CASE REPORT

Vol. 11 No. 2 April-June 2026

doi: 10.35366/122953

Comprehensive approach of patients with cardiac perforation and management of difficult airway: case report

Abordaje integral del paciente con perforación cardíaca y manejo de la vía aérea difícil: reporte de caso

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ABSTRACT

Myocardial perforation related to cardiac pacemakers is a rare but potentially fatal complication. Risk factors such as active fixation electrodes, steroid use, advanced age, female sex, comorbidities, and apical electrode placement confer a higher risk. We report the case of an 83-year-old woman who experienced cardiac perforation two years after pacemaker implantation, caused by electrode migration. Her advanced age and non-septal electrode placement were identified as risk factors. The patient underwent successful surgical repair via anterior thoracotomy, with hybrid intubation employed due to a predicted difficult airway. She exhibited favorable clinical progress and was discharged after a one-week hospital stay. The hybrid intubation technique, although more commonly used in pediatrics, proved useful in this adult patient with predictors of a difficult airway.

Keywords: cardiac pacemaker, difficult airway, electrode migration, hybrid intubation, thoracotomy, ventricular perforation.

RESUMEN

La perforación miocárdica relacionada con marcapasos cardíacos es una complicación rara pero potencialmente mortal. Factores de riesgo como electrodos de fijación activa, uso de esteroides, edad avanzada, sexo femenino, comorbilidades y colocación apical de electrodos confieren un mayor riesgo. Reportamos el caso de una mujer de 83 años que experimentó perforación cardíaca dos años después de la implantación de un marcapasos, causada por la migración de electrodos. Su edad avanzada y la colocación no septal de electrodos se identificaron como factores de riesgo. La paciente se sometió a una reparación quirúrgica exitosa mediante toracotomía anterior, con intubación híbrida empleada debido a una vía aérea difícil prevista. Presentó una evolución clínica favorable y fue dada de alta después de una semana de hospitalización. La técnica de intubación híbrida, aunque más comúnmente utilizada en pediatría, resultó útil en esta paciente adulta con predictores de una vía aérea difícil.

Palabras clave: *marcapasos cardíaco, vía aérea difícil, migración de electrodos, intubación híbrida, toracotomía, perforación ventricular.*

How to cite: Jiménez-González RJ, Ogaz-Escarpita MC, Castañón-Colunga EA, Carrera-Baca M, Aguilar-Romero JD, Marmolejo-Rivera R et al. Comprehensive approach of patients with cardiac perforation and management of difficult airway: case report. Cir Card Mex. 2026; 11 (2): 59-63. https://dx.doi.org/10.35366/122953

Received: 23-07-2025. Accepted: 29-07-2025.

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Abbreviations:
AV = atrioventricular
DA = difficult airways
VCI = video classification of intubation
WHO = World Health Organization

At the Ignacio Chávez National Cardiology Institute in Mexico, a substantial cohort of over 2,000 pacemakers has been implanted between 2018 and 2021.[1] The predominant indications for permanent pacemaker implantation are sinus node dysfunction, notably symptomatic sinus bradycardia, and high-grade atrioventricular (AV) block, encompassing second-degree Mobitz II AV block and complete AV block, as corroborated by existing literature.[2,3] Concomitant with any invasive procedure, there exists an inherent risk of complications, which tend to manifest predominantly within the initial six-month post-procedural period. The primary complication is electrode migration, while other notable adverse sequelae include hematoma formation, infection, pericardial effusion, cardiac tamponade, pneumothorax, and cardiac perforation.[2,4]

Myocardial perforation related to cardiac pacemaker electrodes is a rare but potentially fatal complication.[5] Perforation is more commonly seen in the atria than in the ventricles,[6] due to the thinner wall. However, if the perforation is in the ventricle, it usually affects the right ventricle more frequently and it is classified according to its presentation as: acute if it occurs within < 24 hours of pacemaker placement; subacute if it occurs between > 24 hours and one month after the procedure; and late if it occurs more than one month after implantation.[7] In addition, factors such as the use of temporary transvenous pacemakers, active fixation electrodes, use of steroids seven days prior to implantation, age over 80 years, female sex, the presence of comorbidities such as type II diabetes, electrodes at the apex of the right ventricle, and operator experience are associated with an increased risk of cardiac perforation[5,8,9] *(Table 1)*.

The clinical manifestations of cardiac perforation due to pacemaker electrode migration include sudden onset of severe stabbing chest pain. It is often accompanied by fatigue, exercise intolerance, and syncope. Hemodynamic instability may occur depending on the location of the electrode tip, which can migrate to the myocardium, pericardium, mediastinum, pleural space, lung, or even the abdomen.[10] Another important issue in the management of critically ill patients with myocardial perforation is the approach taken by the anesthesiology team. One of the main objectives of the anesthesiologist during surgery is airway management, which commences with a preoperative assessment, encompassing a comprehensive medical history and physical examination. This assessment serves to evaluate the patient's condition and provide insight into the potential complexity of airway management. A difficult airway is defined as a scenario wherein a trained anesthesiologist encounters difficulty or is unable to provide adequate ventilation during a procedure, attributable to the patient's anatomical characteristics or clinical circumstances.[11]

Recent studies report that between 1.5 and 8% of intubations in the surgical setting are classified as difficult. In emergency situations, this incidence can escalate to 15%.[11] To assess the airway, various scales are employed, including the Mallampati classification, Patil-Aldreti (thyromental distance), sternomental distance, and the Cormack-Lehane classification. Based on these scales, predictive indices for difficult intubation have been established[12,13] *(Table 2)*. Innovations in devices and technologies have significantly transformed the management of difficult airways (DA). The advent of video laryngoscopes has revolutionized the intubation process. The failure rate associated with video laryngoscopy is 2% when utilized as a primary technique and 8% when employed as a rescue technique.[14] The flexible fiberoptic bronchoscope is regarded as the gold standard for intubation in pediatric patients with difficult airways.[14,15]

CASE DESCRIPTION

An 83-year-old female patient with a history of systemic hypertension, hypothyroidism, and mild cognitive impairment, managed with medical treatment, underwent placement of a permanent dual-chamber pacemaker in DDDR mode in March 2023 for complete atrioventricular block. She was admitted to the hospital in July 2025 for scheduled replacement of the device due to suspected malfunction. The patient did not report severe chest pain, but had recently experienced episodes of fatigue, mild dyspnea, and palpitations. Upon device interrogation, an output voltage of 5V was detected, prompting adjustment of the pacemaker mode to DDD with an output voltage of 2V. A chest X-ray was performed,

Table 1: Risk factors for cardiac perforation by pacemaker electrodes.

Patient-related factors	Factors related to the implant or technique
• > 80 years of age • Female • BMI < 20 kg/m^2 (underweight) • Use of steroids • Comorbidities such as T2DM, HTN	• Electrode thickness and stiffness • Active fixation mode • Excessive electrode tension • Temporary transvenous pacemaker • Non-septal tip location • Operator experience

BMI = body mass index. HTN = hypertension.
T2DM = type 2 diabetes mellitus.

Table 2: Predictors of complexity for difficult intubation.[13,14]

Lower complexity	Greater complexity
• Mallampati score III or IV • BMI > 40 (morbid obesity) • Limited cervical mobility • Limited mandibular protrusion • Thyromental distance < 6 cm • Mento-sternal distance < 12 cm • Short, thick neck, dental deformities, macroglossia, facial hair • Male sex	• History of difficult intubation • Two or more predictors of lower complexity • Cervical immobility • Mouth opening < 3 cm • Airway tumors or masses • Craniofacial malformations • Airway manager inexperience

BMI = body mass index.

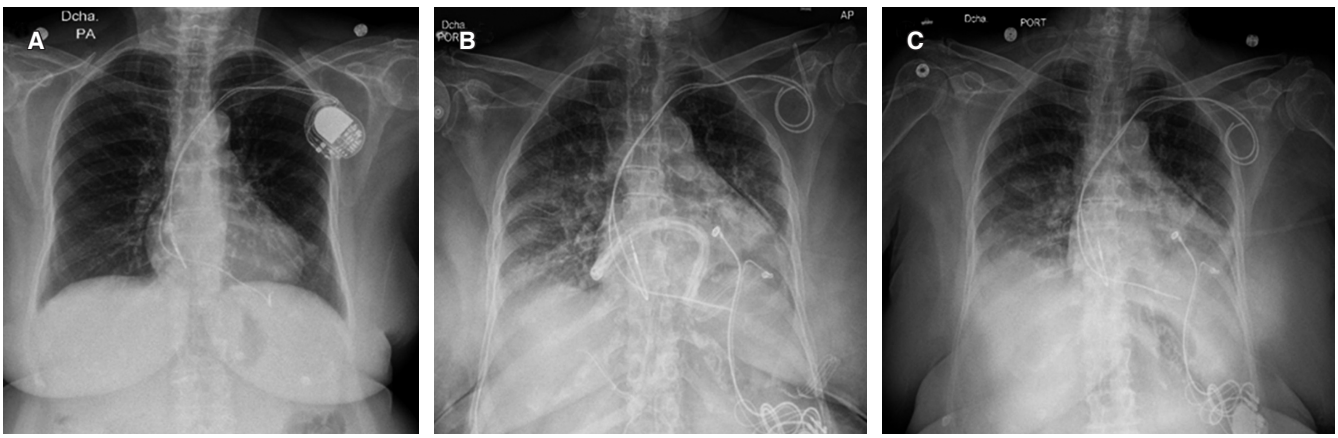

Figure 1: A) Anteroposterior chest X-ray upon admission to the service. A left dual-chamber pacemaker is observed, with one electrode located in the right atrium and another toward the free wall of the right ventricle with myocardial perforation and migration toward the mediastinum. **B)** Anteroposterior chest X-ray immediately after the pacemaker replacement procedure. Presence of mediastinal probe. Left metal electrodes without a pacemaker source, with the presence of a second functional pacemaker with epicardial leads in the left chambers. **C)** Anteroposterior chest X-ray at the time of hospital discharge. Leads from the previous dual-chamber pacemaker without a pacemaker source remain, with the presence of a second functional pacemaker with epicardial leads in the left chambers.

demonstrating a dual-chamber pacemaker with electrodes situated in the right chambers. However, the right ventricular electrode exhibited migration toward the mediastinal space *(Fig. 1A)*. Consultation with the thoracic surgery department was requested, leading to scheduling of surgical replacement of the dysfunctional pacemaker with epicardial leads. The pre-anesthetic assessment yielded the following parameters: mandibular protrusion: 1, Oral opening: II (2 cm), Mallampati: IV, Thyromental distance: II, Atlanto-occipital extension: II, and a body mass index of 30.36 (World Health Organization [WHO] grade I obesity), indicating clinical predictors of a difficult airway. Additionally, the patient reported a history of difficult airway in previous surgical procedures, as documented by anesthesiology. The patient was transferred to the operating room, where Point of Care Ultrasound (POCUS) screening and airway assessment using linear ultrasound were performed to measure the distance between the vocal cords, thereby predicting the endotracheal tube size, which was determined to be 0.45 cm *(Fig. 2)*. Following this measurement, type I monitoring and neuromonitoring were instituted, with induction achieved using fentanyl at 2 µg/kg, lidocaine 1 mg/kg, and rocuronium 50 milligrams. Hybrid intubation was then performed, utilizing a video laryngoscope with a McGrath #2 blade, which yielded a video classification of intubation (VCI): VCI M75D classification by the first operator. A second operator employed a pediatric fiberoptic bronchoscope to locate the carina, facilitating placement of a #5 endotracheal tube. The endotracheal tube was secured at 18 cm from the lip commissure. Anesthesia was maintained with desflurane at 1 minimum alveolar concentration after which the surgical procedure commenced. During the approach via anterior thoracotomy at the level of the fourth

left intercostal space, a pericardial window was created, confirming myocardial perforation of the anterior wall of the right ventricle secondary to migration of the pacemaker electrode *(Fig. 3)*. A mediastinal tube was left in place, and a control anteroposterior radiograph was obtained immediately post-procedure *(Fig. 1B)*. Following a one-week hospital stay characterized by adequate clinical progress, the patient was deemed suitable for discharge *(Fig. 1C)*.

COMMENT

We present the case of an 83-year-old female patient who developed cardiac perforation secondary to migration of a pacemaker electrode that had been placed two years prior. Ventricular wall perforation is a rare but potentially fatal complication if not identified and treated in a timely manner. The patient exhibited several risk factors for cardiac perforation, including age > 80 years, female sex, presence of comorbidities (hypertension), and a non-septal location of the ventricular electrode tip, specifically situated at the free wall. Given the characteristics of the injury and the patient's risk profile, a surgical approach via anterior thoracotomy was elected. Considering the patient's history of difficult airway, a decision was made to employ a hybrid intubation technique, which is a management strategy for difficult airways utilizing a dual-device approach, namely a video laryngoscope and a flexible fiberoptic bronchoscope. Video-laryngoscopy is associated with enhanced glottic visualization, a high success rate (92%), and a relatively rapid learning curve. Although the hybrid intubation technique is predominantly utilized in pediatric populations, it can be highly beneficial in adult patients presenting with difficult airways. The hybrid technique demonstrates a higher first-attempt intubation success rate in adults compared to the standard technique. Furthermore, it reduces the incidence of airway trauma, expedites the intubation process, minimizes episodes of desaturation, and obviates the need for alternative techniques to achieve successful tracheal intubation, relative to standard intubation methods.[14,15]

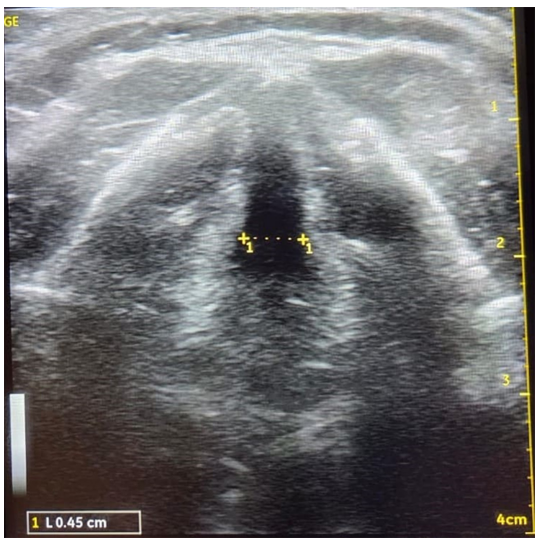

Figure 2: Ultrasound image of the glottis, distance between vocal cords 0.45 cm.

CONCLUSIONS

Although transvenous pacemakers with intraventricular electrodes are generally considered safe, they are associated with a risk of complications, including electrode malfunction and ventricular wall perforation. Device dysfunction should be promptly evaluated and identified, irrespective of the time

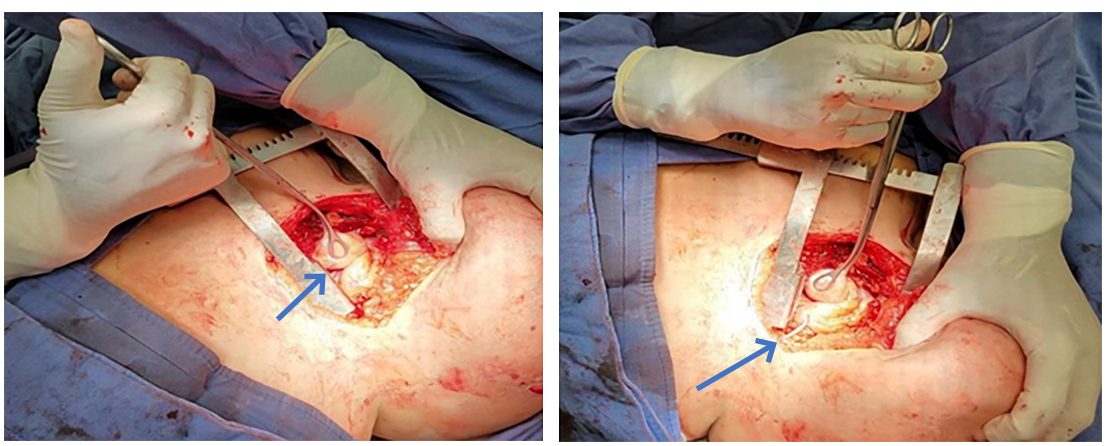

Figure 3: Surgical approach via anterior thoracotomy at the level of the fourth left intercostal space. The electrode originally located in the right ventricle can be seen, which has moved toward the mediastinum, perforating the anterior wall of the right ventricle.

elapsed since pacemaker placement. It is noteworthy that the majority of complications attributable to perforation tend to manifest clinically during the initial months following placement. With regard to airway management in patients with a documented history of difficult airway, as exemplified by the present case, the hybrid technique of flexible bronchoscopy assisted by video-laryngoscopy is of particular importance. Despite its widespread use in pediatric patients, this technique facilitates safe and successful tracheal intubation in these patients and can be employed electively or as a rescue measure.[14,16]

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Funding: none.

Disclosure: the authors have no conflict of interest to disclose.