Regional Thallium Uptake in Irreversible Defects

In their recent article about stress thallium imaging to assess myocardial viability, Dilisizian et al.\textsuperscript{1} make the important point that most mild-to-moderate irreversible defects (on either redistribution or reinjection images) represent viable myocardium. This group reached a similar conclusion in a previous article in \textit{Circulation}.\textsuperscript{2} In the more recent article, the authors used a measurement of “differential uptake” of $^{201}$TI from redistribution to reinjection, as well as $^{18}$F-fluorodeoxyglucose uptake in a subgroup, as confirmatory evidence of viability. They proposed that a differential uptake $>50\%$ of the normal region might be useful as a criterion of viability in irreversible defects on redistribution images. There were some problems, however, with their calculations of differential uptake in irreversible defects. First, the number of defects appeared to proliferate from the overall group of 150 patients, who had 175 irreversible defects, to the smaller subgroup of 15 patients who had PET studies, in whom 169 irreversible defects were found. In the PET subgroup, 11\% of mild-to-moderate defects had differential uptake $<50\%$, whereas in the overall group with mild-to-moderate defects (Figure 3), no patient had differential uptake $<53\%$. In addition, the definition of a defect was based on different criteria for the two groups: A normal subject range was used for the 150 patients, while a criterion of $<85\%$ of the region with maximum counts was used for the 15-patient subgroup.

Many laboratories now use reinjection before delayed imaging as a routine, so a measure of differential uptake is not possible. An additional problem that this group has previously noted is apparent worsening of a defect from redistribution to reinjection, which occurs in 10\% of defects\textsuperscript{3} and could result in a defect appearing irreversible on the reinjection image but reversible on the redistribution image. This phenomenon has also been ascribed to differential uptake.\textsuperscript{3} In our own study,\textsuperscript{4} 11\% of patients having both redistribution and reinjection studies showed at least one defect apparently irreversible on reinjection images but reversible on redistribution images. This problem was not addressed in the most recent article.\textsuperscript{1}

The authors’ conclusion that a high ($>50\%$) differential uptake of thallium after reinjection at rest is a marker of viability is probably correct, but essentially this is a measure of uptake of isotope under resting conditions. The information might better be obtained by measuring uptake in a single rest image.

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References

Reply
In reply to Dr. Freedman’s first question, the apparently large number of irreversible thallium defects in the subgroup of 15 patients who had positron emission tomography (PET) studies compared with the overall group of 150 patients relates to the different methods of analysis used in the two patient groups. For the overall group, thallium activity was assessed in four myocardial regions (anterior, septal, inferior, and lateral) per patient, obtained from short-axis tomograms using a semiautomatic quantitative circumferential profile. This is clearly stated in the “Methods” section under “Quantitative Thallium Analysis.”\textsuperscript{1} Because PET images in the subgroup of 15 patients were acquired in the transaxial view, the three sets of thallium images representing the stress, redistribution, and reinjection studies in each patient were aligned in the transaxial view for direct comparison. Relative regional $^{18}$F-fluorodeoxyglucose uptake and thallium activity were assessed in five myocardial regions drawn from corresponding transaxial tomograms: posterolateral, anterolateral, anteroseptal, and posteroseptal myocardium. Multiple corresponding myocardial slices from the PET and SPECT data were then analyzed for each patient, with an average of 29 regions (from six tomographic planes) evaluated per patient. This is also stated in the “Results” section under “Comparison of Differential Uptake With Metabolic Activity by PET.”\textsuperscript{1} Therefore, Dr. Freedman’s second question regarding the different percentage of mild-to-moderate defects having differential uptake of $<50\%$ (11\% for the PET subgroup versus 0\% for the overall group) should not come as a surprise, because different anatomic regions were assessed in the overall group and the PET subgroup. The third question relates to the definition of a thallium defect. For the overall group, a myocardial region was considered abnormal if the thallium uptake on the stress image was $>2 \text{ SD}$ below the mean observed in the same region for normal volunteers of the same sex. Because the PET subgroup was assessed in the transaxial view, comparison with a normal data base in this orientation was not available. Thus, in keeping with our previous publication,\textsuperscript{2} a myocardial region with thallium activity of $<85\%$ of the region exhibiting the maximal activity over the entire myocardium was defined to be abnormal.

We realize that many laboratories have adopted the routine practice of performing reinjection imaging instead of 3–4-hour redistribution imaging. However, we have never advocated the elimination of redistribution images. In our original article,\textsuperscript{3} we reported that approximately 10\% of thallium defects on stress images develop apparent thallium washout after reinjection of thallium. The reason the subject of apparent thallium washout was not discussed again in the article in question\textsuperscript{4} is that the aim of this study was different. The differential uptake ratio in this article was used to demonstrate that not all irreversible thallium defects connote scarred myocardium. We specifically addressed the issue of apparent thallium washout in a subsequent article involving a different series of patients,\textsuperscript{4} in which 8\% of thallium defects identified on stress images demonstrated apparent thallium washout after reinjection because of low differential uptake of the tracer. These regions represented 25\% of myocardial regions that were reversible on 3–4-hour redistribution and would have been
Regional thallium uptake in irreversible defects.
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