The Effects of Breasts Shielding on Dose Reduction in CT Examinations

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Abstract: CT is a major source of medical radiation and its availability is responsible for increasing dose from CT practice. The breast tissue is one of the the structures that has an increased sensitivity to radiation and its received dose is significant enough to be a matter of concern. Therefore, the purpose of our study was to measure breasts dose during chest CT with and without bismuth and lead shielding.
In this study, the amount of dose reduction achievable by shielding the breast tissues were calculated for UF revised ORNL family of six anthropomorphic phantoms using MCNPX. Siemens DRH was simulated and the Monte Carlo model included parameters that specify its source geometry and x-ray energy spectrum.
Considering the fact that these shields would use for children as well as adult, their weights should be low enough to not feel uncomfortable. Therefore, the effects of bismuth and lead shields up to 0.5 mm thickness were investigated in this research. We selected the size of shields that would cover the anterior surface of the phantom, but not significantly exceed the width of the anterior surface.
The accuracy of simulation was investigated by comparing the effective doses (without considering any shields) by published results.
An exponential relationship was found between breasts absorbed dose and the thickness of shielding. The breasts dose in mGy/mAs for newborn at 80 kVp was 3.02×10^{-2} which was reduced to 1.17×10^{-2} and 5.29×10^{-3} for 0.1 and 0.5 mm of bismuth, respectively. It was observed that for tube voltage of 80 and 100 kVp using a shield with a thickness of 0.4 mm and for tube voltage of 120 and 140 kVp using a shield with a thickness of 0.5 mm would be appropriate. In addition, further reduction in radiation dose can be achieved using a lead shield instead of bismuth one with the same thickness.

Key Words: Dose reduction, CT examination, Breasts' shielding, MCNPX.