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Radioisotope Photoscanning of the Liver in Bilharzial Hepatic Fibrosis

Dr. Abdel-Galil Mustafa (M.B., B.Ch.-D.M.),[1] Dr. Muhammad Abdel Razzak (M.B., B.Ch.-D.M.-M.D.),[1] Dr. Mahmoud Mahfouz (M.B., B.Ch.,-F.F.R.)[1] and Dr. Badie Guirgis (M.B., B.Ch.-M.D.-M.R.C.P.)[1]

Cairo, Egypt

Radioisotope scanning began in 1950, when Cassen *et. al.* (1) utilized the newly developed scintillation counters to obtain a scanning probe that was coupled with a mechanical stylus to print the spatial distribution of ^{131}I in the thyroid gland. The early techniques have been improved and modified and scanning of various organs now represents an important diagnostic procedure.

The aim of this work is to present the use of photoscanning as an aid in the proper assessment of the liver in bilharziasis, the most common cause of chronic liver disease in our country.

MATERIALS AND METHODS

The present report deals with the findings obtained in 51 subjects; 12 normal individuals and 39 cases with hepatosplenic bilharzial affection, representing the different stages of this disease. The bilharzial patients were divided into early (18 cases) and late (21 cases) cases, according to the size and consistency of the liver, the degree of splenic enlargement, and the presence or absence of esophageal varices and/or ascites.

The photoscanner used was built according to the principles described by Bender and Blau (2) and contained a lead-shielded, 3 × 2 inches, thallium-activated, sodium iodide crystal. The attached collimator was either of the focussing 37-hole type or a straight-bore, half-inch, single-hole one. The scanning speed was adjusted to eight inches per minute, and the distance between each two successive lines on the photoscan was 0.25 cm. (3, 4).

Following the intravenous injection of 300-400 microcuries of colloidal gold-^{198}Au[2], the patient was instructed to lie supine under the detector which was

[1]Faculty of Medicine, Cairo University, U.A.R.

[2]Radiogold was prepared by the Nuclear Chemistry Department, A.E.E., U.A.R.

adjusted to be as close as possible to the patient's body. Enough time was allowed for the radioactivity to reach its maximum level over the liver, as shown by stabilization of the count rate. This usually required a time varying between 30 minutes and a few hours, depending on the efficiency of the liver in clearing the radiogold from the circulating blood. The scanning procedure itself took one to two hours, depending on the size of the liver. At the end of the procedure, arbitrary reference points were marked on the film, corresponding to the xiphisternum and the right and left midclavicular lines in the fifth intercostal spaces.

RESULTS

The photoscans obtained were read according to the following criteria: 1) Outline and surface area of the liver; 2) Distribution of radioactivity; 3) The presence or absence of the splenic shadow.

In the 12 normal individuals examined, the borders of the liver scan were defined and regular, giving the usual hepatiform outline (Fig. 1). The lower border was less regular than the upper in most of the cases and sometimes showed a notch. The hepatic shadow usually occupied an area extending from the fifth rib in the midclavicular plane down to the right costal margin. Horizontally, it extended from outside the right midclavicular plane across the middle line to about one inch short of the left midclavicular line. The distribution of radioactivity was found to be homogenous and equal in density over both lobes of the liver. Sometimes, the extreme lateral end of the left lobe and/or the lower part of the right lobe were not quite apparent. The spleen was not visualised in any of these scans.

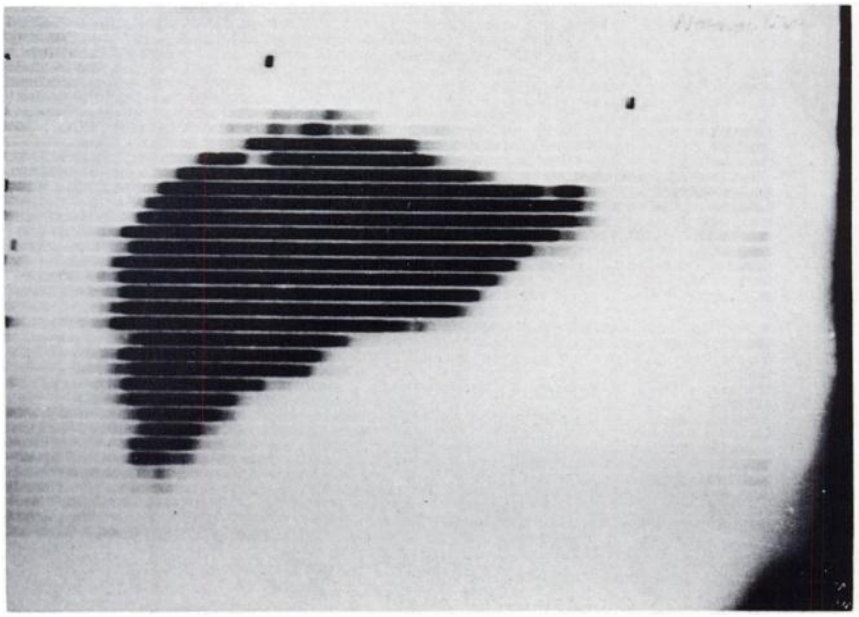

Fig. 1. Radioisotope photoscan of the liver in a normal subject.

Photoscanning of the liver in the early bilharzial cases revealed regular defined borders with normal outline. The hepatic surface area was normal in five cases, whereas in the remaining 13 photoscans there was a slight or moderate enlargement of the liver. The distribution of radioactivity was homogenous all over the hepatic area in nine cases (Fig. 2). In four other patients, localised mottling was apparent in the extreme end of the left and/or the lower part of the right lobe (Fig. 3). In the five remaining cases, mottling was more marked and involved the outer half of the left lobe. In this early group, the spleen could be visualized in the photoscans of six patients.

Out of the 21 photoscans of patients representing the late group, only four showed relatively well-defined hepatic borders; all others had ill-defined irregular borders. The surface area of the liver was variable. It was within normal limits in four cases, enlarged in five, and smaller than normal in the remaining 12 subjects. The reduction in size was more marked in patients having ascites. Radioactivity was distributed rather equally all over the hepatic area in two scans, only while the remaining 19 showed variable grades of reduced density and mottling (Fig. 4). This was much more marked in the left lobe, which was not even visualized in seven photoscans. In the 19 hepatoscans with non-homogenous distribution of radioactivity, it was localised in the main bulk of the right lobe in eight cases, in the perihilar region in four, and in both regions in another three scans. No specfic area of localisation of radioactivity was apparent in the remaining four cases, which showed only severe generalized mottling and reduced density. The spleen was visualized in 12 out of the 21 patients examined (Fig. 5).

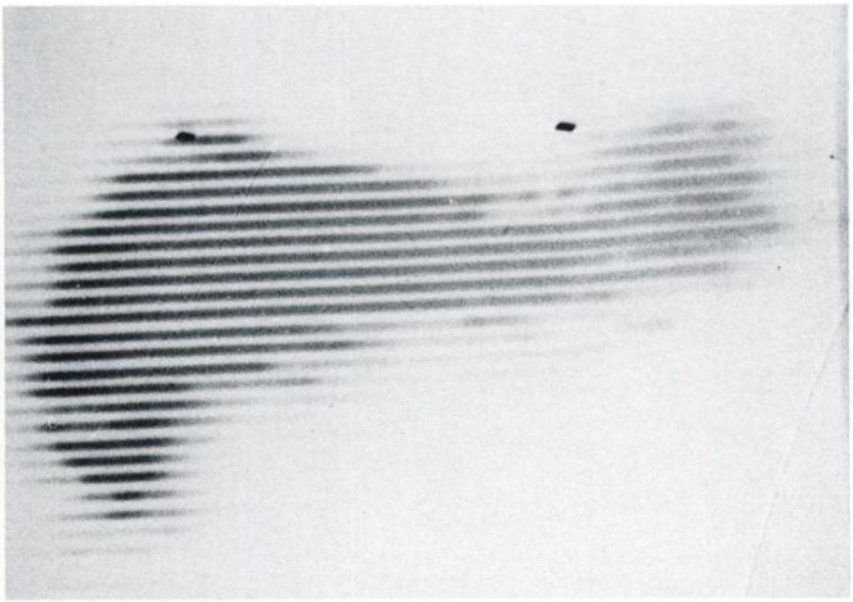

Fig. 2. Early hepatosplenic bilharzial affection. The distribution of radioactivity over the liver is homogenous and the spleen is clearly seen.

DISCUSSION

Radioisotope scanning is the visualization of an internal organ by determining the spatial distribution of a radionuclide within the living body by external measurement. When the data collected are presented in the form of a photographic picture, the technique is called radioisotope photoscanning (5, 6). For this purpose, it is essential to have a gamma-emitting isotope that is selectively deposited in the organ to be examined. In this respect, tagged colloidal gold (^{198}Au) proved to be a suitable isotope for hepatoscanning. Colloidal radiogold-being made of suspended particles is picked by the phagocytic cells of the reticulo-endothelial system, particularly the Von Kupffer cells of the liver (7-9). This action is completely independent of the parenchymatous cellular activity of the liver. Therefore, the photoscan picture will be a function of the distribution of these hepatic reticulo-endothelial cells. In normal livers, the radioactivity would be distributed homogenously and the photoscan would thus present a well-defined regular outline with uniform maximal density in the center of the right lobe, gradually decreasing towards the periphery (10). Because of its lesser thickness, the left lobe may not show as clearly as the right (11). Furthermore, since the splenic uptake of colloidal gold is very low compared to that of the liver, visualization of the spleen would be a remote possibility. The results obtained in the normal individuals included in the present work verify these assumptions and confirm the results reported by previous workers in this field (11-14).

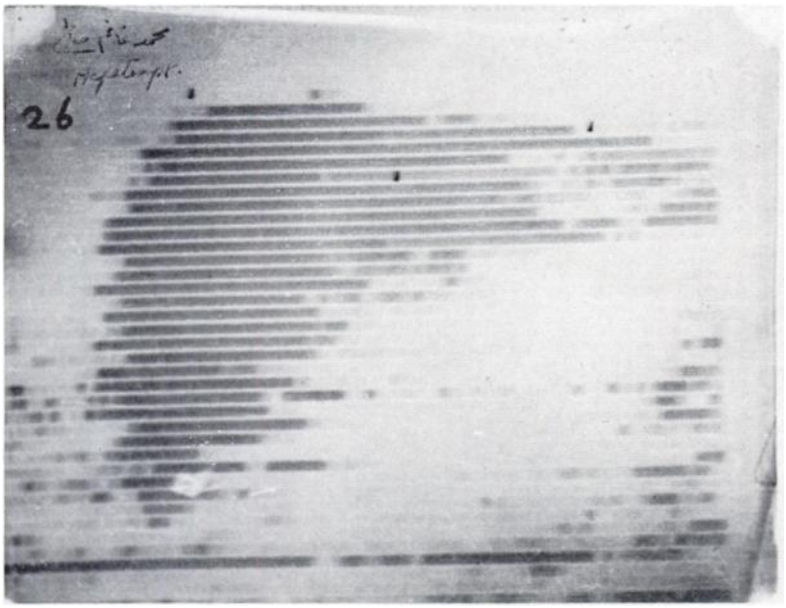

Fig. 3. Hepatoscan of an early hepatosplenic bilharziasis. The liver is enlarged, with mottling of the lateral part of the left lobe and visualization of the spleen.

In the early cases of bilharzial hepatosplenic affection, there was limited deviation from the normal scan pattern, namely slight or moderate enlargement of the hepatic shadow and localised mottling. Since the extreme end of the left lobe and the lower part of the right lobe may not appear in normal hepatoscans, mottling was considered significant only when it occupied sites other than these areas. Significant mottling was noticed in 30% of the cases representing early bilharzial hepatosplenic affection. These minor changes in the scan picture indicate that the granulomatous cellular infiltration of the portal tracts and the reticulo-endothelial hyperplasia characteristic of this early stage (15, 16) are not sufficient to alter the reticulo-endothelial pattern of the liver. The appearance of the spleen in 33% of the hepatoscans of this early stage can be explained by the splenic reticulo-endothelial hyperplasia that occurs in bilharziasis (15), leading to greater accumulation of the radiogold particles in this organ.

The hepatoscans of the patients representing the late stage of hepatosplenic bilharziasis showed a wider range of variations. The hepatic shadow was normal in four cases, enlarged in five, and shrunken in 12 cases. It was noticed that haziness of outline and ill definition of the borders of the scan picture were directly related to the degree of reduction in size. When these findings were marked, mottling became a prominent feature. Mottling usually appeared at the periphery of the liver in earlier cases and involved to the center. As the disease progressed, the left lobe was affected more prominently than the right. This sequence of changes might be explained by the reduction of blood flow, which is known to affect the periphery more than the center of the liver (14). Out of the

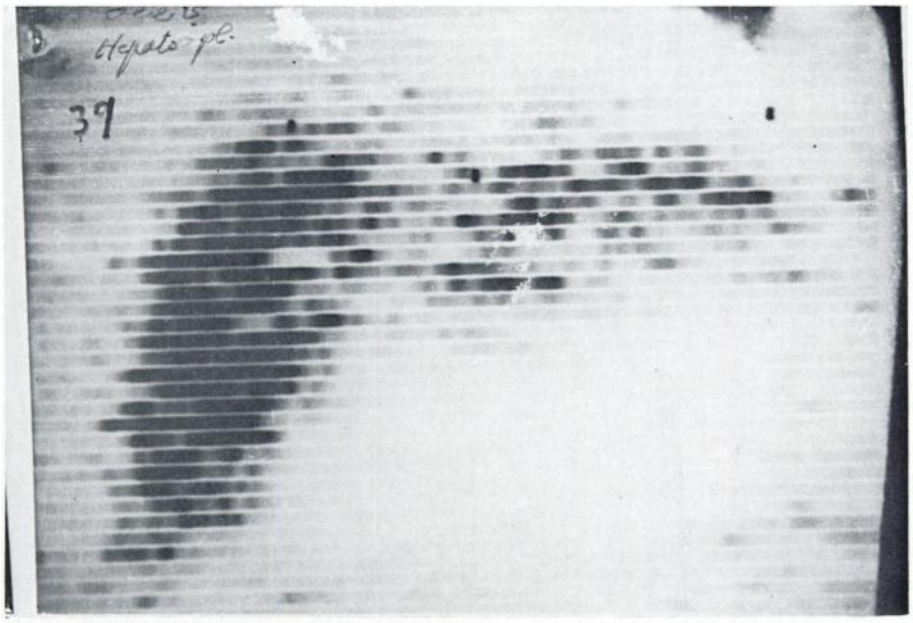

Fig. 4. Late hepatosplenic bilharzial affection. The hepatic photoscan is enlarged with marked mottling of the left lobe and accumulation of radioactivity in the main bulk of the right lobe.

21 late bilharzial cases examined, only two showed homogenous distribution of radioactivity, the rest presenting with variable grades of reduced density and mottling. Furthermore, in most of the cases radioactivity was seen to accumulate in certain sites, namely the main bulk of the right lobe and/or the perihilar region. These findings are most probably because of the characteristic bilharzial periportal hepatic fibrosis that will alter the hepatic reticulo-endothelial pattern and entangle the blood vessels in the affected areas. This change of structural pattern will abolish or reduce the hepatic uptake of the radiogold in these sites.

It should be noticed that the changes in the hepatoscan pattern that were observed in the present series of bilharzial hepatic fibrosis are not qualitatively much different from those seen in Laennec's cirrhosis as reported by various authors (12, 14, and 17). However, their conclusions as regards the most important criteria for the diagnosis of Laennec's cirrhosis from the hepatoscan were somewhat different. Thus, Christie *et. al.* (14) in their extensive work on scanning in hepatic cirrhosis stated that the most important changes in the scan picture were the abnormal distribution with perihilar accumulation of radioactive material and visualization of the spleen. Furthermore, these findings appeared to be directly related to the severity of the disease. Lastly, they stressed the importance of standardizing all possible scanning parameters before drawing any conclusions. On the other hand, Donato *et. al.* (11) considered that the most obvious features in the hepatoscans of liver cirrhosis were the reduced concentration of activity in the liver area, the marked discrepancy between the size of the liver, and the

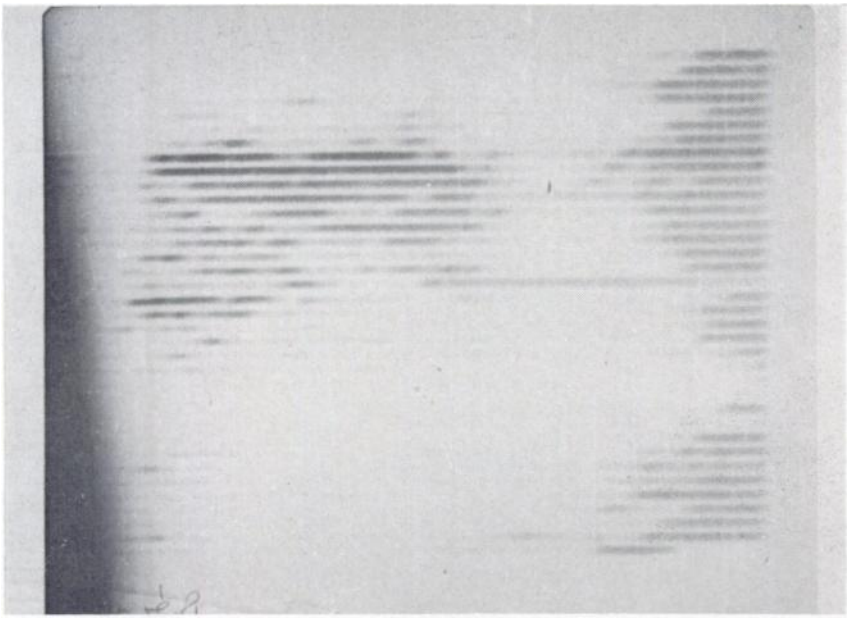

Fig. 5. Photoscan of a late bilharzial case. The hepatic shadow is reduced in size with marked mottling. The spleen is tremendously enlarged.

scan picture and the rarity of visualization of the spleen. In this respect, Whang *et. al.* (17) found that the hepatic scan in cirrhosis frequently had a mottled appearance and the great majority showed varying grades of left lobe enlargement associated with equal or even greater apparent concentration of colloidal gold in the left lobe than in the right lobe. The spleen was seen in 57% of these cases.

In the present study, the main abnormal findings in the hepatic photoscans of bilharzial patients were changes in the size of the liver, abnormal distribution of radioactivity, and mottling as well as visualization of the spleen.

SUMMARY AND CONCLUSIONS

Radioisotope photoscanning of the liver was done in 51 subjects: 12 normals and 39 patients suffering from hepatosplenic bilharziasis, using colloidal gold tagged with gold-198.

In normal individuals the borders of the liver scan were well-defined and regular, the distribution of radioactivity was homogenous, and the spleen was not visualized.

In the early bilharzial cases the hepatic shadow in the scan was more commonly enlarged than not, though retaining its regular defined borders. In 28% of these early cases significant mottling was apparent, whereas the spleen was visualized in 33% of them. In the late group of cases, the main abnormal findings were the irregular ill-defined borders, an abnormal liver size, and unequal distribution of radioactivity with variable grades of reduced density and mottling. The spleen was seen in 57% of these late cases.

Therefore, photoscanning can be used as an aid for the proper assessment of the degree of liver damage in bilharzial patients.

ACKNOWLEDGEMENT

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