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Online tool for fast and accurate assessment of radiation dose received by the fetus in CT

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Introduction

Computed tomography (CT) is sometimes needed during pregnancy. In this case, assessment of radiation dose received by the fetus is required. Existing methods are either cumbersome or limited in their accuracy. The aim of this study is to develop and validate computational algorithm for fetal radiation dose assessment, which could be used in clinical routine.

Materials and methods

First, commercially available Monte Carlo code was modified in order to simulate dose distribution from a vendor-independent (generic) CT system. Then, this code was validated against the CTDI measurements performed on CT systems of two different manufacturers (Siemens and GE). A set of Monte Carlo (MC) simulations with various exposure parameters was performed on computational phantoms representing pregnant patients at various gestational stages. The normalized fetal dose values from these MC simulations were recorded. These normalized dose values were used for the computational algorithm enables fetal dose assessment from CT examination of various body region, at different exposure settings.

In the second stage of the study, the accuracy of the proposed algorithm was validated against detailed MC simulations performed on CT data from 29 real pregnant patients underwent clinically indicated abdominal CTs. After the validation, a user-friendly online tool was developed.

Results

The median fetal dose from abdominal CT calculated for the real pregnant patients was 2.7mGy. The relative error of the dose values calculated by the online tool was 11%, on average. The highest error of about 40% was found in patients with additional hardware (i.e. fixation device) resulted in the increased tube current (mA) applied by the system and thus higher fetal dose estimated by the program.

The online tool (www.fetaldose.org) enables vendor-independent calculations of fetal doses at various gestational ages from CT examination of any type.

Conclusion

The tool provides fast and reliable evaluation of radiation dose, received by the fetus from CT examination of the mother. This tool requires the input of only a few parameter and can be used by clinicians in their routine.

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