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EDITORIAL COMMENT

Radiation Exposure of Interventional Echocardiographers

Protecting and Nurturing a New Subspecialty*

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Structural heart disease (SHD) intervention is a rapidly growing field of cardiovascular medicine. With the advances in SHD intervention techniques, SHD imaging, in particular echocardiography,[1] undoubtedly plays a central role in a variety of SHD interventional procedures ranging from transcatheter left atrial appendage occlusion[2] to transcatheter aortic valve replacement (TAVR)[3] and transcatheter edge-to-edge repairs (TEERs) of mitral[4] and tricuspid regurgitation.[5] SHD imagers are key players in the heart team. Their roles include confirmation of the diagnosis and severity of SHD, establishment of eligibility for intervention, selection of appropriate device types and sizes, detection of procedural complications, and provision of lifelong imaging follow-up.[6] SHD imagers commonly serve as interventional echocardiographers (IEs) and are constantly exposed to high radiation. One cross-sectional study on occupational safety demonstrated that IEs received a radiation dose of up to 20 μSv, which is about 10-fold higher than interventional cardiologists.[7] The radiation hazard could be partly explained by the lack of designated lead shields in most cardiac intervention suites.[8] Additional lead shields, particularly the ceiling-suspended type, have been shown to effectively reduce radiation to IEs. As reported in a study by Lau and Wood,[9] women compared with their male counterparts are more likely to practice echocardiography. However, the radiation exposure and musculoskeletal burden imposed on IEs may deter female cardiologists in childbearing ages from choosing this evolving imaging subspecialty.

In this issue of *JACC: Asia*, Kataoka et al[10] investigated the distribution of radiation exposure on the body surface of IEs involved in SHD procedures, namely TAVR and TEER, using a Monte Carlo simulation. Real-life radiation exposure measurements were performed in 79 consecutive SHD procedures, including 44 TEERs and 35 TAVRs. The study discovered that the right half of the IEs' body, especially the waist and lower body, was more susceptible to higher radiation because it is closer to the x-ray tube. For every fluoroscopic practice, the use of posterior-anterior and right anterior oblique views should be minimized to decrease radiation scattered to echocardiographers. Because TEER is a procedure heavily dependent on transesophageal echocardiographic imaging guidance, it understandably causes more radiation exposure than TAVR (median 0.334 vs 0.053 μSv/mGy; $P < 0.001$). Thus, it is an unshirkable responsibility of every cardiac interventional laboratory to install a designated lead shield to effectively reduce radiation exposure to the IE to as little as possible.

Kataoka et al[10] should be congratulated on their fine work; however, the study has intrinsic limitations. The radiation-protective lead apron, neck shield, and goggles were universally worn in all kinds of cardiac intervention procedures; therefore, running a radiation simulation without these protective clothing items could not reflect real-life interventional practice. Second, perioperative echocardiographic guidance for TAVR procedures has largely changed to the transthoracic approach unless it is an anticipated complex case, such as bicuspid aortic valve or valve-in-valve interventions. The radiation exposure on echocardiographers during

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TAVR has been significantly decreased because catheter manipulation under simultaneous echocardiographic and fluoroscopic assistance may not be necessary. As a result, the comparison of left atrial appendage occlusion to TEER would be more appropriate in view of the necessity of continuous echocardiographic guidance and monitoring of complications. Moreover, patients with a higher body mass index would raise the radiation exposure to interventionalists and echocardiographers. Finally, the sex difference in radiation exposure to men vs women, who may have varying radiation sensitivity, was not studied.

This study has provided further evidence on excessive radiation exposure on SHD IEs. As such, a consensus document or guideline addressing radiation safety should be established as soon as possible. Installation of dedicated lead shields, minimal use of right anterior oblique fluoroscopic views, and close observation of the "as low as reasonably achievable" (ALARA) principle are essential to alleviate radiation exposure to IEs. Future studies should focus on which type(s) of radiation protective measures (ie, ceiling-suspended panels, table-side curtains, floor-mounted boards, or protections customized for SHD interventions) could most effectively protect IEs from radiation exposure in a practical and ergonomically friendly way. As the cardiology community, we need to continue to raise awareness of radiation safety, to recognize the expertise of SHD imagers, and to protect and nurture young-generation cardiologists who are interested in this field. The future prospect of SHD interventional echocardiography will undoubtedly be promising.

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