Case Report

Laparoscopic omentoplasty and split skin graft for deep sternal wound infection and dehiscence patient

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Abstract

Treatment of sternotomy dehiscence secondary to infection is complex. We describe a case where following debridement and negative pressure therapy the greater omentum was harvested laparoscopically, pedicled on the right gastroepiploic artery and transposed through a subxiphoid window and laid into the chest wound. The omentum was covered with a split skin graft. The omental transposition provided a healthy vascular bed for the skin graft to be laid on top of. This technique allows for larger defects to be closed when due to the amount of bone loss the sternum cannot be brought together.

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Such procedures are normally performed when all other measures have failed and myocutaneous flaps cover the omentoplasty. Our case is novel in that the laparoscopic harvest and the use of direct skin grafting make this an option to be considered earlier as a single definitive procedure.

Keywords

chest wall reconstruction, deep sternal wound infection, omentoplasty, laparoscopic omentoplasty, sternum dehiscence, wound healing,

Introduction

Median sternotomies have been used for nearly a century and yet the management of its complications remains difficult. Deep sternal wound infection is a major cause of sternal dehiscence that is not secondary to technical reasons or wire failure. The incidence of deep sternal wound infection (DSWI) in cardiac patients ranges between 1 to 3 %[1-3] and carries a 30-day mortality of 7.3% compared to 1.6% in patients without infection.[4]

The risk factors for sternal wound infection are diabetes, obesity, bilateral internal mammary harvest, prolonged operation time and blood transfusions perioperatively. Prevention of this serious complication is the first priority and this can be achieved by pre-operative chest hair shaving, perioperative antibiotics, meticulous midline sternotomy and its wire closure and sparing use of bone wax and diathermy. [5]

The most common pathogens responsible for DSWI are gram-positive bacteria, namely *Staphylococcus aureus* and *Staphylococcus epidermidis*. Gram-negative organisms and fungi are rarely cultured.

Sternal separation can either be the cause of DSWI by letting superficial infections penetrate deeper or it can be the result of already present

infection causing sternal incompetence. Once this happens the dead space between mediastinal structures and skin is filled with a fibrinous matrix, which harbours the pathogens and makes antibiotic treatment much less effective. Collections form behind the dehisced sternal edges and osteomyelitis of the sternum becomes more significant after a few weeks. This explains why these infections are notoriously difficult to treat.

Traditionally these wounds are treated with debridement, antibiotics and wound packing. Eventual closure will require some sort of flap, usually pectoral myocutaneous flaps. However, it has been shown that obliteration of the dead space offers improved outcomes following wound debridement and prior to flap closure. The greater omentum is an ideal candidate for this role as it is resistant to infection due to plenty of immunologically active cells, is very vascular and absorbs wound secretions.[6]

The Case

A 52-year-old male, diabetic and ex-smoker with a body mass index (BMI) of 42.3 underwent coronary artery bypass grafting in January 2013. He presented to casualty with a non-ST elevation myocardial infarction (NSTEMI) and was found to have left main stem stenosis with mid left anterior descending (LAD) artery and mid circumflex artery disease. The right coronary artery was blocked with some retrograde filling. The ventriculogram gave an ejection fraction of 36%. The left internal thoracic artery (LITA) was used as a pedicled graft onto the LAD and a saphenous vein graft was grafted onto the first obtuse marginal branch. The antiplatelet drugs clopidogrel and aspirin had been stopped one week before surgery.

Post-operatively the patient suffered from atelectasis and copious chest secretions resulting in episodes of relative hypoxia. It was noted that the patient was not compliant in adopting chest protective manoeuvres while coughing. Glycaemic control was poor.

On the tenth post-operative day he developed a serosanguinous discharge from the wound that was negative on swab culturing. Antibiotics were started empirically but over the next few days this discharge became purulent and the sternotomy wound dehisced completely. The patient became febrile and methicillin resistant *Staphylococcus aureus* was cultured from both the wound and blood cultures. He was started on teicoplanin and gentamycin according to the sensitivity results.

***Figure 1**: The sternal wound one-month post-CABG before debridement*

***Figure 2**: CT thorax showing the infective sinus and sternal dehiscence with mediastinal collection*

The wound was surgically debrided and all wires were removed two weeks after the first wound discharge was noticed. The patient spent the following six weeks on negative pressure wound therapy (NPWT) therapy, regular wound irrigation and change of dressings. Antibiotics were continued intravenously for four weeks and then orally for another two weeks. By the end of this course of antibiotics the wound was clean and clinically free from infection and therefore omentoplasty and skin grafting were organized.

***Figure 3**: The sternal wound after thorough debridement*

***Figure 4**: The laparoscopic harvest of the greater omentum*

Ten weeks after CABG the patient underwent wound debridement and laparoscopic omentoplasty under general anaesthesia. The ulcer edges and bed were thoroughly excised and debrided. A deep sinus located at the cranial end of the wound was identified and its depth defined using methylene blue dye. The residual clean wound was packed and covered with a sterile dressing. Four laparoscopy ports were inserted and the greater omentum was mobilized off the stomach and transverse colon, ligating the small gastric arteries and the left gastroepeploic artery. The omental flap was pedicled on the right gastroepiploic artery.

The omentum was delivered through a small subxiphoid midline incision and laid in the chest wound. The omentum was well vascularised after this transfer. The omentum was fixed with sutures to the subcutaneous tissue.

The omental flap was covered with a meshed split skin graft, which was harvested from the right thigh, and was stapled in place.

Graft take at the cranial end of the repair was incomplete and another split skin graft procedure was performed under local anaesthetic to cover the residual defect. Two weeks after this grafting the patient was discharged home with a follow-up plan.

The wound healed well, and is covered by healthy looking skin. The patient improved steadily, his functional outcome was good and he went back to work as a taxi driver. There was eventual fibrous union that gave the patient rib cage relative stability.

Discussion

The first laparoscopic omental harvest was reported in 1993 by Salz *et al*. [(7)] Later, it was reported as a flap for sternal wound closure with many variations. Some report it without prior NPWT and others use pectoral muscle flaps over the omentum.[6,8-11]

In our case the combination of NPWT, omental flap and skin graft was used. A case series by Van Wingerden JJ *et al* reported 6 patients treated with NPWT and omentoplasty, however 5 out of these 6 received local myocutaneous flap closure and only 1 had a skin graft to cover the omentoplasty. A few points to note from this study were the use of large amounts of foam in the wound when on NPWT therapy, as done in our case and also the use of fibrin glue to attach the omentum and skin graft rather than sutures as in our case. They concluded this three-pronged approach to be effective in severe postoperative mediastinitis.[12]

The severity of mediastinitis is described using the Oakley-Wright classification in table 1 below.[5]

***Figure 5**: Retrieval of greater omentum flap through an opening in the diaphragm and out of the sternal wound*

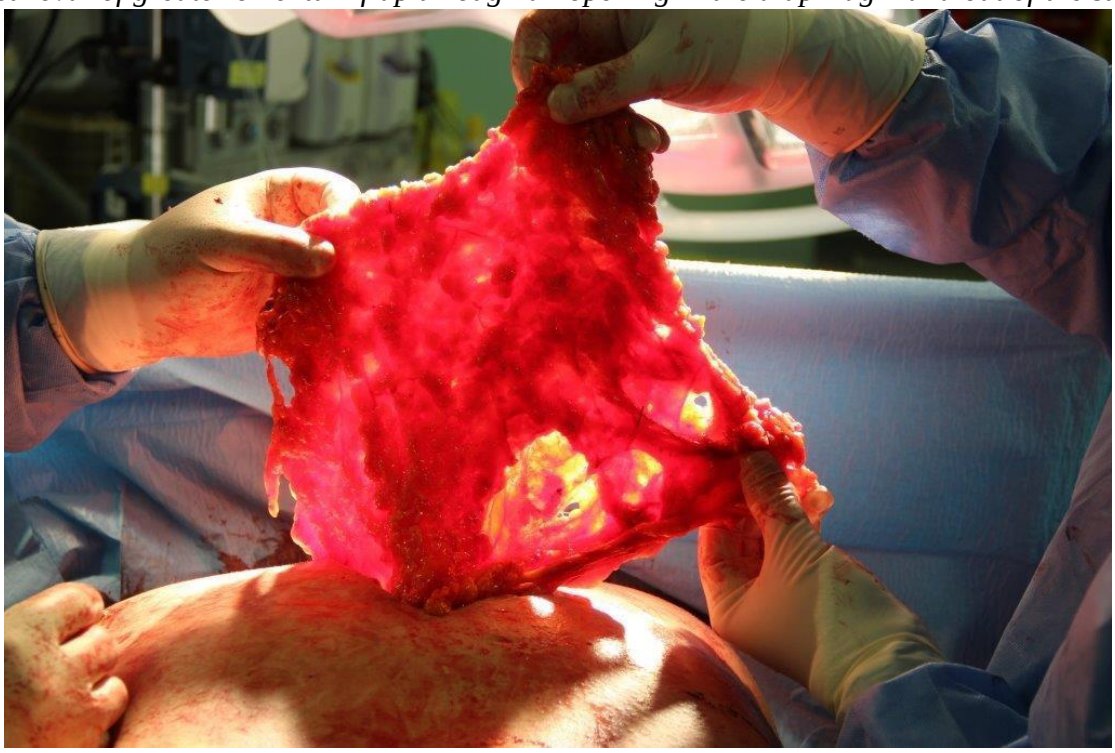

***Figure 6**: Omentum in the sternal defect*

***Figure 7**: Split skin graft overlying omentum and stapled in place*

***Table 1**: Oakley-Wright classification of post sternotomy mediastinitis. A therapeutic trial involves a surgical intervention such as prior grafting*

Class	Description
Type I	Mediastinitis presenting within 2 weeks of operation in the absence of risk factors
Type II	Mediastinitis presenting in 2-6 weeks of operation in the absence of risk factors
Type IIIa	Type I plus one or more risk factors
Type IIIb	Type II plus one or more risk factors
Type Iva	Type I, II or III after one failed therapeutic trial.
Type IVb	Type I, II or III after more than one failed therapeutic trial.
Type V	Mediastinitis presenting more than 6 weeks after operation.

The risk factors for post-operative infection are mentioned in the introduction. Our patient has more than one risk factor due to being diabetic and obese. He also suffered from heavy bouts of coughing post-op. Therefore, our patient classifies as a Type IIIB mediastinitis.

De Brandere K. *et al.* used the same protocol as Van Wingerden JJ, with negative pressure, omentoplasty and myocutaneous flap advancement. They also performed thorough wound debridement and kept the patients on IV antibiotics and NPWT therapy for several weeks prior to grafting. They note the debate over which gastroepiploic artery is the best pedicle for the omentum. They used the right artery due to its larger size as seen in our case too, however both have been shown to be equally effective [6,12]

Domene CE. *et al*[13]. report a case of a 62 year old who underwent pectoralis muscle flap reconstruction, which necrosed. The patient then required re-debridement and omental flap harvested laparoscopically and covered by a split skin graft. The results were satisfactory.

There are other more modern techniques reported in the literature such as plate fixation with myocutaneous flaps following aggressive resection for infection.[14] However, there is significant risk involved when introducing such a large amount of foreign material such as this longitudinal plate and numerous sternal wires. Another option is the use of allogenic bone grafting or sternal transplantation. In both cases the allograft was held in place by titanium plates and results were excellent.[15-16] The problems of introducing foreign material and allograft into a previously infected wound are still present and the difficulties associated with obtaining the allograft and performing the procedure make this less applicable in most centres. Today the availability of a made to measure 3D printed sternum can offer structural stability and fill the space that the omentum was filling. The advantages as such are a better long-term result however the need for plate fixation and the quantity of foreign material makes it risky in the context of infection.

There are potential complications associated with the kind of procedure described here too. De Brabendere *et al* reported an incisional hernia in one patient and a partial dehiscence in another, which settled conservatively [6] Rutger M. *et al* had a 27.3% wound dehiscence rate and an 18.2% incisional hernia rate from the 11 cases treated with omental flap reconstruction.[4] Ghazi *et al* had an overall recipient site morbidity of 23% and a donor site complication rate of 27% from 52 patients undergoing omental flap transposition.[17] It is worth mentioning that the majority of these patients had a laparotomy for omental harvest and hence the complication rate may need to be reviewed for laparoscopic omental harvest. Lopez-Monjardin *et al* conclude that using omental flaps for the treatment of mediastinitis following open heart surgery is more effective than simply using myocutaneous flaps.[18]

Most studies seem to agree that the most important factors are aggressive early local wound debridement (to remove osteomyelitic bone), NPWT therapy and multiple antibiotics for several weeks. Then once infection free one proceeds to laparoscopic omental harvest, transposition into chest pedicled on either gastroepiploic artery and covered by either pectoral myocutaneous flap or by split skin graft. The case we report here followed the above treatment bundle and the patient recovered successfully. The literature concludes that this treatment bundle is highly effective in treating cases that have failed other attempts at treatment, therefore class IVa or IVb. However, here we describe it as a treatment option for a type IIIb patient and in the light of data favouring omental flap versus pectoral flap alone, this seems justified in such patients who have multiple risk factors for wound infection and dehiscence. The stability of the sternum is good and our patient is able to live a normal life with a cosmetic result that is acceptable to him, although further surgery is on offer by the plastic surgical team to refashion the scar into a less visible one.

***Figure 8**: Visible result 3 months after the omental flap and graft*

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