Left mini-thoracotomy for beating heart bypass grafting in a patient with S-ICD

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Abstract

Cardiac surgery in patients already implanted with subcutaneous implantable cardioverter defibrillators (S-ICD) represents a challenge. Although a few reports described successful surgical procedures in these patients, a traditional approach with median sternotomy might potentially cause S-ICD malfunctioning. Minimally invasive techniques (e.g. left anterior thoracotomy) should be considered the first choice in order to preserve the integrity of the S-ICD system in suitable patients. Herein, we provide the first report of a patient implanted with S-ICD due to post-ischemic left ventricular dysfunction who underwent successful minimally invasive direct coronary artery bypass (MIDCAB).

Introduction

The subcutaneous implantable cardioverter defibrillator (S-ICD) represents a valid alternative to conventional transvenous devices for the prevention of sudden cardiac death,[1,2] with the main advantage consisting in the avoidance of short and long-term complications associated with transvenous leads.[1]

The increasing number of S-ICD implants has highlighted some problems in patients undergoing conventional cardiac surgery where the surgical approach can jeopardize the right functioning of the system, due to the risk of displacing the electrode placed in the left parasternal subcutaneous location during median sternotomy, and due to the subsequent presence of sternal wires which can lead to noise production, oversensing and inappropriate shocks.[3]

Although some cases of successful median sternotomy approach in patients implanted with S-ICD have been described,[4,5] this surgical approach is challenging and it can not be deemed completely safe in these patients. Thus, alternative surgical strategies should be considered. Herein, we describe the case of a patient implanted with S-ICD due to post-ischemic left ventricular dysfunction who underwent minimally invasive direct coronary artery bypass (MIDCAB).[6]

Case report

A 63-year-old male, active smoker and with a history of familial hypercholesterolemia, was admitted to our hospital due to angina pectoris relapse. His past medical history included ischemic heart disease with an ST-segment elevation acute myocardial infarction (STEMI) treated with percutaneous coronary intervention (PCI) on the left anterior descending artery (LAD) in 2010. In 2013 and 2019 the patient experienced two acute coronary syndromes (non-ST segment elevation acute myocardial infarction – NSTEMI) due to in-stent restenosis. In both cases he was treated with PCI on LAD. In 2019, due to the residual severe left ventricular systolic dysfunction, the patient was implanted with a S-ICD for primary prevention of sudden cardiac death.

The coronary angiogram repeated soon after hospital admission revealed again a severe in-stent restenosis. Thus, due to the recurrent major adverse coronary events, the patient was scheduled for coronary artery bypass graft surgery (CABG). After a multidisciplinary Heart Team discussion, a minimally invasive direct coronary artery bypass (MIDCAB) was planned in order to preserve the integrity of the S-ICD system, avoiding the risk of displacement, rupture or subsequent malfunction of the electrode in the subcutaneous parasternal position.

CABG was performed via a small anterior thoracotomy in the left fifth intercostal space; Left internal mammary artery (LIMA) was harvested in a skeletonized fashion; a stabilization device (Octopus®, Medtronic) was positioned to expose the LAD, and continuous stitches of 8.0 polypropylene (Prolene®, Ethicon) were used to construct an end-to-side anastomosis from the LIMA to the LAD.

After the surgical procedure, the efficiency of the S-ICD was tested in order to exclude malfunctioning of the system. In order to avoid ventricular defibrillation induction, we delivered a manual synchronous 10J shock to evaluate the shock impedance. The value resulted normal and <100 Ohm (Figure 1).Chest X-ray confirmed the absence of lead displacement after surgery (Figure 2A-B).

The postoperative course was uneventful, and the patient was discharged at home in the fifth postoperative day in very good overall clinical condition.

He returned to the electrophysiology clinic two months later. The surgical incision site was well healed (Figure 3A), and a new S-ICD interrogation confirmed normal functioning of the system (Figure 3B).

Discussion

The surgical access to the chest is of paramount importance in patients previously implanted with a S-ICD system. Traditional open-chest heart surgery with median sternotomy might potentially cause S-ICD malfunctioning due to: 1. Direct lesion/fracture of the electrode in its parasternal course during sternotomy; 2. Displacement of the electrode throughout the surgical procedure especially during chest wall manipulation; 3. Presence of stainless steel sternal wires which can directly damage the electrode, displace it, and which can be the cause of extracardiac oversensing responsible for inappropriate shocks;[3] 4. Infections related to the direct exposure of the electrode. Recently, there were a few reports of patients with S-ICD undergoing cardiac surgery. Gabriels et al.[4] reported the case of a patient requiring the implantation of a left ventricular assist device due to advanced heart failure, while Saour et al.[5] described a patient requiring CABG due to progressive severe triple-vessel coronary artery disease. In both cases the surgical approach consisted in median sternotomy with blunt tissue dissection, isolation and release of the electrode with subsequent reimplantation on the parasternal region avoiding contact with the sternal wires.[4,5]

To the best of our knowledge, our report is the first description of a patient with S-ICD successfully treated with a minimally invasive thoracotomy. In the previous reports of conventional open-chest surgery, median sternotomy required a more complex procedure in order to preserve lead integrity and the S-ICD system. In these cases the lead was exposed and isolated after the skin incision and before sternotomy and re-implanted after re-approximation of the sternum.[4,5] The MIDCAB technique used in our patient allows surgeons to avoid lead exposure and displacement, preserving its functioning and decreasing the risk of subsequent infection. Moreover, the absence of the sternal steel wires reduces the risk of external noise production, oversensing and inappropriate shocks. Of course, not all the patients should be deemed suitable for this surgical approach; thus, a careful patient evaluation and surgical planning possibly involving a multidisciplinary team represent the essential steps to pursuit a successful outcome.

Conclusion

Cardiac surgery represents a challenge in patients with S-ICD. In patients suitable for minimally-invasive thoracotomy, this represents a valid surgical alternative, and it should be considered the first choice in order to preserve the integrity of the S-ICD system, avoiding unnecessary lead manipulation and displacement, thus reducing the chance of subsequent malfunctioning/failure, while decreasing the risk of infections.

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Figure legends

Figure 1. Report of the post-operative S-ICD shock impedance test resulted to be normal (red arrows).

Figure 2. Posterior-anterior chest radiograph before (A) and after (B) surgery showing the same position and course of the subcutaneous lead on the left parasternal border. The absence of sternal wires testifies a mini-invasive surgical approach without sternotomy.

Figure 3. A. The patient with the intermuscular implantation of the S-ICD pulse generator (white arrow) and the site of incision for the small anterior thoracotomy in the left fifth intercostal space (red arrow). The picture shows complete healing of the wound (red arrow) with excellent aesthetic result. **B.** S-ICD report at follow-up visit showing normal functioning of the system.