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Case Report

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Full Thickness Flap of the Greater Pectoral Muscle for Poststernotomy Mediastinitis

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ABSTRACT Poststernotomy mediastinitis is the most severe and dangerous complication in cardiac surgery. Treatment of such patients still poses great difficulties for the surgeon dealing with this problem. At the reconstructive stage, they consist in the lack of criteria for choosing a method of plastic surgery and standardized surgical technologies. The use of autologous tissues is generally performed: greater omentum and muscle flaps. The article presents the experience of treating a patient with poststernotomy mediastinitis. The surgery was two-staged. The effectiveness of using vacuum-assisted dressings has been demonstrated. Performing final debridement and wound preparation followed by repair of the defect with a full-thickness flap of the pectoralis major muscle on the perforating branch of the internal thoracic artery led to the patient's recovery.

Keywords: chest wall defect, poststernotomy mediastinitis, sternal osteomyelitis, muscle flap, perforating branch of the internal thoracic artery

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ACVA – acute cerebrovascular accident
CT – computed tomography
IMA – internal mammary artery
GPM – greater pectoral muscle
PSM – poststernotomy mediastinitis

INTRODUCTION

Poststernotomy mediastinitis is the most severe and dangerous complication in cardiac surgery. Treatment of such patients still poses great difficulties for the surgeon dealing with this problem. It is not an easy task to relieve acute inflammation and eliminate pathogenic microflora from the wound, especially in conditions of drug resistance of hospital microflora [1, 2]. Surgical treatment aimed at eliminating the pathological focus may be accompanied by decompensation of the vital functions of the body and lead to the development of critical conditions. At the same time, pathogenic

flora is often multiresistant to antibacterial drugs, which makes its complete removal difficult. That is why there is no universal surgical tactics for treating patients with infectious lesions of the chest wall. The most recognized and well-reasoned option is to divide treatment into stages [3, 4]. However, it is extremely difficult to achieve a sterile wound in all patients. A good result at the first stage of treatment is considered not only visual cleansing of the wound (lack of exudate, fibrin, necrosis, active granulations), but also a decrease in the microbial number to 10^2 -10^3 CFU /g and below. The difficulties of the second stage of treatment are the lack of criteria for choosing a method of plastic surgery and standardized surgical technologies. The use of autologous tissues is generally accepted: greater omentum and muscle flaps [5, 6]. Not the last place when choosing a plastic surgery method is occupied by the personal preference of the operating surgeon and the traditions of the medical institution. Unfortunately, the problem is the insufficiently reliable blood supply to such flaps, especially in conditions of their movement. The goal of the second stage of treatment is to eliminate the chest wall defect by completely filling the wound with an array of displaced graft and restoring the integrity of the chest wall [6, 7].

Aim of study: to evaluate the possibility and effectiveness of using a full-thickness cutaneous-subcutaneous-fascial-muscular flap on the perforating branch of the internal mammary artery (IMA) in reconstruction of the anterior chest wall in post-sternotomy mediastinitis (PSM).

Clinical observation

Patient F., 64 years old, was admitted to the surgical thoracic department of the surgery clinic of the Institute of Vocational Education of Samara State Medical University on April 26, 2022, with complaints of pain in the anterior chest wall, the presence of purulent discharge from the area of the postoperative scar and increased body temperature up to 37.6° C.

In the period from 02/25/2022 to 04/04/2022, the patient was treated in a cardiac surgery hospital with a diagnosis of "Type I aortic dissection according to DeBakey. Stage 3 hypertension, risk 4. Atrial fibrillation, paroxysmal form, normal tachysystole. H1 (NYHA III). Atherosclerosis of the aorta and cerebral arteries. Urgently, on February 25, 2022, cardiac surgeons performed an operation: resection of the ascending and aortic arch with supracoronary replacement, remodeling of the sinotubular junction with plastic surgery of the aortic valve. The postoperative period was difficult, which was associated with the manifestation of hypocoagulation. Due to prolonged artificial ventilation of the lungs, tracheostomy was formed on March 3, 2022. On March 10, 2022, cardiac tamponade was diagnosed. A lower mediastinotomy was performed and the pericardial cavity was drained (700 ml of blood was removed). Considering the presence of echo-positive inclusions in the pericardial cavity during computed tomography of the chest organs, an operation was performed on March 17, 2022: repeated sternotomy, revision of the thoracic cavity organs, formation of an anastomosis between the pericardial cavity and the left pleural cavity. 800 ml of blood clots were removed intraoperatively. On March 25, 2022, acute cerebrovascular accident (ACVA) developed in the area of the right middle cerebral artery with left-sided hemiparesis. On April 21, 2022, an abscess was formed in the area of the postoperative scar of the anterior chest wall. Upon examination, an area of tissue infiltration measuring 30×25 mm was determined in the upper part of the postoperative scar (Fig. 1). On palpation there was a positive symptom of fluctuation. No pathological mobility of the sternum was detected. CT scans in the area of the transition of the manubrium to the body of the sternum revealed a hypoechoic zone, extending retrosternally and in the projection of the second ribs on both sides.

Fig. 1. The patient's anterior chest wall. Tissue infiltration in the area of the upper part of the postoperative scar is determined

Upon admission the condition was of moderate severity. The patient had limited mobility as a result of a stroke. Blood test: WBC 12.1×10^9/l, hemoglobin 10^9 g/l, RBC 3.1×10^{12}/l, platelets 258×10^9/l, C-reactive protein 55 mg/l. A clinical diagnosis was made: "Post-sternotomy mediastinitis, type 2 according to Oackley-Wright." On April 27, 2022, the patient underwent surgery: "Revision of the chest wall wound, debridement." Two cranial metal ligatures in the area of the manubrium of the sternum were removed, and partial resection of the body of the sternum was performed (Fig. 2). A vacuum-assisted dressing was installed, which was changed every 3 days (there were 3 dressing changes in total). Primary microbiological analysis of exudate from the wound revealed the presence of Staphylococcus aureus 10^4 CFU/g. Cefaperazone/sulbactam 2 g twice a day intravenously was prescribed as antibacterial therapy for 18 days. A control analysis of wound discharge 14 days after the start of treatment did not determine the presence of pathogenic microflora. The chest wall wound was ready for plastic closure.

Prior the operation, the patient underwent color Doppler mapping of the perforating branches of the internal mammary arteries, determination of their projections on the anterior chest wall, and marking of the surgical field for subsequent surgical intervention.

On May 13, 2022, the operation was performed: "Resection of the sternum and cartilaginous parts of the second ribs, plastic surgery of the chest wall defect with a full-thickness flap on the perforating branch of the left IMA." We present the course of the surgical intervention. The edges of the wound were excised to the sternum. There is destruction of its anterior cortical plate in the area of attachment of the second ribs to the sternum. In this place, diastasis of the sternal valves of 5 mm is also determined. The costal cartilages are dull with an uneven surface. Resection of the manubrium and the upper part of the body of the sternum, as well as the cartilaginous parts of the second ribs, was performed. The resulting chest wall defect measured 12x5 cm (Fig. 3). In the projection of the perforating vessel of the left IMA in the 2nd intercostal space in the lateral direction from the edge of the wound with dissection of the skin, subcutaneous tissue and greater pectoral muscle (GPM), a full-thickness skin-subcutaneous-fascial-muscular flap 10 cm long and 4 cm wide was formed. The only place for its fixation there was a perforating branch of the IMA to the chest wall (Fig. 4). The mobilized flap was then transferred into the chest wall defect and rotated 90° relative to the perforating artery. Two perforated drainage tubes were installed in the wounds: one in the area of the taken full-thickness flap, the second in the area of the chest wall defect under the transferred flap. Drainage tubes are brought out through separate incisions on the skin and connected to a Redon-type vacuum. The wound in the area where the flap was harvested was sutured in layers: with a continuous absorbable 3-0 thread on the edges of the bone marrow, with interrupted sutures along the edges of the wound at the level of the superficial pectoral fascia, and with a stapler on the skin. The displaced flap is fixed with knotted absorbable ligatures at the level of

Fig. 2. The wound of the anterior chest wall of a patient with a resected sternum

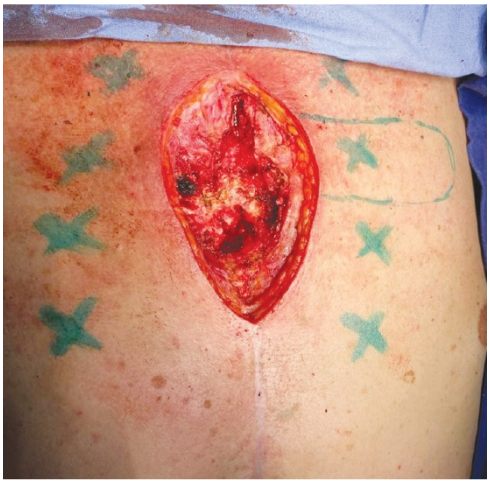

Fig. 3. Intraoperative photo. Chest wall wound with resected sternum and second ribs. There are marks on the perforating vessels of the internal thoracic artery and markings for flap formation

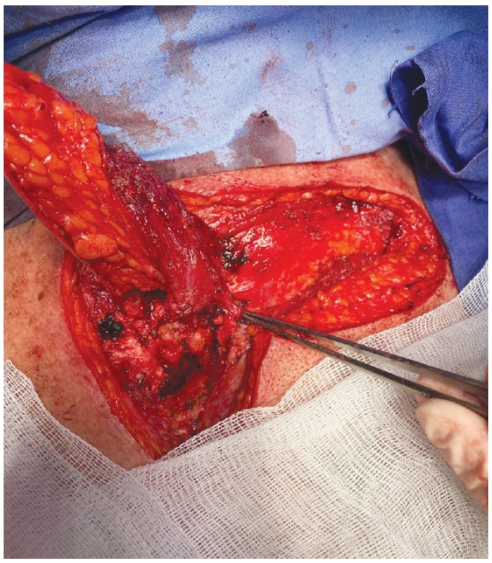

Fig. 4. Intraoperative photo. Full-thickness flap on the perforating branch of the internal thoracic artery

the subcutaneous tissue to the edges of the chest wall wound; the associated skin edges are fixed using a skin stapler (Fig. 5). The drains were removed on the 3rd day after surgery. CT scan revealed no residual cavity under the flap. With intravenous contrast, the vessel supplying the flap with blood is identified—the perforating branch of the right IMA (Fig. 6). Healing by

Fig. 5. Intraoperative photo. The anterior chest wall after suturing the wound

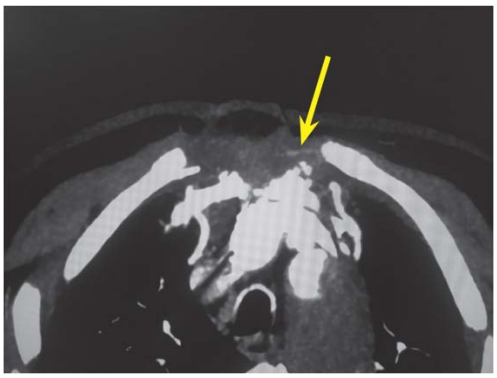

Fig. 6. CT-scan of the chest wall on the 8th day after surgery. The arrow indicates the artery supplying blood to the flap

first intention. The patient was discharged on the 13th day after surgery. The patient was examined 10 months after the operation, had no complaints, and was satisfied with the result of the operation. There were no chest wall defects.

DISCUSSION

Poststernotomy mediastinitis is a serious, often fatal complication in cardiac surgery [8]. Cases of infection of the aortic prosthesis pose a particular danger [9]. Despite well-developed preventive measures, mortality in patients with PSM reaches 20% [10]. As the wound is cleansed, the question arises about choosing a method of plastic surgery for the resulting defect in the chest wall. In conditions of infected tissue, most surgeons prefer to use autologous plastic material as a plastic material. Based on the size, depth, and volume of the wound, you can plan various plastic surgery options. For a limited defect, it is advisable to use anatomically adjacent vascularized muscle grafts [11]. M. Nishimon et al. described the successful use of an adipofascial (cutaneous-subcutaneous) flap on the perforating branch of the IMA to correct a chest wall defect in osteoradionecrosis [12]. Taking into account the peculiarities of the blood supply to the anterior chest wall, in particular the GPM, we considered it possible to use a full-thickness GPM flap, including the cutaneous-subcutaneous and fascial-muscular layers on the perforating branch of the IMA. The anatomical layers of this flap not only have a single arterial blood supply network, but are also a fairly large formation that can easily eliminate the residual cavity in the wound.

However, this type of plastic surgery also has limitations. Firstly, it is only suitable for a small sternal defect. Secondly, a prerequisite for its use must be the presence of a perforating branch of the IMA directly at the upper or lower edge of the chest wound. This is due to the fact that mobility and rotation of the resulting flap will be required relative to the perforating branch, which will be the only point of fixation to the chest wall. Thirdly, in the case of using the left IMA for myocardial revascularization, the option of forming a full-thickness GPM flap on any of its ipsilateral perforating branches is completely excluded.

CONCLUSIONS

A full-thickness flap of the pectoralis major muscle on the perforating branch of the internal mammary artery can be used as a plastic material for reconstruction of a limited defect of the chest wall with poststernotomy mediastinitis. Access planning should be done preoperatively based on a careful assessment of the location and size of the defect. Preoperative ultrasound visualization of the perforating branches of the internal mammary arteries to assess blood flow in the face of potential flap movement is a prerequisite.

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