Presidential Speech

Objective Evaluation of Tl-201 Image Efficacy for Detection of Myocardial Infarction: Report of Cooperative Research Group

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Two major factors influencing the diagnostic accuracy of Tl-201 myocardial images concern the imaging method and the visual image interpretation of observer. This cooperative study was designed to investigate the degree of inter- and intra-observer variation in interpreting the images, and to increase the objectivity of Tl-201 myocardial imaging.

Three hundred forty three cases of Tl-201 myocardial images were retrospectively collected from 7 medical institutions. The cases were 252 males and 91 females ranging from 2 to 92 years old. Of 343, 12 were autopsy cases including 8 infarct positive and 4 negative cases. With respect to myocardial infarction, clinical diagnoses based on clinical history, serum enzyme change, and ECG, etc. were made that 152 cases were definitely present, 34 cases equivocal, and 157 cases not present.

A series of the Tl-201 images consiting of at least three standard views recorded on X-ray film: ANT, LAO and LLAT, for all cases were independently interpreted by 13 experienced observers from the institutions. ECG taken at the time as Tl-201 imaging and that at oncet of myocardial infarction, if available, were read again by 4 cardiologists, and the final diagnoses were made by their majority decision.

The Tl-201 images were interpreted in two days with an average speed of 30 cases per hour following the report form previously designed. Two runs of interpretation were conducted: the first run was made without any knowledge of the patient's clinical data which include ECG, etc., and the second run with the use of the clinical data, but one month after the first run. Each observer did not read the images submitted from his own institution, since he may remember the diagnoses of his own cases.

The response of an observer to given images consisted of the following 4 confidence rating: definitive negative, probably negative, probably positive, and definitive positive, as well as responses for the location and size of infarction. The clinical data and all observer responses were later punched onto computer cards for processing. Results were expressed as Receiver Operating Characteristic (ROC) curves determined by plotting the true positive rate (TPR) and false positive rate (FPR) in per cent.

The ROC curves obtained with the first run showed that the inter-observer variability was quite acceptable, and comparable with that obtained for the interpretation of liver scans. An average

ROC curve of 13 observers passed through points at TPR of 44.6% and FPR of 2.5%, at TPR of 69.5% and FPR of 14.0%, and at TPR of 84.9% and FPR of 38.6%. The ROC curves obtained with the second run were shiftted toward an upper left-hand corner, meaning that the diagnostic efficacy of Tl-201 myocardial image interpretation was markedly improved by giving the clinical data. The second run curves showed much smaller inter-observer valiability. The average curve passed through points at TPR of 62.7% and FPR of 2.8%, at TPR of 83.4% and FPR of 8.1%, and at TPR of 93.2% and FPR of 28.9%.

It was interesting to note that inter-observer variation in the ROC curves was much smaller than inter-institutional variation. This fact indicated that display method and image quality significantly affected on the diagnostic efficacy of Tl-201 imaging and suggested that some opitum imaging method might exist.

Sensitivity, specificity and efficiency for the Tl-201 imaging for the detection of myocardial infarction were also determined, and it was found that the addition of the clinical data at the time of interpretation of the images increased these indices.

The Tl-201 image showed reasonable correlation with the electrocardiographic location of infarction, and excellent correlation existed for anterior, septal and inferior location. The scintigraphic diagnoses of lateral and posterior infarctions were difficult without knowledge of the clinical data. Much better correlation between electrocardiographic and scintigraphic locations was observed for the all locations, when image interpretation was made with the use of clinical data.

To facilitate estimation of infarct location more precisely, each of the images of 114 cases with both myocardial infarction and positive image finding for all projections was divided into 8 nonoberlapping subareas. A correlative study was performed between subarea hypoperfusion and ECG finding. The cases with anterior infarction on the ECG displayed hypoperfusion in No. 5, 6 subareas of LLAT projection and in No. 3, 4 subareas of RAO projection. The cases with septal infarction and lateral infarction displayed hypoperfusion in No. 5–8 subareas of ANT and LAO projections, and in No. 3, 4 subareas of ANT and LAO projections respectively.

The Tl-201 image defect size was compared to the size estimated by ECG and that on the basis of serum enzyme release. In this study a statistically meaningful correlation between them was not confirmed, but further studies will be necessary before making any conclusion.

The method used in this study was very effective in evaluating retrospectively the diagnostic efficacy of Tl-201 myocardial imaging. One drawback of this type of study was the limitation in number of cases to be interpreted. Another problem was that we did not know the true confirmed diagnosis on myocardial infarction except 12 autopsy cases. The ROC analysis had to be performed under assumption that the diagnosis made by majority decision of 4 cardiologists was for the presence of myocardial infarction.

It encouraged us to note that there was acceptable variability among the 13 observers, varying in their experience in reading Tl-201 myocardial images. In 12 cases with complete left bundle branch block, or pace maker rhythm, the ECG diagnosis was impossible and Tl-201 myocardial imaging was very helpful. It was concluded that Tl-201 myocardial imaging together with clinical data was quite efficacious in detection and localizing myocardial infarction.

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