JACC: CASE REPORTS VOL. 2, NO. 2, 2020

CASE REPORT

BEGINNER

CLINICAL CASE

Left-Sided Humerus Fracture as an Unusual Complication of Defibrillation Threshold Testing Following S-ICD Implantation

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ABSTRACT

Comminuted subcapital humerus fracture as a complication of subcutaneous implantable cardioverter-defibrillator insertion is related to an abducted and externally rotated arm position during the defibrillation threshold test at which the current pathway is through the pectoral muscle. It is advisable to adduct the arm before defibrillation threshold testing. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2020;2:255–7) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

PAST MEDICAL HISTORY

A 67-year-old woman with hypertension, chronic obstructive pulmonary disease, percutaneous coronary intervention of the left anterior descending coronary artery and ramus descendens posterior and ischemic cardiomyopathy with a reduced left ventricular ejection fraction of 22% underwent implantation of a subcutaneous implantable cardioverter-defibrillator (S-ICD) (Boston Scientific).

LEARNING OBJECTIVES

- The clinician will prevent complications related to S-ICD implantations.
- The clinician will understand the mechanism of a subcapital humerus fracture caused by DFT testing after S-ICD implantation.
- To prevent this complication in the future, adduction of the left arm before DFT testing is advisable.

HISTORY OF PRESENTATION

The implantation of the S-ICD took place using an ultrasound-guided serratus plane block (1) and local skin anesthesia using lidocaine. To place the generator in a submuscular pocket in the mid-axillary line, the arm was positioned in an abducted, externally rotated position and was strapped to the arm support. The shock electrode was tunneled subcutaneously using the 2-incision technique to the sternum and was placed in a superior parasternal position (2). After implantation of the device, the patient was sedated with propofol for defibrillation conversion testing. Ventricular fibrillation (VF) was induced by a 50-Hz burst during 5 s. The delivery of the 50-Hz burst was accompanied by an extreme twitch of the pectoral muscle. After detection, the device successfully converted VF into sinus rhythm with a 65-joule shock also causing a briefer but more forceful pectoral muscle contraction.

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Informed consent was obtained for this case.

Manuscript received June 7, 2019; revised manuscript received August 23, 2019, accepted August 29, 2019.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2019.08.031

ABBREVIATIONS AND ACRONYMS

DFT = defibrillation threshold

S-ICD = subcutaneous implantable cardioverter-defibrillator

VF = ventricular fibrillation

Regaining consciousness, the patient reported pain in her left shoulder and had reduced function of her left arm. Two weeks later the patient still showed tenderness of the proximal humerus and antalgic disability. We also noticed a drooping shoulder.

DIFFERENTIAL DIAGNOSIS

Because the patient had symptoms of pain in her left shoulder, reduced function of her left arm, and pain in the upper arm region, we assumed that she had discomfort as a result of the abducted and externally rotated position of the left arm.

In a later stage, when the patient was in a standing position, we noticed a drooping shoulder suggesting a possible dislocated shoulder. Our differential diagnosis at this time was either muscle strain caused by the extreme abducted position of the left arm or a dislocated shoulder.

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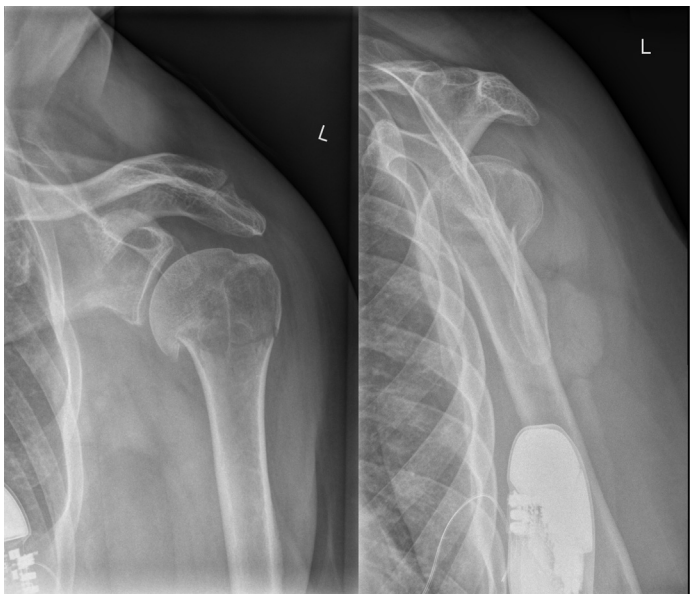
INVESTIGATIONS

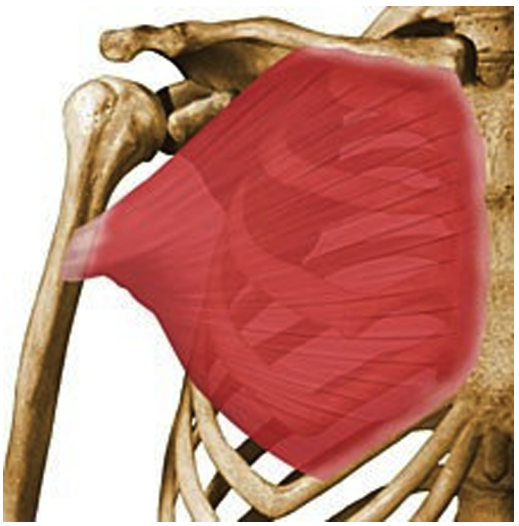
X-ray examination showed a comminuted subcapital humerus fracture (Figure 1).

FIGURE 1 Radiographs of the Left Humerus



(Left and Right) Radiographs showing a comminuted subcapital humerus fracture in a stable position. **(Left)** The subcutaneous implantable cardioverter-defibrillator is also shown.

FIGURE 2 Insertion of the Pectoral Muscle to the Humerus



Induction of ventricular fibrillation with a 50-Hz burst will cause a forceful contraction of the pectoral muscle. The positioning of the arm in an abducted, externally rotated position and strapped to the arm support causes a high-torque moment when the pectoral muscle twitches during the induction of ventricular fibrillation. (From Teitz C, Graney D. Musculoskeletal Atlas: A Musculoskeletal Atlas of the Human Body. Seattle, WA: University of Washington; 2003. Copyright 2003-2004 University of Washington. All rights reserved including all photographs and images. No reuse, redistribution, or commercial use without prior written permission of the authors and the University of Washington.)

MANAGEMENT

Post-S-ICD implantation, the patient was discharged with adequate analgesics to relieve the pain. Two weeks after discharge, her symptoms of pain, discomfort, and tenderness were still present. A radiograph showed a subcapital humerus fracture, and the patient was referred to the orthopedist. Because the fracture was in a stable position, the arm was immobilized with a sling, and the patient was discharged with analgesic medication.

FOLLOW-UP. Two weeks later the patient was seen at the outpatient clinic of the orthopedist. She had some reduction of the pain in her left arm but some discomfort remained. She was referred to the physiotherapist for movement therapy. After 4 months the discomfort and pain almost disappeared.

DISCUSSION

The S-ICD is a safe and effective alternative to endovascular ICD systems for patients without pacing

indications or treatment of ventricular tachycardia with antitachycardia pacing. It reduces the risks related to transvenous access (i.e., myocardial perforation or dislocation of the lead, sepsis with the possibility of endocarditis, and endovascular lead extraction) (3).

Proximal humeral fractures are common fractures and are associated with osteoporosis. Of these fractures, 78% are seen in patients older 65 years of age (4). The incidence lies between 105 and 342 per 100,000 persons per year. Women are twice as often affected as men (5).

The insertion of the pectoral muscle to the humerus is found on the lateral lip of the bicipital groove. The bicipital groove is the groove at the top of the humerus where the biceps tendon passes through it (**Figure 2**).

Positioning the left arm in an abducted, externally rotated, and strapped position to the arm support is necessary to place the S-ICD in the left midaxillary line.

In this patient, the 50-Hz burst to induce VF caused contractions of the pectoral muscle resulting in a forceful high-torque momentum on the humeral bone. After detection the device successfully converted VF into sinus rhythm with a 65-J shock also causing a briefer but more forceful pectoral muscle contraction.

It is unclear whether the fracture can be attributed to the induction of VF or the actual defibrillation shock delivered. This mechanism is comparable to that of the humeral fractures occurring during arm wrestling (6). The spiral structure of the bone combined with the direction of the revolving rotational force causes the fracture.

A comminuted subcapital humerus fracture related to the abducted, externally rotated, and strapped position of the arm during defibrillation threshold (DFT) testing has not been reported. Five years ago a dislocated shoulder was reported in a similar situation, a finding suggesting that the released force is harmful enough to cause trauma.

CONCLUSIONS

Fixation of the left arm in an abducted, externally rotated, and strapped position during S-ICD implantation is necessary to place the generator in a submuscular pocket in the midaxillary line. DFT testing in this position can cause a forceful momentum to the humerus by an extreme twitch of the pectoral muscle. It is advisable to adduct the arm before DFT testing.

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KEY WORDS complication, post-operative, primary prevention, subcutaneous implantable cardioverter-defibrillator