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Sterile Necrosis of the Sternum: A Rare Complication Following Coronary Artery Bypass Surgery

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We herein present the unique case of a 68-year-old male diabetic patient who developed sterile necrosis of the sternum 1 month after myocardial revascularization with the use of bilateral internal thoracic artery grafts. The sternum had been closed by the bilateral Robicsek wiring technique. The sternum was removed, and bilateral pectoralis major flaps were used to cover the defect. The patient had an uneventful recovery.

Key words: 1. Coronary artery bypass
2. Sternum
3. Necrosis

Case report

A 68-year-old male with severe coronary disease was admitted to Onassis Cardiac Surgery Center for a routine coronary artery bypass graft (CABG) operation. A coronary angiogram revealed 80% stenosis of the left main coronary artery, 90% stenosis of the distal left anterior descending (LAD) artery, and 80% stenosis of the proximal circumflex artery. The patient's medical history included type 2 diabetes mellitus.

The patient underwent off-pump total arterial revascularization with the use of skeletonized bilateral internal thoracic artery (BITA) grafts, which were used as *in situ* grafts for the left coronary system. We routinely harvest the right internal thoracic artery (RITA) conduit 1–2 cm distal to the bifurcation, in order to increase *in situ* conduit accessibility, particularly when retroaortic RITAs are used to graft marginal artery targets. For the left internal thoracic artery (LITA) conduit, we use the same technique when we intend to create sequential anastomoses to the diagonal or intermediate branches.

The LITA was grafted to the LAD and the RITA, through the transverse sinus, to the first obtuse marginal branch. During sternal closure, a transverse oblique fracture at the left fifth intercostal space was noticed. Standard figure-eight wiring was used for sternal closure (Fig. 1A). A bilateral parasternal wiring technique, as described by Robicsek, was performed for sternal stabilization.

The patient had an uneventful recovery and was discharged on the sixth postoperative day. Twenty days later, he presented to the clinic for a routine follow-up. He complained of painless swelling at the lower end of the sternal incision, which was sporadically discharging a serous fluid secretion.

Clinical examination revealed instability of the lower third of the sternum, and a small sinus was identified at the bottom end of the incision. A routine

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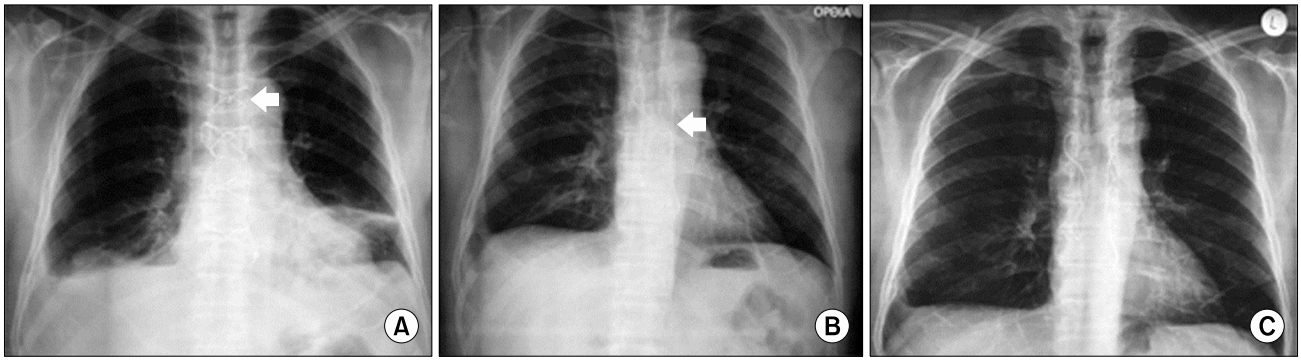

Fig. 1. Chest X-ray evolution. (A) Bilateral Robicsek and figure-eight sternal closure during initial surgery (arrow). (B) Sternum appearance after debridement with parasternal wires retained *in situ* (arrow). (C) Chest X-ray of the patient 5 years after debridement.

laboratory workup yielded normal results. A chest computed tomography scan demonstrated lack of bone porosis in the lower part of the sternum, where the 2 sternal halves were approximated.

Sternal necrosis was suspected, and surgical exploration of the dehiscent part of the sternum was performed under general anesthesia. Intraoperatively, the sternum had a waxy, yellowish, avascular macroscopic appearance, and it was easily disturbed and detached from the adjacent ribs. The affected sternal bone was removed, as well as the figure-eight wiring. Meticulous debridement was performed, including the adjacent heads of each rib. The parasternal wires were retained to maintain the stability of the rib cage (Fig. 1B). Bilateral pectoralis major muscular flaps were used to reconstruct the sternal defect [1].

The patient's postoperative course was uneventful. Histopathology showed bone necrosis with no polymorphonuclear leukocyte infiltration, a feature consistent with bone ischemia. Intraoperative cultures and swabs were negative for aerobic and anaerobic bacteria; therefore, the sterile necrosis of the lower sternum may have been the result of the bilateral Robicsek sutures strangulating the vascular supply. Five years later, the patient remained asymptomatic (Fig. 1C) and enjoyed a good quality of life.

Discussion

LITA grafts have long been the gold standard for CABG surgery. However, BITA grafts seem to offer the optimal myocardial revascularization strategy with regard to survival, freedom from angina pectoris, quality of life, and the need for revascularization in patients undergoing CABG surgery [2]. In particular, BITA grafting in the left coronary system, when compared to LITA and vein grafting, has been shown to improve clinical outcomes in patients undergoing CABG [2].

In diabetic patients, total arterial grafting is the preferred method of myocardial revascularization in terms of survival, relief of angina symptoms, and the need for repeated revascularization [3]. However, the harvesting of BITA conduits, especially in insulin-dependent diabetic patients, has been associated with an increased risk of sternal wound complications [4]. A number of studies have demonstrated that the conventional harvesting technique of pedicled internal thoracic artery (ITA) grafts increases the incidence of sternal wound healing complications. Conversely, skeletonized ITA harvesting spares the venous system and the associated collateral vessels, thereby reducing the aforementioned risk after CABG [5].

Peterson et al. [6] concluded that diabetes should not be considered a contraindication for BITA grafting, provided the ITAs are skeletonized. Therefore, it has been suggested that in diabetic patients, when BITA grafts are to be used, the skeletonized harvesting technique, which reduces the risk of deep sternal wound infection, should be preferred [3,7].

Although LITA is the optimal choice of graft used in myocardial revascularization, the use of the RITA should also be considered, particularly in patients younger than 65 years old. BITAs are preferred for CABG in our hospital, provided they are skeletonized, regardless of whether the patient is diabetic. Moreover, the figure-eight wiring technique is routinely used for sternal closure in our patients. This protocol

has been followed in our hospital since 2005 without any major sternal wound healing complications in our patients.

The sternal necrosis that occurred in the patient discussed in this study may have been related to the significant decrease of blood supply due to the BITA harvesting procedure and the parasternal wiring technique.

Berdajs et al. [8] have previously demonstrated that, following ITA harvesting, the remaining nourishing arteries to the sternum are the branches of the ITA, which arise either as independent arteries or as conjoint branches from the perforating and anterior intercostal arteries. In addition, they noticed that placing wires through the intercostal spaces may interrupt the functional terminals of the sternum and strangulate the perforating arteries that form the superficial and deep arcades, which are necessary for sternal tissue viability after ITA harvesting [8]. These findings support our hypothesis that ischemic mechanisms were responsible for the sternal necrosis in our case. Furthermore, the cultures were negative, which would be unusual for a sternal wound infection or sternal osteomyelitis, which are common complications in CABG patients [9].

The most likely explanation for the sterile sternal bone necrosis in our patient is the significant decrease of blood supply to the sternum after skeletonized BITA harvesting and the parasternal Robicsek wiring technique. We suggest that the surgical community be cautious of these potential complications after cardiac surgery.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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