

Autologous Biological Neosternum. A Surgical Alternative to Third Intention Closure in Patients with Loss of the Sternum after Postoperative Mediastinitis or Osteomyelitis

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Abstract

Median sternotomy is the most common incision for cardiovascular surgery, its deep infection include postoperative mediastinitis, with elevated morbidity and mortality. Sometimes it is associated with partial or total loss of the sternum, which is a very complex situation for closure of the anterior thoracic wall. The purpose of this case report is to present an effective technique to regenerate a new sternum from dermis adjacent to surgical wound and to achieve third intention closure excluding sternum. Bone marrow exposure and bone healing stimulate the performance of resident stem cells and dermis can provide the rest of the stem cells that are required to complete the healing when considering their potential for it.

Keywords: *Wound Healing; Sternal Wound Infection; Surgical Site Infection; Stem Cells; Cardiac Surgery*

Introduction

Median sternotomy is the most common incision for cardiovascular surgery because of its excellent exposure of the heart and great vessels [1-3]. Nowadays, there has been a marked drop in morbidity and mortality for almost surgical cardiac procedures, but prevention and treatment for septic complications of the sternotomy, there are still challenging [4].

Postoperative mediastinitis is a low frequent complication of cardiovascular surgery, but with elevated morbidity and mortality. Sometimes it is associated with partial or total loss of the sternum. In those cases closure of the anterior thoracic wall is very complicated because it may require some plastic procedures to guarantee a save syntheses of it [1-3]. Almost of this procedures entail big tissue remotion from other parts of thorax or abdomen, to build pectoral or dorsal muscle flaps or omental flap to cover the sternal zone [5].

To obtain a tissue from other by regeneration is an interesting field for researching and it means to apply concepts from regenerative medicine, with excellent possibilities at present and for the future [6].

Wound healing is a very complex process. During the wound healing, the cellular responses against the injury are mainly coordinated by mesenchymal stem cells which generate paracrine signals and invoke hemopoietic stem cells, hair follicle stem cells, endothelial precursor cells, and epidermal stem cells to differentiate into resident tissue cells [7,8].

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Superficial wounds may be able to heal without enrolling stem cells; however, repair of deep tissue injury or wounds requires the contribution of not only stem cells with mesenchymal and hematopoietic origin but also resident tissue-specific stem cells during different well-concerted repair cascades necessary for restitution of tissue integrity after injury [7].

Mesenchymal stem cells are non-hematopoietic, adherent multipotent cells of stromal origin with differentiation potential into precursor cells for the bone, cartilage, muscle, tendon, stroma, and adipose tissues [7].

Dermis is a rich tissue in collagen, elastics and reticulars fibers, with excellent possibilities for angiogenesis, and many cellular types like fibroblasts, macrophages, mastocytes and adipocytes. It has blood vessels, nerves, glands and hair follicle [9].

Bone marrow exposure and bone healing when patients suffer from loss of sternum after postoperative mediastinitis or osteomyelitis stimulate the performance of resident stem cells. The dermis can provide the rest of the stem cells that are required to complete the healing when considering their potential for it, in addition to all the cytokines, growth factors and cell types present in it [10]. In this article we describe a surgical technique for third intention closure of anterior thoracic wall in patients with loss of sternum caused by postoperative mediastinitis or osteomyelitis, that was performed in 21 cases with excellent effectiveness. A new sternum was created from the dermis adjacent to surgical wound, and resident stem cells made the bone regeneration in a short time.

Case Report

A 56 year old black man, he gave up smoking three years ago. This man has marfanoids characteristics and chronic obstructive pulmonary disease. He had an aortic insufficiency with severe dilation of ascending aorta, the surgical intervention was made to an aortic replacement with mechanical prosthetic valve and to repair ascending aorta for diameter reduction. He had a weak sternum owing to a severe osteoporotic statement. After surgery, he had complications such as: prolonged mechanical ventilation time for more than 72 hours, pneumonia as a result of the ventilation, coughing fit, sternal dehiscence and surgical site infection. He went to operating room in several occasions for debridement and finally for closure, but it was failed and needed a new sternum that was provide with his own dermis adjacent surgical wound with technique we describe subsequently, because his sternum was not be able to support any suture (Figure 1).



Figure 1

Technique

There are two important conditions to achieve a successful result in this closure technique with the exclusion of the sternum: one is the control of infection and the other is the presence of granulation. Parallel incision was made around the previous incision, (thoracic

wall was opened because of the absence of the sternum for the infection), and it must be deep up to the ribs. After incision, a thin epidermic layer was cut with scalpel in the skin inside (Figure 2), dermis under, in order to approximate both edges, was suture with U figures stitches or continues stitches depend of the tense, some discharge maneuvers may be useful, the aim is to cover the space over opened mediastinum for the absence of the sternum (Figure 3). Subcutaneous adipose tissue (Figure 4) and the skin outside was suture over the dermis remotion (Figure 5). Some pectoral muscle flaps can be used as reinforcement, if it is necessary. The stem cells released by dermis healing in association with the stem cells released by exposure sternal bone marrow or it healing, have differentiation potential into bone tissue, so in short time a new sternum was generated.



Figure 2



Figure 3



Figure 4



Figure 5

This technique was applied in 21 patients, we showed you one of them.

After that, neither dehiscence nor infection had the patient, so he did not require other surgical procedures. His neosternum was stable, firm, strong and hard. Six months later, he had not queloids, he had not deformities (Figure 6).

Discussion

The stability of thoracic wall is very important to keep a suitable respiratory function; it will be affected if the patient has a loss of sternum. Applying this procedure, excluding sternum, a successful closure was obtained with patient's dermis, which it has to be able to regenerate sternal bone using its stem cells. There are others surgical techniques to solve the closure but entail big tissue remotion to



Figure 6

cover sternal zone, with complications such as xeromas and deformities, neither of these techniques exclude the sternum, because they need it to close thoracic wall.

Conclusion

Dermis can provide a neosternum when considering its potential for tissue regeneration using stem cells and other factors present in it, by a surgical technique that is feasible and guarantees a safe third intention closure of anterior thoracic wall in patients with partial or total loss of sternum after postoperative mediastinitis.

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