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(Chairman Prof. Dr. Hideo Ueda)

Part II.

(Continuation from the previous volume)

Panel Discussion : (III) Abdominal Organ Scanning

1. INTERPRETATION OF LIVER SCANS

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The liver scanning already has a history and experience of more than ten years. A remarkable progress is being made along the improvement of technique, choice and development of new radioisotopes and colloids. Time is ripe for evaluation of liver scans which have been accumulated in the past in order to apply this method to and improve our capability of clinical diagnoses. The situation may be somewhat comparable to that long ago when the roentgenographic technique was in its early stage and when more efforts were converted from the technical problem to the clinical application. Therefore, I should like to concentrate today, on the problem of improving [diagnostic interpretation of liver scans because of the time limitation.

Methods: Scintiscanner Type SCC-5, Shimazu, was used to take four color scintigrams by the Kurume Multiscintigram System, in which a 37 hole focusing collimater of the focus distance of 10 cm was used. The cut-off level was adjusted to 8 cps, and with a time constant of 0.6 to 1.0 sec., counts of 8~12 cps were recorded in black, 12~18 cps in green, 18~24 cps in red and above in purple. The number of liver scans taken is about 400 of which 352 cases in which ^{198}Au colloid was used constitute the material for this study.

The material consisted of patients with acute and chronic hepatitis, liver cirrhosis, Schistosomiasis cirrhosis, hepatoma, metastatic carcinoma, cholangioma, Banti's syndrome, extrahepatic obstruction, liver of congestive heart failure, cirrhosis due to constrictive pericarditis, Wilson's disease, constitutional hyperbilirubinemia, liver cyst, situs inversus, liver abscess, and many other diseases in which liver is not involved, for the control. With the recording conditions described above, the contour of the liver is distinct without scattering of the dots around.

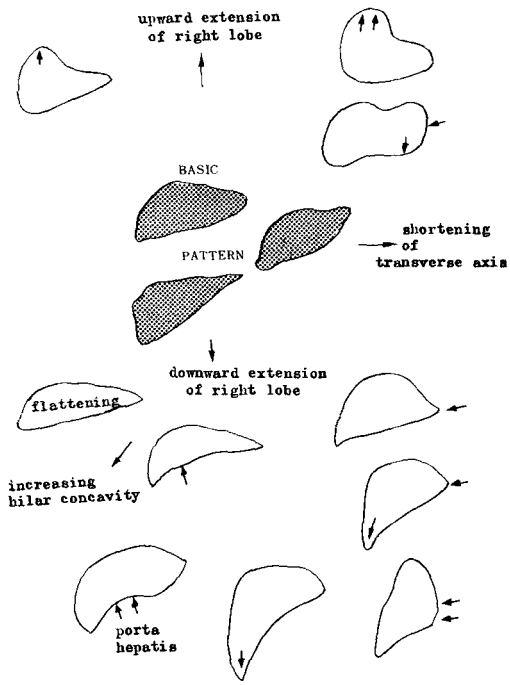
The average area of normal liver in 55 cases was $181 \pm 3.4\,cm^2$ (standard error of the mean). The area was significantly reduced in liver cirrhosis the average of which being $165 \pm 5.2\,cm^2$ and increased in obstructive jaundice the average of which, $245 \pm 28.7\,cm^2$. The liver size is said to be increased in hepatitis, but in our series no significant deviation of the liver area from normal was demonstrated for hepatitis, either acute or chronic.

Visualization of the spleen under our recording conditions always indicates abnormalities and taken in interpretation as "abnormal." The spleen was seen in 72 percent of all cirrhotics, in 79 percent of cirrhosis due to Schistosoma japonicum, and the degree of splenic scan seems to be increased with the advancement of cirrhosis. The spleen was visualized in slightly more than 30 percent of acute hepatitis but only faintly in the majority, while splenic scan was positive in slightly and insignificantly smaller percentage of the patients with chronic hepatitis. The spleen was visualized in all of the few cases of fulminant hepatitis. The spleen was also discerned in many of the cases with liver carcinoma. Although no definite correlation was demonstrated between the degree of splenic scan and the extent of carcinomatous

involvement, the spleen was more distinct in those cases which developed carcinoma on the basis of liver cirrhosis. The figures for positive splenic scan was 60 percent in 43 cases of primary hepatoma, while it was 17 percent in 24 cases of metastatic liver carcinoma. The spleen was also visualized in all three cases of Banti's syndrome in whom splenectomy had not been performed.

Fig. 1 reprsents normal configuration and its variation. The three patterns in the center are the basic and most frequently seen. The variation may be analyzed in terms of changes in certain area of the liver; it consists of shortening of the transverse diameter, cephalad prolongation of the right lobe, caudal prolongation of the right lobe, indentation of the porta hepatis, shortening of the vertical diameter, etc. The indentation of the porta hepatis area may be caused by the pressure of the gall-bladder, boundary between the right and left lobes, etc. It is of prime importance for the interpreter to be acquainted with as many normal liver scans as possible in order to familialize himself with the limit of normal variation in configuration. The patterns in the extreme end of any direction from center in Fig. 1 represents such limits in our experience. It is the author's opinion that the attempts in the past by many investigators to set patterns in groups have little universality subject to individual choice and variation. Such classification has no value except in estimating the frequency of a certain configuration.

Fig. 1. Normal Pattern and Variation of Liver Scan.



The following points have to be considered in interpreting the scans, and they are derived only by careful comparison of the scans with actual livers observed during operations or at autopsies. It has been our practice to place the scan at the side of the liver at autopsy table. The thinning along the lower left border in scan is most likely due to the thin thickness of the liver edge and consequently poor uptake of the colloid. The thinning of the left lobe in the scan is also caused by the same reason of thinness in thickness. Irregularities along the upper border of the scan is probably due to respiratory movement of this portion which is in direct contact of the diaphragm and fast deviation from the surface.

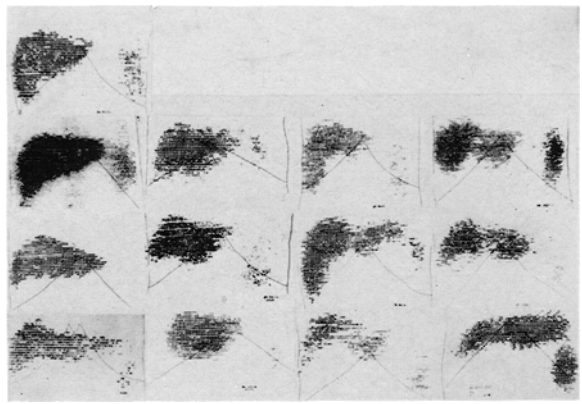
In clinical practice, it is most important that one carefully delineate the liver edge below

the costal margin, and upper border of the liver by purcussion, and transfer these informations on size and configuration onto the scintigram. Besides, simultaneously taken roentgenogram of the abdomen in the area of the liver can be overlapped on the scintigram; they can be synthesized in one picture, if necessary. This has been our practice, and one hardly needs such elaborate instrumentation as used at the Johns Hopkins for simultaneous recording of X-ray and liver scan. In such X-ray photograph, the liver edge is clearly identified in most instances as sharply contrasted with intestinal translucency.

In interpretation, the size, configuration, regularity of the border line, uniformity of scan density, and appearance of the spleen have to be taken into consideration. The following are the points for caution based on the author's experience. 1) The thinning and irregularity of the left lobe has to be interpretated with reservation. In some extremes of normal variation, the left lobe is almost absent as the one on the lowest right in **Fig. 1**, while the liver assumes a similar configuration in carcinoma which is limited in the left lobe without largely involving the right lobe. In such instance, palpation is most important for diagnosis. 2) Slight indentation of the porta hepatis is quite common in normal liver, but if the indentation is shifted toward left or righf below, carcinoma is the likely possibility, followed by compression by enlarged gall-bladder, cyst or extrahepatic neoplasm. 3) Decrease in the vertical thickness beyond normal extent frequently suggests cirrhosis.

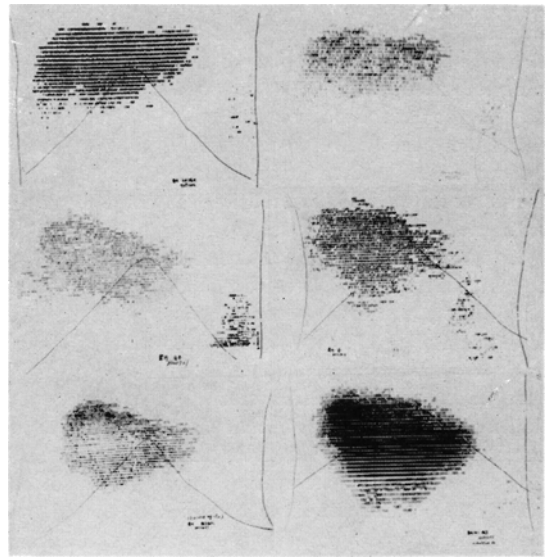
The liver configuration in cirrhosis varies, but in many instances, the boundary between the right and left lobes becomes distinct with relatively enlarged left lobe (**Fig. 2**). The spleen is visualized in most cases, and so is the bone marrow along the vertebral column if the cut-off level was lowered. Nevertheless, there are some in which no changes in size and configuration are noted; they are mostly less advances cases, however, and not distinguishable from chronic hepatitis with spleen by this test only. Another characteristics of cirrhotic liver is its poor uptake of colloid, and such scan is often confused for scattered defects due to carcinoma. For this reason, early detection of primary carcinoma developing on the basis of cirrhosis is vary difficult. For better evaluation of the scan, one has to use a larger dose of colloid as well as different recording conditions to prepare several scans of different densities.

Fig. 2. Patterns of Cirrhotic Livers



One of my emphases lies in the diagnosis of Schistosomiatic cirrhosis with liver scan. It has been our experience without exception that the gross appearance of the liver of advanced Schistosomiasis is quite different from other types of cirrhosis and characteristically has large lobules on the surface caused by fibrotic shrinkage of the capsule of the liver. The parasite ova are numerous below these fibrotic cicatrices. The alteration of gross liver configuration is such that the right lower end projected on the anterior surface is thinned first, then disappears on the scan. **Fig. 3** represents some of the liver scans in Schistosomiatic cirrhosis of our observation. When one sees this kind of alteration in liver configuration in a patient who is from the endemic area, one can be almost 100 percent confident of the diagnosis, and that

Fig. 3. Changes of Liver Scan in Schistosomiasis. Note Disappearance of the Right Lower Corner.



has been our experience.

By and large, the liver scanning proves to be the most reliable diagnostic tool in cirrhosis if one finds the characteristic changes, such as decrease in size, relative increase in the left : right ratio, decrease in the vertical caliber, combined with visualization of the spleen.

The importance of this method in the diagnosis of localized lesions has amply been emphasized. They consist of carcinoma, cyst, abscess, etc. The limit of size of localized defect that can be diagnosed is not the object of my discussion. I would rather emphasize our experience that the defect on liver scans due to carcinoma is often larger than the actual size of the carcinoma. It is probably due to the alteration in blood circulation and RES function in the area adjoining the carcinoma. There is no reliable finding that aids the differentiation of primary from secondary carcinoma except that the spleen is more often distinctly seen in hepatoma that has developed on the basis of cirrhosis. No clear correlation was demonstrated between the degree of splenic visualization and the area of carcinomatous involvement or remaining functioning liver mass.

Based on the discussed criteria, three experienced readers including the author intertreted individual scans without names; if interpretation varied, the decision was by the majority. Out of the 234 cases intertreted as "abnormal" nine (3.8 percent) was without liver abnormalities —false positive, as against seven false negative (10.3 percent) out of 68 scans intertreted "normal." The seven erred cases consisted of three mild cirrhosis, three early carcinoma and one Schistosomiasis without marked liver involvement. It is to be noted that 61.5 percent of non-Schistosomiatic cirrhosis cases was diagnosed with confidence without aid from other information, 44.4 percent of Schistosomiatic cirrhosis, 77.1 percent of primary carcinoma of the liver, and 45 percent of metastatic carcinoma were similarly diagnosed by only interpretation of the liver scan.

Although liver photoscanning has little value in the diagnosis of other diffuse liver diseases, the fact that this test alone makes definite diagnosis possible in a large number of liver patients emphasizes the great importance of this test. It might not be too much to say that liver scanning, compared with individual liver function tests, stands above other tests in diagnostic capacity. While much improvement is expected in the selection of radioisotope and colloid, physicians are now tasked to improve their diagnostic capability by this technique.