Individual optimisation of contrast media application and radiation dose in computed tomographic angiography

9.2
Valorisation

INTRODUCTION

Computed tomographic angiography (CTA) is an imaging method which is widely used as a diagnostic tool for the visualisation and evaluation of various vascular structures. CTA has several advantages over other image modalities, for example because of its widespread availability and the short time required for image acquisition and processing. Furthermore, technology of CT imaging has undergone many changes in the past two decades; especially the advent of multidetector-row CT with high spatial and temporal resolution, wider detector coverage, increased rotation speed and iterative reconstruction improved image quality, resulting in improved visualisation of these various vascular structures. However, there are also potential drawbacks for CTA, including the administration of iodinated contrast media (CM) – which may cause allergic reactions or contrast induced nephropathy (CIN) – as well as the use of ionising radiation dose due to the risk of stochastic effects.
Consequently, it is important to select CTA protocols where patients will benefit from individualised application of iodinated CM and radiation dose in order to use iodinated CM and radiation dose in a more efficient way and to reduce the general drawbacks for CTA.

RELEVANCE OF SCIENTIFIC RESULTS

This thesis addressed several topics on individual optimisation of CM volume and radiation dose for different CTA examinations. For a long time the injection and scan protocols were standardised, in order to ensure diagnostic image quality in all patients, on the basis of the vascular structure that needed to be scanned. This resulted in so-called ''one size fits all'' protocols, which means that every patient received the exact same amount of radiation dose and iodine. One can imagine that not every patient needs this amount of iodine and radiation dose, whereas other patients may need some more in order to maintain diagnostic image quality. It has already been described in literature that body weight and body mass index (BMI) significantly correlate with image quality; higher body weight and BMI will decrease intravascular enhancement and increase image noise, resulting in deterioration of image quality.
The results from this thesis showed that CM volume and radiation dose in CTA could be significantly reduced by individual adaptation of protocols with respect to body size of the patient and clinical indication for the scan. Therefore, we would advise to use individualised CTA protocols in current routine practice; minimising the possible adverse effects of iodine and radiation dose in patients.

TARGET GROUPS

The results of this thesis are relevant for radiologists, and in particular, vascular radiologists as well as for the treating physicians in this case such as cardiologists, vascular surgeons and internists. For the treating physicians it could be important for decision making in the referral for CTA. Furthermore, patients who are referred for CTA and especially the relatively young patients and patients suffering from an impaired renal function can benefit from the individualised protocols.

INNOVATION AND REALISATION

This thesis first shows a standardised way of applying lower radiation dose on an individual basis, directly linking contrast parameters to radiation dose, and subsequently optimising contrast and dose settings. Eventually, there will be a lot of costs that can be saved because of the fact that the amount of CM can be drastically reduced in many cases.
It must be very clear that ''one size fits all'' protocols are outdated now. Obtaining diagnostic attenuation values using reduced CM volumes and radiation dose will play an important role in the future – especially due to the ongoing advancements in detector technologies. Newest CT technologies allow for even faster scanning as well as for the use of low tube voltages (e.g. 80 and 70kVp) in a broader range of patients. Further research should focus on how to efficiently apply radiation dose and CM volume in all different routine CTA protocols using these newest CT technologies.