

Non-invasive Diagnosis for Intermittent Claudication using 201 Thallium Chloride

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Occlusive circulatory disorder for lower extremity causes intermittent claudication, which suggests insufficient blood supply for increased demand of exercising muscle of the leg by walking. However, there is no means to evaluate this state objectively. Recently 201 Thallium chloride (201 Tl) has been introduced as myocardial perfusion imaging agent, which has made possible to visualize myocardial ischemia non-invasively by intravenous administration. Present attempt was to apply this substance to visualize peripheral blood flow distribution of lower extremity and to establish quantitative assessment of the intermittent claudication.

According to the indicator fractionation principle, potassium analogue tracer substances like 201 Tl deposit in peripheral organs soon after intravenous injection mainly dependent upon blood flow distribution, because of its high extraction efficiency at its earlier passage through each organ. In order to validate this fact, we primarily attempted to compare depositional radioactivities of 201 Tl at each segment of the lower extremity with those of ¹³¹I MAA on intraarterial introduction, as a capillary blockages. A fairly well correlation was found between these distribution ($r=0.947$).

After 1-2 mCi of 201 Tl Cl as a bolus was introduced via antecubital vein with or without exercise loading, distribution of this tracer throughout body was scanned using a whole body scanner and stored into storage system for further analysis. Exercise loading was done using treadmill at a rate of 40 m/min more than one kilometer. Segmental deposition of the tracer at thigh, calf and foot, respectively, was expressed as a fractional percentage of total radioactivity, which was assumed to be the fractional blood supply of cardiac output for each segment according to the indicator fractionation principle.

Reproducibility of the present method was 1.01 ± 0.12 , and hence, more than 10% increase on

exercise loading may be significant change. In ten normal controls, the fractional blood flow for thigh at rest was $3.25 \pm 0.82\%$ and $10.69 \pm 2.30\%$ on exercise, that for calf was $1.64 \pm 0.45\%$ at rest and $6.05 \pm 0.64\%$ on exercise, and that for foot was 0.50 ± 0.20 at rest and $0.74 \pm 0.25\%$ on exercise. More than three times increase of the fractional blood flow after the loading was evident concerning total leg of these control group ($6.13 \pm 1.28\%$ at rest to $17.6 \pm 2.04\%$ on exercise). In fifteen patients with arteriosclerosis obliterans, the fractional blood flow for diseased thigh was $2.68 \pm 0.41\%$ at rest and $6.54 \pm 0.88\%$ on exercise, that for diseased calf was $1.22 \pm 0.31\%$ at rest $4.09 \pm 0.58\%$ on exercise, and that for foot was 0.52 ± 0.19 at rest and $0.59 \pm 0.15\%$ on exercise. Significant decrease of blood flow supply for increased demand on exercise loading concerning the total leg in compared to the normal controls was evident ($p < 0.001$) ($4.42 \pm 0.42\%$ at rest to $11.95 \pm 1.36\%$ on exercise). In twelve patients with thromboangitis obliterans, the fractional blood flow for diseased thigh was $3.18 \pm 0.74\%$ at rest and $7.22 \pm 1.20\%$ on exercise, that for diseased calf was $1.44 \pm 0.40\%$ at rest and $4.61 \pm 0.54\%$ on exercise, and that for diseased foot was $0.43 \pm 0.08\%$ at rest and $0.67 \pm 0.12\%$ on exercise. Significant decrease of exercise response concerning the total leg was also evident in compared to the normal controls ($p < 0.001$) ($5.06 \pm 1.12\%$ at rest to $13.10 \pm 1.55\%$ on exercise).

On reviewing distribution images, a defect was well correlated with the site of intermittent claudication as well as angiographic finding and emerged up clearly by exercise loading. In case with severely ill patient who could not walk, distribution image revealed decreased homogenous one, probably representing merely skin flow without any muscle flow. In such cases with ulcer, localized deposition on this site were noted, if it had healing tendency.

Since present method is proved to be reliable

and easily applicable even during exercise loading, it is expected to be useful means for quantitative

assessment of intermittent claudication as well as its distribution image of blood flow supply.

Thallium-201 Myocardial Imaging: Morphological Evaluation of Various Heart Diseases

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Thallium-201 (Tl) myocardial scintigraphy was performed in patients with various heart diseases to evaluate their characteristics in morphology.

They were 105 patients (10 normal, 23 congenital heart disease, 33 valvular heart disease, 17 primary myocardial disease, and 22 other various cardio-pulmonary diseases). Coronary artery disease was excluded in this study. Cardiac catheterization was performed in 67/105 patients. Myocardial imaging was performed at rest 10 minutes after intravenous injection of 2 mCi of Tl. Images were obtained with a Toshiba GCA-202 scintillation camera, using a low-energy high-resolution parallel hole collimator. A 30% window centered on the mercury X-ray peak was used. A complete five projection study was performed with the detector placed in the anterior, left anterior oblique 30°, 45°, 60°, and left lateral projections.

Patients with ventricular overloading revealed characteristic myocardial images. In patients with left ventricular (LV) volume overloading, such as aortic regurgitation, LV myocardial image was enlarged and increased in R.I. activity, suggesting LV enlargement and hypertrophy. In patients with decreased LV contraction, the LV cavity was seen clearly, but that in patients with increased ejection fraction was not identified. In patients with LV pressure overloading, such as aortic stenosis, LV myocardial image was normal in size, though its R.I. activity was highly increased, indicating con-

centric hypertrophy of LV.

In patients with right ventricular (RV) volume overloading, such as a trial septal defect, RV free wall was visualized with dilated cavity, and LV image was small and interventricular septum was convex to the RV cavity. In patients with RV pressure overloading, such as primary pulmonary hypertension, mitral stenosis and pulmonary stenosis, RV free wall was clearly visualized. The septum was straight in appearance. In patients with Eisenmenger syndrome, ventricular septal image was straight in appearance with enlarged RV cavity and increased R.I. activity of RV free wall.

The images of RV free wall were graded in 4 degrees with its concentration of tracer, according to Cohen's criteria. RV free wall activity was increased, related with RV systolic pressure ($P < 0.05$). RV stroke work index was higher in patients with RV visualization (RVV), than in patients without RVV ($P < 0.05$). Higher stroke work accompanies increased coronary blood flow. Tl given via intravenous route distributes in the myocardium in proportion to coronary blood flow. Therefore, RVV does not always suggest RV hypertrophy, but in some cases, reflects only RV overloading.

In conclusion, Tl myocardial scintigraphy is a useful non-invasive technique to evaluate ventricular overloading. Images particularly reflect the type and the degree of RV overloading.