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Case report: a rare case of complete atrial lead fragmentation due to right subclavian crush

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Introduction: Artificial cardiac pacing has an increasing number of indications for device implantation, driven by population aging and the consolidation of clinical indications for implantable cardiac devices. Although considered a minor surgical procedure, the implantation of cardiac devices such as pacemakers, cardiac resynchronization devices, and cardioverter-defibrillators may present short- and long-term complications and technical failures, some of which are potentially severe, including pneumothorax, hemothorax, brachial plexus injury, infection, lead fracture, loss of lead insulation, myocardial perforation, and subclavian crush syndrome. Pacemaker lead fracture is a complication observed in approximately 0.1% to 4.2% of patients undergoing implantation of cardiac implantable electronic devices and represents one of the most common causes of device malfunction. This complication is commonly related to intense physical exertion, while subclavian crush syndrome is a rare and underreported cause of lead fracture. **Case Presentation:** MLC, a 53-year-old female patient, had a dual-chamber pacemaker implanted in 2020 due to complete atrioventricular block (CAVB). At that time, an Accolade IRN generator and Ingevity ventricular and atrial leads (Boston Scientific) were implanted. Lead insertion was performed via dissection of the right cephalic vein without complications. In the immediate postoperative period, chest radiography and a 12-lead electrocardiogram (ECG) were within expected limits. During semiannual outpatient follow-up since implantation, the patient developed a progressive increase in atrial lead impedance over the past two years, concomitant with loss of capture at the most recent evaluation. The patient denied chest or upper limb trauma, chest pain, dyspnea, palpitations, presyncope, or syncope. Physical examination revealed an afebrile patient with normal pulse, blood pressure, and respiratory rate. The pacemaker implantation site (right deltopectoral groove) showed no erythema, swelling, warmth, drainage, or signs of erosion. Device interrogation indicated an estimated remaining battery life of approximately 7 years with DDD pacing mode programmed. The ventricular lead showed normal sensing, impedance, and pacing threshold. In contrast, the right atrial lead exhibited abnormally high impedance (2,150 ohms) and no capture at pacing voltages up to 7.5 mV. Review of the lead impedance trend clearly demonstrated an abrupt increase in atrial lead impedance at a time when the patient had performed high-intensity physical activity (CrossFit) involving the upper limbs. A 12-lead ECG revealed a VVI pacing rhythm with no atrial pacing. Chest radiography demonstrated complete rupture of the atrial lead in the distal third of the right subclavian region, characterizing lead crush syndrome in the subclavicular area. Based on these findings, surgical intervention was planned to replace the atrial lead, with removal of the proximal portion of the fractured lead and implantation of a new lead, resulting in an excellent postoperative outcome. **Discussion:** Complications related to cardiac implantable electronic devices

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may occur during implantation or later, including generator-pocket complications, generator malfunction, and lead-related failures. Pacemaker leads are considered the weakest link in this system. Immediate postoperative chest imaging—particularly chest radiography—is essential for identifying procedure-related complications. Lead fractures are rare, and most occur in the pacemaker pocket or between the clavicle and first rib, primarily due to lead compression at the entry site through soft tissues, muscles, and ligaments. This accounts for approximately 40% of lead fracture cases. Subclavian crush syndrome is one of the most commonly reported causes of traumatic pacemaker lead fractures. Patients with lead fractures may range from asymptomatic to presenting with dizziness, syncope, chest discomfort, and palpitations, depending on device dependency. During device evaluation, electrical integrity testing typically reveals loss of capture and abnormally high lead impedance values, usually exceeding the normal range of 300 to 1,000 ohms, as observed in the present case. Diagnosis generally correlates clinical findings with abnormal device interrogation, including high lead impedance and loss of capture, supported by complementary tests such as ECG and careful review of chest imaging, particularly chest radiography. Treatment involves implantation of a new lead, with or without extraction of the fractured lead (Figs.1-3). The decision regarding lead extraction should be individualized, considering lead age, expected fibrosis, and other factors, including technical difficulty and the high complication rates associated with lead extraction, as highlighted in the present case. Conclusion: Leadless cardiac devices emerge as a promising solution to the weakest link in current cardiac pacing systems. These devices may theoretically reduce complications related to device implantation by eliminating lead-related issues and may represent the future of cardiac pacing.

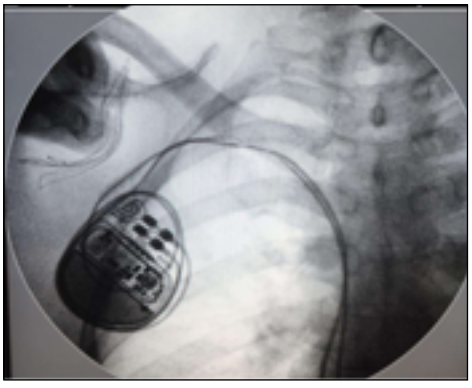

Figure 1. Chest radiograph demonstrating complete fracture of the atrial lead.

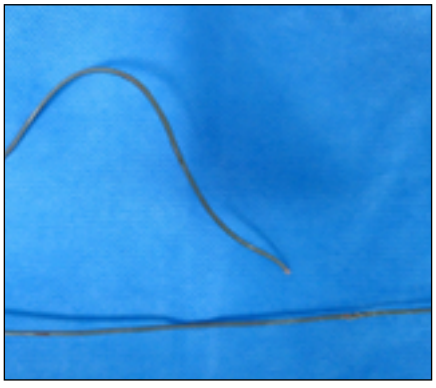

Figure 2. Evidence of the fractured atrial lead after extraction.

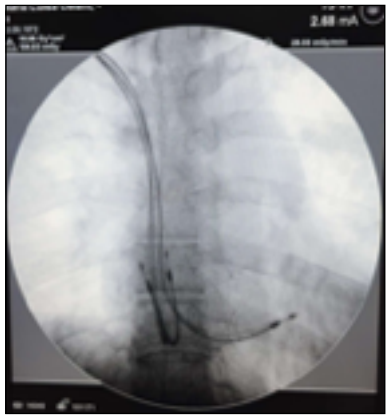

Figure 3. Chest radiograph showing the presence of two atrial leads and one ventricular lead, demonstrating the distal segment of the fractured atrial lead abandoned intravascularly and in the right atrium.