Initial Evaluation of Coronary CT Angiography Image Quality on the Revolution CT System

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QUALITATIVE ANALYSIS

- All Volumetric and 64-Slice CTA scans were subjectively evaluated by one experienced Level 3 CTA reader (DM) with 3 years of post-fellowship experience, on an offline workstation (AW 4.3-4.4 Advantage Workstations, GE Healthcare). The CT reader was blinded to the image acquisition protocols. All scans were graded using a modified Likert scale.
- An overall image quality score was assigned to each coronary CTA, which takes into account the degree of calcium density in the coronary arteries and the presence of image noise and motion artifact.
- A separate image quality score was assigned to the coronary arteries on a per-segment basis. Dichotomization of the five-point Likert Scoring system was performed by grouping scores of 1 and 2 into the "Diagnostically non-diagnostic" category and grouping scores of 3, 4, and 5 into the "Diagnostic" category. A Likert score of 1 was non-diagnostic with impaired image quality that precluded appropriate evaluation of the coronary arteries due to severe image noise, or poor signal or had severe motion artifact.

STATISTICAL ANALYSIS

- Analyses were performed using statistical software (SAS version 9.1; SAS Institute, Cary, NC, USA). A statistically significant difference was defined as a p value (two-tailed) less than 0.05.
- Continuous variables were expressed as median ± standard deviation, or quartile ranges. In the quantitative analyses, the median coefficient of variance (CV) and standard deviation of the CV were calculated across all Volume CT images and all 64-slice CT images.
- The difference in the median CV in the blood pool, myocardium, and aorta respectively in the Volume CT and 64-slice CT images was calculated utilizing Mann-Whitney test. Similarly, the median, SI, Noise and SNR in each region of the myocardium and blood pool were calculated.
- Differences in quantitative measures of image quality (Signal Intensity, Noise and SNR) were tested between the Volume and 64-slice CT image sets.

RESULTS

- Heart Rate: The median heart rate of patients undergoing the Volume CT scan was 60 bpm ± 10 SD (range=49-86).
- The median heart rate for patients undergoing 64-slice CT was 75 bpm ± 6 SD (range=64-85). There was a significant difference in heart rate between the Volume and 64-slice CTA (p=0.036). Motion correction was applied at the time of the scan acquisition in 11 of 24 subjects. Radiation Dose Median effective dose for the Volume CT studies was 2.06 mSv ± 0.87 mSv and for the 64-slice CT images was 3.76 mSv ± 5.76.

- Quantitative Analysis: The distributions between the CV in the Volume and 64-slice CTA were significantly different in each of the myocardium (p=0.057), 0.080 ± 0.125 vs 0.138 ± 0.166, p=0.012; blood pool (p=0.016, 0.099 ± 0.024 vs 0.058, 0.047 ± 0.075, p=0.001) and aorta (p=0.013, 0.008 vs 0.019 vs 0.045, 0.033 ± 0.077, p=0.001).
- Measurements of Signal Intensity were not statistically significant in the 64-slice CTA and Volume CTA Descending aorta (mHCA), first Oblique Marginal branch (OM1), distal Circumflex branch (ILC), second Oblique Marginal branch (OM2), p=0.005 (Table 6). 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 CTA 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 voxel-based 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.

INTRODUCTION

METHODS (CONT’D)

RESULTS (CONT’D)

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.