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Research Article

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Analysis of the Detection Rate and Results of Surgical Treatment of Patients with Infective Endocarditis With/Without COVID-19

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AIM OF STUDY To analyze results of surgical treatment of infective endocarditis in the context of the COVID-19 pandemic at the N.V. Sklifosovsky Research Institute for Emergency Medicine.

MATERIAL AND METHODS From January, 2021 to April, 2022 at N.V. Sklifosovsky Research Institute for Emergency Medicine we performed 59 surgical interventions on patients diagnosed with infective endocarditis, of which 20 patients (33.9%) had a competing diagnosis "new coronavirus infection".

RESULTS The overall mortality was for the specified period was 18.6 %, 11 patients. In the first group, 5 patients died (25%). Hospital mortality in the second group was 6 patients (15.4%).

CONCLUSION Preoperative preparation, as well as the surgical intervention itself, did not differ significantly between patients in the two groups. Hospital mortality in the group of patients with new coronavirus infection was higher than in patients without the virus, despite the fact that the risk of surgical intervention according to EuroSCORE II was higher in the second group. From which we can conclude that the EuroSCORE risk scale II does not fully reflect the initial severity of the condition of patients with COVID-19. Such risk factors as decreased immunity due to immunosuppressive therapy and respiratory failure and coagulopathy influenced the results of surgical treatment of infective endocarditis in this cohort of patients, but not so significantly as to refuse surgical intervention.

The significant difference in the postoperative period was the increase in bed days in intensive care and therapeutic departments among patients with COVID-19. This factor is associated with the initial severity and specifics of management of these patients in the postoperative period, which required greater vigilance and attention from cardiac surgeons, resuscitators and infectious disease doctors in the "red" zones.

Keywords: infective endocarditis, artificial circulation, heart valve replacement, COVID-19, new coronavirus infection, SARS-CoV-2

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ARDS – acute respiratory distress syndrome
CVA – cerebrovascular accident
IE – infective endocarditis
MOF – multiple organ failure

From February 11, 2020 to May 5, 2023, the World Health Organization declared the outbreak of *the COVID-19* epidemic caused by the new coronavirus infection virus *SARS-CoV*-2.

The introduction of quarantine measures, the redistribution of human resources, laboratory and research procedures, primarily for the exclusion and treatment of a new coronavirus infection, has resulted in a sharp reduction in the provision of planned medical care worldwide [1]. But at the same time, the diagnosis and detection of diseases that required more time to verify in everyday life have increased [2–4].

The study of infective endocarditis (IE) dates back to the 16th century. Despite the accumulated experience in studying this disease, the subject of IE

remains relevant from year to year for a number of reasons and issues. Diagnosis of the disease has its own difficulties due to the non-specificity of most symptoms. This requires doctors of various specialties to be more vigilant at the pre-hospital and hospital stages when conducting differential diagnostics. Most patients in this group have a history of chronic pathology, which can worsen against the background of the underlying disease [5-7]. Another reason is the problem of therapy associated with the resistance of modern strains to a large number of antibacterial drugs [8, 9].

IE is not the first on the list of risk factors and complications of *COVID*-19, like myocardial infarction, stroke or heart failure [10, 11]. The gradual onset of the disease and the manifestation of infectious syndrome with fever led to the fact that at the beginning of the pandemic, IE was considered as a possible carrier of *SARS-CoV*-2. Subsequently, with the progression of symptoms, damage to target organs or the conduct of additional instrumental studies, the diagnosis of one or another disease was confirmed [2, 12, 13]. This causes difficulties in deciding on the priority of treatment, COVID-19 or IE, which ultimately requires a multidisciplinary solution [4].

The aim of our study is to analyze the results of surgical treatment of infective endocarditis in the context of *the COVID-19* pandemic at the N.V. Sklifosovsky Research Institute of Emergency Medicine.

MATERIAL AND METHODS

From January 2021 to April 2022, 59 surgeries were performed on patients diagnosed with infective endocarditis at the N.V. Sklifosovsky Research Institute of Emergency Medicine. Of these, 20 patients (33.9%) had a competing diagnosis of "new coronavirus infection". There were 39 men (66.1%) and 20 women (33.9%); the average age was 42.9±13 years.

The majority of patients were hospitalized in the cardiac surgery department or intensive care unit by transfer from other medical institutions in Moscow, nearby regions or CIS countries (91.5%) (Table 1).

Table 1

Place of initial verification of the diagnosis of infective endocarditis

Primary verification location diagnosis of "infective endocarditis"	Quantity patients, *n* (%)	Quantity patients with *COVID* -19, *n* (%)
Other hospitals	49 (83)	20 (40.8)
Outpatient clinics at the place of residence	5 (8.5)	–
At the N.V. Sklifosovsky Research Institute for Emergency Medicine	5 (8.5)	–

Since January 2021, patients with IE and verified coronavirus infection based on a positive PCR test for the presence of the *SARS-CoV*-2 virus and the results of computed tomography [14] have been transferred to the N.V. Sklifosovsky Research Institute of Emergency Medicine for surgical treatment of heart defects in the “red zone” conditions.

To compare the surgical treatment outcomes of patients with IE in the “red and green zones”, 59 patients were divided into two groups: Group 1 included 20 patients (33.9%) with verified coronavirus infection in the preoperative period and Group 2 included 39 patients (66.1%) with negative results for *SARS-CoV*-2. Table 2 presents the baseline characteristics of patients with IE in the two groups.

Table 2

Comparative characteristics of patients by groups

		Group I (IE + *COVID*-19) (*n*=20)	Group II (IE) (*n* =39)	*p*
Average age, years		44 [26–67]	42.2 [20–76]	0.961
Gender, *n* (%)	men	16 (80)	21 (53.8)	0,460
	women	4 (20)	18 (46.2)	0.037
EuroSCORE II, %		3.67 [1.52–12.63]	6.53 [1.41–21.58]	0.044

Note: IE — infective endocarditis

In both groups, the average age of patients did not differ statistically (p = 0.961), but in the second group there were more middle-aged and elderly patients, who more often had concomitant and combined cardiac pathology affecting the general condition of the patient and the results of surgical treatment, respectively, this factor explains the high *EuroSCORE* II of 6.53% (p = 0.044) in the presented group.

A comparative analysis of concomitant pathology (Table 3) revealed a predominance of chronic heart failure in both groups of 30% and 46% (p = 0.177). Arterial hypertension occurred in 25% of cases in the first group and in 21% of cases in the second group. In 10% of patients in the *COVID-19* group and 5% of patients in the second group there was a history of coronary heart disease. In 3 cases (4%), patients had previously suffered acute myocardial infarction. One patient (5%) from the first group and 4 patients (10%) from the second group had previously undergone open-heart surgery.

Table 3

Comparative characteristics of groups for combined cardiac disease

Associated pathology	Group I (n=20)	Group II (n=39)	p
History of cardiac surgery, %	5	10	0.309
Arterial hypertension, %	25	21	0.873
Chronic heart failure, %	30	46	0.177
Atrial fibrillation, %	15	5	0.967
Post-infarction cardiosclerosis, %	0	5	0.302
History of ischemic heart disease, %	10	5	0.309

The groups did not differ statistically significantly in terms of concomitant pathology (Table 4). In both groups, patients with chronic kidney disease were operated on: 4 patients (20%) in the first group and 5 patients (13%) in the second group, respectively. Acute cerebrovascular accident (CVA) was previously suffered by 3 patients (15%) in group I and 6 patients (15%) in group II (p = 1.0). In one third of observations in both groups, patients with chronic viral hepatitis were treated. They also had a history of constant intravenous use of psychoactive substances.

Table 4

Comparative characteristics of groups according to concomitant disease

Associated pathology	Group I (n=20)	Group II (n=39)	p
Diabetes mellitus type II, %	0	10	0.099
Chronic renal failure, %	20	13	0.371
History of acute cerebrovascular accident, %	15	15	1.0
Chronic viral hepatitis, %	30	38	0.909
Chronic exogenous intoxication, %	40	28	0.081

RESULTS

All patients underwent open-heart surgery under artificial circulation (Table 5). Of the 59 patients, 8 had an operation performed on beating heart.

Table 5

Comparative characteristics of the main indicators of artificial circulation by group

Indicators	Group I (n=20)	Group II (n=39)	p
Artificial circulation time, min	98±53.2	106±74.6	0.629
Myocardial ischemia time, min	78±28.2	75±30.6	0.968
Body temperature, °C	35±1.4	34±1.6	0.985

The average time of artificial circulation in group I was 98±53.2 min, in group II — 106±74.6 min, respectively (p = 0.929). The average time of clamping on the aorta did not differ statistically

significantly (p = 0.629). In group I it was 78±28.2 min, in group II — 75±30.6 min. All operations were performed under normothermia.

The extent of surgical intervention performed in both groups is presented in Table 6.

Table 6

Volume of surgical intervention in groups

Volume of surgical intervention	Group I (n=20)	Group II (n=39)
Single valve heart defect correction	15	24
Multivalvular correction of heart defects	2	11
Correction of valve defect and septal defect of the heart	2	–
Re-intervention on heart valves	1	4

In both groups, more biological prostheses were implanted, which was associated with the patient's age and taking into account our own experience with tricuspid valve replacement in all age groups (Table 7).

Table 7

Types of implanted prosthetic heart valves

Model of the prosthesis	Group I (n=20)	Group II (n=39)
Biological prosthesis	18	24
Mechanical prosthesis	6	23

Tracheal extubation in both groups was performed on the first day after surgery. Given the initially severe condition of patients, as well as combined cardiac pathology, inotropic support was required by a greater number of patients on the first postoperative day. In the first group, the average bed-day spent in intensive care was 2 times longer (p=0.052) than in the first group, which is natural and is due to the presence of a competing disease in the form of a new coronavirus infection (Table 8).

Table 8

Comparative characteristics of groups according to resuscitation parameters

	Group I (n=20)	Group II (n=39)	r
Extubation time, h	30±15.8	29±19.4	0.983
Inotropic support in the postoperative period, n (%)	15 (75%)	30 (77%)	0.861
Time in intensive care unit, days	14 [3–49]	6 [1–49]	0.052

A predictably frequent complication in patients from the "red zone" was respiratory failure, 81.3% (p = 0.011). Against the background of the viral disease *COVID-19* and immunosuppression, a secondary infection was added (75%, p = 0.203) in the form of bacterial pneumonia with the development of acute respiratory distress syndrome (ARDS) (12.5%, p = 0.049). In addition, in the first group, complications in the form of acute renal failure (43.8%, p = 0.043) and paroxysms of atrial fibrillation (p = 0.022) were statistically significantly predominant. The remaining complications occurred in the compared groups in approximately equal proportions and had no statistical significance (Table 9).

In 2 observations (6%) in the second group, as a result of the development of acute cardiovascular failure, intraoperative installation of a central extracorporeal membrane oxygenation system was required.

The overall mortality rate for the specified period was 18.6%, 11 patients. In the first group, 5 patients died (25%). Hospital mortality in the second group was 6 patients (15.4%). In group I, the cause of death in 4 patients was the progression of multiple organ failure (MOF) against the background *of COVID*-19. In one observation, on the 10th day after surgery, the patient developed cardiac hemotamponade with cessation of effective blood circulation. Emergency

re-sternotomy and pericardial revision were performed. Six days later, the patient died in the intensive care unit from stroke

Table 9

Comparison of the frequency of in-hospital complications in the study groups

Complications	Group I (*n*=16)		Group II (*n*=33)		*r*
	Abs.	%	Abs.	%	
Unilateral/bilateral hydrothorax with subsequent puncture and drainage of the pleural cavity	6	37.5	11	33	0.856
Unilateral/bilateral pneumothorax with subsequent puncture and drainage of the pleural cavity	1	6.3	1	3	0.251
Paroxysm of atrial fibrillation	3	19	2	6	0.022*
Cardiovascular failure	4	25	10	30	0.735
Respiratory failure	13	81.3	12	36.4	0.011*
Renal failure	7	43.8	10	30	0.043*
Liver failure	0	0	2	6	0.422
Acute cerebrovascular accident	3	19	9	27.3	0.531
Infectious complications	12	75	22	66.7	0.203
Hydro/hemopericardium requiring drainage	4	25	6	18	0.140
Acute coronary syndrome	0	0	1	3	0.422
Acute respiratory distress syndrome	2	12.5	2	6	0.049*
Extracorporeal membrane oxygenation	0	0	2	6	0.401
Repeated sternotomy	1	6.3	1	3	0.742

Note: sign (*) indicates statistically significant differences in indicators

The cause of death in patients of the second group was MOF. In 2 observations, the early postoperative period in patients was complicated by acute cerebrovascular accident with their subsequent death.

DISCUSSION

With the emergence of the *COVID-19* pandemic, the volume of planned cardiac surgery care for the population has decreased worldwide, but at the same time, this has had a significant positive impact on diagnostics and treatment in hospitals. In patients with *COVID* -19, due to more thorough examination, competing diseases were identified that would have taken more time to find in pre-pandemic times.

According to E.O. Kotova et al., the detection rate of IE increased by 9.6%, according to the results of observation *by T. Pommier et al.*, in France an increase of 7% was noted, in the study of *XinPei Liu et al*., in Beijing the incidence rate of IE increased by 5.5%. In our observation, the detection rate of IE in comparison between 2020 and 2021 increased by 11.8%, which is due to a more detailed examination of all patients and echocardiography [4, 15, 16]. According to the review by *J.A. Quintero-Martinez* (2022), the group of patients with *COVID-19* in combination with IE was characterized by a younger age. In our study, the average age in group I was 44 years, and in group II 42.2 years [17]. The surgical risk according to the *EuroSCORE* II scale in the first group was 3.67%, in the second group - 6.53%. In a similar foreign study, the surgical risk was 4.15% [15]. *EuroSCORE* II does not fully reflect the initial severity of the condition of patients with cardiac pathology against the background *of COVID*-19. The risk scale does not take into account indicators such as acute respiratory failure and severe systemic inflammatory response. In this regard, the severity of the condition of patients in the *COVID-19* group did not correspond to the surgical risk of standard cardiac surgery described by this scale.

A number of authors have suggested that open surgery under artificial circulation may aggravate the course of the infectious process, since the mortality

rate in these patient groups is 20.6% [1], and the 30-day mortality rate is 23.8% [18]. In our study, hospital mortality in patients with *COVID-19* combined with IE was 25%. According to L.S. Kokov et al., S. Zaim et al., the *SARS-CoV*-2 virus, due to high expression of angiotensin-converting enzyme-2, has a direct adverse effect on the myocardium [19, 20]. In our patients, cardiovascular failure was observed in 25% of cases in group I and in 30% in group II ($p = 0.735$). In Group I, against the background of a new coronavirus infection, a frequent complication was observed in the form of respiratory failure due to the addition of a secondary infection in the form of bacterial pneumonia or the development of ARDS. Also, due to a violation of hemostasis, this group of patients experienced hemorrhagic complications in the form of hemorrhagic effusion into the pericardial cavity.

CONCLUSION

Preoperative preparation, as well as the surgical intervention itself, did not differ significantly in patients in the two groups. Hospital mortality in the group of patients with a new coronavirus infection was higher than in patients without the virus, despite the fact that the risk of surgical intervention according to *EuroSCORE* II was higher in the second group. From this we can conclude that the *EuroSCORE* II risk scale does not fully reflect the initial severity of the condition of patients with *COVID*-19. Risk factors such as decreased immunity against the background of immunosuppressive therapy, respiratory failure and coagulopathy affected the results of surgical treatment of infective endocarditis in this cohort of patients, but not so significantly as to refuse surgical intervention.

A significant difference in the postoperative period is noted in the increase in bed days in intensive care and in therapeutic departments among patients with *COVID*-19. This factor is associated with the initial severity and specificity of the management of these patients in the postoperative period, which required greater vigilance and attention from cardiac surgeons, resuscitators and infectious disease doctors in the "red zones".

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