A pacemaker-dependent patient undergoing high-dose stereotactic radiotherapy with the device located in the radiation area

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The population of patients with cardiovascular implantable devices (CIEDs) who require radiotherapy has been constantly growing over the last decades. It is well-known that ionizing radiation can cause malfunction or damage to CIEDs. Despite that, strategies for the management of these patients are limited and vary widely.[1,2]

An 80-year-old woman with a history of coronary artery bypass grafting surgery and permanent atrial fibrillation, who underwent a single-chamber pacemaker implantation due to complete atrio-ventricular block (AV-junction ablation) in 2002 and its replacement for Vitatron G20 SR device in 2014, was diagnosed with lung cancer (carcinoma planoepitheliale) in 2017. After oncological assessment, the patient was scheduled for radical stereotactic radiotherapy using a 10-MV photon beam. Unfortunately, the pacemaker was located within the planned target volume (FIGURE 1). Furthermore, the patient was scheduled for 3 sessions with total radiation dose of 5400 cGy, which substantially exceeds the dose limits for Medtronic / Vitatron devices (500 cGy). During initial device assessment, no intrinsic rhythm was detected and according to the Polish and German guidelines for patients with CIEDs undergoing radiotherapy, she was classified into the high-risk category.[2,3]

In order to maintain pacing in case of pacemaker failure, we decided to perform lead implantation via the right jugular vein. We used bipolar active fixation lead (Medtronic 5076, 52 cm). First, the lead was fixed in the mid-septal position, then, it was connected to the single-chamber pacemaker (Vitatron G20 SR), located superficially on the neck in a safe distance from the radiation area. This device was programmed to a backup VVI 45/min mode, while the primary pacemaker located within planned target volume was left in a VVI 60/min mode. The patient was on intravenous antibiotic treatment for the time of temporal pacing and underwent 3 radiotherapy sessions within 10 days with all recommended precautions. Effective pacing was maintained and no malfunction of permanent or temporary pacemakers was observed. Subsequently, the temporal lead and superficial pacemaker were explanted without any complications. Repetitive follow-up assessments after 1, 3, and 6 months were performed and showed correct function of the device.

Lack of unified rules for the management of stimulator-dependent patients undergoing radiotherapy puts clinicians in a difficult position. According to the guidelines of the American Association of Physicists in Medicine (1994), CIED should not be located directly in the beam. Polish, German, and Dutch guidelines suggest to consider CIED relocation.[2-5] Moreover, it is impossible to predict the behavior of any given CIED when it is located in the radiation area. The results of ionizing radiation depend on many factors: quality of radiation, dose rate, type of device, and its software.[1,2]

Our proposed approach to the management of such patients is minimally invasive. Using active fixation lead prevented its dislocation, and during the radiotherapy, the patient was provided with stable pacing. The right venous access was preserved and is still available for future

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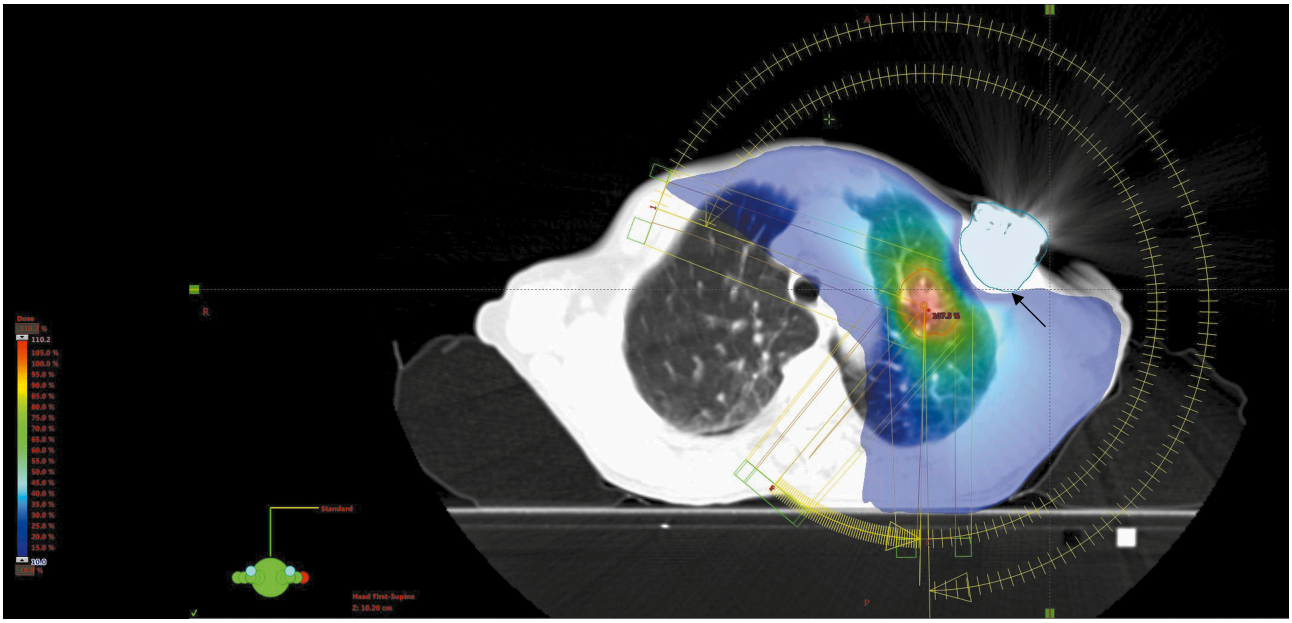

FIGURE 1 Three-dimensional visualization of radiotherapy dose distribution. The presented image shows complex relationships between tumor, pacemaker, treatment beam and radiation dose. The color scale represents radiotherapy-dose distribution. Due to the limitations of the software and artifacts, the pacemaker pocket area was excluded from the precise visualization of radiation dose. The pacemaker is located on the left side, within the planned target volume (arrow). As a result, the patient's pacemaker absorbed a significant dose of radiation. The second device was located in a safe distance from the radiation area.

interventions in case of CIED malfunction or infection. What is of importance, we also avoided the risk of extraction of the lead which was implanted more than one year ago.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

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