

Auto-contouring at 90° dual head fitting angle: A potential cause of a myocardial perfusion SPET artifact in slim patients

To the Editor: Artifacts in cardiac single photon emission computed tomography (SPET), leading to misinterpretation of reconstructed perfusion images, could be generally considered in two main categories: Camera based and activity based artifacts. The SPET artifacts due to flood non-uniformity, center of rotation (COR) offset, non-linearity of the detector, flaws in collimator construction, mechanical inaccuracy of the gantry and reconstruction errors are considered camera based artifacts. Patient motion, extra-cardiac activity, diaphragm, breast and lateral chest wall attenuation are activity based artifacts. The varying distance from the source of activity (the heart) to the detector during a body-contour noncircular orbit or out of COR in circular orbit can create serious artifacts on SPET images because of varying spatial resolution [1-6]. Image truncation artifacts are known to occur on images using camera systems with convergent-beam collimations [7]. No published report involving image truncation in myocardial perfusion SPET (MPS) imaging using parallel beam collimation could be found by reviewing the current related literature.

In this letter, we describe a specific patient-detector configuration in which a serious truncation artifact occurs during the use of parallel beam collimation in MPS. A congress presentation concerning this issue was already held by the authors of this communication [8].

During auto-contoured acquisitions with 90 degree angled double detectors, it is possible to partially miss the cardiac activity in skinny patients with flat anterior body con-

tours. This acquisition geometry occurs when the upper positioned detector comes extremely close to patient's flat chest wall and the laterally positioned detector becomes unable to fully cover the cardiac area due to its extra-lowered position. Thus, the heart enters partly in a narrow, un-visualized gap in a non-negligible number of SPET projections. This handicap can be overcome by placing a pillow or folded blanket on the abdomen and thickening the patient artificially (Fig.1 A-E).

As an example, we present a 16 years old girl who referred to us for stress myocardial perfusion imaging to evaluate atypical chest pain for 2 months. She had no clinical history of any disease and her cardiac examination was totally normal. She was a zero size, slim person with flat anterior body contour. She underwent a single-day myocardial rest/stress perfusion study, receiving 296MBq of technetium-99m methoxy isobutyl isonitrile (^{99m}Tc -MIBI) for rest imaging acquisition and 888MBq for stress imaging. SPET imaging was performed in auto-contour non-circular mode with a variable angle dual-head camera (Siemens, E-CAM Dual Head, Germany) equipped with low-energy, high-resolution, parallel-hole collimators fitted at 90°. A 15% energy window centered on the 140keV photo peak was used. Projection images were acquired in 64X64 matrix using steps of 3° over 180° from the 45° right anterior oblique to 45° left posterior oblique position. The data were reconstructed using the filtered back-projection algorithm (Butterworth filter, cutoff: 0.55cyc/cm; order: 5). Since the problem of image truncation in skinny patients was

well known in our department, a folded blanket was placed on patient's abdomen for rest imaging. Two successive stress acquisitions, without (Stress-1) and with (Stress-2) artificial thickening, were performed for illustrative purposes. The raw data of Stress-1 images was evaluated for a possible truncation of cardiac activity revealing temporary incomplete visualization of cardiac activity between frames of 49 to 64, acquired by the lower positioned detector (Fig. 2). The following acquisition (Stress-2) resulted in complete cardiac visualization (Fig. 3 and 4).

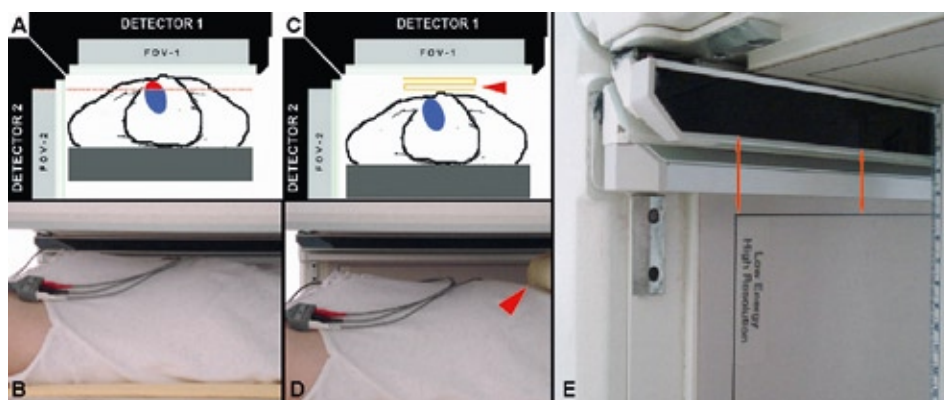


Figure 1. Illustration of the slim patient / detector positions causing the target truncation (A,B) and the practical solution (C,D). Note the positioning of the yellow blanket (C,D) on the abdomen (arrow heads). The technically unavoidable gap for the FOV 2 of detector 2 (above the dotted red line, A) in 90° angled position of the detectors is marked with red arrows (E). In our system, the width of this gap measures approx. 2.5cm (Note the ruler on the right side of the image E). Optical sensor barriers are presented as green bars and the heart as an ellipsoid in blue. Truncated part is illustrated in red.

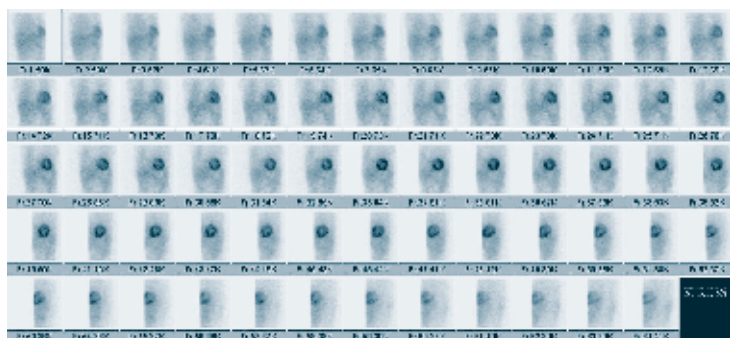


Figure 2. Raw ^{99m}Tc -MIBI SPET images obtained without artificial thickening of the patient, demonstrating truncation of the apical part of cardiac activity in frames 49 to 64 acquired by detector 2.

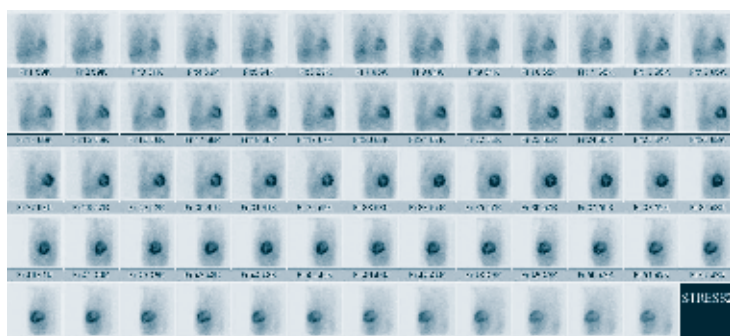


Figure 3. Raw ^{99m}Tc -MIBI SPET images acquired with a folded blanket on patient's abdomen showing complete visualization of cardiac activity.

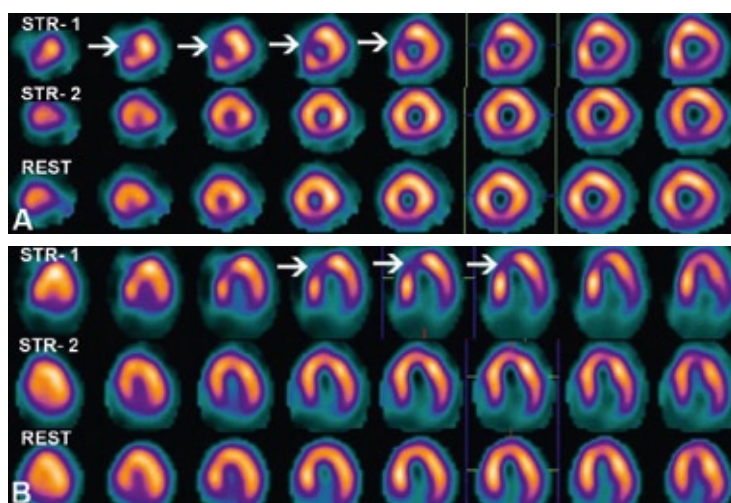


Figure 4. Processed SPET images of the patient: (A) Short axis images, (B) vertical long axis images (from top to bottom) at stress without artificial thickening, at stress with thickening and at rest with thickening. Arrows indicate appearance of perfusion defects at anteroapical and anteroseptal walls without artificial thickening.

Although auto-contouring serves in general for reliable MPS in dual head systems, upon our clinical experience and experimental work [8], anteroapical and anteroseptal wall defects in slim patients with flat anterior body contours may be occasionally observed. As described above and in Figure 1, this artifact defect is due to a technically unavoidable "blind" gap that can occur temporarily in a SPET dual head sys-

tem in 90° fitting angle position. In perfusion SPET imaging of such patients, we strongly recommend to place a relatively thin pillow or a folded blanket on patient's abdomen, to avoid any truncation of cardiac activity. When determining the necessary patient to upper detector distance for a reliable acquisition, the most practical approach seems to check laterally the patient's flat anterior body contour (see Figure 1, B-D) in relation to the upper detector in its absolute horizontal position and the field of view (FOV) of the lower detector. Using pillows thicker than necessary would result in an unnecessary increase in patient-to-upper detector distance meaning a loss of image quality.

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