

## Sternoptasty with pectoral muscle and dermal flaps due to total loss of sternal bone tissue caused by osteomyelitis

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### ABSTRACT

Mediastinitis is a rare complication in our days, but when occurs it presents high mortality, especially in cardiovascular surgery services. When early treated, the cases with little involvement of the bony structures surrounding the mediastinum have a better outcome and the integrity of the chest wall is usually kept. When the bone, especially the sternum, is affected and sometimes completely destroyed by the infection (osteomyelitis), the difficulty for attaining a solid closing of the anterior mediastinum arises. In this circumstance, the cardiovascular surgeon needs to use, in many cases, concepts and techniques of reconstructive surgery to solve the complex situation created. In the case presented, superficial skin structures and the pectoral muscle are used for reconstruction of the chest wall after mediastinitis with osteomyelitis and total loss of sternal bone tissue.

**Key words:** Mediastinitis, Osteomyelitis, Sternum, Plastia

### **Plastia esternal con dermis y músculo pectoral por pérdida total del esternón debido a osteomielitis**

### RESUMEN

La mediastinitis es una complicación rara en nuestros días, pero cuando se presenta se comporta con elevadas cifras de mortalidad, sobre todo en servicios de cirugía cardiovascular. Los casos con escasa afectación de las estructuras óseas que rodean el mediastino evolucionan mejor cuando son abordados precozmente, y generalmente se logra mantener la integridad de la pared torácica. Cuando el hueso, en especial el esternón, es afectado y en ocasiones totalmente destruido por la infección (osteomielitis), surge la dificultad para lograr un cierre sólido de la región anterior del mediastino. En esta circunstancia, el cirujano cardiovascular necesita emplear, en muchas ocasiones, conceptos y técnicas de cirugía reconstructiva para solucionar la

compleja situación creada. En el caso que se presenta se emplean estructuras dérmicas superficiales y el músculo pectoral para la reconstrucción de la pared torácica, posterior a una mediastinitis con osteomielitis y pérdida total del esternón.

**Palabras clave:** Mediastinitis, Osteomielitis, Esternón, Plastia

## INTRODUCTION

In November 1938, Stephens and Benteen<sup>1</sup> reported that the viable muscle graft was used successfully in a thoracoplasty, to fill the cavity resulting from the infection of a surgical wound. It is difficult to accurately predict whether this was the first successful reconstruction of the chest wall due to complicated wounds, since the literature does not gather much information about the history of these procedures.

The median longitudinal sternotomy, conceived in the late nineteenth century to intervene mediastinal organs, is the standard approach for cardiac surgery<sup>2</sup>. Currently, when morbidity and mortality for most cardiovascular operations have been greatly reduced, largely due to significant improvements in surgical technique, prevention and treatment of their infectious complications remain a major challenge for cardiothoracic surgeons<sup>3</sup>.

Mediastinitis is a rare but devastating complication, which is accompanied by high mortality and increased costs; since many patients require additional surgical procedures and therefore prolonged hospitalizations<sup>4</sup> to <sup>6</sup>. Its incidence reported in the literature is 0.15 to 20%, with an average of around 2%; mortality varies widely and can reach 47%, according to series analyzed<sup>7-9</sup>.

Deep sternal infection or mediastinitis is classified into four subtypes, based on the time of presentation, presence or absence of risk factors and whether there have been unsuccessful treatment procedures. The case presented is classified as III B, where the deep wound infection is associated with sternal osteomyelitis with or without infection of the retrosternal space<sup>2</sup>. Its treatment may require multiple operations and the high mortality is linked to the high rate of multiple organ dysfunction syndrome due to sepsis.

The main diagnostic elements of mediastinitis are: the presence of infected tissues during the operation, evidence of positive cultures (secretions or blood), instability of the sternum with purulent flows, chest pain and fever, among others<sup>10</sup>.

In the vast majority of patients different therapeutic

approaches based primarily on closed treatment are used<sup>11,12</sup>. If the progression of the infection can be stopped with minimal bone loss, this may be the ultimate solution; but unfortunately the closed irrigation with antibiotics and povidone-iodine is associated with a high rate of torpid progression, and some authors indicate a mortality of up to 23%.

The failure of initial closed treatments in centers where they do not have specialized systems of vacuum-assisted closure, requires the open chest treatment<sup>13</sup>. In extreme cases, such as the one presented, the initial osteomyelitis, practically accompanying all mediastinitis, is widespread and extends to the point of destroying the sternum completely. This situation extremely complicates chest wall reconstruction in these patients, since the bone structure is lost and on which most of the external anterior integrity of the mediastinal space depends. The surgeon will have to manage to close a wound by second or tertiary intention, which as a rule, has been open for several weeks.

## CASE REPORT

This is the case of a 50-year-old white female with a history of being a smoker, and regular consumer of alcoholic beverages. She has also suffered from chronic obstructive pulmonary disease for several years. On the tenth postoperative day of a mitral valve replacement surgery (CarboMedics mechanical prosthesis No. 27), she begins with a fever of 38.5 °C and a flow of purulent material through the middle third of the surgical wound (median longitudinal sternotomy) so she attends the postoperative medical encounter at the Cardiocentro Ernesto Che Guevara. Admission is decided for a better study and treatment, with the presumptive diagnosis of surgical wound sepsis. The following day the patient presents presternal chest pain, the amount of pus ejected from the partially open wound increases and sternal dehiscence is confirmed, so that emergency surgery is decided.

During reoperation deep sepsis of the surgical wound is found, involving all retrosternal space (me-

diastinitis) without extension into the pericardial cavity. Abundant washing of the abscessed region is performed (with several liters of physiological saline and povidone-iodine) as well as extensive debridement and necrectomy. The good condition of the sternum is confirmed and placement of mediastinoclastis probes and chest drains is decided to perform the closed treatment with vacuum aspiration.

For 6 days iodine is instilled into the infected space but with no objective clinical improvement and the expulsion of purulent material from the wound begins again. Sternal reopening and reexamination are decided which evidence septic involvement of the bone (osteomyelitis) with several areas of weakness, necrosis and frank bone loss. Open chest treatments are initiated, under anesthesia (propofol infusion), with

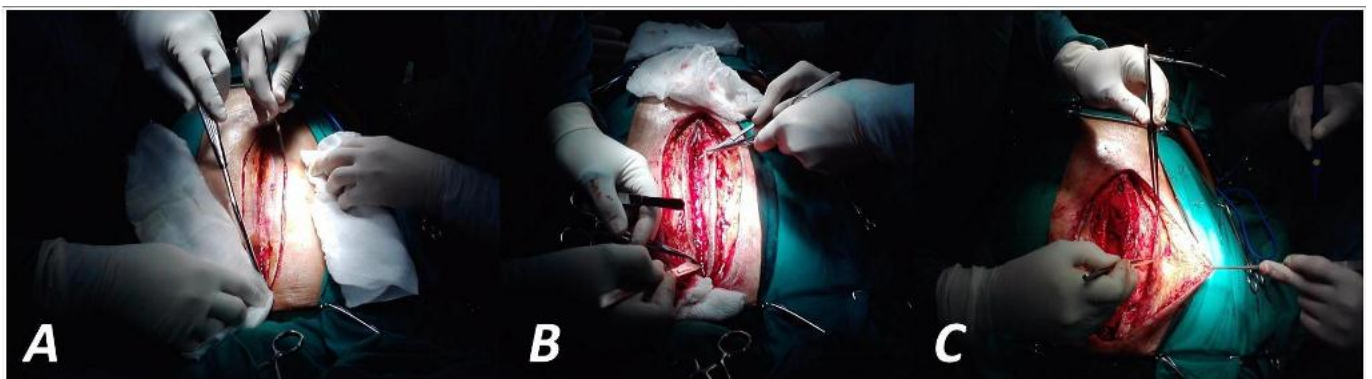
abundant cleaning and disinfecting of the cavity, and necrectomy of both soft and bony parts. These treatments last for a period of 8 weeks, during which most of the central part of the bone is lost, although sternochondral joints are kept. Finally infection is controlled and a third surgery is performed in order to perform a plasty allowing reconfiguration of a rigid central structure to replace the sternum, and over which the wound closure might be achieved by tertiary intent, with an aesthetically pleasing result for the skin planes of the chest wall that were frankly affected (**Figure 1**).

In this procedure an incision in the form of melon slice is made, about an inch out from the edges of the earlier wound, from which the deep tissues are preserved (granulation) (**Figure 2A**). A thin layer of all epidermis around the cavity of the previous surgery (**Figure 2B**) is resected. Discharge maneuvers at the edges of the wound are performed (to allow the approach of these planes to the midline) (**Figure 2C**). With continuous stitches the desepithelized edges of the prior surgery approximate this level (granulation tissue, dermis and hypodermis, which must later calcify to replace the sternum). Below this line of suture the wall is reinforced with several stitches in U to face the remaining deep muscle tissue (**Figure 3A**). Pectoral muscles are located (favored by the discharge maneuvers previously discussed) and faced, with stitches in U, in the midline to cover and reinforce the plasty described above (**Figure 3, B and C**). The remaining planes are closed (anterior aponeurosis of the pectoral muscles, subcutaneous tissue and skin). (**Figure 4, A and B**).

The patient improved favorably, and one year after



**Figure 1.** Condition of the chest wall before the third surgery.



**Figure 2. A y B.** Preparation of tissues of the residual cavity for its reconstruction by replacement of the lost sternum. **C.** Discharge Maneuvers.



**Figure 3.** A. Reconstruction of the wall in the midline. B. Strengthening of the "neo-sternum" with pectoral muscles. C. Approach of the pectoral muscles to the midline.

surgery the good anatomical and aesthetic results (Figure 5B) were maintained.

#### COMMENTS

When the sternum is not affected during mediastinitis, once the infection is controlled, synthesis of the wall can be done (closure by tertiary intention) or allow granulation tissue to occupy the surgical site (healing by second intention)<sup>7,9</sup>. The latter choice usually results in an irregular scar, unpleasant from the cosmetic point of view, and not infrequently with deformation of the skin planes of the chest wall (Figure 5A).

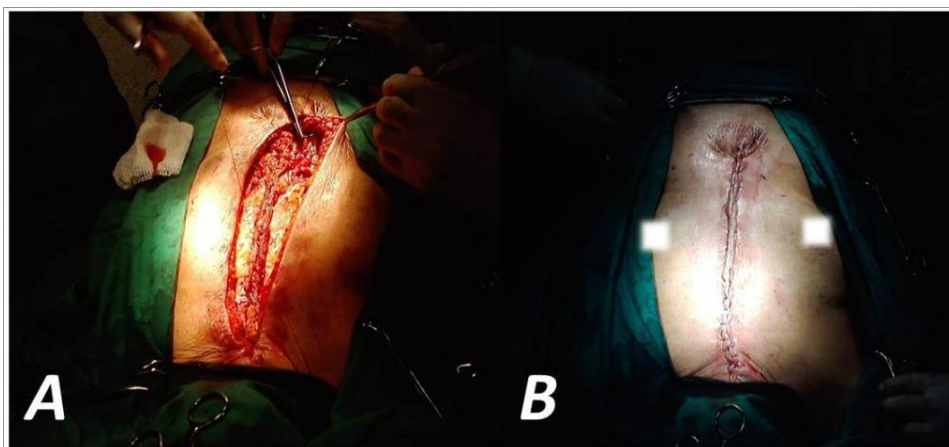
Over the years the surgical approach to these patients has changed to include, currently, plasty with well vascularized tissues such as the pectoral muscle, the *latissimus dorsi*, or even tissue of the abdominal cavity (greater omentum)<sup>10</sup>. These plastic procedures are considered high-risk and demanding, since they

are sometimes large interventions in very critical, infected patients, and in the postoperative stage of a cardiac surgery<sup>9-16</sup>. Some degree of failure of the primary technique is also reported, but this should not discourage a surgery that is without doubt for many patients, such as that presented in this case, the last option when an overwhelming infection has almost completely wasted their sternum away.

Mediastinitis is associated with high mortality in any service analyzed<sup>11,12</sup>. Of the patients who survive only a small number develop major sternal osteomyelitis. Bone loss rarely occurs in an area that does not allow using it to strengthen the anterior limits of the mediastinum.

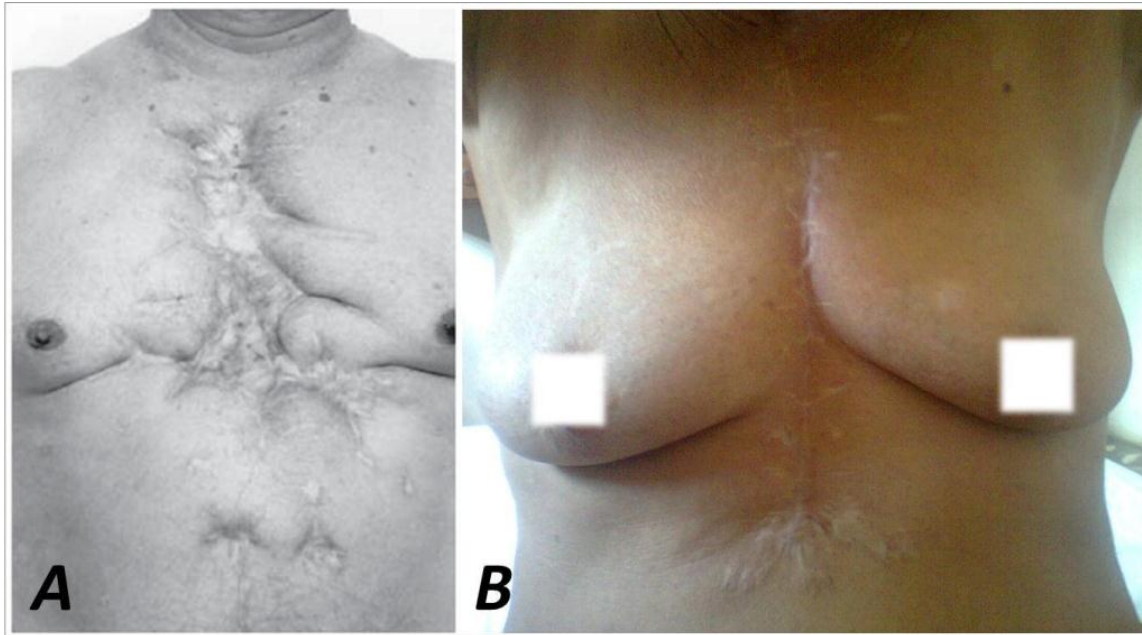
For this reason, the procedure described here is fortunately very rarely performed, and many cardiovascular surgeons of recent promotion are unaware of this technique because they have never had the opportunity or the need to perform it.

Plasty of the chest wall in a patient with sternal osteomyelitis and extreme loss of bone tissue forces the heart surgeon to blend their skills in thoracic surgery with the execution of reconstructive surgery procedures, making these cases even more interesting and peculiar. In the future, innovative prosthetic materials will undoubtedly emerge which will allow an easy and safe chest wall re-



**Figure 4.** A. Closure of superficial planes (subcutaneous tissue). B. Plasty completed.





**Figure 5.** Differences in the aesthetic result of other approaches for closing of the wall after mediastinitis. **A.** Closure by secondary intention (Reprinted, with permission, from: Parra T, *et al.* Rev Colomb Cardiol 2001; 8 (8): 378-86). **B.** Anterior aspect of the chest of the patient 1 year after the plasty.

construction in these people, but while we wait for them, the technique presented will continue to encourage the work of the cardiac surgeons and saving the lives of their patients.

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