Initial experience on time-resolved whole aortic tomography angiography using a $3^{rd}$ generation dual source CT

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Aims and objectives

Aortic computed tomography angiography (CTA) has become the standard of reference in the diagnosis and follow up of aortic diseases [1-3]. Time-resolved aortic CTA (TR-CTA) might offer more information regarding the dynamics of contrast enhancement in some pathologies, such as dissections and endoleaks after endovascular repair. However, there were still some disadvantages in the application of time-resolved technique in aortic CTA, on a 1st or 2nd generation dual source CT, such as limited scan range, and the radiation dose [4,5]. Using a 3rd generation dual source CT, the scan range could be extended up to 80cm, and radiation dose could be lower.

The purpose of this study was to evaluate the feasibility and the value of TR-CTA of the whole aorta using a 3rd generation dual source CT.
Methods and materials

Patient population: 12 patients who were clinically referred to radiology department for aortic CTA were included in the study. The patients were referred for follow up of aortic aneurysm, or aortic dissection, and had undergone an earlier bi-phase high-pitch dual source CTA within half a year.

Data acquisition: All patients underwent a time-resolved aortic CTA (8 phases, temporal resolution 2.5s/scan, 80kVp, 40 mAs/rot, scan range 63cm, 40mL Ioversol 370mgI/ml and 50mL 0.9% saline, flow rate 5.0mL/s, delay 10s) on a 3rd generation dual source CT scanner with the possibility of bidirectional table movements for dynamic CT imaging (SOMATOM Force, Siemens Medical Solutions, Forchheim, Germany). The bi-phase high-pitch dual-source CTA (80-100kVp, using an automated tube potential selection technique, 35-45mL Ioversol 370mgI/ml and 50mL 0.9% saline, flow rate 3.5-4.5, adapted to tube potential, using a bolus tracking technique, threshold value 100 hounsfield unit) were also undergone on a 3rd generation dual source CT (SOMATOM Force, Siemens Medical Solutions, Forchheim, Germany) within half a year.

Data analysis: The CT dose indices (CTDIs), dose length products (DLP), maximum Hounsfield unit value and standard deviation (SD) were recorded for both TR-CTA and high-pitch CTA in all the patients. Maximum Hounsfield unit value and SD were determined in the ascending aorta. For TR-CTA, the measurement was made in the maximum enhanced phase; for bi-phase high-pitch CTA, the measurement was made in the first phase. The effective radiation dose (ED) were calculated from the DLP, a conversion factor of 0.017mSv/mGy was used [6]. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were also calculated. Subjective diagnostic quality was rated for TR-CTA using a 3-point scale (3, good; 2, adequate; 1 non-diagnostic).

Statistical analysis: All statistical analyses were performed using dedicated software (SSPS 17.0#. ED, maximum Hounsfield unit value, SD, SNR and CNR were compared between the TR-CTA and the bi-phase high-pitch CTA using the Student t test for paired samples. A P value<0.05 was considered statistically significant.
Results

Among 12 patients, 8 patients underwent TR-CTA for follow up of aortic aneurysm, 4 for follow up of dissection. Totally 4 endoleaks were detected. TR-CTA detected 2 endoleaks which were missed in high-pitch dual-source CTA, which were both type II endoleaks. Fig1-4 showed the dynamic filling of a type II endoleak in an 33-year-old female, treated with a stent because of aortic dissection.

Radiation dose: Mean ED of TR-CTA (7.81±0.00mSv) was higher than the bi-phase high-pitch CTA protocols (5.39±2.51mSv; \(P=0.007\)).

Image quality: Maximum Hounsfield values and SD were significantly higher in TR-CTA (657.05±111.64HU and 36.97±8.61HU) than in bi-phase hi-pitch CTA (478.81±111.64HU, \(P=0.000\) and 25.41±7.58HU, \(P=0.015\)). There were no significant differences in SNR or CNR of TR-CTA in compare with bi-phase hi-pitch CTA (\(P>0.05\)).

Subjective diagnostic quality: 75% of the TR-CTA were fully evaluable, whereas 25% were of limited evaluability because of motion artifact of the aortic root. None of the examinations was non-diagnostic.
Fig. 1: Filling of endoleak.

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Fig. 2: Filling of endoleak

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Fig. 3: Filling of endoleak.

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Fig. 4: Flow out of endoleak.

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Conclusion

TR-CTA consisting of whole aorta using a 3rd generation dual source CT can obtain a sufficient image quality with acceptable radiation dose, and is feasible for follow-up of aortic aneurysm and aortic dissection.
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