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IMAGE QUALITY AND RADIATION DOSE WITH SINGLE HEART BEAT 320 MULTIDETECTOR CT CORONARY ANGIOGRAPHY

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Introduction CT coronary angiography (CTCA) is widely applied in coronary artery disease. It is therefore important that imaging protocols are optimised to obtain diagnostic images at the lowest possible radiation dose. We aimed to establish the feasibility of single heart-beat imaging in 320-multidetector CTCA, and assess variables that affect image quality.

Methods Consecutive patients (n=249, 38% male) underwent contrast enhanced prospective electrocardiogram-gated single heart-beat CTCA. We assessed images before and after the introduction of sublingual glyceryl trinitrate to the CTCA protocol. Tube current and voltage were selected based on body-mass index (BMI) and acquisition window was selected based on heart rate (70–80% or 30–80% if the heart rate was below or above 65 beats/min respectively). Images were assessed by two trained observers and image quality was graded on a 4-point scale (1, excellent; 4, poor). Obstructive disease was defined as a stenosis of greater than 70% diameter.

Results The mean heart rate was 60 beats/min (95% CI 59 to 62), BMI 29 kg/m^2 (28, 30), age 58 years (56, 59) and dose-length product 283 mGy cm (266, 301). During scanning, 133(51%) received sublingual glyceryl trinitrate (GTN), 9(4%) had ectopic

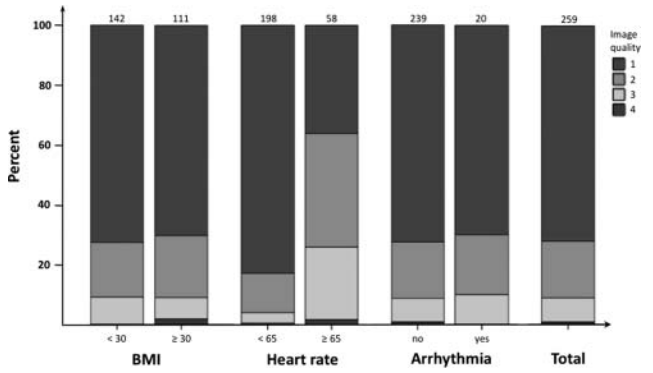

Figure 1 The effect of heart rate, BMI and arrhythmia on the proportion of CTCA with diagnostic image quality.

beats, and 12(5%) had atrial fibrillation. Diagnostic image quality was obtained in 99% with mean image quality 1.4 (1.3, 1.5). For patients with a BMI of 30 or above (n=111) diagnostic image quality was obtained in 109 scans (98%) and excellent image quality was obtained in 78 scans (70%). For patients with a heart rate above 65 bpm (n=58) diagnostic image quality was obtained in 98% (57 scans) and excellent image quality was obtained in 36% (21 scans). The mean dose-length product was 283 mGy cm (266, 301). An increase in heart rate led to an increase in radiation dose to 377 mGy cm (286, 268) for patients with a heart rate of greater than 80 beats/min ($p<0.001$). A higher radiation dose was also associated with a BMI above 30 (DLP 231 (213, 248) vs 353 (330, 377), $p<0.001$) and the presence of arrhythmia (DLP 275 (259, 290) vs 384 (301, 467), p 0.013). Age, sex, atrial fibrillation, ectopics, diabetes mellitus (12%) and the presence of obstructive coronary disease were not related to image quality. In multivariate regression analysis a lower heart rate and GTN were associated with improved image quality (β 0.439, $p<0.001$ and β −0.199, $p=0.001$ respectively).

Conclusions Optimal image quality in single heart-beat 320-multidetector CTCA is achievable at low radiation doses in 99% of unselected patients. Image quality is further improved by lower heart rate and sublingual GTN.

This study has established the use of half-segment reconstruction in all patients undergoing wide volume CTCA irrespective of heart rate, ectopic beats and the presence of atrial fibrillation. A widened window of acquisition can be used to improve image quality in patients with a heart rate greater than 65 beats per minute. In addition we have established that the use of GTN improves image quality in 320 multidetector CTCA.