Simulation of CTDI using GATE for 2, 16, 64 slices CT system

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Purpose: the aim of this study was to validate the simulated CTDI against the measured one using the Geant4 Application for Tomography Emission (GATE) for 3 CT system dual slices, 16 and 64 slices.

Introduction:

CT is one of the most irradiating medical imaging techniques. Multiple examinations can increase the likelihood of cancer occurring in adults, especially in children. It is therefore imperative to have a good estimate of the dose delivered according to the acquisition parameters, as well as the morphology of the patients [1].

The dose measurement delivered to patients in CT is difficult to assess. In practice there are only two standard phantoms: PMMA (PolyMethylAcrylate) head and body. GEANT4 Application for Tomographic Emission (GATE) simulation appears as a tool to simulate several diameters. This study describes the validation of the GEANT4/GATE simulation platform for dosimetric applications in CT.

Materials and methods:

--- 3 CT scanner dual, 16 and 64 slices were used in this study.

--- Calibrated pencil ion chamber (model 10X6-3CT RADCAL CORPORATION USA) and electrometer (RADCAL CORPORATION USA) was used. Accu-Gold+ was interface software used to show the output parameters (absorbed dose, dose rate...).

--- PMMA phantom (16 and 32cm) to simulate the patient's head and body respectively.

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\text{CTDI}_{W} = \frac{2}{3} \text{CTDI}_{100,C} + \frac{2}{3} \text{CTDI}_{100,F} \quad [1]
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\text{CTDI}_{100} = \frac{1}{7} \int_{-50}^{50} D(z)dz \quad [1]
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--- station HPC Gamma + (64 Cores, 256 GB RAM, 4 TB Storage).

Results & discussion:

Results of the simulation are presented and good agreements are observed between measured and simulated CTDI. For 16 slices (less than 1.18% for head phantom and 1.85% for body phantom for all applied voltages). For dual slices (less than 3.7% for head phantom and 3.8% for body phantom for all applied voltages). For 64 slices (less than 1.7% for head phantom and 2 % for body phantom for all applied voltages). These differences observed can be geometry explained by the difficulty to model a precise geometry and the random errors in the simulated CTDI. Based on these results, it is possible to optimize the CT parameters in clinical applications using the Monte Carlo code GATE.