Major Upward Creep of the Heart During Exercise Thallium-201 Myocardial SPECT in a Patient with Chronic Obstructive Pulmonary Disease

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We report on a patient in whom we observed an unusually important upward creep of the heart on postexercise ^{201}Tl tomographic acquisition. When uncorrected, this led to reconstruction of grossly abnormal tomograms, which were normal after correction of upward creep of the heart. This phenomenon may be related to the patient's history of chronic obstructive pulmonary disease. Special attention should be given to upward creep artifact in such pulmonary diseases.

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Upward creep of the heart during exercise ^{201}Tl myocardial SPECT acquisition is a well known source of artifact on reconstructed tomograms (*1–5*). Previous studies reported that it could reach 3 pixels (*2,4*). We report a case in which we observed an 8-pixel upward creep of the heart.

CASE REPORT

A 71-yr-old male was referred for routine exercise ^{201}Tl myocardial SPECT for suspicion of coronary artery disease. He had a history of chronic obstructive pulmonary disease (COPD) and experienced atypical chest pain. ECG at rest showed right bundle branch block. His blood pressure and heart rate at rest was 150/80 mmHg, 80 bpm, respectively.

The patient underwent bicycle ergometric exercise. Heart rate and blood pressure rapidly and significantly increased during exercise (Table 1). Exercise lasted 6 min and was stopped because of fatigue, at which time heart rate reached to 94% of the predicted maximal. A dose of 74 MBq ^{201}Tl was intravenously injected 1 min before the completion of exercise. At 3 min following exercise, blood pressure was 165/70 mmHg and heart rate was 105 bpm. No ischemic ECG change was found during exercise.

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Immediate imaging was started within 5 min and delayed imaging with reinjection 4 hr later. Tomographic projections were acquired over a 180° arc starting at 45° left posterior oblique position with 32 steps of 30 sec per step. The tomograms were reconstructed by standard filtered backprojection algorithm. Maximal upward creep of the heart of 8 pixels was found between the first and last postexercise projections (Fig. 1). The correction of upward creep was performed using a linear fitting method as previously described (*4*).

When immediate postexercise oblique slices were reconstructed from the raw projections, horizontal long-axis tomograms (Fig. 2) showed a significant apical defect, short-axis tomograms (Fig. 3) showed anterior and inferior defects, and the right ventricle was not well visualized. Vertical long-axis tomograms (Fig. 4) were completely distorted and the myocardium was not clearly seen. On the oblique angle tomograms reconstructed from corrected projections, activity distribution of left ventricle was homogeneous and right ventricle was clearly visualized (Figs. 2–4). There was no upward creep on the delayed acquisitions, and delayed imaging showed normal activity distribution of left ventricle (Figs. 2–4).

DISCUSSION

In 102 unselected patients, Friedman et al. (*2*) found that 30 patients had an upward creep of two or more pixels, 22 had an upward creep of 1 pixel, and 50 had no upward creep. Of 45 patients with a less than 5% likelihood of coronary artery disease, they found that 17 patients (38%) had an upward creep of two or more pixels. Of

TABLE 1
Heart Rate and Blood Pressure at Rest and During Exercise

	Heart rate (bpm)	Blood pressure (mmHg)
Baseline	80	150/80
Exercise		
3 min	95	170/70
6 min	140	210/90
Following exercise		
1 min	130	200/70
3 min	105	165/70

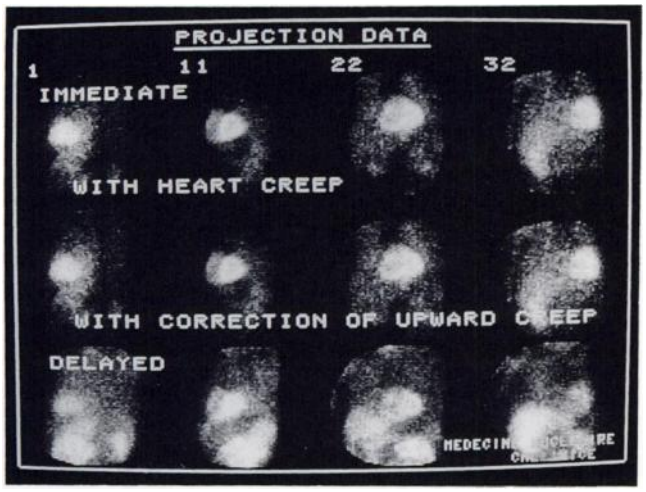

FIGURE 1. Acquired projections. (Top) Postexercise imaging showing an upward creep of the heart. (Middle) Postexercise imaging after correction of upward creep. (Bottom) Delayed imaging.

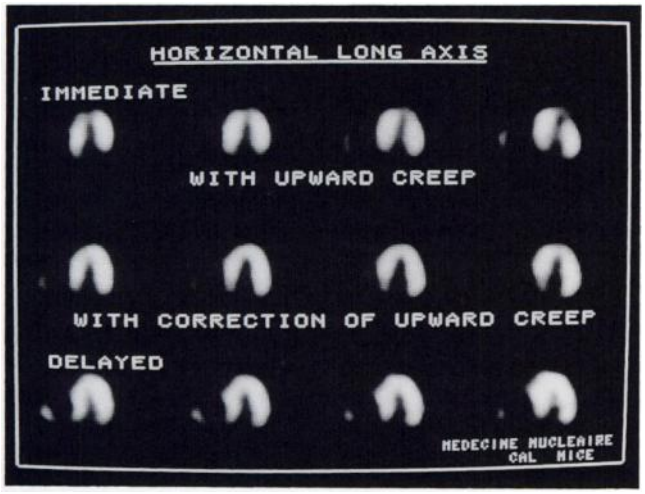

FIGURE 2. Four contiguous horizontal long-axis slices. (Top) Postexercise uncorrected projections. (Middle) Postexercise corrected projections. (Bottom) Delayed imaging.

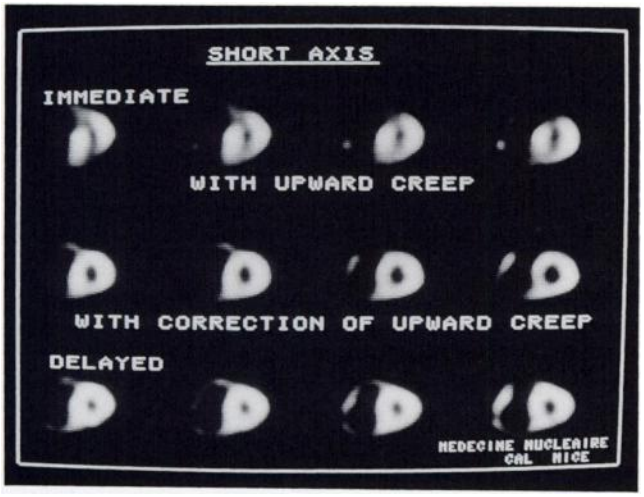

FIGURE 3. Four contiguous short-axis slices. (Top) Postexercise uncorrected projections. (Middle) Postexercise corrected projections. (Bottom) Delayed imaging.

FIGURE 4. Four contiguous vertical long-axis slices. (Top) Postexercise uncorrected projections. (Middle) Postexercise corrected projections. (Bottom) Delayed imaging.

these, nine had a reversible perfusion defect localized in the inferior and basal inferoseptal walls. In a series of 100 consecutive, supine ergometric exercise studies, Mester et al. (*4*) found 1, 2 and 3 or more pixels of upward creep in 16, 4 and 3 patients, respectively. They observed that an upward creep of at least 2 pixels (7/100) led to evident, mostly anteroseptal defects on quantitative bull's-eyes, and that an upward creep of 3 pixels or more (3/100) produced false-positive diagnostic results. Upward creep of the heart during exercise ^{201}Tl myocardial SPECT results from the change of the depth of respiration and diaphragmatic flattening.

The major upward creep observed in our case can be related to COPD. Chronic obstruction of the pulmonary airways leads to a decreased reserve of respiratory functions. In response to increased oxygen demand during exercise, breathing frequency and the depth of respiration significantly increases, especially diaphragmatic movements. These changes slowly recover following exercise even if the oxygen demand normalizes. These phenomena may be responsible for an unusually important postexercise upward creep of the heart. Heart creep during exercise ^{201}Tl myocardial tomography can lead to significantly artifacted reversible perfusion defects, which might be more significant in COPD patients.

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