

suitable scintillation detector with the surface attachment (for the details of the construction refer to Topic No. 28). Such a detector should not only be a portable one but also must have a constant relation of the relative position to liver, and it should be provided with a sufficient insulation as well as be easily adaptable. For this reason a surface apparatus was devised. In this instance, a special care was taken to minimize the change in the relative position to be caused by the alterations in the body position, on the basis of the shift in the boundary line of the lung-liver as well as of the liver accumulation KL curves at different postures as observed by roentgenograms.

As for the method of detecting the mode of hepatic blood flow, the subject is made to take a supine position for taking the recordings of liver accumulation KL curves, then standing position to ascertain the stability of the curves. This standing position if kept for 10 minutes to record KL curves, then a relaxed position is kept for 10 minutes, and again make the subject to assume the standing position again to confirm the plateau.

Similar procedures are taken in the recordings of the walking period, but in this instance, the individual is made to take 100 steps per minutes for ten minutes. The subjects of our test were consisted of 13 normal control, 7 cases of chronic hepatitis, and 12 cases of liver cirrhosis. In each group KL decreases in the standing posture and then it increases in the walking, but the KL in standing. As for the changes of KL at different postures, the patient with liver cirrhosis definitely gives a lower KL value than the control group. Further, in studying the changes of KL values precisely with each disease, in the control KL value in the standing position decreases about 20% in average from that in the supine position, but on assuming the walking again this decrease recovers to 7% decrease. In chronic hepatitis there can be recognized no definite tendency, but KL values both in standing and supine postures decrease to some extent. Liver cirrhosis group shows approximately the similar pattern to that of the control, i.e. the KL values are on the whole lower and the changes during the walk tend to be slightly greater.

## Hepatic Circulation and Thoracic Lymph Flow in the Hepatic Cirrhosis

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It is important to consider a role of the hepatic lymph as well as hepatic vessels in hepatic circulation, especially disturbance of hepatic outflow.

In acute experiments of the constriction of supradiaphragmatic inferior vena cava in dogs, portal pressure was elevated markedly by ligation of thoracic duct but recovered to normal levels immediately after release of ligated thoracic duct.

We studied of the three groups of dogs:

first group: ascitic dogs by constriction of supradiaphragmatic inferior vena cava

second group: dogs of cardiac cirrhosis

treated tricuspid valvotomy and pulmonary artery stenosis

third group: dogs of liver fibrosis induced by  $\text{CCl}_4$

Hepatic blood flow by using colloidal gold ( $^{198}\text{Au}$ ) decreased 77% in first group and 51% in the second but third group was almost normal. The thoracic lymph from polyethylene tube cannulated into thoracic duct was collected. Thoracic lymph flow rate increased not only markedly in first and second group but also moderately in third group. The increase of thoracic lymph flow rate was in proportion to elevation of hepatic venous pressure. The radioactive sodium ( $^{24}\text{Na}$ ) was

given intravenously in amount of 200 micro curies to determine the extracellular fluid volume of the liver (with Manery's method) and to measure the appearance time of  $^{24}\text{Na}$  into thoracic lymph. Extracellular fluid volume of liver (20.8% in normal) was 24.4% in the first, 40.0% in the second and 33.8% in the third group. Appearance time of  $^{24}\text{Na}$  into thoracic lymph was more short in third group than in normal. Using the Phillips and can Slike copper sulfide method, the specific gravity of liver slices averaged in about 1090

in normal, but lowered about 1080 in first group and 1070 in the second and the third group.

Although hepatic blood flow is almost normal in group of liver fibrosis induced by  $\text{CCl}_4$ , the facts of increased thoracic lymph rate and extracellular fluid volume of the liver, of rapid appearance of  $^{24}\text{Na}$  into the thoracic lymph and lowered specific gravity of liver slice indicate increase of permeability at the sinusoidal wall resulting from disturbance of postsinusoidal outflow.

### Studies of Phagocytosis and Digestion in RES by $^{131}\text{I-AA}$

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Particulate matter is removed from the circulation by the RES, comprising the Kupffer cells of the liver, cells which are lining the sinuses of the spleen, of the lymph nodes, and of the bone marrow, and endothelial cells of various other organs. To examine the function of RES, aggregated human albumin of small size labeled with radioiodine ( $^{131}\text{I-AA}$ ) was used.  $^{131}\text{I-AA}$  is rapidly metabolized after the removal from the circulation chiefly by the Kupffer cells of the liver and radioiodine isolated from AA reappears in peripheral blood.

The subjects without immunological, hematological and hepatic disorders were selected among the patients troubled with a gastrointestinal series. After the intravenous administration of  $30\ \mu\text{Ci}$  of  $^{131}\text{I-AA}$  with or without carrier-AA, gamma ray activities over the liver, over the left femoral area and in blood samples were measured.

(1) Fractional plasma clearance rate  $k_1$  ( $\text{hour}^{-1}$ ), the peak time of surface counting over the liver and the rate of breakdown of

$^{131}\text{I-AA}$  in the Kupffer cells of the liver  $k_2$  ( $\text{hour}^{-1}$ ) are  $1.940 \pm 0.441$ , 14.5 min. and  $0.109 \pm 0.021$  respectively, when carrier-AA was not added.

On the condition of loading with carrier-AA (3 mg/kg),  $1.597 \pm 0.069$  of  $k_1$ , 18.0 min. of the peak time and  $0.044 \pm 0.009$  of  $k_2$  were gained.

(2) While the change of fractional plasma clearance was due to the hepatic blood flow and did not closely correlate with the dose of carrier-AA, the rate of breakdown of  $^{131}\text{I-AA}$  in RES had better correlation within certain levels of the dose of carrier-AA in the same subject.

(3) Therefore, to examine the function of RES, observation of breakdown of  $^{131}\text{I-AA}$  is thought to be more useful rather than its plasma clearance.

(4) Decrease of surface counting over the liver after the removal from the circulation can be analyzed quantitatively at the definite considerable dose of carrier-AA.