A 32-year-old man, with known VATER syndrome, presented with a history of previous cardiac surgery (tetralogy of Fallot repair 20 years ago), which was complicated by a complete heart block, and therefore a permanent pacemaker was implanted. His pacemaker was replaced twice in the following years; the latest was a dual-chamber with rate-modulation pacemaker (DDDR) that was placed transvenously (Medtronic, ADDR06 Adapta DR, implanted in 2009). He had severe pulmonary regurgitation and was primarily experiencing increasing dyspnea.

He was referred to computed tomography (CT) coronary angiography to rule out coronary artery disease and for anatomic definition postrepair and quantification of ventricular volumes and function. MRI was not considered appropriate because of the presence of epicardial leads. The patient was pacemaker dependent. Initially, the pacemaker was functioning well in DDD mode, with regular synchronized pacing. After appropriate preparation, the CT examination was conducted with the use of a 256-slice multidetector CT scanner. Helical scanning with low pitch (0.2) and retrospective gating was used because functional information was to be obtained. Scout images show the pacemaker and its connected leads within normal position, and the abandoned epicardial leads placed from an infradiaphragmatic location, as well. The pacer was within the scan field (Figure 1). The patient did not experience any symptoms during the examination. Surprisingly, during the scan, pacemaker malfunction was detected in the form of oversensing, which inhibited ventricular pacing, and dropped pacemaker beats were noted, as shown in ECG strips (Figure 2). Multidetector CT images show normal anatomy of coronary arteries (Figure 3) and normal leads position (online-only Data Supplement Movie I). There was a period of transient ventricular asystole as the CT gantry (contains high-voltage x-ray tube) was rotating around the pacer, disturbing its electric circuit, whereas the native atrial contraction proceeded unchanged (online-only Data Supplement Movies II and III). This inhibitory effect was transient, lasting only while the width of the x-ray beam directly irradiated the pacemaker, a time that was <2 s in duration. It was terminated spontaneously, as the gantry moved away from the location of the pacemaker generator (online-only Data Supplement Movie IV). Interrogation of the device after the scan demonstrated a sensed arrhythmia with a cycle length of 271 ms (the gantry rotation speed of the scanner) that inhibited ventricular pacing.

Although it has been traditionally believed to be a safe and harmless procedure in pacemaker patients, computed tomography scanning uses high doses of ionizing radiation and can trigger pacemaker malfunction, when the radiation is directed on the device.1

Oversensing may occur on certain pacemaker circuits (eg, the ventricular sense amplifier) and may cause inhibition of pacing. This may be clinically important for pacemaker-dependent patients if inhibition is persistent (pauses >3 s are potentially clinically important).2 However, in general scan protocol, the x-ray beam is directly crossing over the pacer for a very brief time and, therefore, the risk in most clinical scenarios is very low.

Although this problem is generally benign, medical staff should be aware of this possible complication, because this awareness would decrease the chance of its occurrence and allow better management if complications occur. Possible approaches to minimize its incidence are: the use of a lead to cover the pacemaker, exclusion of the pacemaker from the scan range, the use of asynchronous mode, and the use of the lowest possible x-ray tube current consistent with obtaining the required image quality.

Disclosures

None.

References

Figure 1. Scout images show the pacemaker generator in the right infraclavicular region. Two connected leads are seen within normal position extending from the pacemaker into the right atrium and right ventricle. The whole pacemaker system is entirely within the field of view of the MDCT scan. MDCT indicates multidetector computed tomography.

Figure 2. ECG strips recorded from the workstation of the MDCT scanner at the time of acquiring images. The patient was pacemaker dependent; regular synchronized pacing spikes precede each QRS complex at normal rate. Suddenly, loss of pacing spikes was noticed as soon as the MDCT scan started, resulting in a pause of about 2 s. Shortly thereafter, the pacemaker recaptures the heart rhythm, when the pacemaker generator was out of range of the gantry. MDCT indicates multidetector computed tomography.

Figure 3. Examples of MDCT images show normal anatomy of coronary arteries. Left, left anterior descending artery. Right, right coronary artery. MDCT indicates multidetector computed tomography.
Pacemaker Malfunction Attributed to Multidetector Cardiac Computed Tomography
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