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Contrast-noise-ratio (CNR) analysis and optimisation of breast-specific gamma imaging (BSGI) acquisition protocols

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Abstract

Background: Breast cancer is one of the most prevalent forms of cancer in women. Breast-specific gamma imaging (BSGI) is a diagnostic imaging method that uses sestamibi-labelled ^{99}Tc and a dedicated gamma camera to localize malignant lesions in breast tissue. The aim of this study is to investigate if the current acquisition protocol for BSGI at our hospital is optimized for the detection of lesions in our patients.

Methods: We analyzed patient data and performed a phantom study with a Dilon 6800 gamma camera. The patient data were collected from a group of 13 patients (740 MBq ^{99m}Tc-sestamibi , four views per patient were dynamically acquired with a frame duration of 30 s per frame and a total acquisition time of 8 min per view). Reduced-time static images were created, and contrast-to-noise ratios of identified hotspots were determined for different acquisition times. For the phantom study, we used a contrast detail phantom to investigate the contrast and resolution properties, within the range of relevant clinical acquisition parameters. The phantom was filled with a concentration of 80 MBq in 500 ml of water, and we dynamically acquired frames for a total acquisition time of 60 min using a general purpose (GP) collimator. To compare the GP collimator with the high-resolution collimator, a second acquisition was made for both collimators with a total acquisition time of 16 min.

Results: The initial analysis of BSGI scans of the 13 patients showed that a dose reduction by a factor of 3 would not have reduced the number of observable hotspots in each of the acquired views. However, a subsequent systematic analysis of our protocol with a contrast-detail phantom showed that dose reduction results in a lower observability of hotspots, whereas increased doses resulted in a higher observability.

Conclusion: We believe that the results of our phantom study are relevant for clinical practice and that further dose reduction cannot be recommended for the BSGI exams at our hospital and that an increase of the administered activity should be considered.

Keywords: Breast cancer, Scintimammography, ^{99m}Tc-sestamibi, Breast-specific gamma imaging, Contrast-detail phantom, CNR analysis

Background

Breast cancer is one of the most prevalent forms of cancer in women. In the Netherlands, every year 13,000 new cases are reported, and it is a condition that affects one in every nine women. Patients with breast cancer have a good prognosis if the disease is detected early. Mammography is the standard modality of choice for screening and diagnosing breast cancer. Unfortunately, the mammogram is not conclusive in all cases, especially in women with dense breast tissue; mammograms can be difficult to interpret and can lead to ambiguous findings. As a result, these patients are referred for a magnetic resonance imaging (MRI) scan. Breast MRI has a high sensitivity for detecting malignancy in the breast, but specificity is sub-optimal, potentially leading to unnecessary invasive procedures [1]. Breast-specific gamma imaging (BSGI) is an improved breast scintigraphy technique that uses a

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