Service Priorities and Programmes

Electronic Presentations

Convention ID: 593
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Urgent computed tomography imaging in pregnancy: From fetal simulation and dose measurements to providing information to mother on childhood cancer risk

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Keywords:
urgent CT to pregnant patient
fetal radiation dose
childhood cancer risk
public understanding to radiation
fetus simulation

Introduction

Pregnant patients may experience non-obstetrical emergencies during pregnancy when computed tomography (CT) remains essential for clinical diagnosis. For pregnant women undergone abdominopelvic CT, the concern of consequential childhood cancer risk is relevant because the fetus, with greater radiation sensitivity than the mother, is directly exposed to radiation. Information of childhood cancer risk is of concern to the mother and is of clinical reference to monitor the growth of the new-born child. We describe procedural fetal simulation and dose measurement for a pregnant patient with aortic dissection in order to obtain such clinical information.

Objectives

(1)To experimentally simulate a late stage fetus; (2) to measure the CT dose and to estimate its consequential childhood cancer risk; (3) to translate cancer estimation to simple language understandable to general public; (4) to be aware of previous high dose scan during pregnancy.

Methodology

A standard female phantom weighing 70 kg was used in this retrospective measurement to study the radiation dose to the fetus of a pregnant patient suffering from aortic dissection. To model a fetus of gestational age of 36 weeks, a cylindrical phantom was used and layers of beeswax were pasted onto the humanoid abdominal region to simulate the patient's maternal dimension. Radiation dose was measured with equipment available from radiology department. Childhood cancer risk was

estimated based on international recommendation of 0.4%/mGy irradiation.

Result

The average dose delivered to the simulated fetus was measured as 20 mGy for each acquisition according to the patient's CT scanning protocol. Therefore a pre- and post-contrast CT acquisition would have accumulated a fetal dose of 40 mGy. The lifetime risk of developing childhood cancer was estimated 1.6% in this patient's case. General public understood that there was a better than 98% likelihood that the child would be unaffected by the fetal irradiation. Fetal simulation and dose measurements can be efficiently performed to obtain clinical information to the pregnant patient concerned and to monitor the childhood development. However, should the pregnant patient have history of high dose radiological examinations prior to the urgent CT, it would be necessary to reassess and provide updated information on risk and benefit to the patient.