ditions, circulatory disturbances were made in dogs.

As the results, following factors should be considered in C.B.V. measurement.

(1) Infusion tube or monitoring tube should not be used for blood sampling or injection of RISA. It may induces erroneous estimation of C.B.V.

(2) Usual mixing time were 10 minutes. It should not be exeeded 15 minutes.

(3) For the first measurement distilled water was used for premix blood instead. It is advantageous especially in the case of infants.

(4) In infats and children C.B.V. showed correlation to body wight rather than body surface area. In the cases having left to right shunt C.B.V. prone to be measured larger.

(5) Since, in dogs, repeated measurement of hematocrit in one animal under same condition showed some variation, inevitable errors may be induced in calculating the corpuscular-volume and plasma volume.

(6) Relatively correct value of lost or overinfused blood could be available, but some variation from the estimated values were observed, which may be resulted from concentrration or dilution of blood.

(7) As the most reliable index for transfusion, corpuscular volume should be used, it is almost independent of concentration or dilution of blood.

(8) Hemorrhage during measurement of C.B.V. may cause inevitable loss of RISA, which resulted in erroneous estimation of the blood loss.

(9) In case of the disturbance of venous return, which was brought about by right sided hemothorax or half ligature of inferior vena cava, measured C.B.V. was greater than otherwise.

(10) In cardiac tamponade, erroneous overestimation of C.B.V. tend to be occured.

(11) When there was difference between peripheral hematocrit and body Ht measured C.B.V. were greater than otherwise. But it has little significance c'inically.

When C.B.V. is estimated considering above mentioned factors together with another hemodynamic data and clinical findings, proper care of postoperative circulatory disturbance can be done.

Studies on Measurement and Clinical Application of Functional ECF
Its Measurement by $^{24}NaCl$ and $Na_2{}^{35}SO_4$

T. FUJITA

Prof. & Chief, Department of Anesthesiology, Gunma University Hospital

Y. HANAI

Department of Anesthesiology, Gunma University Hospital

Y. FUKUDA

Department of Anesthesiology, Tokyo Central National Railway Hospital

Since the introduction of an idea on 'Functional Extracellular Fluid' by Prof. Shires in Texas based on his bled-animal experiments, clinical meaning of E.C.F. has been changed from its 'Stational' status of body fluid to its 'Functioning' one of which amount is available on an emergency to fill intravascular beds. He utilized plasma taken 20 minutes after injection of $Na_2{}^{35}SO_4$ to evaluate functional ECF, however, authors speculated on plasma radiogram of ^{24}Na that multiple sampling method of 20, 40 and 80 minutes after $^{24}NaCl$ given, in order to extrapolate 'zero time' has been more reliable and highly reproducible, even though time-consuming they were. Authors believe these ECF on authors' method means 'Functional one'.

Experiment I 50μCi of $^{24}NaCl$ is injected intravenously to 60 preoperative surgical candidates. Sampling blood is drawn from large cubital vein and/or femoral artery each 20, 40 and 80 minutes thereafter. Radioactivities of sera were measured by well-type NaI scintillation counter. By means of extra-

polation to zero time on their specific radioactivities, functional ECF is obtained.

Experiment II In order to compare sodium space and sulphur one, 100μCi of $Na_2{}^{35}SO_4$ is given to some 20 preoperative surgical candidates either with or without simultaneous administration of ^{24}NaCl. Sampling sera were divided into three parts; one for counting of γ-emission of ^{24}Na, one for β-emission of ^{35}S by 2π-gas flow counter and the rest for the same by S. N. Albert's method utilizing anthracene cell scintillation counter for β-emission after treated by 20% TCA. (The cell was kindly offered us by Dr. Albert).

Results

Experiment I Mean value of ECF on 50 cases denotes to 194.5 ± 4.3 ml/kg of body weight, which is smaller than ordinary 'stational' values of ECF measured by ^{22}Na or ^{24}Na, and is closer to ordinary mean values of ECF by many reporters. Its reproducibility was ±6.1% in successive measurements in three cases.

Clinical importance of those ECF was reassured by authors that, there was linear relationship between the amounts of surgical candidates' ECF and their degree of hypotension after they were introduced general anesthesia. Their correlation ratio was $\gamma = +0.642 \pm 0.093$ ($p < 0.001$). Anyhow, all those cases were estimated as good risk and their hematocrits ranged between 35 to 45%.

Experiment II In order to apply ECF as a routine work, ^{24}Na is inconvinient as its half-life is too short. Radioactivities of ^{35}S in sera measured according to Albert's method had reliable merit compared to ones by 2π-gas flow method. The latter has inferior reproducibilities. Though it is not conclusive yet, authors obtained almost the same value between sodium space and sulphur one. These investigations are still on progress by authors.

Quantitative Evaluation of the External Monitoring Method Using Radioisotopes in the Studies of Congenital Heart Disease with Left-to-Right Circulatory Shunts

M. Yokota*, Y. Kanzaki*, Y. Hikasa*, Y. Ishii** and K. Torizuka***

Kyoto University School of Medicine, Second Surgical Clinic, Medical Clinic**, Department of Nuclear Medicine****

Since 1965 the external monitoring method using radioisotopes has been one of the routine examinations in our clinic. The purposes of the examination are (1) screening of patients with heart murmur of uncertain etiology on the outpatient basis, (2) postoperative evaluation of the cardiac patients, and (3) cardiac evaluation of the poor-risk patients for whom cardiac catheterization is not recommended.

Following intravenous injection of RIHSA or ^{131}I Hippuran, dilution curves were recorded by placing the probes on the precordium, the peripheral lung field, and the peripheral arteries (frontal). The precordial curve is characterized by the two primary peak waves followed by systemic recirculation waves, whereas the pulmonary curve shows a single primary peak wave, which lies between the two primary peaks of the precordial curve, and followed by recirculation waves as well.

In congenital heart diseases with shunts alterations of the curves are observed according to the type of the shunts; prolongation of the descending limbs in cases of left-to-right shunts, and a short appearance time and a reduced peak concentration of the peripheral arterial curves in cases of right-to-left shunts.

In this report curves obtained in 79 patients (V.S.D., A.S.D. P.D.A., and normals) were analysed. The concentration values of the descending limb of a dilution curve indicate a straight line, when plotted on a semi-log paper, and half-time ($T\frac{1}{2}$) was determined on the line. The left-to-right shunt group was clearly differentiated from normal by using $T\frac{1}{2}$ of the pulmonary curves. A good correlation was observed between $T\frac{1}{2}$ and left-to-right shunt expressed as per cent (obtained