

AbstractID: 5585 Title: Monte Carlo simulation to assess fetal dose from MDCT imaging using patient based voxelized models

Purpose: To use detailed Monte Carlo simulations to investigate fetal dose from a multidetector CT (MDCT) using voxelized models created from actual patient images including early and late term pregnancies.

Method and Materials: Detailed voxelized models of anatomy were created based on image data from a cohort of pregnant patients who had previously undergone abdomen/pelvis CT scans. The gestational ages ranged from less than 5 weeks to 33.7 weeks. Three regions, corresponding to fetus, gestational sac, and uterus, were contoured on each image series by a radiologist.

A MDCT model was created using details about the source spectra, filtration, collimation, and geometry. To simulate an actual scan, a helical source path was defined and particles were transported through the anatomy of the voxelized patient models; radiation dose was tallied in voxels belonging to the three regions of interest. The simulated abdomen/pelvis scan used a helical scan of 120kVp, pitch 1, and 4 x 5 mm total nominal beam collimation.

Dose on a per mAs basis was separately calculated for the fetus when the fetus was distinguishable from the gestational sac and uterus in the original image. These doses were then compared to two generally accepted fetus dose estimations: the Felmlee et al method and the ImPact estimation of dose to a uterus (for fetuses < 8 weeks).

Results: The radiation dose to the fetus in the models with gestational ages of <5 weeks, 6.6 weeks, 7.1 weeks, and 28.3 weeks, were 8.31 mGy/100mAs, 9.67 mGy/100mAs, 14.22 mGy/100mAs, and 11.70 mGy/100mAs, respectively. The fetus dose estimate using the Felmlee technique was 11.30 mGy/100mAs. The ImPact dose estimate to a fetus was 13.0mGy/100mAs.

Conclusion: Radiation dose to the fetus was successfully estimated at different gestational ages using detailed models of actual patient and fetus morphology, scanner geometry, and acquisition protocols.