Case Report

Diagnostic Value of Color Doppler Ultrasound and US Angiography for Small Hepatic Angiomyolipomas

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We report a case of small hepatic angiomyolipoma (AML) in which we preoperatively identified the color Doppler ultrasound (US) and CO₂-US angiography characteristics. A 49-year-old woman was found to have a liver tumor 13 mm in diameter in segment V by abdominal US and computed tomography (CT), but it was difficult to make a definite diagnosis of the tumor by conventional imaging studies. Color Doppler US revealed a pulsating arterial afferent tumor vessel and constant efferent flow from the tumor. US angiography demonstrated heterogeneous positive enhancement of the tumor immediately after injection of CO₂ and the contrast enhancement persisted for 600 seconds. The results in this case show that US angiography and color Doppler US are extremely useful for diagnosing small hepatic nodules.

Key Words : angiomyolipoma (AML), CO₂-US angiography

Introduction

Angiomyolipoma (AML) of the liver is a rare, benign tumor composed of varying amounts of mature adipose tissue, smooth muscle, and blood vessels¹⁾. The imaging features of hepatic AML depend on the relative proportion of the tissue components within the tumor, and the characteristics of such tumors have been well documented²⁻⁵⁾. However, the precise criteria for preoperative imaging diagnosis of small hepatic AMLs have not been established. We report a case of small hepatic AML and discuss the color Doppler ultrasound (US) and CO₂-US angiography characteristics, which were useful in establishing a definitive preoperative diagnosis.

Case Report

A 49-year-old woman was found to have a tumor in segment V of the liver by abdominal US during a routine medical checkup in May 2000. She had no symptoms related to the hepatic tumor and no relevant family history. The patient was referred to our hospital in August 2000 for further examination and treatment of the hepatic tumor. The liver, spleen, and tumor were not palpable during the physical examination on admission. Laboratory values were all within the normal range. Tests for hepatitis B surface antigen and hepatitis C virus antibody were negative.

Computed tomography (CT) without contrast demonstrated a well-defined, heterogeneous lesion 13 mm in diameter with slight enhancement in the early phase of dynamic CT (**Fig. 1**). Selective hepatic digital subtraction angiography demonstrated a hypervascular mass in the arterial phase and a tumor stain in the venous phase without arteriovenous or arteriportal shunting. Digital

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Fig. 1 Contrast enhancement CT demonstrating a well-defined, heterogeneous lesion 13 mm in diameter, with slight enhancement.

Fig. 3 Color Doppler waveform showing a pulsating arterial afferent tumor blood flow into the tumor.

Fig. 2 Digital subtraction angiography revealed a hypervascular tumor with dilated vessels within the tumor.

Fig. 4 US angiography revealed differences in the amount of blood flow in the tumor between the start of the CO2 infusion and the late phase.

subtraction angiography (DSA) showed normal portal venous flow. DSA showed a hypervascular tumor within dilated vessels, but there were no microaneurysms (Fig. 2).

US revealed a hyperechoic mass 13 mm in diameter in the anterior-inferior area of the liver. That was well demarcated from the surrounding parenchyma. Color Doppler US revealed a pulsating arterial afferent tumor vessel and constant efferent flow from the tumor. The single peak flow velocity pattern was characteristic of the hepatic artery (Fig. 3).

US angiography was performed before angiography by means of a quick manual injection of CO2

microbubbles through a catheter inserted into the common hepatic artery. US angiography demonstrated clear heterogeneous positive enhancement of the tumor immediately after the CO2 injection (Fig. 4), and the contrast enhancement persisted for 600 seconds. Because the lesion was near the liver surface, pathological diagnosis by fine-needle biopsy was not performed. Since it on the basis of these findings, whether the lesion was a benign tumor or a malignant tumor with fatty change could not be determined, partial hepatic resection was performed (Fig. 5a, 5b). The tumor was round, soft, elastic, lacked a capsule, and measured 13 mm in diameter (Fig. 6a). Pathologic examination of the

Fig. 5a, 5b The resected liver and gallbladder.

resected specimen revealed the three components: smooth muscle, adipose tissue, and blood vessels (Fig. 6b). Epithelioid tumor cells immunostained positive for HMB-45, predominantly in the central cytoplasm. These histological findings confirmed the diagnosis of hepatic AML.

The postoperative course was uneventful, and the patient was discharged on postoperative day 12. The patient has been well for 72 months after surgery, with no signs of recurrence.

Discussion

Because its appearance on imaging studies varies with the relative proportions of the tissue components, hepatic AML is often difficult to distinguish from other fat-containing hepatic tumors, such as lipomas, liposarcomas, hepatocellular carcinomas (HCCs), hepatocellular adenomas, and metastatic

Fig. 6a Resected specimen (HE stain, ×1). The tumor was round, soft, elastic, lacked a capsule and measured 13 mm in diameter.

Fig. 6b Resected specimen (HE stain, ×40). Pathologic examination of the tumor showed the three components. smooth muscle, adipose tissue, and blood vessels.

tumor¹⁾. Hypervascular masses such as hemangiomas and typical HCCs that are more than 2 cm in diameter can usually be definitively diagnosed by echography, dynamic CT, and angiography. However, making a definitive diagnosis is sometimes more difficult when the hypervascular mass is less than 2 cm in diameter and has a lipid component. Although CT is extremely sensitive and specific for fat within lesions, attenuation in small lesions is not always reliable because of the partial-volume effect.

US imaging in our patient revealed a homogeneous, hyperechogenic mass, and thus conventional US was not useful for differentiating AML from other tumors with lipomatous lesions, such as early

HCC, and did not provide information on blood circulation within the tumor.

Color Doppler flow imaging is a noninvasive method for examining hemodynamics under physiological conditions. A pulsating arterial afferent tumor vessel and constant efferent flow from tumor vessels may be characteristics of HCC. Because each of these characteristics was observed in our patient, a malignant tumor could not be ruled out. On the other hand, a slightly dull arterial pulsating pattern was visualized in the intratumoral area, in contrast to the spiky arterial pulsating vessels visualized in HCC⁹⁾. Two arterial pulsating patterns may be the characteristics of HCC.

US angiography with arterial infusion of CO₂ microbubbles was first used to diagnose hepatic tumors by Matsuda and Yabuuchi⁷⁾. This technique combines US with angiography and is extremely sensitive in demonstrating the vascular pattern in tumors. By observing the tumor blood flow from the start of the CO₂ infusion until CO₂ washout from the liver parenchyma, the vascular pattern of the hepatic nodule can be more accurately evaluated^{8,9)}. In our patient US angiography revealed relative differences in the total amount of blood in the tumor between the start of CO₂ infusion and the late phase. This finding suggested that the tumor contained many capillaries. This vascular pattern observed by US angiography in small AMLs also may not be present in small HCCs.

To our knowledge, this is the first report of US angiography and color Doppler flow imaging studies of AML. These imaging studies are highly sensitive in detecting vascular patterns, even in small lesions less than 2 cm in diameter.

Hepatic AML is often difficult to diagnose on the basis of conventional imaging methods. Hepatic AMLs are frequently resected because a malignant tumors cannot be ruled out. We showed that US

angiography and color Doppler US are extremely useful for diagnosing small hepatic nodules.

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