An investigation of scatter removal techniques in paediatric cardiac catheterisation imaging: effects upon radiation dose, image quality and DNA integrity.


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Introduction
Paediatric cardiac catheterisations provide immense benefit but also result in a considerable ionising radiation burden to children who are more radiosensitive than adults. The transition from using image intensifiers to flat panel detector technology, as well as wide variations in imaging protocols, indicates that children may be receiving greater radiation doses than necessary. Our on-going study is investigating the effect of scatter removal techniques upon radiation dose and image quality and DNA integrity.

Methodology
To date, 44 paediatric patients aged 0-15 years have been randomly allocated into one of three imaging protocols prior to cardiac catheterisation: use of an anti-scatter grid (A), removal of anti-scatter grid (B), and removal of anti-scatter grid with a 15 cm air-gap between patient and the image detector (C). For each patient the effective radiation dose and relevant organ doses are being calculated by performing Monte Carlo photon simulation. The number of radiation induced DNA double-strand breaks are being quantified for all examinations using the γH2AX assay. A visual grading analysis will be performed by blinded clinicians using sample images from each imaging protocol.

Results
Preliminary data from the 44 participants has demonstrated that the mean effective dose of protocol B is lower (5.1 mSv) compared to protocols A (7.5 mSv) and C (5.2 mSv). Increases in mean γH2AX-foci are greater for protocol A (0.14) compared to protocols B (0.07) and C (0.08).

Conclusion
Preliminary data has demonstrated that the removal of the anti-scatter grid in paediatric cardiac catheterisations may result in reductions in radiation dose (~32%) and radiation induced DNA damage (~50%). Protocols A, B and C have each provided images which were sufficient for successful completion of cardiac catheterisation. Our study will be fully completed for presentation at AEPC 2015 and will also include blood and organ radiation doses and estimated cancer risk calibrated from DNA damage observations.