Annals of Clinical Case Reports

Case Report
Published: 10 Aug, 2021

Complex Redo-Reconstruction of Recurrent Sternal Non-Union

Nora Mayer[1], Katherine De Rome[1], Periklis Perikleous[1], Kamran Baig[3] and Vladimir Anikin[1,2]*

[1]Department of Thoracic Surgery, Royal Brompton and Harefield Foundation Trust, UK

[2]Department of Oncology and Reconstructive Surgery, Sechenov First Moscow State Medical University, Russia

[3]Department of Cardiac Surgery, Guy's and St Thomas' NHS Foundation Trust, UK

Abstract

Sternal dehiscence after median sternotomy in cardiac surgery, especially in Coronary Artery Bypass Grafting (CABG) patients in which both Internal Mammary Arteries (IMA) have been utilized, is a rare but serious complication that can have significant adverse effect on quality of life and morbidity. We report a case of complex redo sternal reconstruction using moldable titanium bars and rib clips (Strasbourg Thoracic Osteosyntheses System - STRATOS™; MedXpert GmbH, Heitersheim, Germany), transposition of the greater omentum, bone grafting and advancement of pectoralis muscle flaps. This was performed in a patient with recurrent sternal dehiscence after CABG, which resulted in symptomatic non-union and a large sternal defect.

Keywords: Sternal dehiscence; Sternal reconstruction; Omentoplasty

Abbreviations

ARDS: Acute Respiratory Distress Syndrome; BMI: Body Mass Index; CABG: Coronary Artery Bypass Grafting; COPD: Chronic Obstructive Pulmonary Disease; COVID-19: Coronavirus-Disease 2019; CT: Computer Tomography; ILD: Interstitial Lung Disease; IMA: Internal Mammary Artery; LOS: Length of Stay; RT-PCR: Real-Time Polymerase Chain Reaction; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus type 2; STRATOS™: Strasbourg Thoracic Osteosyntheses System; VATS: Video Assisted Thoracoscopic Surgery; 3D: 3-Dimensional

Introduction

Sternal dehiscence and non-union are serious complications after median sternotomy in cardiac surgery with an incidence of 0.5% to 7.9% in high risk patients [1,2]. Deep wound infection with pathogen isolation remains the main cause in 0.8% to 6% of cases [3], while non-infected dehiscence without detection of pathogens occurs in 0.05% [4] of cases. The list of risk factors for this complication include diabetes mellitus, obesity, osteoporosis, Chronic Obstructive Pulmonary Disease (COPD), heart failure New York Heart Association (NYHA) class IV [4] and use of corticosteroids. Bilateral IMA harvesting in particular significantly impairs the sternal healing process due to reduced blood supply [5]. Patients with sternal dehiscence can suffer from pain and a clicking sensation, frequently on movement but often also at rest during inspiration. Sternal reconstruction with bony stabilization and a revascularization strategy with transposition of the greater omentum in addition to various muscle flap techniques is a promising approach. Evidence for this approach is poor, being largely based on rare case presentations [6,7]. We present the first case of a redo sternal fixation for a recurrent sternal dehiscence with stabilization of the sternum, bone grafting, omentoplasty and pectoralis muscle advancement.

Case Presentation

A 63-year-old patient presented with recurrent symptomatic sternal dehiscence after having undergone 4x CABG surgery utilizing both IMAs in June 2018 for severe coronary artery disease. Initial sternal reconstruction with internal fixation plates (SternaLock®, Zimmer Biomet) was performed in July 2019 but symptoms reoccurred 4 to 6 months after the intervention. On examination the sternal scar was well healed but the sternum was remarkably unstable and painful on palpation, with audible clicking. The patient's comorbidities include obesity with a BMI of 33.4 kg/m^2, asthma, fibromyalgia, rheumatoid arthritis and Interstitial Lung Disease (ILD); VATS lower lobectomy for pT3N0M0 squamous cell carcinoma, open cholecystectomy via midline laparotomy,

OPEN ACCESS

Correspondence:

Nora Mayer, Department of Thoracic Surgery, Royal Brompton and Harefield Foundation Trust, Hill End Road, Harefield, Middlesex, UB9 6JH, UK, Tel: +447307968651;

E-mail: n.mayer@rbht.nhs.uk

Received Date: *21 Jul 2021*

Accepted Date: *06 Aug 2021*

Published Date: *10 Aug 2021*

Citation:

Mayer N, De Rome K, Perikleous P, Baig K, Anikin V. Complex Redo-Reconstruction of Recurrent Sternal Non-Union. Ann Clin Case Rep. 2021; 6: 1961.

ISSN: 2474-1655

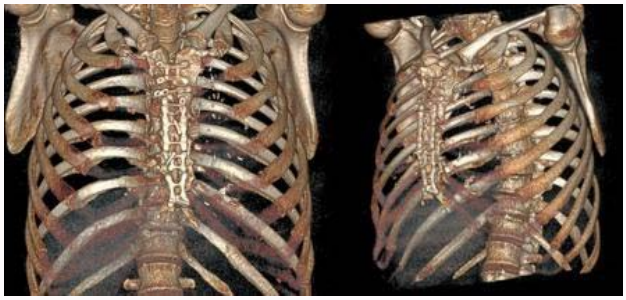

Figure 1: 3D-resconstruction of CT-scan images of recurrent sternal dehiscence and loosened SternaLock® plates and screws. **A** anterior view, **B** oblique anterior view.

Figure 2: Loose SternaLock® system in situ (A) prior to complete removal. The upper half of the sternum showed to be largely absent (B).

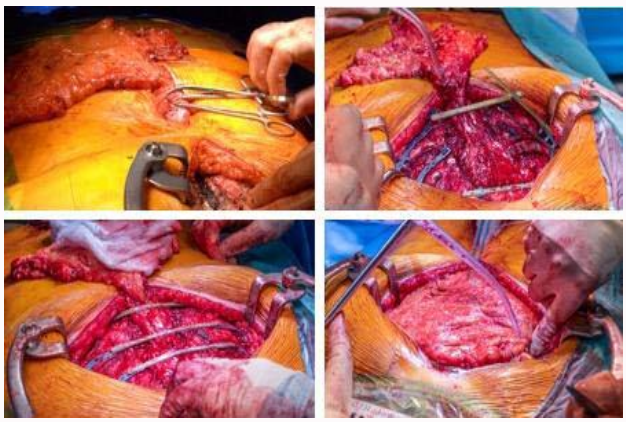

Figure 3: Pedicled omentum following ligation of the gastric tributary arteries (**A**) prior to intrathoracic transposition. Positioning of the minor part of the omentoplasty into the sternal defect (**B**) underneath the STRATOS™ bars (**C**) with the greater part of the pedicled omental flap fixed on top of the STRATOS™ reconstruction (**D**).

hysterectomy and previous spinal surgery Figure 1. The patient was consented for a redo repair of recurrent sternal dehiscence with titanium STRATOS™ bars, omentoplasty and bilateral pectoralis major muscle flaps advancement and bone grafting. The sternum was exposed via the old sternotomy scar. The loose plates and screws were completely removed (Figure 2A). The upper half of the sternum was largely absent (Figure 2B) and so the defect was filled with autologous bone grafts from the xyphoid process and the sternal margins cut obliquely with the sternal saw. An upper redo-midline laparotomy was performed and the omentum was first separated from adhesions from the previous laparotomy and the transverse colon. The omental flap was then harvested dividing the small gastric tributaries, dependent on the right gastroepiploic artery (Figure 3A). Intrathoracic transposition of the pedicled greater omentum was then performed through a window in the anterior portion of the diaphragm. The

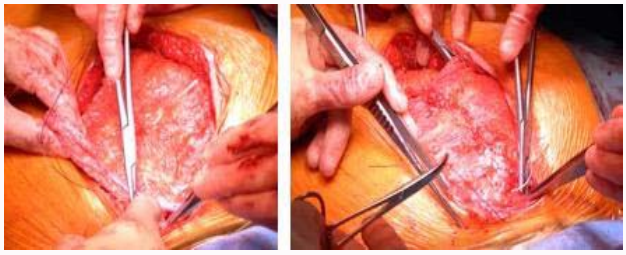

Figure 4: Mobilization of bilateral pectoralis major muscle (**A**) for bilateral pectoralis major muscle flap with fixation/connection of the muscles in the midline on top of the omentoplasty for full sternal coverage (**B**).

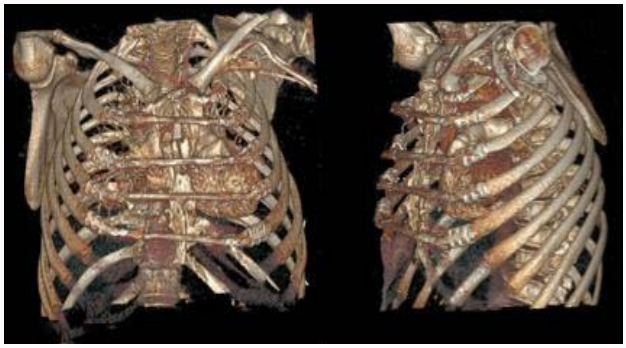

Figure 5: Post operative chest CT-scan 3D-reconstruction of position of the implanted STRATOS™ bars. **A** anterior view, **B** oblique anterior view.

omental flap was divided longitudinally, and the smaller portion was positioned into the sternal defect over bone grafts (Figure 3B). Following elimination of the defect, stabilization of the sternum was achieved by cross-linking of the second, third, fourth and fifth rib by STRATOS™ bars bridging the sternal bone (Figure 3C). The greater portion of the omental flap was positioned on top of the STRATOS™ bars and the diaphragmatic window was partially closed avoiding compression on the vascular pedicle. Bilateral pectoralis major muscle flaps were mobilized and advanced (Figure 4A) to cover the complete sternal area, securing them in the midline with running PDS sutures (Figure 4B). Wound closure was performed in layers with a pleural drain positioned in the right pleura due to an incidental opening, a second drain positioned on top of the muscle flap and a third drain used for subcutaneous tissues. The patient was extubated in theatres. A Computed Tomography (CT) scan was performed postoperatively after removal of the drains; this showed accurate positioning of the STRATOS bars (Figure 5). The postoperative course was complicated with an exacerbation of the patient's ILD with acutely worsened pattern of diffuse alveolar damage, accelerating pulmonary fibrosis and a diagnosis of Acute Respiratory Distress Syndrome (ARDS) was made. Reintubation and tracheostomy were required along with high dose intravenous corticosteroid treatment to control the ILD exacerbation. She required intravenous antibiotic treatment after radiological exclusion of pulmonary embolism and repeatedly negative Real Time Polymerase Chain Reaction (RT-PCR) testing for Severe Acute Respiratory Syndrome Coronavirus type 2 (SARS-CoV2) infections to exclude Coronavirus Disease 2019 (COVID-19) pneumonitis. The patient was weaned off ventilation and transferred back to her local hospital 22 days postoperatively. She was discharged to a rehabilitation facility on the 30th postoperative day with clinically stable sternal repair.

Discussion

The surgical management of sternal dehiscence remains controversial and the level of evidence is low. In this 63-year-old female patient, sternal dehiscence was initially diagnosed six months after CABG without evidence of infection or proof of bacterial growth. We suspect a rare sterile dehiscence on the basis of her combined risk factors including obesity with BMI of 33.4 kg/m^2, reduced sternal blood supply post bilateral IMA harvesting and corticosteroid medication for her ILD to be causative for the sternal dehiscence. Non-union after first reconstruction can be attributed to the same risk factors and poor bone quality responsible for implant loosening. Indication for complex sternal reconstruction is given especially in non-union after previous attempt of sternal re-osteosynthesis with common sternal reconstruction plates [8]. Simple re-wiring of sternal dehiscence carries the risk of damage to the grafts and other intrathoracic structures and is not generally recommended [7,9]. The repeat use of a well-established sternal osteosynthesis systems fixed to the sternal bone, e.g. the Titanium Sternal Fixation System (DePuy Synthes) or SternaLock® (Zimmer Biomet), may be problematic due to the poor sternal bone quality in this case which is crucial for achieving a good result. The STRATOS™ rib-to-rib fixation system was chosen for reconstruction instead. After its introduction in 2007, the main indications for STRATOS™ bars were established in rib fracture fixation [10], reconstruction after chest wall resection [11] and in pectus excavatum repair [12]. STRATOS bar usage offers the advantage of indirect sternal stabilization without compromising the sternal area in comparison to sternal reconstruction plates placed directly onto the sternum. Another advantage of the STRATOS™ bars is the possibility of permanent implantation which was considered favourable in our redo patient. Due to the bilateral IMA harvesting for bypass grafting in this case, a simple addition of a latissimus dorsi, pectoralis major or rectus abdominis muscle flap alone was considered insufficient and the greater omentum, a well vascularized fatty abdominal apron was therefore considered. The use of the greater omentum as a salvage flap in deep sternal wound infections is well described [13-15].The omentum's unique angiogenic and immunological properties have shown to promote wound healing even in hostile recipient sites with prior radiation exposure and infection. Another favourable characteristic is its high lymphoedema absorptive capacity and amorphous structure, easily able to fill cavity defects. The harvesting of the omentum in our case had to be done through open approach and special care taken due to previous laparotomy with resultant adhesions between the abdominal structures and abdominal wall. Unlike in our case, omental flap harvesting may be performed laparoscopically, reducing the possibility of laparotomy related complications and side effects [16]. Supplemental pectoralis advancement muscle flaps were required to ensure coverage of the omentum and implanted material. Due to the rare occurrence of sternal non-union post cardiac surgery, prospective trials are not applicable. However, we strongly suggest that in cases where complex sternal redo-reconstruction are indicated, these patients are treated as aggressively as possible.

References

1. Careaga Reyna G, Aguirre Baca GG, Medina Concebida LE, Borrayo Sánchez G, Prado Villegas G, Argüero Sánchez R. [Risk factors for mediastinitis and sternal dehiscence after cardiac surgery]. Rev Esp Cardiol. 2006;59(2):130-5.
2. Celik S, Kirbas A, Gurer O, Yildiz Y, Isik O. Sternal dehiscence in patients with moderate and severe chronic obstructive pulmonary disease undergoing cardiac surgery: The value of supportive thorax vests. J Thorac Cardiovasc Surg. 2011;141(6):1398-402.
3. Eklund AM, Lyytikäinen O, Klemets P, Huotari K, Anttila V-J, Werkkala KA, et al. Mediastinitis after more than 10,000 cardiac surgical procedures. Ann Thorac Surg. 2006;82(5):1784-9.
4. Heilmann C, Stahl R, Schneider C, Sukhodolya T, Siepe M, Olschewski M, et al. Wound complications after median sternotomy: A single-centre study. Interact Cardiovasc Thorac Surg. 2013;16(5):643-8.
5. Gatti G, Dell'Angela L, Barbati G, Benussi B, Forti G, Gabrielli M, et al. A predictive scoring system for deep sternal wound infection after bilateral internal thoracic artery grafting. Eur J Cardio-Thorac Surg Off J Eur Assoc Cardio-Thorac Surg. 2016;49(3):910-7.
6. Ceresa F, Casablanca G, Patanè F. Complicated sternal dehiscence treated with the Strasbourg Thoracic Osteosyntheses System (STRATOS) and the transposition of greater omentum: A case report. J Cardiothorac Surg. 2010;5:53.
7. Voss B, Bauernschmitt R, Will A, Krane M, Kröss R, Brockmann G, et al. Sternal reconstruction with titanium plates in complicated sternal dehiscence. Eur J Cardio-Thorac Surg. 2008;34(1):139-45.
8. Schiraldi L, Jabbour G, Centofanti P, Giordano S, Abdelnour E, Gonzalez M, et al. Deep sternal wound infections: Evidence for prevention, treatment, and reconstructive surgery. Arch Plast Surg. 2019;46(4):291-302.
9. Huh J, Bakaeen F, Chu D, Wall MJ. Transverse sternal plating in secondary sternal reconstruction. J Thorac Cardiovasc Surg. 2008;136(6):1476-80.
10. Moreno De La Santa Barajas P, Polo Otero MD, Delgado Sánchez-Gracián C, Lozano Gómez M, Toscano Novella A, Calatayud Moscoso Del Prado J, et al. [Surgical fixation of rib fractures with clips and titanium bars (STRATOS System). Preliminary experience]. Cirugia Espanola. 2010;88(3):180-6.
11. Billè A, Okiror L, Karenovics W, Routledge T. Experience with titanium devices for rib fixation and coverage of chest wall defects. Interact Cardiovasc Thorac Surg. 2012;15(4):588-95.
12. Stefani A, Nesci J, Morandi U. STRATOSTM system for the repair of pectus excavatum. Interact Cardiovasc Thorac Surg. 2013;17(6):1056-8.
13. Kaul P. Sternal reconstruction after post-sternotomy mediastinitis. J Cardiothorac Surg. 2017;12(1):94.
14. Milano CA, Georgiade G, Muhlbaier LH, Smith PK, Wolfe WG. Comparison of omental and pectoralis flaps for poststernotomy mediastinitis. Ann Thorac Surg. 1999;67(2):377-80.
15. Cheung EH, Craver JM, Jones EL, Murphy DA, Hatcher CR, Guyton RA. Mediastinitis after cardiac valve operations. Impact upon survival. J Thorac Cardiovasc Surg. 1985;90(4):517-22.
16. Ni C, Zhu Z, Xin Y, Xie Q, Yuan H, Zhong M, et al. Oncoplastic breast reconstruction with omental flap: A retrospective study and systematic review. J Cancer. 2018;9(10):1782-90.