INITIAL EVALUATION OF CORONARY CT ANGIOGRAPHY IMAGE QUALITY ON THE REVOLUTION CT SYSTEM

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**INTRODUCTION**

CT Perfusion allows for the evaluation of myocardium in particular for the detection of ischemia and infarction. Previous studies have, however, described beam hardening artifacts within the myocardium, which may have an effect on identifying true perfusion defects. Larger or eccentrically located coronary CT scanners have shown promise in reducing myocardial heterogeneity but have been limited by cone beam artifacts and lower gantry rotation speeds. We sought to evaluate the performance of a new volume CT scanner (Revolution CT, GE Healthcare) enabled with novel wide cone reconstruction software (Volume HD reconstruction) and improved temporal resolution with regards to image quality and signal homogeneity.

**METHODS**

**DESIGN AND SETTING**

- **Study Groups**: Prospective enrollment of 24 subjects was performed from May 2013 to November 2013. This study was approved by IRB. All 24 patients provided informed consent. Inclusion criteria were: 18 years or older not requiring acute care, without allergies to iodinated contrast media, and without renal insufficiency. Women less than 60 years of age confirmed to be non-pregnant.
- **All CT acquisitions with the Volumetric CT scan were axially prospectively triggered CTA with different acquisition windows dependent on heart rate. Motion correction software (SnapShot Freez, GE Healthcare) was selectively applied only if motion was present.
- **Patients were given an injection of 60 cc of contrast in the first phase, followed by 20 cc of contrast and 30 cc of saline in the second phase and completed by 50 cc of saline. Effective radiation dose was calculated by multiplying dose-length product with the conversion factor for Cardiac CT examinations (0.034 mSv/100mGy).

**QUANTITATIVE ANALYSIS (SIGNAL INTENSITY, NOISE AND CONTRAST)**

- **The post-processing analyses were performed on an offline three-dimensional workstation. Planar reconstructions of the left ventricular cavity at 5 mm thickness were created. Quantitative measures of image quality were performed in the myocardium, blood pool and aorta. Six Region of Interest (ROI) measurements were made across the myocardium in each of the Volume CT image sets as well as in the 64-slice CT image sets (Figure 1).**
- **An ROI of the myocardial wall was obtained, which ranged between 0.1cm² and 0.2cm². These measurements were made in the following regions: base-anterior, base-inferior, mid-anterior, mid-inferior, apex-anterior, apex-inferior. The same technique was used to assess myocardial blood pool using three ROI measurements made in the left ventricular chamber at the base, mid, and apex of the heart in each of the Volume CT as well as the 64-slice CT image sets.**
- **Unlike the smaller ROIs in the myocardial wall, a larger maximum ROI ranging between 1cm² and 4cm² was utilized to assess the most possible blood pool ROI. Measurements ranging between 1cm² and 2cm² were made in the aorta in each of the Volume CT image sets as well as the 64-slice CT image sets.**

**RESULTS**

- **Heart Rate**: The median heart rate of patients undergoing the Volume CT was 60 bpm ± 10 SD (range=49-86). The median heart rate for patients undergoing the 64-slice CT was 77 bpm ± 6 SD (range=44-85). A statistically significant difference was found in heart rate between the Volume and 64-slice CCTA (p=0.036). Motion correction was applied at the time of the scan acquisition in 11 of 24 subjects. Radiation Dose Volume Effective dose for the Volume CT was 2.06 mSv ± 0.87 (median = 2.00 mSv) and for the 64-slice CT images was 3.79 mSv ± 5.76.
- **Table 5: Signal:Noise-Ratio (SNR) as a median ± standard deviation at the base, mid, and apex of the blood pool and the base anterior, base inferior, mid anterior, mid inferior, and apex anterior of the myocardium between Volume and 64-slice CT. The p value has been calculated and is considered statistically significant if p < 0.05.**

- **Qualitative Analysis**: The measurements of Signal:Noise-Ratio in image quality was observed at a per-patient as well as per segment level. Overall Likert score was 4.5±0.7 and 3.7±1.2 for Volume and 64-slice CT respectively (p=0.001). Significant improvement was observed in multiple segments: signal right coronary artery (RCA), mid right coronary artery (mRCA), mid left anterior descending artery (mLAD), mid left circumflex artery (mLCA), and postero-inferior segment of the left anterior descending artery (PLAD). In terms of image quality, 346 of the 432 segments (80.1%) were classified as having good image quality in the Volume CT image sets, compared to 299 of the 432 segments (69.2%) for the 64-slice CCTA image sets (p < 0.001).

**CONCLUSIONS**

- **CT Perfusion allows for the evaluation of myocardium in particular for the detection of ischemia and infarction. Previous studies have, however, described beam hardening artifacts within the myocardium, which may have an effect on identifying true perfusion defects. Larger or eccentrically located coronary CT scanners have shown promise in reducing myocardial heterogeneity but have been limited by cone beam artifacts and lower gantry rotation speeds. We sought to evaluate the performance of a new volume CT scanner (Revolution CT, GE Healthcare) enabled with novel wide cone reconstruction software (Volume HD reconstruction) and improved temporal resolution with regards to image quality and signal homogeneity.**