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Choose Your Collimator Wisely: Inappropriate Collimator Selection During a ^{177}Lu-DOTATATE Posttreatment Scan

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Proper collimator selection is critical to obtaining high-quality, interpretable nuclear medicine images. Collimators help eliminate scatter, which leads to poor spatial resolution and blurry images. We present the case of a posttherapy ^{177}Lu-DOTATATE (Lutathera) patient who was initially imaged with a low-energy, high-resolution collimator routinely used in ^{99m}Tc imaging. On image review, the patient was reimaged with the appropriate medium-energy, high-resolution collimator, which resulted in improved image quality. When reviewing the quality of images, it is important to understand modifications to the imaging that can significantly improve image quality and interpretation.

Key Words: quality control; collimator; image resolution

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An increasingly common radionuclide in nuclear medicine, ^{177}Lu emits high-energy β-particles (498, 385, and 176 keV) and medium- to low-energy γ-rays (208 and 113 keV) with a half-life of 6.73 d (*1*,*2*). The importance of this radionuclide is illustrated in its use in treatments for neuroendocrine tumors and prostate cancer (*3*,*4*). β-particles are not imaged; rather, they are used to treat cancer when coupled in radiopharmaceuticals. The γ-rays emitted from ^{177}Lu can be imaged with a γ-camera. The 208-keV γ-ray is emitted with an abundance of 11%, whereas the 113-keV γ-ray is emitted with an abundance of 6.4%. Standard practice recommends the use of medium-energy collimators, such as medium-energy high-resolution (MEHR) or medium-energy low-penetration collimators, to prevent septal penetration, scatter, and low spatial resolution (*5*). In routine practice, low-energy collimators are more commonly used for the ^{99m}Tc-labeled radiopharmaceuticals; therefore, as nuclear medicine practice shifts to using more radiopharmaceuticals emitting medium to high energy, it is important to change the collimator to match the radiopharmaceutical correctly. We present a case in which the incorrect collimator was used in a ^{177}Lu-DOTATATE (Lutathera; Novartis) posttreatment scan, resulting in poor imaging characteristics compared with the correct collimator.

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CASE REPORT

At our institution, ^{177}Lu-DOTATATE patients routinely undergo whole-body planar γ-camera imaging the day after treatment. This imaging is performed to ensure correct radiotherapy localization and to assess potential new sites of disease. On the day in question, the technologist did not switch the low-energy, high-resolution collimator to the MEHR collimator. The images were brought to the nuclear radiologist for review before patient discharge (Fig. 1). Together, the physician and the technologist realized that the images were noisy and had poor spatial resolution. After a discussion about the reasons for the poor image quality, the technologist realized that the wrong collimator had been used in the study. After the collimator was switched to an MEHR collimator, imaging was repeated (Fig. 2). The subsequent images were of much higher quality, with improved spatial resolution and contrast-to-noise ratios.

DISCUSSION

We describe a patient who was treated with ^{177}Lu-DOTATATE but for whom the technologist did not switch to the correct collimator (MEHR) for ^{177}Lu after treatment, instead keeping the most common collimator on the camera, which was the low-energy, high-resolution collimator. This type of collimator lets scattered high-energy γ-rays pass through the thinner septa more readily than does an MEHR collimator. These scattered high-energy γ-rays result in poorer spatial resolution and blurry

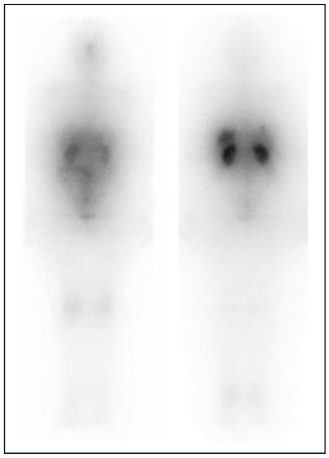

FIGURE 1. Anterior (left) and posterior (right) posttreatment ^{177}Lu-DOTATATE images obtained with low-energy, high-resolution collimator demonstrate poor spatial resolution and increased noise.

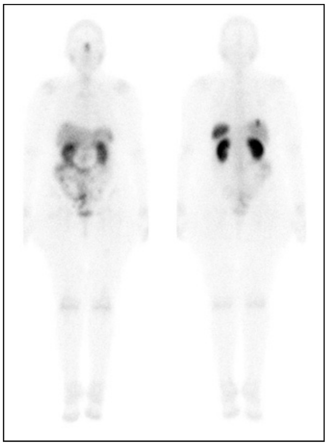

FIGURE 2. Anterior (left) and posterior (right) posttreatment ^{177}Lu-DOTATATE images obtained with MEHR collimator demonstrate increased contrast-to-noise ratio with higher spatial resolution.

images (Fig. 1). As the field of nuclear medicine moves to different radionuclides, such as ^{177}Lu, technologists need to check the radiopharmaceutical and match the peak energy with the correct collimator. High-energy collimators should be used for radionuclides such as ^{131}I, medium-energy collimators should be used for radionuclides such as ^{111}In or ^{177}Lu, and low-energy collimators should be used for radionuclides such as ^{99m}Tc. The experience taught the technologists and physicians how to review images for quality and ways to improve that quality through collimator selection.

CONCLUSION

Currently, general nuclear medicine clinics focus predominantly on ^{99m}Tc-labeled radionuclides; the collimator thus does not need to be changed as frequently as in the past. As new radionuclides enter nuclear medicine practice, it is important to learn about their properties for safety and high-quality imaging. An important step in ensuring high-quality imaging is selecting the correct collimator for the imaged radioisotope. In this case, we learned that the MEHR collimator provides higher-quality images than the low-energy, high-resolution collimator for this scan after ^{177}Lu-DOTATATE treatment.

DISCLOSURE

No potential conflict of interest relevant to this article was reported. The opinions and assertions expressed here are those of the authors and do not necessarily reflect the official policy or position of the Uniformed Services University or the Department of Defense.

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