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Scanning with Macroaggregates of Radioiodinated Human Serum Albumin as an Adjunct to Celiac Arteriography:

A Preliminary Communication

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When macroaggregates of radioiodinated human serum albumin are injected into the celiac axis at the conclusion of celiac arteriography, satisfactory scans in which hepatic, splenic and pancreatic-duodenal outlines are present can be obtained. Following preliminary experiments in dogs, five patients were scanned after celiac arteriography and injection of macroaggregates. No adverse reactions were noted and good delineation of upper abdominal viscera was possible. One case demonstrated good clinical-pathological correlation, in that tumour site and extent, and cirrhosis were predictable from the antemortem scan.

Par l'injection dans le tronc céliaque de macro-agrégats d'albumine sérique humaine marqués à l'iode radioactif, effectuée à la fin d'une artériographie céliaque, il est possible d'obtenir une cartographie satisfaisante des profils hépatique, splénique et pancréato-duodénal. Après avoir expérimenté la méthode chez le chien, on l'a appliquée chez cinq malades qui avaient subi une artériographie céliaque et reçu une injection de macro-agrégats. Il n'y eut aucune réaction défavorable. On a obtenu une bonne image du contour des viscères de la portion abdominale supérieure. Dans un cas, existait une bonne concordance clinico-pathologique ainsi que le siège et l'ampleur de la tumeur et la cirrhose ont pu être prévues d'après la cartographie antemortem.

MACROAGGREGATES of radioiodinated (^{131}I) human serum albumin (MA) have been employed to demonstrate the vascular pattern in lungs,[1] brain,[2, 3] heart, kidneys,[4] and limbs.[5] These particles remain within the microvasculature sufficiently long for an external scan to be performed. This is a brief report of a study undertaken to determine the safety and value of scanning upper abdominal viscera after injecting MA into the celiac axis at the conclusion of routine celiac arteriography.

MA used have been previously described.[3] Catheters were placed in the celiac axis by standard selective arteriographic techniques.[6, 7] Subsequent to celiac arteriography, particles diluted in 10 c.c. of normal saline were injected via the same catheter used for the arteriogram. Twenty minutes after injection, anterior and right lateral scanning of the upper abdomen and lower thorax was commenced with a Nuclear-Chicago Pho-Dot apparatus (19-hole focusing collimator, peak—354 kev., speed 30-45 cm./min., suppression 10-30%). Serum glutamic oxaloacetic transaminase (SGOT) levels, bromsulphalein retention values, and serum bilirubin levels were monitored before injection and serially on three days after the procedure.

Animal Studies

Three 25-kg. thiopental-anesthetized mongrel dogs were scanned after receiving 150 μc. (5-7 mg. albumin) of MA by celiac artery injection. A second intra-celiac axis dose of 860 mg. was given to one animal five days after the initial injection. Another animal was given, after a five-day interval, the 150-μc. dose, and a three-hour post-injection laparotomy provided organ surface counts as well as tissue samples for autoradiography. All three dogs had surface counts over the xiphoid to determine the biological half-time of the material in the upper abdominal viscera.

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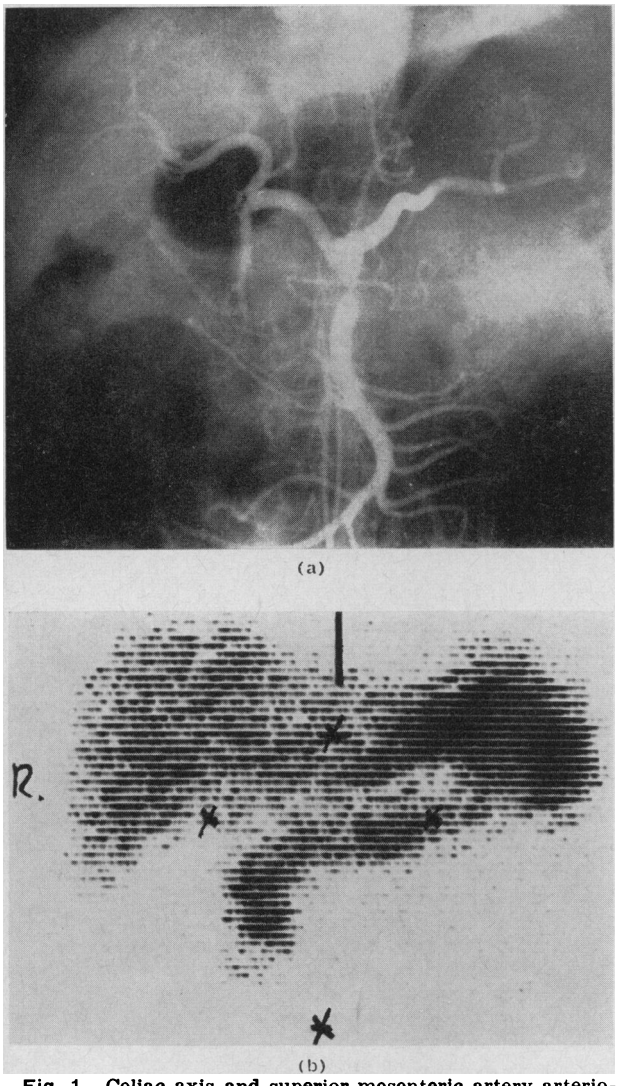

Fig. 1.—Celiac axis and superior mesenteric artery arteriogram (a), and celiac axis MA scan (b)—patient A. The scanning head was angled cephalad to achieve organ separation. Midline, costal margins and umbilicus are marked "X".

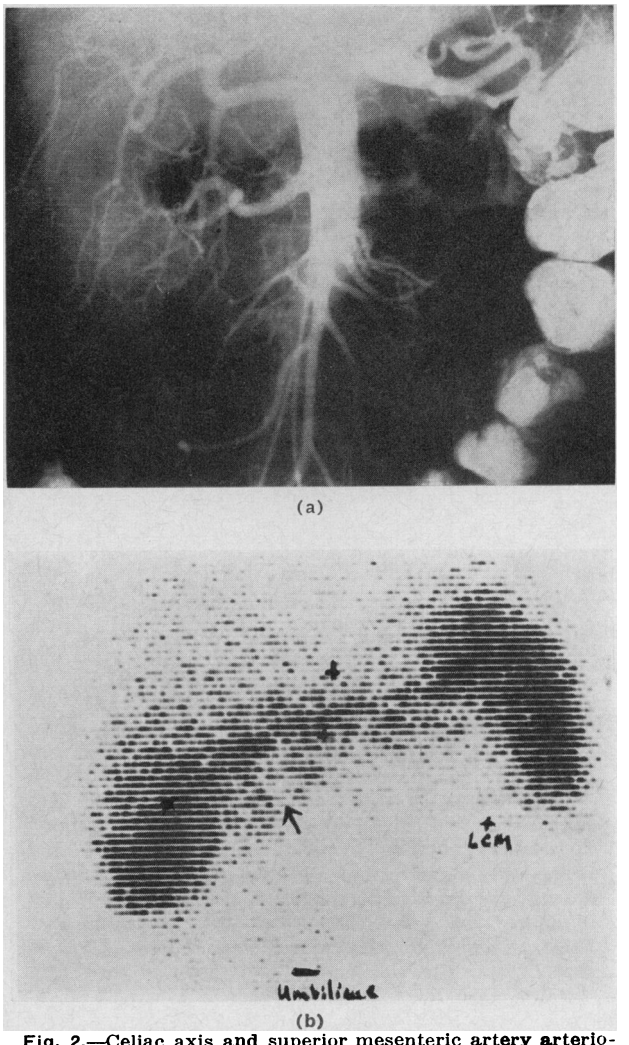

Fig. 2.—Celiac axis and superior mesenteric artery arteriogram (a), and celiac axis MA scan (b)—patient J. Note the generally poor liver activity with an area of marked uptake in the right lobe of liver.

Good scan outlines of liver, spleen and what was presumed to be pancreas were obtained. Liver function studies remained unchanged following injection of even the 860-mg. dose of MA, except for a transient half- to one-fold rise in the SGOT on the day after the procedure. Organ surface counts indicated that virtually all of the radioactivity was within the liver, spleen and pancreas, although some counts were registered over stomach, first and second parts of duodenum, and retroperitoneal tissues. Pancreatic activity was confined to the lobus sinister, body and tail. Autoradiography confirmed these findings and indicated that at three hours all of the particles were within portal tracts, precapillary arterioles and pancreatic arcades. The biological half-time was 39 hours.

CLINICAL STUDIES

Five patients requiring celiac arteriography received 150-200 μc. (5-8 mg. of albumin) of MA. Two interesting features were observed in the resulting scans: (1) as in the animal studies, liver and spleen were well delineated, and (2) there was a difference in activity between normal and neoplastic tissue. Figs. 1 and 2 illustrate two cases. In patient A., liver, spleen and pancreas-duodenum are outlined. In patient J., the region of concentrated radioactivity in the right lobe of the liver proved at postmortem examination to be a cholangiocarcinoma. The remainder of the liver was cirrhotic, accounting for the generally poor hepatic uptake. The area of decreased radioactivity (arrow in Fig. 2b) was a 2 x 3 cm. tumour-involved lymph node that displaced and extended into the pancreas. Liver function tests remained unaltered by the procedure, and the patients' clinical status was unaffected.

COMMENTS

Liver, spleen and, apparently, pancreas can be demonstrated by external scanning after intraceliac axis injection of MA. While the scans of the illustrated cases were valuable, two other scans were disappointing. Scan outline, autoradiography

and organ surface counts implied pancreatic delineation by this method; however, it should be realized that some activity is also present in gastric wall, first and second parts of duodenum, and retroperitoneal tissues. In addition, variations in pancreatic arterial supply may render interpretations of pancreatic morphology difficult. As with selenomethionine-75 pancreatic scans, separation of liver and pancreas remains a problem with conventional scanning apparatus, requiring the utilization of variable views and suppression. It was also apparent that the position of the catheter tip in the celiac axis influenced the destination of MA, and uniform distribution could only be obtained with the catheter just inside the main trunk. Further study is required to evaluate the usefulness of the procedure in specific clinical conditions, viz. cirrhosis, neoplasms and hepatosplenomegaly. Autoradiographic studies in organ samples taken at three hours after injection indicated that the site of accumulation of radioactivity was intra-arterial; however, the long biological half-time suggests that the reticuloendothelial system of liver and spleen may retain MA.

SUMMARY

MA injected through the catheter used for celiac arteriography permit visualization of liver, spleen and pancreas-duodenum by external scanning. It may also display neoplasia in these organs. No adverse effects were noted in five patients, and this procedure may prove to be a useful adjunct to celiac arteriography.

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REFERENCES

1. WAGNER, H. N., JR. *et al.*: *New Eng. J. Med.*, **271**: 377, 1964.
2. ROSENTHALL, L.: *Radiology*, **85**: 110, 1965.
3. KING, E. G., WOOD, D. E. AND MORLEY, T. P.: *Canad. Med. Ass. J.*, **95**: 381, 1966.
4. QUINN, J. L., III, SERRATTO, M. AND KEZDI, P.: *J. Nucl. Med.*, **7**: 107, 1966.
5. WAGNER, H. N., JR. *et al.*: *Ibid.*, **6**: 150, 1965.
6. ODMAN, P.: *Acta Radiol. (Stockh.)*, **45**: 1, 1956.
7. SELDINGER, S. I.: *Ibid.*, **39**: 368, 1953.