In order to investigate the redistribution of muscle perfusion in the lower extremities, early and delayed scintigrams were performed in 35 normal subjects at rest (n=18) and during exercise using ergometer (n=10) and treadmill (n=7).

The ratio of early count for thigh and calf to whole body and D (that of delayed count for them to whole body) were calculated in all subjects and we obtained the relation between D/E (the redistribution ratio) and E. The relation between D/E and E was found to be the hyperbola Y(D/E)=0.75+3.4/E(X/E) in the thigh, Y(D/E)=0.70+1.8/E(X/E) in the calf. The curves of D/E vs E in normal subjects were expected to be one of the indices for prognosis of the patients with peripheral vascular disease.

In order to investigate the muscle blood flow (MBF) during exercise (Ex), a new Xe-133 single dose multi-step method (SDMM) for leg MBF measurement before, during and after exercise using gamma camera was developed. Theoretically, if the activity of Xe-133 in the muscle immediately before and after Ex are known, then the mean MBF during Ex can be calculated. In SDMM, these activities are corrected through correction formula using time delays between end of data acquisition (DA) at rest (R1) and beginning of the Ex (TAB) and between end of Ex and beginning of the DA after Ex (R2) (TDA). Validation of the SDMM and MBF response on mild and heavy Ex were evaluated in 11 normal volunteers.

MBF calculated from 5 and 2.5 min. DA (5 sec/frame) both at R1 and R2 were highly correlated (r=.996). MBF by SDMM and direct measurement by fixed leg exercise were also highly correlated (r=.999). Reproducibility of the R1 and Ex MBF were excellent (r=.999). The highest MBF was seen in GCM on mild walking Ex and in VLM on heavy squatting Ex. After mild Ex, MBF returned to normal. After heavy Ex, MBF remained high in VLM. SDMM is simple and accurate method for evaluation of dynamic MBF response.

Kinetics of T1-201 was analysed using a compartment model in order to explain the clinical results of early and delayed T1-201 scintigrams in the lower extremities, based on the following assumptions: 1. The early distribution of T1-201 is proportional to the perfusion. 2. Concentration of T1-201 in serum qE(t) decreases exponentially except in initial stage, as qE(t)=qE(0)exp(-μE t). T1-201 can migrate from blood to muscle and vice versa. Then the concentration of thallium in muscle can be expressed by the equation: qM(t)=λ1 qM(0)/(λ1-μE)·exp(-μE t)+qE(t)+qM(0)exp(-λ1 t), where λ1 and λE are the uptake and release rate constants for muscle. The equation states that if initial uptake qE(0) is lower than the equilibrium concentration, qE(t) increases with time and that if the initial uptake is sufficient for making equilibrium with blood, it decreases corresponding to the decrease of thallium in blood. The relation between the Y(E=qE(t)/qE(0)) and initial uptake X=qE(0) is described as Y=A/X+B (A and B are constants) from the above equation. The relation is in accordance with the clinical results of T1-201 redistribution in the normal thigh and calf.