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Specific features of anesthesia management in a patient with a transplanted heart

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Abstract

Background. *The number of heart transplant patients makes 1 per 100,000 in the Russian Federation, 1.2 per 100,000 population in the Tambov Region. The medical community is poorly informed about the specific features of managing such patients during non-cardiac surgical interventions. The article presents a case report of the management of a patient with a transplanted heart undergoing surgery for acute appendicitis. Preoperative preparation, anesthesia management, surgery, and postoperative care and rehabilitation were provided taking into account the presence of a transplanted heart in the patient, according to the Guidelines developed by the experts of the V.I. Shumakov Federal Research Center of Transplantology and Artificial Organs where the*

heart transplant had been performed to the patient, and standard clinical recommendations.

Case Report. *An 18-year-old patient diagnosed with acute phlegmonous appendicitis with a heart transplanted in 2021 for dilated cardiomyopathy underwent laparoscopic appendectomy 3 years after heart transplantation. Anesthesia was provided taking into account the presence of a denervated donor heart, a high risk of myocardial ischemia and heart failure (low cardiac output syndrome), and the need for a timely correction of hypovolemia and hypotension. Anesthesia management was a general combined multicomponent anesthesia.*

Conclusion*. This clinical case has shown the possibility of providing medical care to a patient with a transplanted heart at a modern level in an urban multidisciplinary hospital. Non-cardiac surgery was performed in accordance with recommendations of specialists of V.I. Shumakov Federal Research Center of Transplantology and Artificial Organs and clinical recommendations in order to achieve optimal results and the fastest possible rehabilitation in the postoperative period.*

Keywords: non-cardiac surgery for a patient with a transplanted heart, laparoscopic appendectomy, anesthesia management

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BP, blood pressure
i.v., intravenously
HR, heart rate
ECG, electrocardiography

SpO_2, oxygen saturation

Introduction

Currently, the number of heart transplants worldwide is estimated at approximately 5500 operations per year [1]. In the Russian Federation in 2020, there were 1,524 patients with a functioning heart transplant (1 per 100,000 population). The number of organ transplants in the Russian Federation in 2022 increased by 10.2% compared to 2021 [2]. In 2022, there were 21,969 patients with organ transplants in Russia (15.1 per 100,000 population), and over 9 years of surveillance, the number of such patients in the Russian Federation increased 2.6 times. In 2022, 2555 organ transplants were performed in the Russian Federation, of which 310 were heart transplants [3]. In the Tambov region, there were 12 patients with a transplanted heart (1.2 per 100,000 population) registered in 2023. In recent years, there has been a significant improvement in the survival rate of patients undergoing successful heart transplantation [4].

Despite the fact that in the general population the percentage of people with a transplanted heart is insignificant, there is always a probability that such a patient will be admitted for emergency or planned non-cardiac surgery. For an anesthesiologist at a health care institution of any level providing emergency care, the choice of tactics for anesthesia management in surgical interventions in patients with a transplanted heart is relevant. A specific feature of patients in this category is a lifelong use of immunosuppressants, the likelihood of inflammation and transplant rejection. The transplanted heart is devoid of sympathetic and parasympathetic innervation and cannot respond to hypovolemia and hypotension by increasing heart rate; and there is no inhibitory vagal effect, either, while sensitivity to endogenous and exogenous catecholamines remains [5]. In donor heart transplant recipients, there

have been described cases of the development of bradycardia up to complete atrioventricular block with the need for cardiac pacing [6, 7].

The main tasks in the perioperative period of non-cardiac operations in patients with a transplanted heart include: maintaining the pumping function of the heart and normovolemia, creating conditions for restoring the functions of the gastrointestinal tract and early rehabilitation of patients. It is important to reduce the time of surgical intervention, choose a balanced infusion program, early initiate the enteral nutrition and ambulation of patients, rational antibacterial therapy [2, 9].

According to clinical recommendations, when hospitalizing a patient with a transplanted heart, it is necessary to inform the staff of the center where the organ transplant had been performed and jointly develop the management tactics for such a patient [2].

The objective was to demonstrate the specific features of anesthesia during surgical treatment of acute phlegmonous appendicitis in a patient with a transplanted heart.

Material and methods

The study used the data from the medical documentation of Tambov City Clinical Hospital No. 3 n.a. I.S. Dolgushin, data from laboratory and instrumental studies, anesthesia and intensive care protocols, data from the Regional Medical Information System, and literary sources from the Internet databases E-library, Cyberleninka, PubMed.

Case Report

Patient M., 18 years old, was delivered by an ambulance team to the Emergency Department of Tambov City Clinical Hospital No. 3 n.a. I.S. Dolgushin with complaints of severe pain in the right iliac region,

which appeared in the morning on the day of referral to the Emergency Medical Service, nausea, vomiting up to 4 times. An increase in pain was noted. The patient was urgently hospitalized to the Surgical Department with suspected acute appendicitis. After series of investigations and examination and taking into account the ineffectiveness of conservative therapy, she was diagnosed with "Acute phlegmonous appendicitis" as the primary diagnosis, and "Dilated cardiomyopathy" as secondary one. "Condition after donor heart transplantation of May 03, 2021. Having a transplanted heart. Graft dysfunction. Chronic heart failure stage 1. Functional class 2. Chronic bronchitis of a smoker (tobacco smoking for 3 years)". The decision was made to perform an emergency laparoscopic appendectomy. The responsible Administration Manager reported to the Deputy Chief Physician for the Medical Unit of the Hospital about the hospital admission of a patient with a transplanted heart and about the upcoming emergency surgery for acute appendicitis. Current actual information about the patient's previous visits to the Regional Advisory Clinic was obtained from the Regional Medical Information System. A telephone consultation was arranged with a transplantologist and anesthesiologist-intensivist of the Federal Institution V.I. Shumakov Federal Research Center of Transplantology and Artificial Organs. Management tactics were determined, recommendations were received for preoperative preparation, examination, and anesthesia management for surgical intervention.

The results of laboratory tests and instrumental examinations were as follows. Complete blood count: leukocytes $10.34x10^{9}$/L, erythrocytes $4.02x10^{12}$/L, hemoglobin 90 g/L; band neutrophils 11%, segmented neutrophils 68%, lymphocytes 17%, monocytes 4%, erythrocyte sedimentation rate 30 mm/h. Electrocardiography (ECG) recording on the day of admission showed: “Sinus rhythm 73 per minute; vertical position

of the electrical axis of the heart." According to the expert recommendations obtained from V.I. Shumakov Federal Research Center of Transplantology and Artificial Organs, an echocardiographic study was performed to measure the cardiac ejection fraction, which was 67%. The volumetric status was assessed by ultrasonoscopic measurement of the diameter of the inferior vena cava that made 18 mm, while the collapse during inspiration was more than 50%, which we regarded as minor hypovolemia that had developed as a result of restricted nutrition and fluid intake due to the present inflammation focus in the abdominal cavity and pain syndrome. Physical health status was assessed as Class 2, according to the American Society of Anesthesiology (ASA). According to the Mallampati Score, the patient's oropharynx structure was referred to Class 1, the thyromental distance was 6 cm, and so, a low risk of difficulty in tracheal intubation was stated. The decision was made to perform surgery under general combined multicomponent anesthesia. Preoperative preparation included the catheterization of a peripheral vein; due to the presence of moderate hypovolemia in the patient, the infusion of a polyionic solution (sodium chloride 6.8 g, potassium chloride 0.3 g, calcium chloride dihydrate 0.37 g, magnesium chloride hexahydrate 0.2 g, sodium acetate trihydrate 3.27 g, malic acid 0.67 g in 1 liter of solution) was performed preoperatively, 500 ml; antibiotic prophylaxis was made with ceftriaxone 2.0 g by intravenous (i.v.) stream infusion at 40 minutes before the skin incision. Premedication included diazepam 5 mg/mL at a dose of 10 mg intramuscularly at 30 minutes before surgery. In the operating room, the standard intraoperative monitoring was performed: blood pressure (BP), ECG, heart rate (HR), respiratory rate, oxygen saturation (SpO_2), capnometry. Preoxygenation with 100% oxygen through a face mask was undertaken for 3 minutes. Induction anesthesia was performed using propofol 10 mg/mL at a dose of 100 mg

i.v. in divided bolus doses of 40 mg until the effect was achieved [8]. Also, at the stage of induction anesthesia, fentanyl 50 μg/mL at a dose of 150 μg i.v. was used. Tracheal intubation was performed without technical difficulties on the first attempt after administration of rocuronium bromide 10 mg/mL at a dose of 30 mg i.v. Maintenance of anesthesia included the inhalation of sevoflurane 2.5 vol%, fentanyl 6 mcg/kg/h. During surgery, the hemodynamic profile was stable. Blood pressure 115/65-120/70 mm Hg, heart rate 80–87 per minute, SpO_2 98–100%. There were no periods of tachycardia, which indicated an adequate depth of anesthesia at all stages of the surgical intervention. The surgery performed was laparoscopic appendectomy using video endoscopic technologies. The surgery duration was 20 minutes. At 10 minutes after the surgery completion, the patient underwent tracheal extubation after restoration of consciousness, spontaneous breathing and muscle tone. The patient was transferred to the Intensive Care Unit, where dynamic follow-up, cardiac monitoring, control of volumetric status were carried out. Sonoscopic measurement of the inferior vena cava diameter showed was 18 mm on the first day of the postoperative period, collapses on inspiration more than 50%, 20 mm on the 3rd day, collapses on inspiration lower than 50%. ECG one day after surgery showed atrial rhythm, heart rate 71 per minute; additional (autonomous) P waves of positive polarity; atrial dissociation; transient change in the processes of myocardial repolarization in the anteroseptal region of the left ventricle. ECG recorded on the 2nd day after surgery showed accelerated atrial rhythm, heart rate 92 per minute. Postoperative treatment included antibiotic therapy (ceftriaxone 2 g/day, metronidazole 1500 mg/day), prevention of thrombus formation (compression garments for the lower extremities, sodium heparin 15,000 units/day subcutaneously). After 12 hours post-surgery, the patient was transferred to the patient ward of the pertinent

department. Ambulation and physical therapy were initiated from the first day of the postoperative period. The patient resumed oral food intake after 12 hours post-surgery and continued taking immunosuppressants: tacrolimus 8 mg/day (4 mg 2 times a day) and mycophenolate mofetil 2000 mg/day (1000 mg x 2 times a day). The postoperative period was uneventful. The patient was discharged from the hospital on the 7^{th} day in satisfactory condition for outpatient treatment by a surgeon with a mandatory supervision by a cardiologist.

Conclusion

Considering that non-cardiac surgery in patients with a transplanted heart is performed extremely rarely due to the small percentage of such patients in the population, it is very important to familiarize surgical doctors and anesthesiologists-intensivists with the specific requirements of perioperative management and anesthesia management in this category of patients. Based on the results of this Case Report, taking into account the recommendations from literature sources and the expert recommendations from V.I. Shumakov Federal Research Center of Transplantology and Artificial Organs, we have identified the following main provisions for the management of patients with a transplanted heart during non-cardiac surgical interventions in our medical institution:

1. When a patient with a heart transplant is hospitalized in a medical institution, the team of doctors on duty should inform the responsible administrator on duty, the deputy chief physician of the medical institution responsible for medical units and the attending physician of the transplant center where the heart transplant was performed.

2. Anesthesia management should be provided taking into account the presence of a denervated donor heart, the high probability of

myocardial ischemia and heart failure (small output syndrome), considering the need for timely correction of hypovolemia and hypotension. The preference should be given to general combined multicomponent anesthesia in abdominal and neurosurgical interventions, to regional anesthesia in non-abdominal surgical interventions. One should be cautious with using neuroaxial analgesia methods.

3. After surgery, he patient should be transferred to the Intensive Care Unit providing mandatory cardiac monitoring in the early postoperative period, early mobilization measures; and as soon as the patient is able to take food, taking immunosuppressants should be resumed.

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