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Case Report

Restoring the Recurrent Extrusion of the Subcutaneously Implanted Defibrillator by Means of Subpectoral Replacement: The Benefits of Subpectoral Implantation in the Current ICD Era

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A 72-year-old man with a thin build had an ICD system with a generator implanted at left prepectoral space. The generator was exposed through thin overlying skin at 11 months following surgery. Although it was undermined with the adjacent skin, it was exposed again 6 months later. The generator was replaced in the ipsilateral subpectoral space. Since then, no signs of recurrence have been observed for the subsequent 12 months, with the patient pleased with its cosmetic appearance. This case illustrates the benefits of subpectoral implantation in the current ICD era in which subcutaneous implantation is common.
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Key words: Implantable cardioverter defibrillator, Cosmetic benefit, Device protection

The development of smaller biphasic ICD devices has made it feasible to implant ICDs at the pectoral site with a high success rate and with minimal mortality. The procedural complexity of current defibrillator implantation seems to have become analogous to that of pacemaker systems; subcutaneous, i.e. prepectoral, placement is now the common site for the defibrillators. However, it should be noted that a major difference remains in generator size. Even the latest ICD models (32–39 ml) are still three times as large as the current dual-chamber pacemaker pulse generator (11 ml). Accordingly, when ICDs are implanted in the subcutaneous position, the mechanical stress to the overlying skin may be significant, especially in thin patients, indicating increased risks for erosion or infection of the skin[1]. In this regard, subpectoral placement is considered to be an attractive alternative. The device is implanted beneath the pectoral major muscle, which provides better protection of the system from mechanical stress with reduced risk for erosion and possible infection[2,3]. Furthermore, this approach has a cosmetic advantage as a less visible device[4]. Arguments have been recently made for subpectoral placement[2,3]; however, few cases have been reported to actually prove the benefits of subpectoral implantation in the current ICD era.

Case Report

In February 2002, a 72-year-old male with Brugada syndrome received a single chamber ICD. He had had two episodes of syncope preceded by chest discomfort. Twelve-lead electrocardiogram (ECG) indicated typical Brugada type-I, and ventricular fibrillation was reproducibly induced by programmed electrical stimulation. An ICD system (VENTAK

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MINI IV [Guidant, Minneapolis, MN]: 78 g, 63 mm ×49 mm×16 mm, 39 ml) was subcutaneously implanted through a left pectoral approach. Because the patient was thin (170 cm in height and 55 kg in weight), meticulous attention was paid to make the pocket large enough to accommodate the generator without undue tension on the surrounding tissue. The process of wound healing was uneventful without any signs of erosion or infection.

Following ICD implantation, the patient was followed-up at 3-month intervals. In January 2003, he visited our department complaining of the extrusion of the device. The upper margin of the generator was exposed in an area 15×15 mm without any signs of infection. The exposed region was successfully undermined with the adjacent skin under local anesthesia. However, the device was extruded again after 6 months following surgery. The exposed region was larger (23×27 mm) than the initial one and the protrusion of the lead as well as the generator had become more prominent through the thin overlying skin (**Figure 1**). Considering the above, we concluded that keeping the generator at the subcutaneous location would lead to serious infection of the whole system although signs of infection were not apparent.

Accordingly, we decided to re-implant the generator in the subpectoral space via a lateral approach[3]. The procedure was performed under general anesthesia. The patient was placed in the supine position. The left arm was abducted at a slight angle in order to expose lateral margin of the pectoral major muscle. After routine skin preparation and draping, a 5-cm-long skin incision was made along the upper margin of the generator. The tissue surrounding the

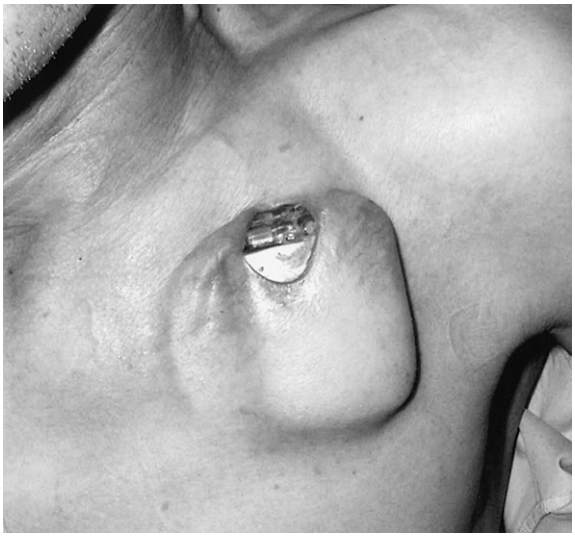

Figure 1 Frontal view of the chest before re-implantation.
The extrusion of the subcutaneously implanted defibrillator is seen in the upper margin of the generator with prominent protrusion of the whole device and lead.

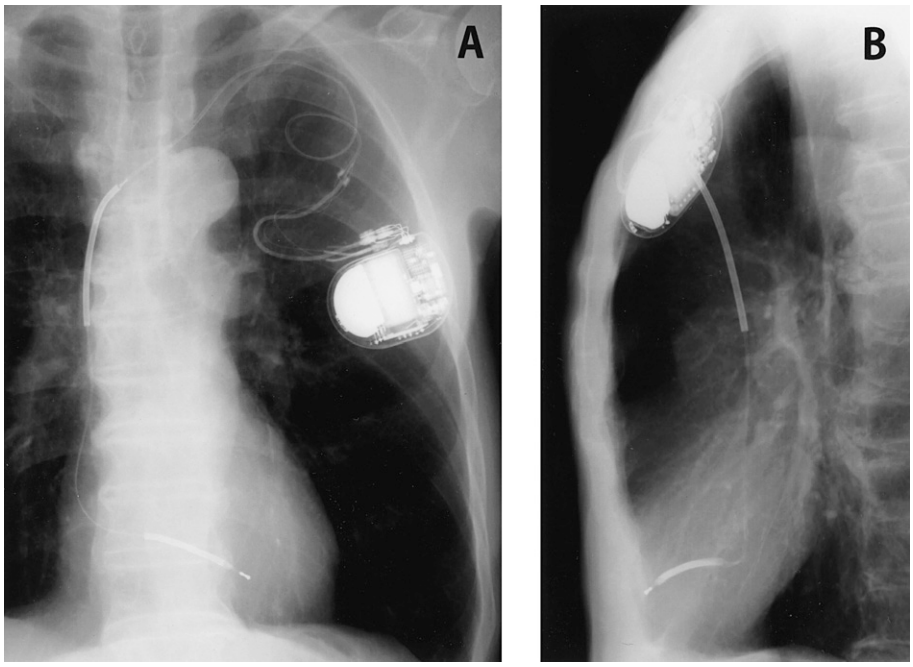

Figure 2 Posteroanterior (A) and lateral (B) chest X-rays after subpectoral re-implantation.
The lateral view indicates that the device is located away from the skin.

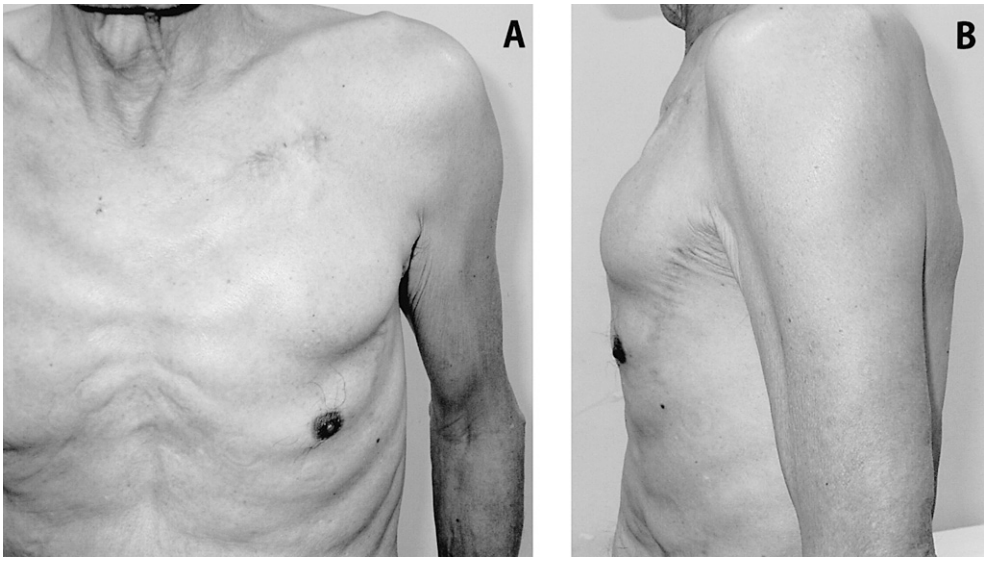

Figure 3 Frontal (A) and lateral (B) view of the chest at 7-months following re-implantation. The device is hardly seen with a plenty of overlying tissue. The lateral incision line is also inconspicuous, concealed by the lateral margin of the pectoral major muscle.

exposed region was carefully trimmed and the pocket was exposed. The generator was retrieved and disconnected from the leads. Then, a 10 cm-long skin incision was made along the line of the lateral margin of the pectoral major muscle. The dissection was continued to the muscle margin by blunt dissection, and then the device pocket was formed between the pectoral major muscle and the ribs with precaution not to injure major vessels in the submuscular space. A tunnel was made between the new subpectoral pocket and the old prepectoral pocket. Following vigorous irrigation of the pockets, leads were advanced through the tunnel to the subpectoral pocket and attached to the new generator (VENTAK PRIZM2 [Guidant, Minneapolis, MN]: 82 g, 65 mm $\times$51 mm$\times$12 mm, 32 ml). The generator was fixed to the pectoral minor muscle and subpectoral fascia. A suture was placed between the pectoral major muscle and the serratus anterior fascia to seal the pocket. Finally, both incisions were closed in layers. During wound closure, the defibrillating effect was confirmed by device-based testing. Posteroanterior and lateral chest X-rays after re-implantation are shown in **Figure 2**. The lateral view indicates that the device is located away from the skin. The wound healing progress was satisfactory. The patient has been free from recurrence during the subsequent 12 months.

Figure 3 shows frontal and lateral view of the chest at 7-months following re-implantation. The generator bulge is hardly seen with plenty of overlying tissue. The lateral incision line is also inconspicuous. In addition, the patient commented that he is pleased with the placement's cosmetic appearance. Since the initial surgery he had been always aware of the visible bulge of the generator and had hidden it with a towel when he went to a public spa. He is now enjoying the spa without self-consciousness regarding the device.

Discussion

The present case clearly demonstrates the advantages of the subpectoral placement of the ICD over subcutaneous placement in the current ICD era.

Subpectoral placement was initially recommended in the beginning era of nonthracotomy pectoral ICD implantation[5]. At that time, the devices were still too bulky to be placed subcutaneously without causing skin erosion and infection. However, with the development of smaller devices, subcutaneous placement has become relatively safe and is now the most commonly preferred placement. The procedural simplicity of the subcutaneous approach may contribute to its wide acceptance as the primary choice; the procedure is quite similar to the implantation of pacemaker systems with which electrophysiologists worldwide are familiar.

However, the question arises as to whether the simplicity of the subcutaneous approach justifies disregarding the various benefits of subpectoral approach. The major advantage of pectoral implantation is the better protection of the system from mechanical stress. Since the size of the current defibrillators are still significantly larger than pacemaker

generators, the current ICDs implanted subcutaneously have a potential risk for erosion and infection to the equivalent extent which early pacemakers had decades ago[1]. This risk may be greater in patients who have a thin layer of tissue on their chest. Thus, they are considered to benefit the most from subpectoral implantation. This was true in the present case, indicating that in thin or small patients subpectoral implantation should be the first choice of placement over the subcutaneous approach.

Good cosmetic appearance is another advantage of the subpectoral implantation[2–4,6]. As shown in figures, the generator bulge is almost invisible after subpectoral re-implantation (**Figure 3**) in contrast to the pre-operative condition (**Figure 1**). As expressed by the patient's comments, the cosmetic benefits of the subpectoral implantation may lead to greater patient satisfaction.

We should be aware of disadvantages of the subpectoral placement, when we decide the generator location[3,6]. General anesthesia is often required. The procedure is relatively complex and the bleeding risk may be higher when compared with the subcutaneous placement; it requires significant modifications to the implantation technique. Post-operative pain may be increased although this patient was almost free from pain.

Conclusion

In the current ICD era, subpectoral implantation has advantages over the subcutaneous approach mainly in regard to two aspects: 1) greater protection of the device leading to a lower infection and extrusion rate; and 2) better cosmetic appearance. Subpectoral implantation may be considered a primary choice for thin patients or for those require good cosmetic appearance.

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