Letters to the Editor

Effect of Delay in Imaging

TO THE EDITOR: The recent article by Rothendler and his co-workers (*1*) makes the important point that excessive delay may reduce the sensitivity of Thallium-201 (^{201}Tl) scintigraphy, but it is also susceptible to overinterpretation. The optimal time for imaging occurs when the ratio of activity in normally perfused myocardium to that in hypoperfused muscle is maximal, after clearance of the radiotracer from the blood is sufficient to yield an acceptable target to background ratio. This ideal time reflects an interplay between the attainment of peak activity in normal myocardium and the clearance (or delayed uptake) rates in normal and ischemic regions and obviously will vary among individuals.

Several experimental studies have indicated that peak myocardial activity occurs from 10-40 min after injection (*2,3*). The blood-pool ^{201}Tl concentration reaches a relatively stable nadir after 5-10 min (*3-4*). Clearance rates are determined by the initial tissue radiotracer activity, the subsequent myocardial blood flow, and the time course of ^{201}Tl activity in blood (*2-5*). Important variables which will affect the blood clearance rate and, hence, the optimal imaging time include the level of work performed by skeletal muscle and the interval between the radiotracer injection and the cessation of exercise (*4,6*).

The authors have not provided us with the information necessary to determine the relation between the 2 min-2 hr and 18 min-2-hr reading differences and the duration of exercise or workload achieved or with the timing of the injection relative to the termination of stress. These data might help identify a subset of patients in need of immediate imaging. Most importantly, this study did not examine the sensitivity of scintigraphy performed 10 min postexercise, an interval that our experience and that of others (*7*) suggests is satisfactory and also permits safe monitoring in an exercise laboratory in the vicinity of the imaging suite. Furthermore, the use of the more usual 3-4-hr interval before the delayed images may have minimized the differences between the two initial imaging times. These types of information are essential before the need for immediate postexercise imaging, which would necessitate a combined scintigraphic-exercise suite with attendant additional cost and inconvenience in many institutions, can be assessed.

Rothendler's findings raise one additional point which is not discussed in the manuscript but is relevant whatever the optimal imaging time may be. The dynamic pattern of regional ^{201}Tl distribution in the early post-exercise period may profoundly affect single photon emission computed tomography images, since the reconstruction algorithms assume a stable target. This is an important area for future investigation.

References

1. Rothendler JA, Okada RD, Wilson RA, et al: Effect of a delay in commencing imaging on the ability to detect transient thallium defects. *J Nucl Med* 26:880–883, 1985
2. Okada RD, Leppo JH, Strauss HW, et al: Mechanisms and time course for the disappearance of thallium-201 defects at rest in dogs. Relation of time to peak activity to myocardial blood flow. *Am J Cardiol* 49:699–706, 1982
3. Nishiyama H, Adolph RJ, Gabel M, et al: The effect of coronary flow on thallium-201 uptake and washout. *Circulation* 65:534–542, 1982
4. Patterson RE, Halgash DA, Horowitz SF, et al: Physiological influence on perfusion imaging in transient myocardial ischaemia: Importance of early distribution of thallium-201. *Cardiovasc Res* 16:47–54, 1982
5. Grunwald AM, Watson DD, Holzgrefe HH, Jr., et al: Myocardial thallium-201 kinetics in normal and ischemic myocardium. *Circulation* 64:610–618, 1981
6. Massie BM, Wisneski J, Kramer B, et al: Differences in myocardial thallium-201 washout following maximal and submaximal exercise. Implications or diagnosis of coronary disease. *J Nucl Med* 23:381–385, 1982
7. Pohost GM, Zir LM, Moore RH, et al: Differentiation of transiently ischemic from infarcted myocardium by serial imaging after a single dose of thallium-201. *Circulation* 55:294–302, 1977

Barry Massie
University of California
San Francisco, California

Wangden Carson
Nigel Soper
John Radcliffe Hospital
University of Oxford
Oxford, UK

REPLY: We thank Drs. Massie, Carson, and Soper for their interest in our article. We agree that the relationship between activity in normal compared with ischemic myocardium and the target to background ratio are complex functions of time and differ from patient to patient. We disagree, however, with some of the conclusions concerning early imaging which were presented in the letter.

Due to the high thallium extraction fraction of the myocardium and other organs, the level of thallium-201 (^{201}Tl) in the blood falls very quickly after injection. Investigations in animals at rest have shown that activity decreases to a value of ~10–15% of its peak within 3 min after injection (*1,2*), with some additional fall to 5–10% of peak at 5-10 min. Due to a shorter circulation time, blood levels following injection at peak exercise might be expected to fall even more rapidly.

While "peak" myocardial ^{201}Tl activity has been found to occur in normal zones 10-40 min after injection (*3*), more than 90% of this peak occurs by the end of the first minute. Again, these experiments were in anesthetized animals at rest, and thallium activity would be likely to peak more quickly with exercise, as suggested by studies during reactive hyperemia (*1*) and norepinephrine infusion (*4*). In the latter study, peak myocardial ^{201}Tl occurred 1–2 min after injection.

Since, as indicated in the article, the ^{201}Tl was injected ~60 sec prior to cessation of exercise, the "2-minute" set of images was begun 3 min after injection. Based on ^{201}Tl kinetics in animal models, we felt that this would not be "too early," especially since the data collection for each view extends over 6 min, ending 9 min after injection for the first view. The empiric observation that there was a significant gain in sensi-