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Introduction

Interventional X-ray systems used for cardiac catheterisation procedures are operated by pre-programmed automatic dose rate control (ADRC)\(^1\). Radiographic factors are selected based on imaging geometry and estimated patient thickness.

The research aim was to determine optimal X-ray beam energy for cardiac digital image (‘cine’) acquisition in a system-independent manner (bypassing ADRC), for a range of patient sizes.

Methods

Patients and iodine based contrast medium were simulated using PMMA and tin with PMMA thickness 8.5, 12, 16, 20, and 30 cm representing a range of patient chest thickness in the posterior-anterior (PA) projection\(^2,3\). X-ray tube voltage (kVp) and Cu X-ray beam filtration were independently varied and raw images were captured on a flat panel detector based cardiac X-ray system.

Tin detail contrast was calculated and flat field image noise was measured to determine the contrast to noise ratio (CNR). Entrance surface dose (ESD) and effective dose measurements were obtained to calculate CNR\(^2 /\) dose, which determined dose efficiency.

Results

Results are shown below with 5% error; highest bars are most dose efficient. Lower peak tube voltage was favoured, more so for thinner PMMA and as Cu increased.

Anthropomorphic Phantom

As a first stage of assessing clinical implications of optimization results\(^4\), two images of an anthropomorphic chest phantom with contrast-filled coronary arteries with the same ESD were compared, the left with 65 kVp, 0.4 mm Cu and right with 110 kVp, 0.9 mm Cu representing high and low adult dose efficiency respectively. Image quality is superior on the left hand side.

Acknowledgements

This project was supported by a bursary from Yorkshire Cancer Research, Harrogate, UK, and by the cooperation of staff at Leeds General Infirmary. Adult image data was analysed by Catherine McMillan.

References