Sociedad Cubana de Cardiología

Case report

Sternal reconstruction in a patient with postoperative mediastinitis

Reconstrucción esternal en paciente con mediastinitis posoperatoria

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ARTICLE INFORMATION

Received: 18/11/2025
Accepted: 18/12/2025

Competing interests:
The authors declare no competing interests.

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Article category:
Cardiovascular surgery

ISSN: 2078-7170
RNPS: 2235-145

ABSTRACT
Postoperative mediastinitis is a severe infection with an incidence ranging from 0.5% to 3% and and mortality rates exceeding 20%. We present the case of a 58-year-old woman with chronic obstructive pulmonary disease and post–COVID-19 pulmonary fibrosis who developed mediastinitis caused by multidrug-resistant *Klebsiella pneumoniae* following mitral valve replacement surgery. Initial surgical interventions, including debridement with irrigation and a Robicsek stabilization attempt, were unsuccessful. Following infection control, definitive reconstruction was successfully performed using a neo-sternum technique with adjacent-tissue combined with pectoralis flaps, thereby restoring thoracic stability despite impaired wound healing. This case highlights the usefulness of this approach in complex scenarios where conventional techniques have failed.
Key words: Postoperative Mediastinitis; Sternal Infection; Risk Factors; Sternal Reconstruction.
RESUMEN
La mediastinitis posoperatoria es una infección grave con una incidencia del 0,5 % al 3 % y una mortalidad que puede superar el 20 %. Se presenta el caso de una mujer de 58 años con enfermedad pulmonar obstructiva crónica y fibrosis pulmonar poscovid-19, que desarrolló una mediastinitis por *Klebsiella pneumoniae* multirresistente tras una cirugía de reemplazo valvular mitral. El tratamiento quirúrgico inicial con desbridamiento e irrigación fracasó, al igual que un intento de estabilización con la técnica de Robicsek. Tras el control infeccioso, se logró una reconstrucción exitosa mediante una técnica de neoesternón con tejidos adyacentes y colgajos pectorales, lo que permitió rescatar la estabilidad torácica a pesar de los trastornos de cicatrización. Este caso destaca la utilidad de dicha técnica en escenarios complejos con fallo de las opciones convencionales.
Palabras clave: Mediastinitis posoperatoria; Infección esternal; Factores de riesgo; Reconstrucción esternal.

INTRODUCTION

Postoperative mediastinitis remains one of the most feared complications in cardiovascular surgery, with an incidence ranging from 0.5% to 3% and an associated mortality that can exceed 20%.[1, 2] It presents a significant surgical and medical challenge due to the severity of infection within a critical anatomical space adjacent to vital structures, as well as its profound impact on morbidity, mortality, hospital stay, and healthcare costs. Its management requires a high index of suspicion and early multidisciplinary intervention to modify prognosis.[3]

The pathophysiology usually begins with contamination of the longitudinal median sternotomy, progressing from superficial cellulitis to deep tissue infection, which may eventually result in sternal osteomyelitis.[4] Patient-related risk factors such as diabetes mellitus, obesity, chronic obstructive pulmonary disease (COPD), and use of both internal mammary arteries for grafting compromise sternal perfusion and healing, providing a favorable environment for microbial invasion in a cavity with abundant adipose tissue and poor drainage.[5–7]

This report presents a patient with several of the aforementioned risk factors who developed postoperative mediastinitis with confirmed sternal osteomyelitis as a complication of mitral valve replacement surgery. The aim is to illustrate surgical therapeutic options when conventional approaches fail.

CASE REPORT

The case of a 58-year-old female patient is presented, who has a past medical history of combined mitral valve disease with a predominance of severe stenosis, permanent atrial fibrillation, COPD, and pulmonary fibrosis secondary to COVID-19 infection. Family history was notable for collagen vascular disease. The patient developed a febrile syndrome leading to a diagnosis of community-acquired pneumonia. Fever persisted despite multiple courses of empiric antibiotic therapy with ceftriaxone, cefixime, and moxifloxacin. Two blood culture samples yielded *Staphylococcus* species other than *aureus* (SOSA), formerly known as coagulase-negative staphylococci, suggesting native mitral valve infective endocarditis. Preoperative echocardiography revealed multiple vegetations on the mitral valve, the largest measuring 14 mm and pedunculated in shape.

Following echocardiographic confirmation, intravenous antibiotic therapy with vancomycin and gentamicin was initiated. Cardiovascular surgery consultation assessed the indication for surgical intervention.

Following a four-week antibiotic course, mitral valve replacement surgery was performed. Through a median longitudinal sternotomy with cardiopulmonary bypass, a 29-mm CarboMedics Standard mechanical prosthesis was implanted. In the immediate postoperative period, the patient required mechanical ventilation for 48 hours due to respiratory failure and low cardiac output syndrome.

On postoperative day eight, purulent discharge was noted through the drainage sites, accompanied by chest pain and sternal crepitus. Surgical re-exploration confirmed sternal dehiscence with necrotic tissue and purulence in the retrosternal space, without involvement of the pericardial sac. Management included surgical debridement and placement of a continuous closed mediastinal irrigation system (formerly closed mediastinal lavage) with iodinated solution at a rate of 100 mL/hour for five days, based on institutional experience in continuous cavity lavage. Cultures of the secretions isolated extended-spectrum beta-lactamase–producing *Klebsiella pneumoniae*, prompting initiation of meropenem therapy.

Persistent sternal instability after seven days led to a second operation, revealing bilateral sternal fractures at both sides of the sternotomy. Extensive mediastinal and chest wall lavage and further debridement were performed. Despite persistently positive cultures, a modified Robicsek technique was employed in an attempt to restore sternal stability, given the patient's respiratory difficulty and impaired oxygenation. Mediastinal irrigation was maintained for an additional ten days.

Eleven days after the third surgical intervention, complete wound dehiscence involving all layers became evident, suggesting impaired healing. Daily wound care was instituted (Figure 1). Cultures remained positive for *Klebsiella pneumoniae* for a total of 28 days.

After the cultures turned negative and a multidisciplinary evaluation, the patient was considered a candidate for definitive reconstruction. Due to extensive sternal destruction and poor quality of surrounding tissues, a combined technique was designed. The primary technique consisted of creating an autologous neosternum using adjacent tissues[8] employing the dermis and subcutaneous tissue of the wound edges to generate a new stabilizing structure. This procedure was complemented by mobilization of both pectoralis major muscles and midline suturing of the resulting flaps. **Figure 2** illustrates the key steps of this technique. Postoperative evolution was favorable, with resolution of the infectious process and clinical improvement allowing hospital discharge. Outpatient follow-up demonstrated satisfactory healing and evolution (**Figure 3**).

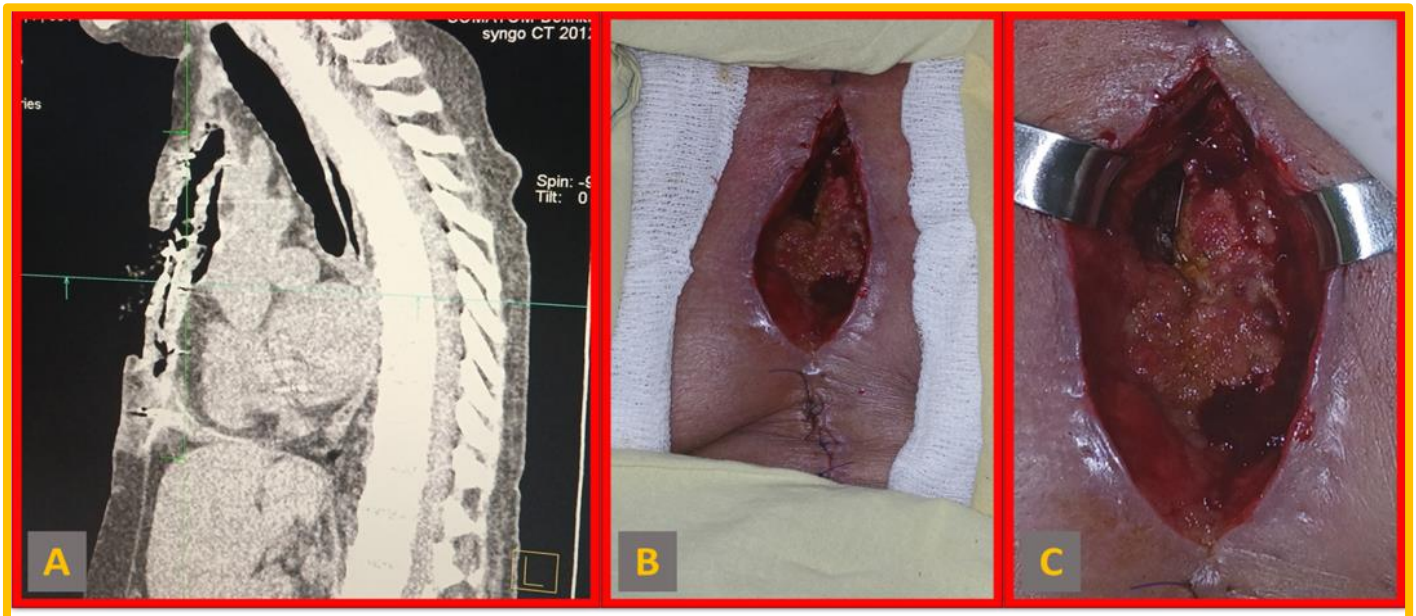

Figure 1. Surgical wound dehiscence (longitudinal median re-sternotomy). A: CT image showing osteomyelitis and gas within the mediastinum. B: External appearance. C: Close-up demonstrating exposed steel sutures.

COMMENT

According to the Centers for Disease Control and Prevention (CDC), deep sternal wound infections following cardiac surgery are classified into two categories: deep incisional surgical site infection, which involves only tissues located beneath the presternal fascia, and organ/space surgical site infection of the substernal area or sternal bone, a category that includes mediastinitis[9]. This condition entails microbial invasion of deep tissues, including the sternum, costal cartilages, mediastinal adipose tissue, and in advanced cases, the pericardial cavity and great vessels, resulting in a devastating impact on morbidity and mortality.[6]

The microbiological spectrum of postoperative mediastinitis is predominantly Gram-positive cocci, with Staphylococcus aureus and SOSA as the main pathogens, most infections being monomicrobial. However, Gram-negative bacteria such as enterobacteria and Pseudomonas aeruginosa are also isolated, with local prevalence often associated with varying degrees of antimicrobial resistance. Despite advances in surgical techniques and prophylaxis, the incidence of this infectious complication remains between 0.5% and 3%, with mortality exceeding 20% and a substantial impact on morbidity and healthcare costs.[1,2,10]

Risk stratification includes preoperative, intraoperative, and postoperative factors.

Preoperative factors primarily include patient-related conditions such as diabetes mellitus, obesity, COPD, advanced age, and colonization with *S. aureus.*[2,5,11,12] Prevention and early intervention are therefore critical to improving cardiovascular surgical outcomes.

Intraoperative factors include coronary artery surgery; use of bilateral internal mammary arteries, particularly when a pedicled dissection is performed since it significantly compromises sternal vascularization;[5,7] prolonged operative, aortic cross-clamp, and cardiopulmonary bypass times; as well as cardiac transplantation and use of mechanical ventricular assist devices.[12]

Postoperative factors include prolonged mechanical ventilation exceeding 24 hours, development of pneumonia, endovascular sepsis, and the need for reoperations, all of which substantially increase the risk of contamination and tissue trauma.[1,3,5,12] Finally, mechanical sternal instability acts both as a consequence of infection and as an aggravating factor perpetuating the infectious process.[3,13]

Diagnosis is primarily clinical and should be suspected in patients with risk factors who present with persistent fever, chest pain, purulent discharge from the wound or drains, and sternal crepitus or instability.[3,6] The study by Bermúdez Yera *et al.*[13] proposes a classification based on five major clinical criteria (purulent discharge, fever, local inflammatory signs, leukocytosis, and sternal dehiscence) and four minor criteria, which combined in the PREDICMED score define diagnostic probability patterns. Microbiological confirmation through deep tissue cultures is essential to guide antibiotic therapy.[4] Chest computed tomography is the imaging modality of choice to identify complications such as col-

lections, osteomyelitis, or sternal dehiscence, although its interpretation requires caution due to potentially nonspecific findings that may be normal in the immediate postoperative period.[6,11]

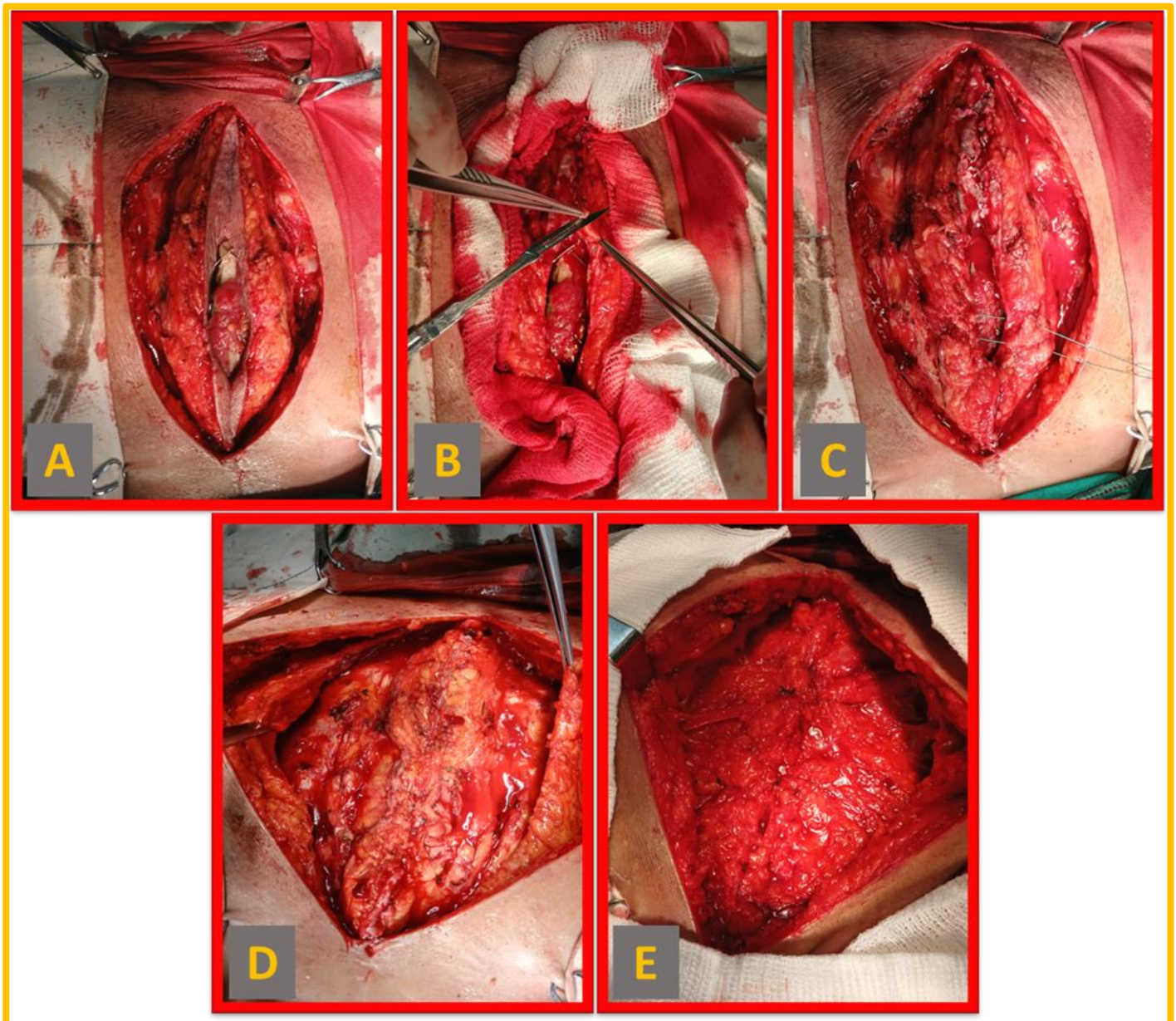

Figure 2. Sternal reconstruction. A: Incision with a 2-cm margin around the surgical wound. B: Dermal exposure. C: Dermal suturing to create the neo-sternum. D: Preparation of both pectoralis flaps. E: Midline suturing of both pectoral muscles.

The cornerstone of medical treatment is initial broad-spectrum empiric antibiotic therapy, which should be tailored according to culture and susceptibility results. Treatment duration is prolonged, generally 4 to 6 weeks, guided by clinical response and normalization of inflammatory markers.[4,12]

In mediastinitis, initial surgical management focuses on thorough debridement and infection source control. Surgery should ideally be performed within the first 24 hours after diagnosis and includes removal of all necrotic tissue, drainage of purulent collections, and extraction of foreign bodies such as infected sternal wires.[12] The median re-sternotomy approach is most commonly used, whereas cervicotomy or lateral thoracotomies are reserved for atypical dissemination patterns or mediastinitis of other etiologies, usually involving the posterior mediastinum.[14] In selected cases, video-assisted thoracic surgery may be considered, although open access ensures more complete debridement.[14,15] The primary objective at this stage is to drastically reduce the bacterial inoculum.[12]

For complications involving sternal substance loss or chest wall instability, reconstructive options are essential and selected according to defect classification.[16] In type 1 defects (skin

and subcutaneous tissue only, stable sternum), skin perforator flaps (epigastric or internal mammary) provide simple and effective coverage.[16–18] For type 2 defects (partial sternectomy with moderate dead space), pedicled muscle flaps are the mainstay of treatment, with the pectoralis major flap being prominent in its advancement or turnover variants.[16–19] In more severe type 3 defects (total sternectomy with large dead space and exposure of vital organs), rectus abdominis flap or, to a lesser extent, latissimus dorsi flap or omental flap provide the necessary volume and vascularization.[16,20]

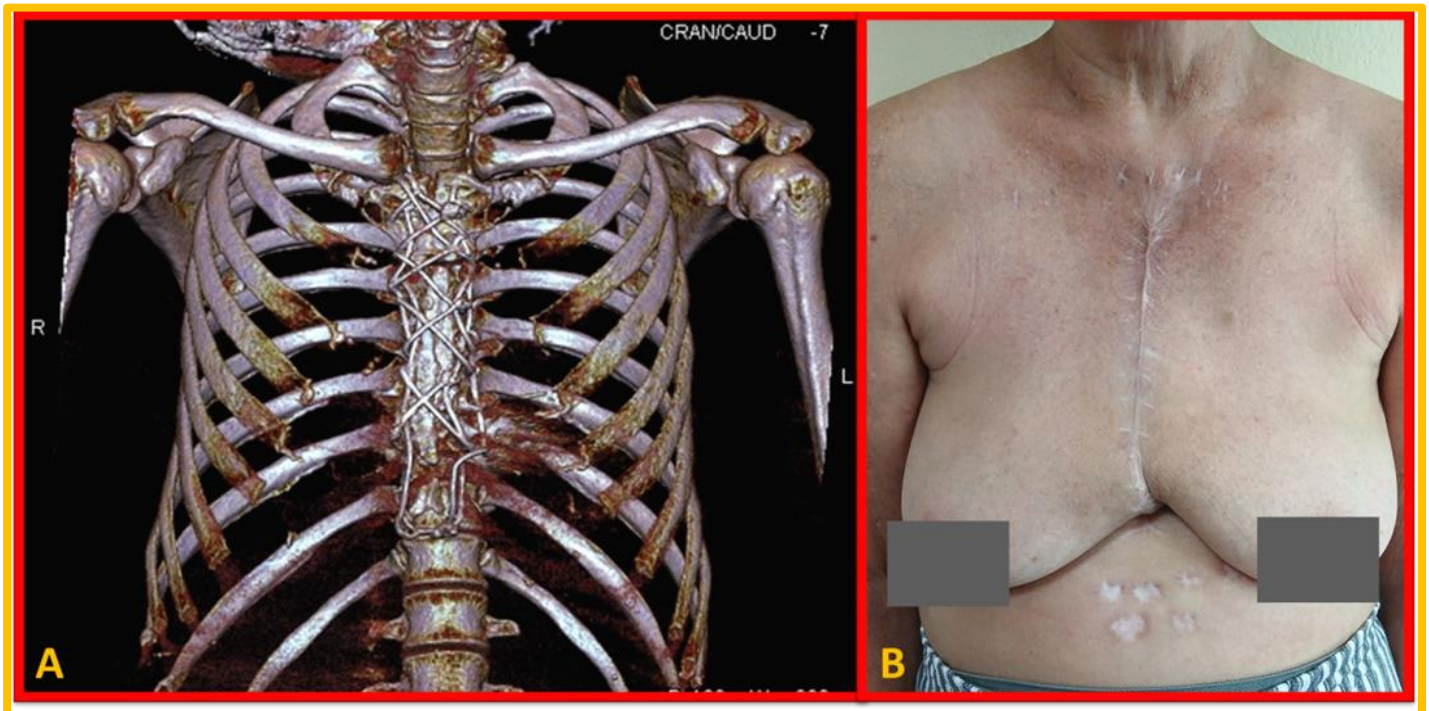

Figure 3. Postoperative evolution at 3 months. A: CT image showing sternal consolidation and Robicsek technique. B: Patient's external appearance.

The present case illustrates the challenge of chest wall reconstruction in a patient with multiple prior surgical failures, impaired wound healing, and infection caused by a multidrug-resistant pathogen. Although the reconstructive armamentarium includes muscle flaps and rigid fixation techniques,[15,16,19] the neo-sternum technique using adjacent tissues[8] proved to be a viable and successful alternative in this complex scenario. The main advantage of this approach lies in the fact that the neo-sternum provides inherent structural stability using well-vascularized tissue *in situ*, without relying solely on distant vascular pedicles that may be compromised. When complemented with pectoralis major muscle flaps, the chest wall is reinforced, well-vascularized tissue is provided, and a durable coverage over the reoperated cavity after multiple attempts is achieved. This allows for a hermetic seal and reinforcement of the midline. The outcome demonstrates that even after failure of reinforcement techniques such as Robicsek's, stable and definitive reconstruction can be achieved through innovative approaches tailored to the patient's specific defect.

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