Continuing Medical Education Article

Nuclear Imaging Techniques for the Assessment of Hepatic Function in Liver Surgery and Transplantation

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Disclosure

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Target Audience

This article contains information of value to nuclear physicians, hepatobiliary surgeons, hepatologists, and radiologists.

Objectives

On successful completion of this activity, participants should be able to describe:

1. The relevance of assessment of liver function in liver surgery and transplantation.

2. The technical background of ⁹⁹ᵐTc-labeled diethylenetriaminepentaacetic acid galactosyl human serum albumin (GSA) scintigraphy and ⁹⁹ᵐTc-mebrofenin hepatobiliary scintigraphy.

3. The role of ⁹⁹ᵐTc-GSA scintigraphy and ⁹⁹ᵐTc-mebrofenin hepatobiliary scintigraphy for preoperative assessment of future remnant liver function, follow-up after preoperative portal vein embolization, and evaluation of postoperative liver regeneration.

Questions

1. What is the drawback of conventional dynamic quantitative liver function tests such as the indocyanine green clearance test for the assessment of liver function in the context of liver surgery?
A. They are expensive tests.
B. They can be unreliable because they measure only global liver function.
C. They have not been validated in the context of liver surgery.
D. They provide only an indirect measurement of liver function.

2. Which technique is currently the established method to determine if a patient can safely undergo liver resection?
A. Indocyanine green clearance test.
B. Galactose elimination capacity test.
C. CT volumetry.
D. $^{99m}$Tc-mebrofenin hepatobiliary scintigraphy.

3. $^{99m}$Tc-GSA binds to which protein present on hepatocytes?
A. The asialoglycoprotein receptor present in mammalian hepatocytes.
B. Organic anion transporter polypeptides.
C. Multidrug resistance proteins 2.
D. None of the above; $^{99m}$Tc-GSA diffuses into the hepatocyte and is phosphorylated subsequently.

4. What are the most commonly used parameters determined from planar dynamic $^{99m}$Tc-GSA scintigraphy?
A. The modified receptor index.
B. Liver uptake ratio.
C. Hepatic uptake ratio of $^{99m}$Tc-GSA (LHL15) and blood clearance ratio (HH15).
D. Maximal removal rate of $^{99m}$Tc-GSA ($R_{\max}$).

5. In cirrhotic patients, $^{99m}$Tc-GSA scintigraphy correlates with…
A. The histologic severity of liver disease.
B. Postoperative complications after liver surgery.
C. Conventional liver function tests such as the Child–Pugh classification.
D. All of the above.

6. What is the advantage of liver volume measured by both $^{99m}$Tc-GSA SPECT and $^{99m}$Tc-mebrofenin SPECT, compared with liver volume measured by CT volumetry?
A. Liver volume measured by both $^{99m}$Tc-GSA SPECT and $^{99m}$Tc-mebrofenin SPECT is not influenced by liver fibrosis and can therefore be used in cirrhotic patients.

B. Liver volume measured by both $^{99m}$Tc-GSA SPECT and $^{99m}$Tc-mebrofenin SPECT can distinguish between functional and nonfunctional liver tissue, whereas CT volumetry cannot.

C. Liver volume measured by both $^{99m}$Tc-GSA SPECT and $^{99m}$Tc-mebrofenin SPECT is more accurate because of the high-resolution images.

D. $^{99m}$Tc-GSA SPECT or $^{99m}$Tc-mebrofenin SPECT enables assessment of both liver uptake and excretion.

7. Dual-head (rotating) $\gamma$-cameras enable the calculation of a geometric mean dataset of the anterior and posterior projection of the liver. Why is this geometric mean dataset recommended for dynamic $^{99m}$Tc-mebrofenin hepatobiliary scintigraphy?

A. Because of the anatomic position of the liver, the left hemiliver is situated more anteriorly, leading to an overestimation of segmental left liver function in the anterior projection.

B. Geometric mean is better in assessing segmental liver function.

C. Geometric mean enables the measurement of functional liver volume.

D. Geometric mean increases temporal resolution and hence the accuracy of measurement.

8. The uptake of $^{99m}$Tc-mebrofenin can be influenced by…

A. Hepatic blood flow.

B. Hypoalbuminemia.

C. High plasma concentrations of bilirubin.

D. All of the above.

9. What is the advantage of both $^{99m}$Tc-GSA scintigraphy and $^{99m}$Tc-mebrofenin hepatobiliary scintigraphy over conventional quantitative liver function tests and CT volumetry?

A. They measure both total and regional liver function and thereby enable the functional assessment of specifically the future remnant liver.

B. Two separate cutoff values are available for patients with a normal and a compromised liver to predict whether a patient can safely undergo liver surgery.

C. They are not influenced by the presence of underlying parenchymal liver disease.

D. They are available worldwide and provide simple parameters to measure liver function.
10. Which $^{99m}$Tc-iminodiacetic acid agent is regarded as most suitable for hepatobiliary scintigraphy?

A. $^{99m}$Tc-mebrofenin.
B. $^{99m}$Tc-disofenin.
C. $^{99m}$Tc-lidofenin.
D. $^{99m}$Tc-arclofenin.