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In the hepatic scans of patients with liver diseases, such as hepatitis and cirrhosis, the splenic visualization must depend on changes of portal blood circulation and enlargement of spleen followed liver fibrosis, and depend on relative fluctuation of the function of reticuloendothelial system in liver and spleen.

**Splenic Scintiscanning and Its Significance**

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Despite some obscurity about the functions of the spleen, visualization of this organ is needed in several clinical problems. For this purpose roentgenographic examination requires skill and experience but does not always provide a clear figure, while radioisotopic scanning, if once the procedure has been established, can be performed with relative ease and more constant results. Nevertheless, the use of splenic scanning seems less popular when compared with that of thyroid gland or liver. Here in his report the procedures of splenic scanning which are used at present and will be used in the near future are described, and its significances are discussed.

Use of 198Au or 99mTc colloid paricles might sometimes bring about visualization of the spleen but not a single figure of this organ. On the routine life span studies using...


\[ 5^{1}\text{Cr} \] tagged red blood cells,\(^1\) remarkable sequesterotation of these cells in the spleen was observed in some cases of hereditary spherocytosis, acquired hemolytic anemia and congestive splenomegaly. At that time accumulation of radioactivity over the spleen became three times that or more of the activity over the liver and the precordium, the value which permitted the clear scintiscannography of the spleen. In general cases, however, certain procedures were required in order to make radioactive red cells become sequestered in the spleen. There are several methods to denature red cells for splenic sequesterotation \(^2\,^3\,^4\,^5\,^6\) such as sensitization with incomplete antibody, blocking of cell metabolism with chemical agents and heat treating. Among these, the last one seems to be used most frequently for splenic scanning and it has been usually employed also in our laboratory. As to the antibody sensitization method, reliability as well as some drawback as described by others\(^7\,^8\) were also experienced in our laboratory. The methods using chemical agent, especially a new radiopharmaceutical of M.H.P., shall be described later.

"In the \[ 5^{1}\text{Cr} \] labelling heat treating method."

About 20 ml of whole blood with 5 ml of A.C.D. solution was used for \[ 5^{1}\text{Cr} \] labelling and cell denaturation which was performed in a water bath at the temperature of 49.5 ± 0.5°C for 30 to 50 minutes. Under these conditions nearly constant results, as follows, were obtained. Red cells became spherocytic, making bud like protrusion and fragmentation, and increased in osmotic fragility, 50% hemolysis occurring in 0.45 to 0.55% NaCl solution. These cells were removed from circulation, after having been returned to the donor, with the half time of 30 to 60 minutes. Body surface counting showed simultaneous rapid increase in radioactivity over the spleen which reached about two hours thereafter to nearly maximum values, 5 to 7 times of that over the precordium or 3 to 7 times of that over the liver, sufficient values to get a clear splenic scintigram; and these organ-surroundings ratio were preserved for several weeks. Between the degree of cell damage represented by the concentration of NaCl solution causing 50% hemolysis and removal rate of damaged cells represented by the half time of disappearance, a reverse cor-

 relation was observed, which indicates that the more the cells were damaged the more rapidly they were removed from circulation, and further, if the individual variations of cell damage were corrected, clearance rate of these cells was considered to reflect the sequesterotation function of reticulo-endothelial cells especially in the spleen. In some cases of congestive splenomegaly and of iron deficiency anemia, splenic hyperfunction in this sense, and in such cases with tumor invasive splenomegaly as of chronic myeloid leukemia or of lymphosarcomatosis, hypofunction were assumed respectively.

"On the M.H.P. method."

Recently, a new method of splenic scanning using chemically damaging agent of 1-bromomercuri, 2-hydroxy propane, B.M.H.P., labelled with \[ 20^{3}\text{Hg} \] or \[ 19^{7}\text{Hg} \] was investigated by Wagner et al.,\(^12\,^13\) and its reliability as well as security was confirmed also by several clinical studies in our laboratory. According to Wagner et al. 1ml of red cells were mixed with 1mg of B.M.H.P. labelled with 100 to
300μc of 197Hg and returned to the donor instantly. Although 00 remarkable change in the figure of red cell or in osmotic fragility was observed at the time of injection, these cells were removed from circulation with the half time of 60 to 120 minutes accompanied by progressive accumulation of radioactivity only over the spleen. Between 1½ and 3 hours after the injection, clear scintigram of the spleen could be obtained. The characteristics of this method recognized in comparison with heat treating method were as follows.

1. Labelling and damaging procedure of red cells can be carried out simultaneously and with much more ease in B.M.H.P. method than in heat treating method which requires time and carefullness.

2. Low γ-ray level of 197Hg is no doubt an advantage for getting sharp scannogram, but the problems of absorption and coherent scattering in the tissue might be a disadvantage for uniform visualization of an enlarged spleen. From this standpoint 51Cr and 203Hg are rather preferable.

3. Release of Hg fom splenic tissue was observed to be far more rapid, half time being 4 to 6 hours, than 51Cr, effective half time being 7 to 10 days. This rapid release of Hg indicates less radiation effect on splenic tissue\(^{11,13}\) but on the other hand, implies that duration of optimal time for detection is restricted in B.M.H.P. method and that some hazards might be encountered with increasing radioactivity in kidneys which become the critical organ for radiation effect, that is calculated\(^{13}\) to be excessive when 203Hg is used.

Our observation as described above also recognized several advantages of M.H.P. method as routine scanning techniques but some disadvantages seemed to exist yet for further improvement, and either of these methods might be selected according to the purpose of splenic scanning.

“Scanning techniques.”

Conventional stylographic scanner with shielded 3 × 2 inch crystal and 10cm focusing 37 hole honeycone collimeter was used.

In order to determine the cut off level so as to make the scannogram express as real size as possible, preliminary studies were done with two models containing homogeneously about 200 μc of Cr-51. One was of normal splenic figure and the other was of trapezoid cube which was composed of 5 × 5 cm upper plane with constant height of 5 cm, declining plane with height of 5 to 0 cm and 5 × 15 cm bottom plane. When only part of the latter model with the height (or thickness) of 5 cm was under consideration for expressing the real size, part with thickness of below 1 cm was not expressed in the scannogram, and in order to minimize the scanning aberation from model size, it was necessary to choose the cut off level so as to keep the background radioactivity within...
minimal expression. Within the range of 7 to 13 cm, the distance from the end of the collimator to the center of models had no marked effect on the expression of the size or figure of the scannogram. Considering the complexity of localization and figure of spleen, especially when it enlarges, several scannograms from different directions were necessary to obtain a cubic image of this organ. For this purpose, posterior, lateral and, in cases with palpable enlarged spleen, if necessary, anterior scannograms were taken. These scannograms were also compared with roentgenograms that were taken after having filled the splenic surroundings with air, and accuracy of the scannograms obtained under the conditions described above was confirmed.

“Significance of splenic scintiscanning.”

Our studies also confirmed the clinical uses of splenic scanning as described by Wagner et al.\textsuperscript{10}–\textsuperscript{12} But only a single scannogram makes one sometimes run the risk of doing under- or overestimate\textsuperscript{10}. Therefore, our proposal of poly-directional scanning to get a cubic image of the spleen in comparison with splenic roentgenography, when possible, was considered to make it more accurate to assess the spleen quantitatively, as well as to determine the mode with which the spleen enlarges. In this respect, latent enlarged spleen was observed in some cases of iron deficiency anemia, idiopathic thrombocytopenic purpura, chronic hepatitis, hyperthyroidism, etc. Further, careful scintiscanning of spleen with reference to clearance rate of damaged cells as an index to reflect splenic function is considered to be useful not only as an additional aid for indication of splenectomy, but also for elucidating obscure functions of this organ and pathophysiology of some splenic diseases.

Reference