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CASE REPORT

Use of allogenous bone graft and osteosynthetic stabilization in treatment of massive post-sternotomy defects

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Abstract

Thoracic stabilization using transverse plate fixation represents a modern and safe method of sternal dehiscence treatment. However, it still remains difficult to apply in cases of massive loss of bone tissue of the chest wall. An unsatisfactory stability of thorax often results in severe respiratory insufficiency, and also affects healing of soft tissue closure while increasing the risk of development of chronic fistulas and other dehiscences. In the reported case, we opted for a unique treatment of massive post-sternotomy defect using an allogenous bone graft of calva. Transverse titanium plates were applied to achieve stabilization of bone grafts and chest wall.

Keywords: Sternotomy dehiscence • Thoracic stabilization • Bone graft

INTRODUCTION

Along with vacuum-assisted closure (VAC) therapy, transverse plate fixation (Synthes®) of the sternum is a currently used method for treatment of sternal dehiscences. Application of transverse titanium plates enables safe restoration of the chest wall stability. However, a massive deficiency in bone tissue of sternum and neighbouring ribs often places limits to its use. Capitalizing on orthopaedic surgery experience, we replaced a massive deficiency of chest skeleton by an allogenous bone graft and applied transverse plate osteosynthesis to achieve stabilization of bone grafts and chest wall.

CASE REPORT

A man, aged 63, with an anamnesis of chronic obstructive pulmonary disease, diabetes mellitus, chronic renal insufficiency and obesity underwent acute surgical revascularization using the left internal mammary artery graft to the left anterior descending artery and two venous grafts to the left circumflex and diagonal branch arteries due to non-ST myocardial infarction. Sternal dehiscence with deep sternal wound infection resulting in a massive loss of left hemi-sternum and ribs developed within the post-operative period. Multi-resistant *Staphylococcus epidermidis* was repeatedly isolated from sternal osseous fragments in wound cultures. The case required 15 procedures of VAC therapy along with radical debridement of soft tissue and left hemi-sternum and ribs (Fig. 1A). The duration of VAC therapy was 60 days. Antibiotic treatment using the combination of imipenem (2 × 500 mg) and linezolid (1 × 600 mg) was initiated on the recommendations of the microbiology laboratory.

To replace the deficiency in the sternum and ribs, we opted for an allogenous bone graft of calva bone provided by the National Tissue Centre of the Czech Republic (Fig. 1B). The patient received all the relevant information and confirmed it by official informed consent.

In the first step of the operation, the plastic surgeon mobilized and prepared a dextral musculocutaneous pectoral flap for V-Y transposition.

Before bone graft implantation, we performed prophylactic resection of the residual skeleton edges 1 or 2 cm to the healthy bone tissue. Osteosynthesis using four 30-groove plates and one 20-groove plate was applied. Crushed allogenous spongy bone and tricalcium phosphate (Chronos, Synthes®) were applied to fill the gaps between the fragments. The wound was then closed using the prepared flap (Fig. 2A).

Within the post-operative period and following the recommendations of the microbiology laboratory, we continued prophylactic antibiotics treatment with imipenem (30 days) and linezolid (40 days) after the chest wall reconstruction. A minor necrosis occurring latter within the lower pole of the transpositioned flap was managed. The patient was afebrile, with no increase in inflammation markers. The hospitalization period was 122 days including the rehabilitation phase. A check-up CT reconstruction 7 months later showed excellent results proving the wound healed and the chest wall was stable (Fig. 2B).

DISCUSSION

Application of VAC device in the treatment of deep sternal wound infections is a currently used approach for the treatment

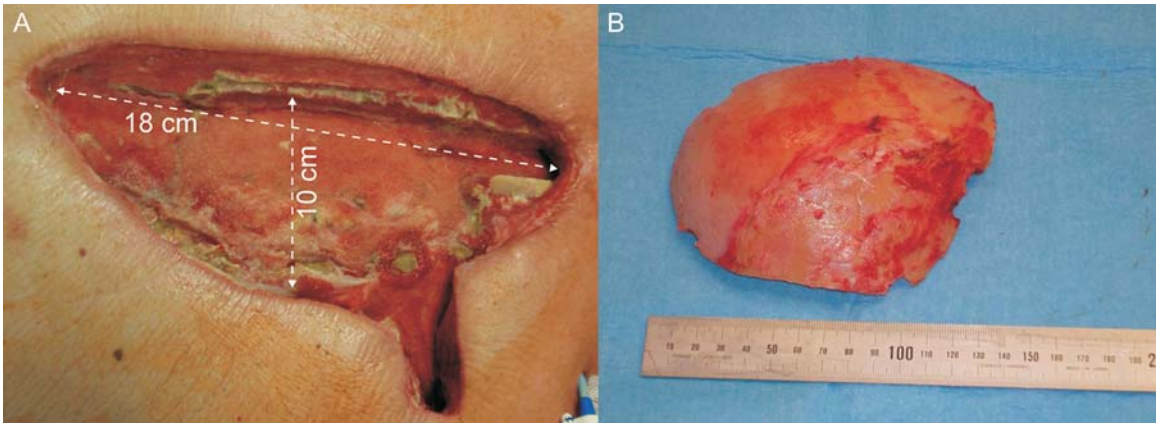

Figure 1: (**A**) Sternal dehiscence with a massive loss of left hemi-sternum and ribs. (**B**) Calva bone graft.

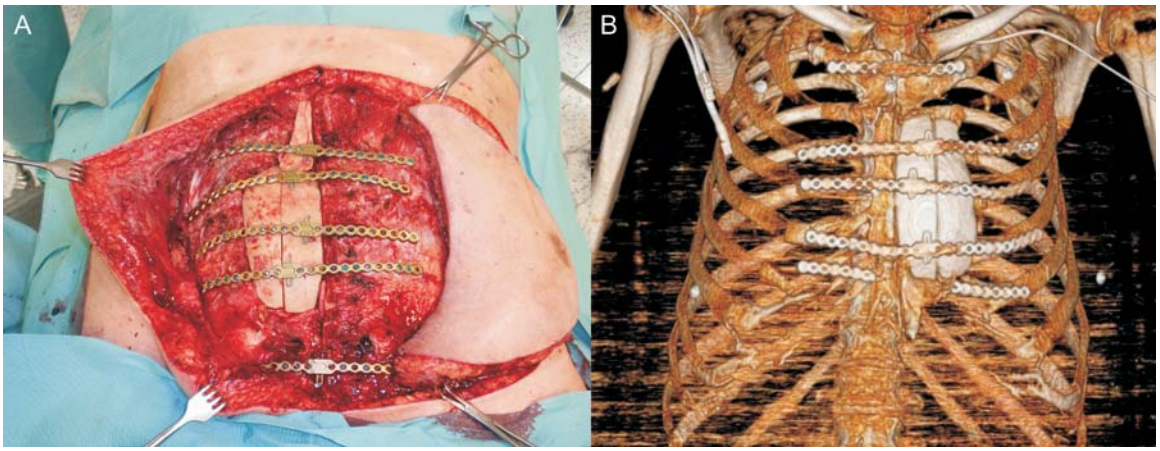

Figure 2: (**A**) Thoracic reconstruction with dextral musculocutaneous flap. (**B**) CT image 7 months later.

of this complication [1]. Adjustable transverse titanium plates are applied on the surface of the ribcage skeleton using bicortical screws without the necessity for the preparation inside the ribcage that minimizes the risk of iatrogenic lesion to suture-included right ventricle and bypasses [2]. However, in the case of massive sternal and ribs defects, this method fails—osseous fragments cannot be retracted and application of the plates is not recommended due to the major risk of complete failure of the whole osteosynthesis.

In this case, overflapping the wound with soft tissues without stabilizing the sternal wall is the only way of closure. However, this is not ideal as the instability causes pain and severe respiratory insufficiency often necessitating assisted pulmonary ventilation. The pathological movement of bone fragments increases the risk of chronic fistulas and other dehiscences [3]. The above results in increased post-operative mortality, longer hospitalization and increased the cost of treatment.

In the cardiosurgery literature, rare cases of deficiency replacement with autografts, e.g. Achilles tendon, fibula, ribs and omentum, are reported [4–7]. References to chest wall reconstruction following tumour resection are more available, and various methods of musculocutaneous flap transposition and prosthetic material implantation have been published [8].

We have made notable progress in several cases using autologous spongy bone harvested from iliac crest bone. Recently, we have used a prepared allogenous bone graft in replacement of massive deficiency. A calva bone was used in the case reported here. The bone was originally removed in a brain oedema patient and kept for later replantation. The donor died the next day and the graft remained within the depository. In legal terms, the Czech Republic adopts the principle of the assumed consent of deceased patients to tissue taking.

We opted for the calva bone for its structural similarity to the sternum, its firmness and appropriate shape. In combination with spongy bone, successful grafting was very probable. The case of calva bone—originally an autotransplant, then used as an allotransplant—application remains rare and holds its primacy in the 50-year history of the National Tissue Centre. The National Tissue Centre is an innovative company pursuing the objectives of the development and production of Advanced Therapy Medicinal Products and processing of tissues and cells in a Good Manufacturing Practice system in accordance with appropriate EU legislation [9]. It is a unique company involving public and private sectors in cooperation with the Czech Ministry of Health [10].

Tissue taking was performed during surgery under sterile conditions. The graft was packed into sterile covers and stored in the freezer at −80°C. Appropriate tests were then made, according to Czech legislation for serology tests for HBsAg, HCV, HIV-1, -2 and *Treponema pallidum*. Prior to its clinical application, the graft underwent a de-frosting procedure at 4–6°C for 12 h. After unpacking in sterile conditions, the graft was dipped into 0.9%

NaCl solution with gentamycine. A sterility test was then performed to ensure that the calva was free from bacterial contamination. The graft was finally packed and stored in the freezer until the time of transplantation. Before the implantation, the graft underwent a final de-frosting procedure at 4–6°C for 12 h. Following its unpacking in the operation theatre, 0.9% NaCl solution with neomycine was applied.

Allogenous bone graft transplantation could be a novel approach for achieving the maximal stability of the chest wall in the management of complicated sternal dehiscence. In our experience, two principles are paramount: early radical tissue debridement and strict repeated microbial examination of osseous fragments of the wound.

Conflict of interest: The authors declare that they have no commercial relationship with the National Tissue Center of the Czech Republic or with the Synthes® Company referred to in this paper.

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