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Abstract: Evaluation of vertebral fracture assessment images for the detection of abdominal aortic calcification

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Abstract

Dual-energy x-ray absorptiometry (DXA) is an established modality for the assessment of bone mineral density. DXA has also been used for the detection of abdominal aortic calcification (AAC) using lateral images taken for vertebral fracture assessment (VFA). In this phantom study, the capability of VFA for the detection of AAC was investigated. A Perspex phantom of variable width in the range 15-30 cm was used to simulate abdominal soft tissue. Aluminium strips of thickness 0.05-2.0 mm were sandwiched between two halves of the phantom to mimic aortic calcification. VFA images of the phantom were acquired in single-energy mode and analysed by placing regions of interest over the aluminium strip and an adjacent area of Perspex. For each phantom width, the minimum detectable aluminium thickness was assessed visually and related to contrast-to-noise ratio (CNR). Linearity of pixel value with aluminium thickness was tested by linear regression and correlation. Repeatability was measured with five repeated scans for selected phantom configurations. The minimum thickness of aluminium that could be visualised increased with phantom width and varied from 0.05 mm at 15 cm Perspex to 0.5 mm at 30 cm Perspex; the CNR threshold was about 0.03. At all phantom widths, the variation of pixel value with aluminium thickness was strongly linear (r^2>0.98, p<0.001). Repeatability was good with a coefficient of variation of less than 0.04%. The results of the study suggest that under idealised imaging conditions, VFA is capable of detecting small thicknesses of calcification with good linearity and repeatability.

Public Full-texts 2 | Private Full-text 1

Elmasri Abstract.pdf

Page 1

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Dual-energy x-ray absorptiometry (DXA) is an established modality for the assessment of bone mineral density [1]. DXA has also been used for the detection of abdominal aortic calcification (AAC) using lateral images taken for vertebral fracture assessment (VFA) [2]. In this phantom study, the capability of VFA for the detection of AAC was investigated.

A Perspex phantom of variable width in the range 15-30 cm was used to simulate abdominal soft tissue. Aluminium strips of thickness 0.05-2.0 mm were sandwiched between two halves of the phantom to mimic aortic calcification [3,4]. VFA images of the phantom were acquired in single-energy mode and analysed by placing regions of interest over the aluminium strip and an adjacent area of Perspex. For each phantom width, the minimum detectable aluminium thickness was assessed visually and related to contrast-to-noise ratio (CNR). Linearity of pixel value with aluminium thickness was tested by linear regression and correlation. Repeatability was measured with five repeated scans for selected phantom configurations.

The minimum thickness of aluminium that could be visualised increased with phantom width and varied from 0.05 mm at 15 cm Perspex to 0.5 mm at 30 cm Perspex; the CNR threshold was about 0.03. At all phantom widths, the variation of pixel value with aluminium thickness was strongly linear (r^2>0.98, p<0.001). Repeatability was good with a coefficient of variation of less than 0.04%.

The results of the study suggest that under idealised imaging conditions, VFA is capable of detecting small thicknesses of calcification with good linearity and repeatability.

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