Imaging of Iatrogenic Conditions of the Thorax

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KEYWORDS

• Iatrogenic • Thoracic complications • Device lead fracture • Catheter placement
• Medical procedures

KEY POINTS

- Common medical interventions performed by cardiologists, radiologists, surgeons, dentists, and alternative practitioners can result in complications within the thorax that lead to significant patient morbidity.
- Prompt radiologic identification of iatrogenic complications of medical procedures in the thorax is essential to guide patient triage and treatment.
- Understanding the approach to common thoracic interventions and the placement of thoracic medical devices can aid radiologists in the evaluation of iatrogenic complications.

INTRODUCTION

Iatrogenic thoracic conditions resulting from the placement of medical devices, access catheters, cardiovascular procedures, and interventional radiology procedures can be a significant source of patient morbidity. Radiologists play an essential role in identifying iatrogenic thoracic conditions that may result from these common procedures in a timely fashion so that patients receive appropriate management.

The objectives of this article are to review the expected radiographic findings after common interventions and to guide radiologists in identifying iatrogenic complications within the thorax. The subtypes of interventions and procedures discussed include cardiac conduction devices, vascular catheters, cardiothoracic endovascular procedures, diagnostic and interventional radiology procedures, dental procedures, and alternative/complementary medicine procedures.

IMAGING FINDINGS/PATHOLOGY

Cardiology Interventions

Cardiac conduction devices

The placement of cardiac pacemakers and implantable cardioverter defibrillators has become a common procedure in the United States and is performed by cardiologists trained in cardiac electrophysiology. The 3 most common types of cardiac conduction devices seen on radiographs are single-chamber, dual-chamber, and biventricular devices.[1,2]

A single-chamber device lead is typically placed in the right ventricle (RV) with the tip at the ventricular apex projecting to the left of the spine on an anteroposterior (AP) chest radiograph. Dual-chamber devices typically have a similar RV lead, with a second lead in the right atrium (RA), usually with its tip in the right atrial appendage, leading to an upward curvature of the lead tip on a lateral chest radiograph (**Fig. 1**). Biventricular pacing

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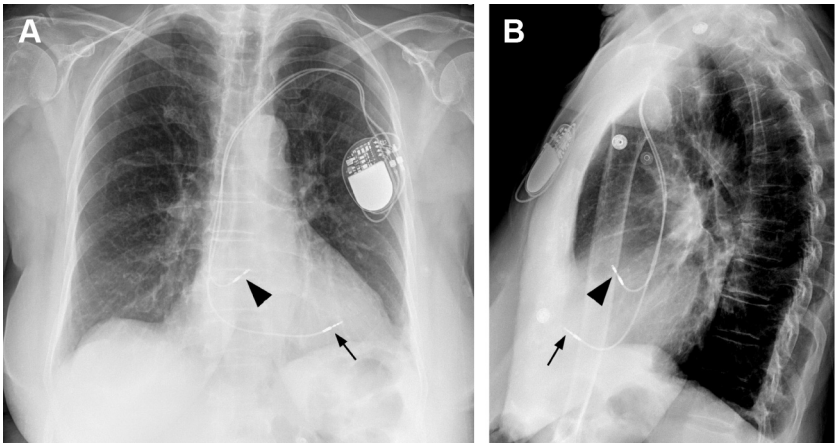

Fig. 1. Normal appearance of a dual-lead pacemaker. (*A*, *B*) PA and lateral radiographs demonstrate a dual-lead pacemaker with pulse generator overlying the left chest wall. Pacemaker wires descend over the expected location of the SVC into the RA and RV. The atrial lead (*arrowheads*) typically curves upward in a "J" configuration to reside in the right atrial appendage. The ventricular lead (*arrows*) ideally terminates in the ventricular apex to the left of the spine.

includes an RV lead and an additional lead placed through the RA into the coronary sinus and terminating in a cardiac vein along the free wall of the left ventricle (LV). The LV is thus paced in an epicardial fashion.[1,2] An RA lead may also be present in biventricular pacing. All of these leads are typically placed transvenously via the axillary or subclavian vein. Common minor immediate postprocedural complications include pneumothorax and hematoma.

A potential major complication is inadvertent intraarterial lead placement via the subclavian artery into the aorta. This diagnosis is suggested when leads follow a course medial to the expected position of the superior vena cava (SVC), suggesting that they are within the aorta (**Fig. 2**). Intraarterial leads are associated with a high thromboembolic risk, whereas leads extending into the coronary arteries may result in cardiac ischemia. Immediate CT imaging and echocardiography should be used to exclude coronary artery or ventricular perforation to allow for anticoagulation. Pacemaker lead removal requires multidisciplinary intervention.

Ventricular leads are fixed into the myocardium either actively via a screw tip or passively via radiolucent tines at the tip of the lead that are caught within trabeculated myocardium.[2] Another potential major complication is myocardial perforation, which can be symptomatic or asymptomatic (**Figs. 3** and **4**). On radiographs, the only clue to this diagnosis may be abnormally lateral or superior positioning of the RV lead tip. An important finding suggesting this diagnosis on CT is hemopericardium, although the absence of a pericardial effusion does not exclude the possibility of perforation (see **Fig. 4**). Myocardial perforation can also occur with atrial leads, which in unusual situations can be symptomatic due to irritation of the chest wall or diaphragm (**Fig. 5**).

Cardiac conduction leads can also become dislodged over time (**Fig. 6**). It is important when interpreting routine chest radiographs to compare lead tip position with prior examinations to ensure that lead position has not changed. Dislodged RA or RV leads can migrate into other areas of the right heart, the SVC, or inferior vena cava (IVC), which can result in insufficient or inappropriate pacing (see **Fig. 6**). Perhaps the most commonly detected abnormality on radiographs is lead fracture. A common location for failure is near the generator on the chest wall; this location should be carefully examined for lead fracture or disconnection. Additionally, a region of friction exists where the wires extend between the first rib and clavicle prior to entering the subclavian vein, known as subclavian crush. These fractured leads can result in noncapture and lack of cardiac pacing in addition to stimulation and contraction of chest wall muscles. Uncommonly, lead fragments can migrate into the RV outflow tract or even into the liver via the IVC (**Fig. 7**).

Pulmonary vein ablation

Pulmonary vein radiofrequency ablation or pulmonary vein isolation (PVI) is a common procedure performed by cardiologists to treat symptomatic atrial fibrillation.[3] PVI is performed via an