that the isolation of the internal thoracic artery without surrounding retrochondral tissues (costal pleura, intercostal muscle and endothoracic fascia), preserves the collateral blood supply to the sternum in contrast to

the traditional technique, which is more important in bilateral transplantation and has been recognized as the leading principle of coronary artery bypass grafting [12] in order to reduce infectious complications [15]. As has been observed, this technique for bimammary bypass surgery made it possible to reduce to a certain extent the incidence of infectious complications from $8,77 \pm 3,75$ to $1,72 \pm 0,54\%$ ($t = 1,86$, $p > 0,05$), which was obviously achieved by maintaining the collateral blood supply to the sternum. Setting aside bimammary bypass surgery, the incidence of postoperative infectious complications has significantly decreased by 3.8-fold in the last three years (from 2019 to 2021) to $0,42 \pm 0,13\%$ vs. $1,58 \pm 0,24\%$ in 2016-2018, $p < 0,001$.

One of the factors contributing to the growing number of postoperative infectious complications is the use of wax for hemostasis caused by mechanical blockage of bone marrow lacunae. At that, the introduction of wax into bone tissue inhibits the activity of osteoblasts and bone regeneration [13]. At the same time, bone wax behaves like a foreign body and prevents the formation of callus [11]. In the first group of patients with complications, wax was used in $91,52 \pm 4,07\%$ of cases. In the second group, wax was not used; in case hemostasis was necessary, vancomycin paste (3 g of the drug mixed with 3 ml of saline solution to obtain a homogeneous waxy mass) was used.

Conclusion. The introduction into clinical practice of the Khabarovsk Federal Center of Cardiovascular Surgery of systemic complications prevention after median sternotomy during cardiac surgery made it possible to achieve a 2.7-fold reduction in the incidence of superficial complications from $1,18 \pm 0,21$ to $0,43 \pm 0,12\%$, $p < 0,001$, as well as to reduce the rate of postoperative sternomediastinitis from $0,55 \pm 0,14$ to $0,23 \pm 0,09\%$ ($t = 1,90$, $p > 0,05$), which indicates that a wider use of the above-mentioned systemic preventive measures in the clinical practice is appropriate.

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DETERMINATION OF ANTINUCLEAR ANTIBODIES BY IMMUNOBLOTTING TO CLARIFY THE IMMUNOLOGICAL CHARACTERISTICS OF PATIENTS WITH SYSTEMIC LUPUS ERYTHEMATOSUS AND SJOJREN'S SYNDROME

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Objective: to study the immunological characteristics of patients with systemic lupus erythematosus and Sjogren's syndrome by determining antinuclear antibodies using immunoblotting.

Materials and methods. We observed 69 patients whose average age was 38.9 years [23.2-62.9], of which 63 (91.30%) were women and 6 (8.69%) men. BMI was 27.3 kg/m² [21.8-49.2]. Inclusion criteria: age from 18 to 70 years, presence of a reliable diagnosis. To study the diagnostic value of determining the ANA profile, patients were divided into 3 groups: 1st group – 15 patients with systemic lupus erythematosus (SLE), 2nd – 21 patients with the disease and Sjögren's syndrome (SS), 3rd (control) group – 33 patients with osteoarthritis. The control group was comparable to the study groups by gender and age.

Results. The determination of anti-SS-A in SLE has good quality (area under the ROC curve - 0.66). A cut-off value was determined with 79.6% specificity and 53.3% sensitivity. Anti-RNP/Sm, anti-Sm, anti-dsDNA and anti-HI were somewhat less sensitive (30%), with a specificity level of 91% for anti-dsDNA and anti-Sm and 100% for anti-RNP/Sm and anti -HI. The most informative diagnostic tests for the disease and Sjogren's syndrome are anti-Ro-52 recombinant (sensitivity 57.1%, specificity 96%), anti-SS-Anative (sensitivity 52.4%, specificity 86%). The determination of anti-Ro-52 in SS is of good quality, which confirms the value of the area under the ROC curve (>0.7). The optimal cut-off value corresponded to 99.6% specificity and 57.1% sensitivity. Somewhat less sensitive (28.6%) were anti-Sm (specificity - 92%), anti-dsDNA (specificity - 92%) and anti-RIB (specificity 100.0%).

Findings. The laboratory tests studied, as a rule, had high specificity, but rather low sensitivity. The most specific tests for diagnosing SLE are antibodies to the antigens RNP/Sm, SS-Anative, antibodies to histones, for SS - anti-SS-Anative, anti-Ro-52 recombinant, anti-RIB.

Keywords: systemic lupus erythematosus, Sjögren's syndrome, immunoblotting, antinuclear antibodies.