Medical Research Institute

Department of Medical Biophysics

Assessment of low versus standard kV settings in cerebral CT angiography for the optimization of contrast medium and radiation dose

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In

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SUMMARY

Recent advances in computed tomography (CT) have greatly increased the clinical applications of CT, especially since the advent of multi-detectors row CT (MDCT) technology. CT angiography (CTA) has been advocated for pre-operative evaluation of cerebral blood vessels pathologies and their relationship with the main branches. Moreover, it is crucial to detect other vascular morbidities, such as arterial occlusive diseases. CTA allows the proper visualization of main vascular structures and has several advantages: minimal invasiveness, with a lower complication rate than that of angiography; generation of high spatial resolution images; availability of multiplanar reconstructions and 3D reconstructions; and short examination time, allowing extended scan ranges. The extended use of MDCT in the clinical practice, however, may result in an increase of both the frequency of CTA studies and patient's radiation exposure compared with single-slice CT.

Consequently, potential benefits of lower-kV scanning at contrast-enhanced CT include reduced radiation dose with similar contrast-to-noise ratio and reduced effective dose. Recently, lower-kV imaging has been shown to result in improved conspicuity of cerebral blood vessels lesions and dominancy in different patients. In addition to the radiation dose savings, lower-kV scanning may be beneficial, for diagnostic purposes in patients with poor *i.v.* access or renal impairment in whom a smaller contrast dose or slower infusion rate may be necessary or in patients in whom subtle attenuation differences may be diagnostically important.

Scanning with lower-kV can be a challenge in adult patients because of the increased noise and susceptibility to beam-hardening and other artefacts. Low-tube-voltage-setting protocol combined with low contrast agent volume, by using new MDCT scanners, represents a feasible diagnostic tool to significantly reduce the radiation dose delivered to patients and to preserve renal function, while also maintaining adequate diagnostic quality images in assessment of cerebral blood vessels. Since the introduction of MDCT, CTA has become a standard imaging tool for the evaluation of diseases affecting the carotid arteries and their branches.

Therefore, CT protocols should be properly designed and carefully applied in order to obtain the highest amount of information by using the lowest radiation dose achievable. Since the theoretical risk of radiation-induced cancer from CT examinations has been reported as not negligible. As the radiation exposure is linearly dependent on the tube current, a helpful technique for reducing radiation dose involves the modulation of tube current itself, according to real-time local attenuation (i.e. Siemens Medical Solution, Forchheim, Germany and Philips Medical Systems, Best, Netherlands).

Result of the present study was as follow:

There was a higher significant difference in all study cases group (1) when compared with the control group (2). The dose of contrast medium and radiation given to the patient to perform a MDCT scan on the cerebral vascular system by using the low kilovolt technology was reduced by 38% and 40%, respectively. and this was proved by.

Determination of Image quality by calculation the following parameters:

a. Quantitative Analysis of the following calculations:

Calculation of Hounsfield unit values (HU) for segment one of the right middle cerebral artery, there was a statistically significant increase in all studied cases of group (1) compared to the control group (G2), also calculation of the standard deviation (SD) for it, there was a statically significant increase in all studied cases of group (1) compared to the control group (G2).

Calculation of the values of signal to noise ratio(SNR) for segment one of the right middle cerebral artery, there was a statistically significant decrease in most of studied cases of group (1) compared to the control group (G2), also calculation of the values of contrast to noise ratio(CNR) for it, there was a statistically significant increase in studied cases of group (1) compared to the control group (G2).

b. Qualitative image scoring was performed independently by two staff radiologists with experience in MDCT cerebral angiography examinations.

Determination of Radiation Exposure outcome by calculation the following parameters:

Calculation of the values of Computed tomography dose index volume ($CTDI_{vol}$) for segment one of the right middle cerebral artery, there was a statistically significant decrease in all studied cases of group (1) compared to the control group (G2), also calculation of the values of dose length product (DLP) for it, there was a statistically significant decrease in all studied cases of group (1) compared to the control group (G2).

Calculation of the values of the dose reduction (DR) for it, there was a statistically significant decrease in all studied cases of group (1) compared to the control group (G2).