

Impaired hepatic function in segmental biliary obstruction demonstrated with a receptor-binding radiotracer

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A patient with cholangiocarcinoma underwent left-sided cholangiojejunostomy, and hepatic functional imaging with a receptor-binding radiotracer and SPECT was performed to evaluate the distribution of functional reserve. It revealed decreased accumulation in the regions with residual dilatation of the intrahepatic bile ducts, indicating several kinds of focal damage in hepatic function caused by segmental biliary obstruction. The radioligand may be useful in assessing regional hepatic function, and the high spatial resolution provided by SPECT appears to play an important role for this purpose.

Key words: ^{99m}Tc -GSA, segmental biliary obstruction, SPECT

INTRODUCTION

^{99m}Tc -diethylenetriaminepentaacetic acid-galactosyl human serum albumin (^{99m}Tc -GSA),^{1,2} a compound similar to ^{99m}Tc -galactosyl-neoglycoalbumin (NGA),³ is a radioligand to the asialoglycoprotein receptor (ASGP-R) that resides exclusively in mammalian hepatocytes.^{4,5} Decreased hepatic accumulation and prolonged blood retention of the ASGP-R-binding radiotracer has been shown in diffuse liver diseases such as liver cirrhosis and chronic hepatitis,¹ and ^{99m}Tc -GSA and ^{99m}Tc -NGA are considered to serve as agents for functional hepatic imaging, which provides anatomical information and estimates of global hepatic functional reserve simultaneously.^{2,6,7}

Regional liver function may be assessed by functional imaging with a hepatocyte-oriented radioligand. Detailed evaluation of heterogeneity in liver function cannot be performed by other noninvasive methods, and may be an important role of functional imaging. In this paper, we report reduced accumulation of ^{99m}Tc -GSA in the region with dilatation of the intrahepatic bile ducts in a patient with cholangiocarcinoma.

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CASE REPORT

A 65-year-old man was referred to Saitama Medical Center for progressive jaundice. Transmission computed tomography (XCT) showed a small low density area in the right hepatic lobe and dilatation of the intrahepatic bile ducts in bilateral lobes, indicating biliary obstruction. Percutaneous transhepatic cholangiography revealed stenosis of the common bile duct. Angiography showed normal hemodynamics in both the hepatic arterial and portal systems. Magnetic resonance imaging was also performed, and finally cholangiocarcinoma in the hepatic hilum was diagnosed. In laparotomy, pathological confirmation of adenocarcinoma was obtained, but the lesion, from the right hepatic duct to the common bile duct in the pancreatic head, was considered too extensive to resect completely, and the left hepatic duct was anastomosed with the jejunum. His serum bilirubin level returned to normal postoperatively.

One month after the cholangiojejunostomy, functional hepatic imaging was carried out to assess the distribution of functional reserve. A single-head rotating gamma camera (ZLC 7500, Siemens) equipped with a low-energy all-purpose collimator interfaced to a minicomputer (Scintipac 2400, Shimadzu) was used. Dynamic imaging of the anterior abdominal view was performed for 20 min following the intravenous injection of 185 MBq ^{99m}Tc -GSA. Twenty-five min after the injection, 64 views were

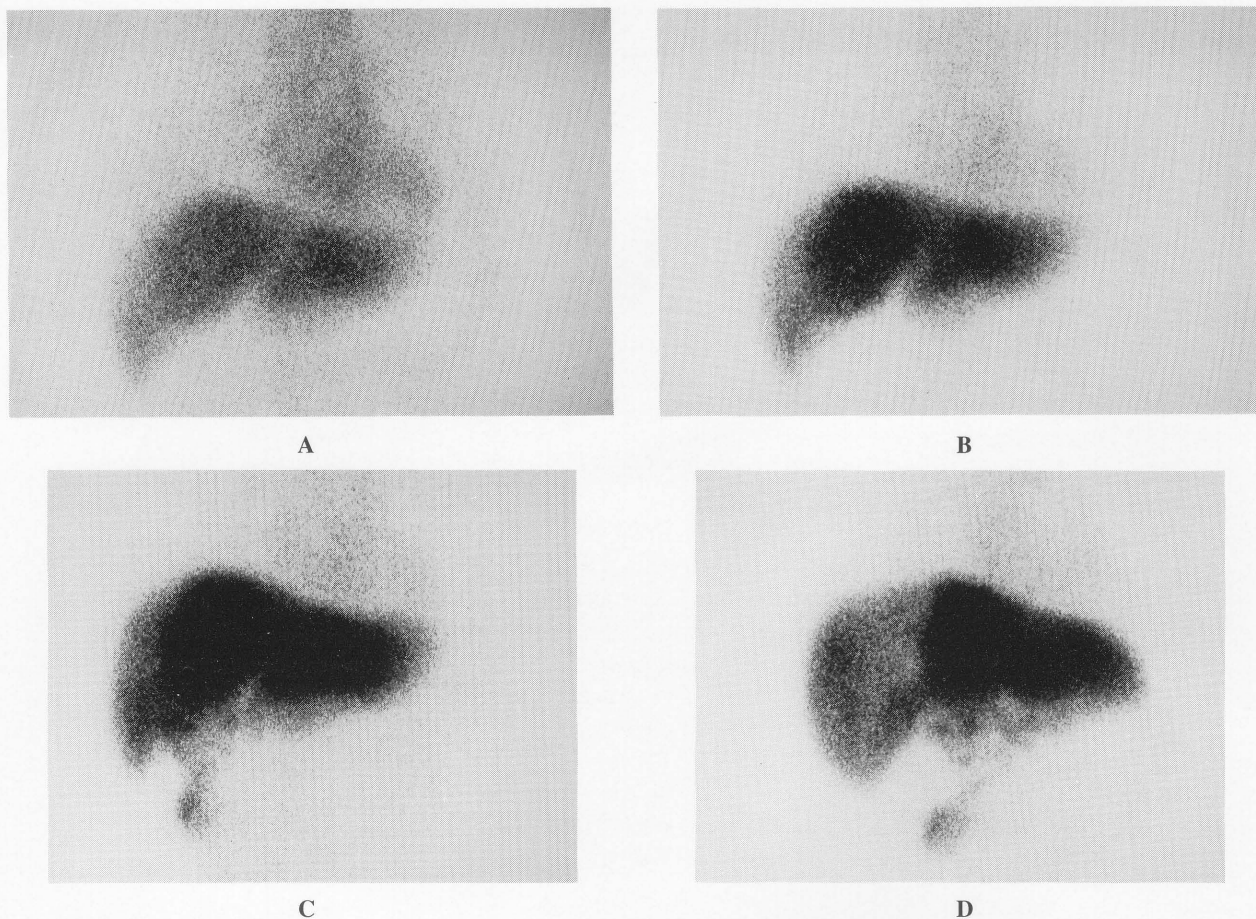


Fig. 1 Anterior views 5 min (A) and 15 min (B) after ^{99m}Tc -GSA injection, and anterior (C) and right-anterior-oblique (D) static images 60 min post-injection. Decreased uptake in the right lobe is revealed (arrows).

acquired 20 sec each for single-photon emission computed tomography (SPECT). Transaxial images were reconstructed using a Shepp and Logan filter and smoothing, with no attenuation correction. Moreover, static planar images were obtained 60 min after the tracer administration.

The dynamic images showed local decrease in the accumulation of ^{99m}Tc -GSA in the right lobe, which was seen more clearly on the static images (Fig. 1). SPECT demonstrated a region of mildly reduced uptake as well as a wedge-shaped area of markedly decreased uptake (Fig. 2). Relative uptake was obtained using 3×3 cm rectangular region of interest, and the counts per pixel for the mildly and severely impaired areas were calculated to be 23% and 65%, respectively, as percentages of those for the left lobe.

Three weeks after the radionuclide imaging, XCT showed dilated intrahepatic bile ducts in the right lobe, and the dilatation of the intrahepatic bile ducts in the left lobe had disappeared (Fig. 3). The regions with residual dilatation were consistent with the decreased uptake areas on the functional images. A part of the liver surface was

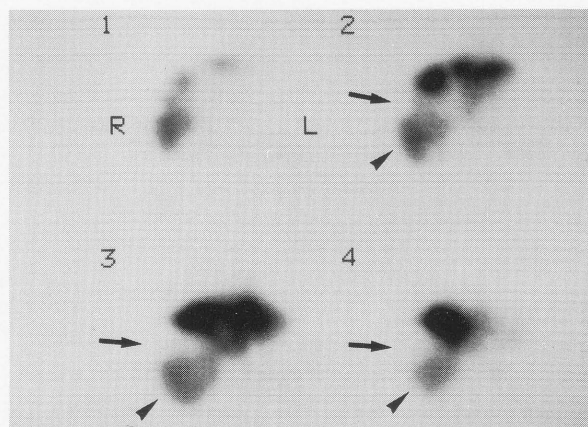


Fig. 2 Transverse SPECT images, numbered from the bottom to the top. A wedge-shaped area of markedly decreased uptake (arrows) and a region of mildly diminished uptake behind it (arrowheads) are observed.

concave, which was considered to reflect focal atrophy of the hepatic tissue with severely decreased accumulation of the radioligand.

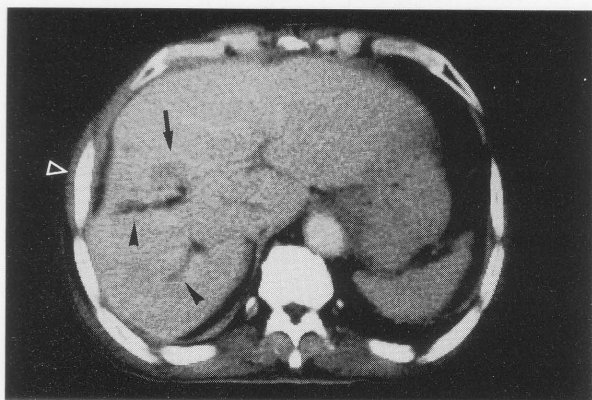


Fig. 3 XCT with contrast enhancement. A low density area (arrow) and dilated intrahepatic bile ducts in the right lobe (arrowheads) are shown. It is also noted that a part of the liver surface is concave (open arrowhead). The regions with dilatation appear to correspond to the areas of decreased ^{99m}Tc -GSA accumulation.

DISCUSSION

Assessment of regional liver function is important in predicting residual liver function after surgical resection or radiotherapy. As conventional indicators for hepatic function such as blood biochemical tests can not offer information on regional liver function, functional hepatic imaging may play a major role in the evaluation of regional liver function.

The accumulation of radioligands to ASGP-R has been investigated mainly for the whole liver. As for nondiffuse liver diseases, decreased concentration of ASGP-R and diminished uptake of the radioligands have been shown in intrahepatic tumors,⁶⁻⁸ however no report on regional impairment of hepatocytes has been published yet.

In the patient presented here, local reduction in accumulation of ^{99m}Tc -GSA was shown for nontumorous liver tissues, indicating focal disorders in hepatic function. Because there was no evidence of ischemia on angiography, these disorders appear to be caused by segmental biliary obstruction. This observation suggests that liver imaging with ^{99m}Tc -GSA may serve as a regional hepatic function test. Relatively high accumulation in the left lobe where bile passage was improved by the surgical intervention may be ascribed to the comparatively short duration of biliary stasis. Short-term obstruction may not have damaged hepatocytes, and it is also possible that regional function had recovered after the cholangiojejunostomy.

Reduced uptake in segmental biliary obstruction was also reported for hepatobiliary imaging agents, another group of hepatocyte-oriented radiopharmaceuticals, such as ^{99m}Tc -pyridoxylidene-5-methyl tryptophan (PMT) and ^{99m}Tc -dimethyl iminodiacetic acid (HIDA).⁹ However, because of the rapid clearance from the liver^{10,11} and possible coexistence of intrahepatic pooling,¹² the de-

tailed extent of impaired tissue is difficult to assess employing these radiopharmaceuticals. The radioligand to ASGP-R remains in the liver longer than hepatobiliary agents,⁴ and is suitable for SPECT imaging. SPECT provides higher spatial resolution than planar imaging. In our patient, mild decrease in accumulation, in addition to severe diminution, was clearly observed on SPECT images, and quantitative evaluation of the impairment was feasible with them. Relative counts are not necessarily equal to relative hepatic function, however, they are assumed to be correlated substantially. In estimating regional hepatic function, the detection of mild decreases, as well as that of defects, and qualification of the residual function in the damaged tissues appear to be of clinical value, and SPECT may be helpful for these purposes. Dynamic SPECT, which cannot be performed with our equipment, will provide further information.

In summary, a cholangiocarcinoma patient with localized decrease in accumulation of the receptor-binding radiotracer due to segmental biliary obstruction was described. Our observation suggests the usefulness of the radioligand, especially combined with SPECT, in assessing regional hepatic function, and encourages a study to determine its utility in predicting the outcome after surgical liver resection.

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