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PERICARDIAL WINDOW AS A SURGICAL METHOD FOR PREVENTING SIGNIFICANT POSTOPERATIVE PERICARDIAL EFFUSION

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Postoperative pericardial effusion (PPE) represents a very common complication in cardiac surgery. Accumulation of a significant amount of free fluid in the pericardial cavity is a multifactorial process. Identifying the cause is not always possible. This complication occurs more frequently in patients after heart transplantation than in patients who underwent reconstructive cardiac surgery. Having hemodynamically significant effusion requires surgical evacuation of fluid from the pericardial cavity. This can affect the postoperative period and increase the length of stay at the hospital. For this reason, developing and ensuring widespread use of methods for prevention of this complication are urgent and relevant tasks.

Keywords: heart transplantation, pericardial window, pericardial effusion.

Objective: to provide data on practical application of the pericardial window procedure in heart transplant recipients for preventing significant pericardial effusion formation.

INTRODUCTION

Heart transplantation (HT) remains the gold-standard therapy in end-stage heart failure. The efficacy of HT today is not under dispute because of its significant advantage over drug therapy and alternative surgical interventions. Each year, about 300 HT surgeries are performed in the Russian Federation. This number is rising steadily. It is obvious that introduction of new methods of treatment and prevention of complications in this field is necessary to further develop and strengthen the position of transplantology in the Russian Federation. For many years now, the Shumakov National Medical Research Center of Transplantology and Artificial Organs (hereinafter referred to as Shumakov Center) in Moscow has remained the absolute leader in terms of the number of HTs performed. Since 2016, the center has performed about 200 HTs per year, which is the best indicator among all institutions in the world today [1]. The accumulated experience allows to reliably assess the current issues regarding the course of the postoperative period in HT recipients in the Russian Federation, including the incidence and significance of complications.

PPE is one of the most common findings after cardiac surgery [2–7]. This complication is also characteristic of cardiac recipients. The incidence of PPE in this group of

patients is significantly higher due to different immunological and surgical components [2, 3]. Large pericardial effusions can cause compression of heart chambers, leading to decreased hemodynamic parameters. The only way to treat such conditions is additional surgical intervention, an undesirable event that affects the postoperative period. Today, one of the ways of radical prevention of this complication in reconstructive cardiac surgery is the pericardial window procedure or posterior pericardiotomy in one-stage with the main stage of surgery [8–11]. This method is widely used in clinical practice due to its simplicity, efficiency and safety.

At present, it is difficult to speak about the breadth of application of the procedure in cardiac transplantation practice. However, it is worth considering the effectiveness of its use in reconstructive cardiac surgery [12–15]. This surgical technique can reduce the incidence of pericardial effusions, the number of drainage operations performed and the length of stay in the hospital. Currently, this technique is used at Shumakov Center for HT recipients. Given the novelty and lack of clear indications for use, the effect on the postoperative period in cardiac transplant patients is being studied.

MATERIALS AND METHODS

In order to analyze the effectiveness of the method of surgical prevention of PPE in HT recipients, we performed the pleuropericardial window technique in 22 recipients at Shumakov Center during the main stage of surgery from December 2021 to December 2022. For

the purpose of objective analysis of the procedure, selection criteria were not used, and the pericardial window was performed randomly. The average time of stay and follow-up at the surgical hospital was 19 ± 10.3 days. Patient mean age was 45.9 ± 10.3 years, 86% men, 14% women. The prevalent pre-transplant diagnoses were: dilated cardiomyopathy (59%) and ischemic cardiomyopathy (36%). The vast majority of patients (95%) had no history of previous cardiac surgery. The mean time of the main stage of surgery was 51 ± 10.5 minutes. Cardiopulmonary bypass time was 103.7 ± 17.7 minutes. Heart graft ischemic time was 175.9 ± 62.8 minutes. The data of 190 patients who underwent HT in 2022 at Shumakov Center were used for comparison. The presence of severe pericardial effusion that required repeated surgical intervention due to signs of hemodynamically significant compression of the heart chambers and volume of free pericardial fluid ≥ 300 mL were assessed.

SURGICAL TECHNIQUE

The pericardial window procedure consists of excision of a 3–4 cm² area of the pericardium using electrocoagulation below the left diaphragmatic nerve, 4–5 cm down from the left inferior pulmonary vein (Fig. 1). After completion of the main stage of the operation, it is suggested to place a 27–30 F pleuropericardial drainage tube through the pericardial window into the left costophrenic angle in order to drain both the pleural cavity and the pericardial cavity (Fig. 2). The duration of pleuropericardial drainage should be no more than 72 hours from the time of surgery when the discharge rate reaches <100 mL per day. When the tube is removed, the skin defect should be sutured to prevent pneumothorax and pneumopericardium. After removal of the drainage tube, negative pressure in the pleural cavity creates active aspiration from the pericardial cavity, provided the latter is airtight. Thus, redistribution of fluid volume changes the character and significance of clinical manifestations of the effusion process. Besides, the pleural cavity is characterized by a greater resorption surface, which allows in some cases to be limited to conservative methods of treatment.

RESULTS

A standard protocol for assessing the presence of effusion in the pericardial cavity during echocardiography (EchoCG) was used, including daily examination during patient follow-up in the intensive care unit (ICU) and pericardial ultrasound twice a week after transfer to the surgical ward. The average amount of fluid content in the pericardial cavity was found to be 50–100 mL in 95% of patients, which is an acceptable norm and does not require active treatment. Only one patient, despite surgical prophylaxis, had massive pericardial and pleural effusion that required drainage of the pericardial cavity on day 27 after transplantation and two pleural cavity drainage procedures, which was due to hypoalbumine-

mia, deficiency of plasma coagulation factors, decreased diuresis and hypodynamic patient against edema syndrome. The patient also had fibrin clots in the pericardial cavity along the contour of the right ventricle and hemorrhagic discharge during drainage. This may indicate signs of delayed bleeding resulting from blood clotting disorders. Two more patients had significant left-sided pleural effusion, which required evacuation of fluid from the pleural cavity. Hydrothorax can be one of the predictable features of the method and develop due to fluid outflow through the pericardial window into the pleural cavity [10]. Of course, pleural effusion is also an undesirable postoperative event in this group of patients. But this complication does not affect hemodynamic characteristics of the graft, and surgical manipulation of evacuation of significant volume of fluid from the pleural

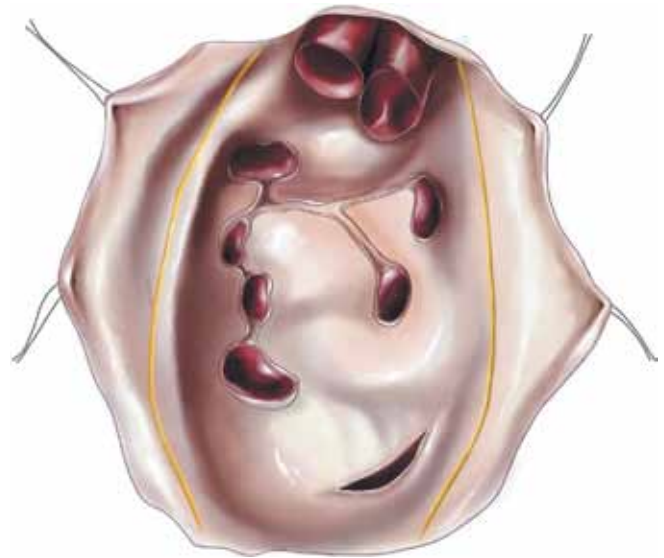


Fig. 1. Image of optimal localization of the pericardial window relative to the nearest anatomical structures

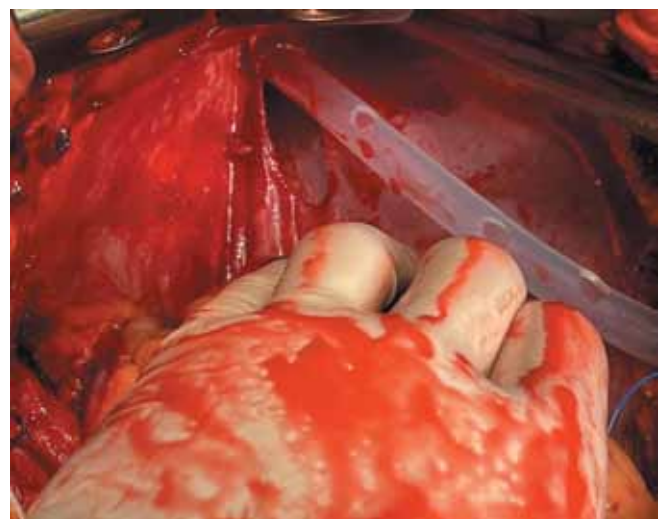


Fig. 2. An example of placement of a pericardial drainage tube after completion of the main stage of the operation

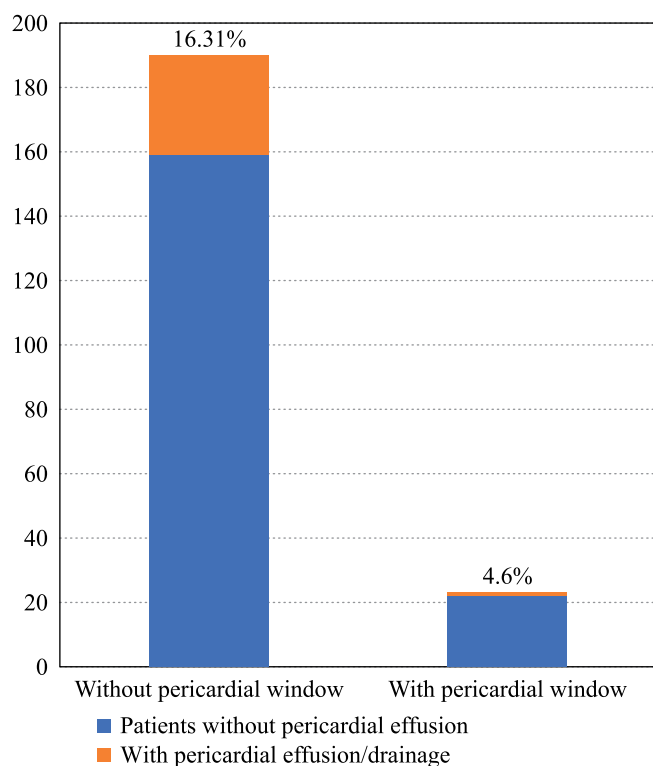


Fig. 3. Comparison chart

cavity compared to pericardial cavity drainage is a much gentler intervention, not requiring patient sedation.

In the group of patients who underwent HT without undergoing a pleuropericardial window, severe pericardial effusion requiring surgical evacuation of fluid was noted in 16.3% of cases. This shows the advantage of the presented procedure and the difference between the groups by more than 10% $p > 0.05$ (Fig. 3).

DISCUSSION

At first glance, such a complication as fluid accumulation in the pericardial cavity does not have obvious negative consequences for patients and sometimes is not considered by clinicians as a serious problem requiring special attention. However, as practice shows, the increase in free fluid volume in the pericardial cavity in the early postoperative period negatively affects the patient's hemodynamic parameters, can cause arrhythmia, lead to compression of the heart chambers and cardiac tamponade. According to global statistics, PPE occurs in approximately 6–35% of patients after cardiac surgery [16–22]. According to the 2019–2022 statistics from our institution, this complication leads to significant heart graft dysfunction and requires additional surgical intervention in 15–20% of cases. It has been noted that HT recipients account for an average of 83% of all patients who underwent cardiac surgery and required drainage of the pericardial cavity in the postoperative period in the operating room. This once again proves the predis-

position of this category of patients to accumulation of pathological amounts of pericardial fluid.

From our point of view, the most optimal method of radical treatment of large pericardial effusion is drainage of the pericardial cavity through subxiphoid access. This intervention does not require additional incisions and is performed by opening the sternotomy suture in the lower third for 5–6 centimeters and evacuating fluid, followed by placement of a drainage tube. The main advantage of subxiphoid access is the possibility to perform complete evacuation of pericardial effusion, which is not always possible when performing pericardial puncture, especially when accumulation is encysted along the posterior surface of the heart [23–25]. Pericardial puncture is also an effective procedure that is used as the method of choice in many institutions, and the procedural success rate is 97%. However, a prerequisite is to perform the procedure under ultrasound guidance, optimal ultrasound window, or to perform the puncture in an X-ray operating room [26]. Although drainage procedures and pericardial punctures have long been used as a safe treatment strategy in patients with this complication, it is worth bearing in mind that these surgical manipulations cause additional emotional stress for the patient, may increase length of stay at the hospital due to the need for extended follow-up, and are among the undesirable postoperative events in terms of clinical and economic factors.

Techniques for surgical prevention of severe pericardial effusion are used worldwide and are becoming increasingly common in reconstructive cardiac surgery due to the revealed effectiveness with regard to postoperative atrial fibrillation – reduced amount of effusion and decreased inflammatory response [12–15]. Pleuroperitoneal shunting using pericardial window or posterior pericardiectomy can significantly reduce the risk of hydropericardium, which is especially relevant in patients after heart transplantation. The advantage of performing a pleuropericardial window during the main surgical phase is to prevent the buildup of significant pericardial effusion due to effusion redistribution and, as a consequence, reduce the incidence of complication.

Given the data obtained, it can be concluded that surgical prevention of pericardial effusion in patients after heart transplantation by shunting is effective due to absence of signs of pathological fluid accumulation in 95% of cases, which exceeds by 10% the indicator of patients who did not undergo pericardial window during the operation. This technique can improve the efficiency of medical care for patients with end-stage heart failure, preventing this complication in patients after heart transplantation.

The question about indications and contraindications for the use of the method in everyday practice in heart transplant recipients is open because of the need to identify the main predisposing risk factors and determine

the probability of complications such as formation of hydrothorax due to fluid distribution.

CONCLUSION

The use of pleuropericardial window as a surgical method for prevention of significant PPE after heart transplantation may reduce the risks of repeated surgical interventions aimed at evacuating severe hydropericardium, and improve the early postoperative period.

The authors declare no conflict of interest.

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