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Research Letter

Impact of clinical radiation audits on patient radiation exposure in cardiac implantable electronic device procedures

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Clinical audits are established as systematic assessments with the aim of improving the quality, safety, and effectiveness of medical processes. The primary objective of clinical radiation audits is to ensure the ideal use of ionizing radiation in clinical practice through both the justification of exposure and the optimization of the process.[1] While this kind of audits are already well established in radiology departments,[1] data on the efficacy of clinical radiation audits conducted in cardiology departments are lacking. In Switzerland, the first clinical radiation audit in a cardiology department took place at our hospital in 2019. The team of external auditors was composed of a cardiac electrophysiologist, an interventional cardiologist, a medical physicist, and an allied professional working in the catheterization laboratory.

We examined whether patient and physician radiation exposure was affected by the clinical audit. This retrospective cohort single-center study included all patients undergoing device implantation (pacemaker [including leadless], implantable cardioverter-defibrillator, or cardiac resynchronization therapy device), or lead extraction, between October 2018 and October 2020. Approval of the ethics committee was obtained.

To examine whether the clinical audit affected patient radiation exposure, the dose-area product, cumulative dose, fluoroscopy time, and number of cine acquisitions before and after the audit were compared. As efficacy and safety end points, we assessed the acute procedural success rate and 30-day complications before and after the clinical audit. All hypothesis testing was 2-tailed, and *P* values <.05 were considered statistically significant.

In total, 541 patients were included in the study: 247 patients (45.7%) had their procedure performed before and 294 patients (54.3%) after the clinical audit. Between both groups, there was no significant difference regarding sex, body mass index, comorbidities, or preprocedural medication. Procedures included lead extraction in 11.5% and pacemaker, implantable cardioverter-defibrillator, and cardiac resynchronization therapy device implantation in 50.2%, 21.1%, and 17.2 % respectively. There were no significant differences in the partition of device subtypes before vs after the audit.

After the audit, the dose-area product ($P = .02$) (Figure 1A) and the cumulative dose ($P = .01$) significantly decreased for conventional pacemaker implantation whereas no significant difference was found in fluoroscopy time ($P = .21$) (Figure 1B). There was a significant reduction of cine acquisitions (to assess for venous patency, venous access, and coronary sinus angiography) after the audit (19.5% vs 18.6%; $P = .048$) (Figure 1C). We attribute this to optimized operator practices after the audit. In total, we report 10 complications before (10 of 247 [4.0%]) vs 23 complications after (23 of 294 [7.8%]) the audit, with no significant difference between the groups ($P = .07$).

We notably reduced the usage of cine acquisitions to minimize radiation exposure, considering that cine radiation levels

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Figure 1
Patient radiation exposure for conventional pacemaker implantation before and after the audit. **A:** Box plots showing the dose-area product (DAP). **B:** Box plots showing the fluoroscopy time (t). **C:** Bar plots showing the prevalence of cine acquisitions. Groups were compared using the Welch test.

typically exceed those of fluoroscopy by a factor of 10.[2] In addition, we aimed at maintaining a low frame rate of 3 frames/s while ensuring diagnostic image quality. For the other procedures, we found no notable difference in patient radiation exposure before and after the audit. We attribute the lack of statistical significance to lower procedure numbers in comparison to pacemaker implantation and the already low fluoroscopy exposure before the audit. There were no significant differences in acute procedural success rates (98.4% vs 89.9%; $P = .71$). However, there was a numerical increase in complications from 4.0% before the audit to 7.8% after the audit that did not reach statistical significance, which may be associated with the efforts to reduce radiation exposure.

Our findings indicate that audit recommendations not only address deficiencies in imaging practices, which correspond to a similar report on clinical audits conducted in radiology units in Finland,[1] but also alerts the audited department to continue good optimization practices. The audit conducted at our department had a relevant impact on reducing patient and physician radiation exposure during pacemaker implantation without compromising efficacy. The impact that efforts to reduce radiation may have on the rate of complications should be monitored.

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