Imaging Technique, Radiation Dose and Image Noise: CT Acquisition for Noninvasive 3D Cardiac Mapping Using the CardioInsight System

Toral Patel  
Patrick Norton  
Elona Rrapo Kaso  
Anna Lam  
Klaus Hagspiel  
Kenneth Bilchick  
Pamela Mason  
Rohit Malhotra  
Nishaki Mehta  
Andrew Darby  
Mike Mangrum

Introduction: Noninvasive 3D cardiac mapping, CardioInsight™ Cardiac Mapping System, (Medtronic, Inc. Minneapolis, MN) requires the patient to wear a multi-electrode vest and then undergo a CT from the neck through the abdomen in order to spatially locate each vest electrode and relate it to the cardiac surface. Vest size (S, M, L, XL) is matched to patient's weight and height. Objective: To compare two different CT techniques and their associated radiation doses and image noise for patients undergoing 3D cardiac mapping.

Methods: Fifty-three patients (age range 19-84, male 57%) underwent CT prior to mapping using either a dual-source CT with an automatic kVp selection (120 or 100) protocol or a single-source CT with a fixed 120 kVp protocol. Effective dose measurements were calculated using Radimetrics (Bayer Healthcare, LLC. Whippany, NJ). Imaging noise was measured as standard deviation of CT density of the air anterior to the chest. T-test was used to compare means for significant differences.

Result: Fifty-three CT exams were performed with a mean effective dose of 9.3 mSv (±2.2) and mean image noise 8.7 (±2.9). Twenty of 53 exams were performed using an automatic kVp selection CT protocol with a mean effective dose and image noise of 8.3 (±2.0) mSv and 6.7 (±1.6). Fourteen of the 20 exams selected 100 kVp. Mean values for 100kVp vs 120 kVp selection groups: body mass index 28.1 (±4.8) vs 36.8 (±9.2) kg/m2, body surface area 2.0 (±0.2) vs 2.3 (±0.3) m2, effective dose 7.5 (±1.2) vs 10.2 (±2.4) mSv [p<0.04], and image noise 6.1 (±0.9) vs 8.5 (±1.8) [p<0.02]. Thirty-three of 53 exams were performed with a fixed 120 kVp CT protocol. Mean effective dose and image noise was 9.8 (±2.2) mSv and 9.3 (±3.2). Comparing automatic kVp selection protocol vs fixed 120 kVp protocol, there is significantly less effective dose (p<0.01) and less image noise (p<0.001) despite similar BSA and BMI between groups. There was no significant difference between effective doses based on vest size.

Conclusion: Employing an automatic kVp selection protocol when performing CT imaging prior to 3D cardiac mapping results in significant reduction in effective radiation dose and image noise as compared to a fixed kVp protocol.