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Radiation Dose Management Program For CT Brain Perfusion: Application of Computer Simulations And Dosage Measurements To Moyamoya Children

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Introduction

Moyamoya is a cerebrovascular disease characterized by the blockage of terminal portion of the bilateral carotid arteries. Computer tomographic perfusion (CTP) is the imaging modality to assess the cerebral hemodynamic changes in moyamoya disease. Although the imaged head circumference coverage is small, CTP is a high radiation dose examination which involves continuous scanning of the same circumference to quantify the flow of contrast agent. Particular concern is the paediatric subgroup because children have a longer life expectancy in that repetitive CTP is the follow-up modality. Therefore it is necessary to ensure correct radiation dose delivered in order to avoid adverse radiation effect.

Objectives

We would like to share our experience by describing (1) computer simulation technique to obtain organ absorbed doses; (2) radiation dose measurement of each CTP protocol; (3) comparing results among simulation, measurement and patient dose; (4) the awareness for correct dose for protocol modification prior to patient application.

Methodology

Radiation doses from two CTP protocols using a 320 multi-detectors CT in our institution have been evaluated. The radiation dose is simulated using computer code ImPACT which has been recognized for calculating patient organ absorbed doses from CT examinations. We measure the radiation dose directly from each CTP protocol by using a head phantom and radiation measuring chamber.

Result

Effective doses for the two protocols, when applied to both genders of paediatric moyamoya patients, are ranged 5.4 – 7.5 mSv comparable to 3 years of background

radiation level in our institution area. The doses among simulation, measurement and dose report are in good accord with each other. We wish to share our experience because there has been extensive global effort to prevent incident of over-dose in CTP. The management program can be efficiently performed with 0.5 hour of CT machine time and computer simulation without using the CT facility. We recommend that this management program should be performed when routine protocol has to be modified. While CTP is an important part to our healthcare community, an efficient, pragmatic and safe system to deliver its correct radiation dose should be implemented in order to ensure the best and safe use of radiation in our paediatric patient service.