

An Attempt to Estimate Heart-Lung Volumes and Left to Right Shunt Rate Using Scintillation Camera

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After a rapid injection of ^{99m}Tc albumin into antecubital vein, the dilution curves of central circulatory system, i.e., superior vena cava, right atrium, right ventricle, lung, left atrium and left ventricle, were obtained using scintillation camera with 1600 word memory and computer compatible magnetic tape system. These dilution curves were analyzed by an analog computer, assuming that the circulatory system was approximated by a series of first order lag systems and additional time delays of lung and body. The time constant (volume/flow) of each chamber or compartment was estimated by the fitting simulation model of its dilution curve and the flow rate through the series (cardiac output) was calculated from the two values, total blood volume (TBV) and one-around mean circulation time (MCT), i.e., flow rate = TBV/MCT . The determination of the time constant and the flow rate permitted the volume of each chamber to be estimate.

Good correlation was obtained between actual mixing volume size of model and computed volume by the fitting analysis method

by analog computer model.

In clinical studies, the patient was placed in the sitting position and collimator was faced at a slight left anterior oblique view. Approximately 5 mc of ^{99m}Tc albumin was injected into a right antecubital vein. The dilution curves were obtained and fitting iteratively by the method mentioned above. The volume values of each chamber for the 16 patients without hemodynamic anomalies and the 6 patients with left to right shunt diseases were obtained.

The average for each chamber size for normals were as follows; RA=87 ml/m², RV=86 ml/m², PBV=315 ml/m², LA=82 ml/m², LV=79 ml/m². In general the calculated volumes by our method seem to be reasonable as compared to volumes derived from previous determinations using other methods. The shunt rate was estimated by the simulation of pulmonary dilution curve which seemed to be the least contamination by the radioactivity of surrounding regions. In comparison with Fick method, good correlation was obtained as far as shunt ratio concerned.