Diagn Interv Radiol 2012; 18:387–390

Imaging findings in myomatous angiomyolipoma of the liver

Piero Boraschi, Francescamaria Donati, Giulia Gherarducci

ABSTRACT
Angiomyolipoma of the liver is a rare benign mesenchymal tumor, comprising three tissue components: blood vessels, smooth muscles, and adipose cells. Depending on the predominance of these components, tumors are categorized into various types, out of which the myomatous variant is the most rare. Most of these tumors are detected incidentally and are solitary when discovered. Definitive preoperative diagnosis is often difficult because the radiological appearance of hepatic angiomyolipoma can be non-specific and varied. This is because the distribution and relative proportion of the three tissue components vary widely from tumor to tumor. Here, we present ultrasonography (US), multidetector computed tomography (CT), and magnetic resonance imaging (MRI) findings with pathological correlations of myomatous angiomyolipoma of the liver in a 21-year-old asymptomatic man who had no history of liver disease, hepatitis, or tuberous sclerosis. The tumor was hypoechoic on US and showed wash-in in the arterial phase and wash-out in the portal-venous phase on both dynamic contrast-enhanced CT and MRI. Additionally, the lesion was hypointense in the hepato-biliary phase on MRI obtained two hours after gadobenate dimeglumine administration and was not clearly identified from fat tissue in the in-phase/opposed-phase T1-weighted sequences.

Key words: • *angiomyolipoma* • *liver* • *X-ray computed tomography* • *magnetic resonance imaging* • *smooth muscle cell*

From the Department of Oncologic and Radiological Sciences (P.B. ✉ *p.boraschi@do.med.unipi.it*, F.D.), Pisa University Hospital, 2nd Unit of Radiology, Pisa, Italy; Diagnostic and Interventional Radiology of the Department of Oncology, Transplants and Advanced Technologies in Medicine (G.G.), University of Pisa, Pisa, Italy.

Received 13 October 2011; revision requested 24 October 2011; revision received 30 October 2011; accepted 3 November 2011.

Published online 19 April 2012
DOI 10.4261/1305-3825.DIR.4870-11.2

Angiomyolipoma (AML) is usually seen in the kidneys and rarely involves the liver. Hepatic AML presents as a benign mesenchymal tumor, comprising three tissue components: blood vessels, smooth muscles, and adipose cells. These tumors are solitary in the vast majority of cases and are typically discovered incidentally (1). Depending on the predominance of the tissue components, AML is categorized into various types, out of which the myomatous variant is the most rare (2). The accuracy of the preoperative diagnosis is very low, and most cases are usually misdiagnosed on medical imaging as other hepatic tumors, such as hepatic hemangioma or liver cancer (3). Imaging findings of hepatic AML have been described on computed tomography (CT) and magnetic resonance imaging (MRI) with and without serial contrast enhancement (4, 5).

Here, we describe a case of myomatous AML of the liver without tuberous sclerosis that has been evaluated with ultrasonography (US), CT, and serial contrast-enhanced MRI using a hepato-biliary contrast agent with a pathological correlation.

Case report

A 21-year-old man was admitted to our hospital for a routine abdominal US which revealed a nodular hypoechogenic mass with a diameter of 4 cm in the V segment of the liver (Fig. 1a). The patient had no abdominal discomfort and no clinical signs or constitutional symptoms of chronic liver disease. No evidence of an association with tuberous sclerosis was found in clinical, laboratory, or radiological tests. Liver function tests were normal and levels of serum tumor markers including α-fetoprotein, carcinoembryonic antigen, and carbohydrate antigen 19-9, were within normal ranges.

The patient underwent multiphasic CT of the liver that confirmed the presence of a subcapsular oval lesion with lobulated margins in the V segment. On an unenhanced CT scan it was slightly hypodense (Fig. 1b), showed nearly homogeneous contrast uptake in the arterial phase, and became hypoattenuating in the portal-venous phase (Fig. 1c and 1d). No capsule was noted around the lesion. The surrounding liver parenchyma was normal and there was no evidence of cirrhosis.

To further characterize the lesion, MRI of the liver was performed at 1.5 T (Signa HDx, GE Healthcare, Milwaukee, Wisconsin, USA) with a phased-array coil; the examination was performed using spoiled gradient-echo T1-weighted images in dual phase and respiratory-triggered fast spin-echo and breath-hold, single-shot fast spin-echo T2-weighted sequences, with and without fat saturation. A three-dimensional fat-suppressed breath-hold T1-weighted LAVA sequence (TR/TE, 3.6 ms/1.6 ms; 2.4 mm thk/-1.8 mm sp; matrix, 224×192; one NEX) was performed before and after intravenous administration of

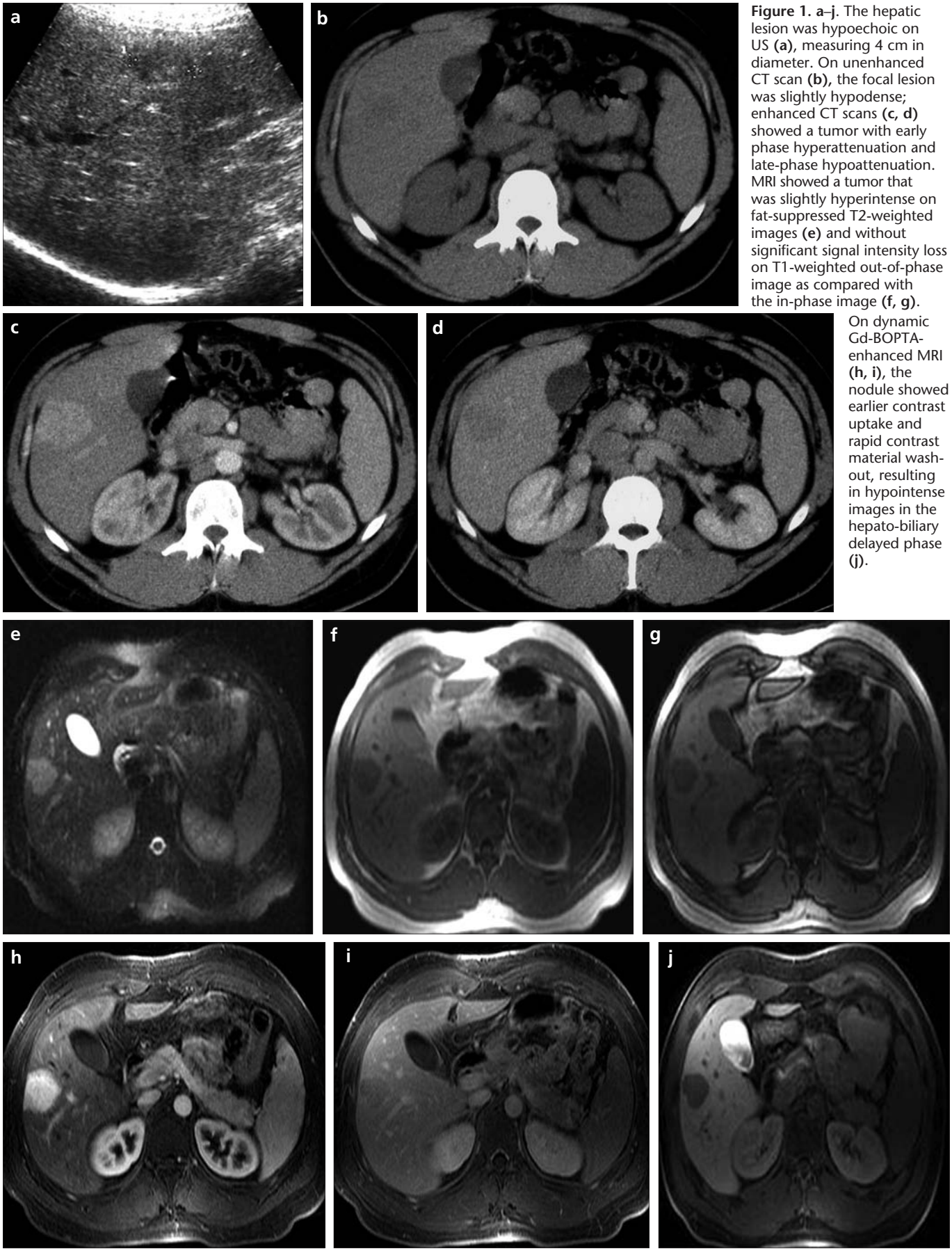

Figure 1. a–j. The hepatic lesion was hypoechoic on US **(a)**, measuring 4 cm in diameter. On unenhanced CT scan **(b)**, the focal lesion was slightly hypodense; enhanced CT scans **(c, d)** showed a tumor with early phase hyperattenuation and late-phase hypoattenuation. MRI showed a tumor that was slightly hyperintense on fat-suppressed T2-weighted images **(e)** and without significant signal intensity loss on T1-weighted out-of-phase image as compared with the in-phase image **(f, g)**. On dynamic Gd-BOPTA-enhanced MRI **(h, i)**, the nodule showed earlier contrast uptake and rapid contrast material wash-out, resulting in hypointense images in the hepato-biliary delayed phase **(j)**.

gadobenate dimeglumine (Gd-BOPTA, MultiHance, Bracco Diagnostic Inc., Singen, Germany) at a dose of 0.1 mmol/kg body weight as a bolus injection with a flow-rate of 2 mL/s, followed by injection of isotonic saline (20 mL). Contrast-enhanced dynamic images were acquired in the arterial dominant phase, portal-venous phase, late venous phase (after five minutes), and hepato-biliary phase (about two hours after administration). On T2-weighted images, the lesion appeared slightly hyperintense and did not reveal significant signal intensity decay on T1-weighted out-of-phase sequences (Fig. 1e–1g). On dynamic MR images, the nodule showed earlier contrast enhancement and rapid contrast material wash-out after injection of Gd-BOPTA, resulting in clearly hypointense images in the hepato-biliary phase (Fig. 1h–1j). Collectively, MRI findings for the lesion were consistent with a non-fat-containing hypervascular mass. Although serum α-fetoprotein levels were within normal limits and the patient had no history of chronic liver disease; hepatocellular carcinoma was suspected on the basis of the radiological imaging.

The patient underwent hepatic resection of the nodule. Histologically, the tumor was composed primarily of smooth muscle cells and contained small amounts of adipose cells and blood vessels (Fig. 2). Based on immunohistochemical staining, the tumor was negative for hepatocytes and the smooth muscle cells were strongly positive for a melanocytic cell-specific monoclonal antibody (HMB-45). The final histopathological diagnosis of the specimen was consistent with myomatous AML.

The patient's postoperative course was unremarkable and he is in good health two years after the surgery.

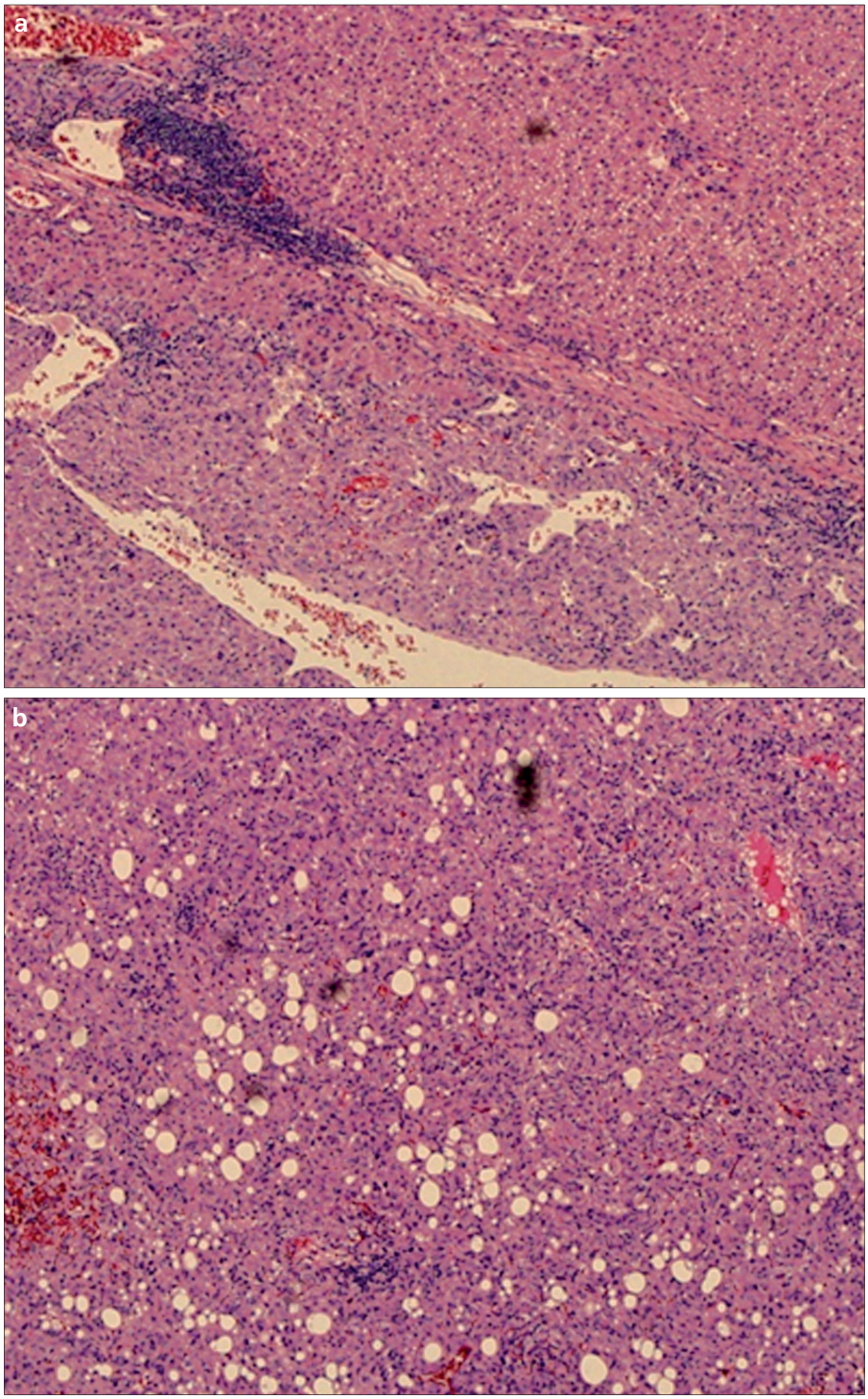

Figure 2. a, b. Histological features of the tumor showed that it was composed mainly of smooth muscle cells **(a)** (hemotoxylin eosin, ×4) and a small number of adipose cells and blood vessels **(b)** (hemotoxylin eosin, ×40).

Discussion

AML of the liver is an uncommon benign mesenchymal tumor. Following the first description by Ishak (1), only about 200 cases have been reported in the literature since 1976. The incidence of renal AML in cases of tuberous sclerosis has been reported to be 40%–80% (6), while only 5%–10% of patients with tuberous sclerosis have an AML of the liver (7). In most cases, hepatic AML occurs spontaneously, is not associated with renal locations (8), and is usually identified in adult women where its size may range from microscopic to giant. Most cases are asymptomatic and discovered incidentally, but they can be symptomatic and may occasionally rupture (9).

Hepatic AML has traditionally been considered to be a benign hematoma, but recently it has been identified as a tumor of mesenchymal tissue and may be related to perivascular epithelioid cell tumors (10, 11), as proposed by Bonetti et al., (11) who introduced the concept of a perivascular epithelioid cell tumor (PEComa). PEComa has been described as a mesenchymal

tumor composed of histologically and immunohistochemically distinctive perivascular epithelioid cells that are immunoreactive for HMB-45, a monoclonal antibody for melanoma. Because AML is included in PEComas (12), this can be considered a defining criterion for diagnosis because liver tumors other than AML are negative for this marker. Hepatic AML is histologically indistinguishable from its renal counterpart and it is characterized by the presence of a varying heterogeneous mixture of three tissue components: mature adipose tissue, smooth-muscle cells, and thick-walled blood vessels. The fat components are highly suggestive of AML, but its proportion is highly variable from patient to patient, ranging from less than 10% to more than 90% of the tumor volume. This causes diagnostic problems if the amount of fat is too low to show characteristic features on images (3).

The radiological appearance of hepatic AML varies widely due to the fact that the distribution and relative proportions of the three components vary widely from tumor to tumor. Goodman and Ishak (7) first reported five cases in which the fat component occupied less than 10% of the tumor on average. According to the predominance of tissue components, the tumors are subcategorized into mixed, lipomatous (≥70% fat), myomatous (≤10% fat), and angiomatous types (2, 10). The mixed type is the most common in the literature; the rarest cases are those tumors with a small number of adipose cells, such as the myomatous type, that show widely variable morphology patterns. In 1996, Terris et al. (13) reported four cases of AML in which the low content of fat failed to appear as typical images. Tsui et al. (2) also presented 10 cases of tumors with low fat content and showed that these tumors had widely variable morphology patterns. In 2006, a rare case of hepatic AML was reported, where the amount of fat was <1% (14). The last reported case was in 2009, where the tumor was composed almost exclusively of epithelioid smooth muscle cells that exhibited a trabecular growth pattern, few thick-walled blood vessels, and few adipose cells. The fat component accounted for only 5% of the mass (15).

In our patient, we were unable to clearly identify the low fat component of the lesion with all imaging modalities, including in- and opposed-phase MRI. To our knowledge, this is the first case report of AML in which MRI was performed using a hepato-biliary contrast agent, such as Gd-BOPTA; the lesion showed earlier contrast enhancement and rapid contrast material washout and showed low signal intensity with respect to the surrounding liver in the hepato-biliary phase. Even though serum α-fetoprotein levels were within normal limits and the patient had no history of chronic liver disease, this behavior was suspicious for hepatocellular carcinoma. As described by Ahmadi et al. (16), AML can demonstrate early intense contrast enhancement that peaks later than that of hepatocellular carcinoma. Dynamic contrast-enhanced CT or MRI obtained during the early phase of enhancement may be useful in discriminating between AML and fat-containing hepatocellular carcinoma. The fatty areas of AMLs are well vascularized and enhance early, whereas steatotic foci in hepatocellular carcinoma are relatively avascular and have less contrast enhancement. Unfortunately, in our case, the specific pattern of the time density/intensity curve was not significant, so a preoperative radiological diagnosis was not possible.

As a conclusion, preoperative diagnosis of hepatic AML should be considered and is important because of its benign nature. However, the diagnosis of this uncommon disease entity is challenging for radiologists because it has various histological patterns, and in particular, the imaging findings of the myomatous-type, including MRI with hepato-biliary contrast agents such as Gd-BOPTA, can be very similar to those of hepatocellular carcinoma.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Ishak KG. Mesenchimal tumors of the liver. In: Okuda K and Peters RL, eds. Hepatocellular carcinoma. New York: John Wiley & Sons, 1976; 247–307.
2. Tsui WM, Colombari R, Portmann BC, et al. Hepatic angiomyolipoma: a clinicopathologic study of 30 cases and delineation of unusual morphologic variants. Am J Surg Pathol 1999; 23:34–48.
3. Basaran C, Karcaaltincaba M, Akata D, et al. Fat-containing lesions of the liver: cross-sectional imaging findings with emphasis on MRI. AJR Am J Roentgenol 2005; 184:1103–1110.
4. Chang Z-G, Zhang J-M, Ying J-Q, Ge Y-P. Characteristics and treatment strategy of hepatic angiomyolipoma: a series of 94 patients collected from four institutions. J Gastrointestin Liver Dis 2011; 20:65–69.
5. Yoshimura H, Murakami T, Kim T, et al. Angiomyolipoma of the liver with least amount of fat component: imaging features of CT, MR, and angiography. Abdom Imaging 2002; 27:184–187.
6. Schneider-Monteiro ED, Lucon AM, de Figueiredo AA, Rodrigues Junior AJ, Arap S. Bilateral giant renal angiomyolipoma associated with hepatic lipoma in a patient with tuberous sclerosis. Rev Hosp Clin Fac Med Sao Paulo 2003; 58:103–108.
7. Goodman ZD, Ishak KG. Angiomyolipomas of the liver. Am J Surg Pathol 1984; 8:745–750.
8. Carmody E, Yeung E, McLoughlin M. Angiomyolipomas of the liver in tuberous sclerosis. Abdom Imaging 1994; 19:537–539.
9. Ros PR. Hepatic angiomyolipoma: is fat in the liver friend or foe? Abdom Imaging 1994; 19:552–553.
10. Takahara M, Miyake Y, Matsumoto K, et al. A case of hepatic angiomyolipoma difficult to distinguish from hepatocellular carcinoma. World J Gastroenterol 2009; 15:2930–2932.
11. Bonetti F, Pea M, Martignoni G, Zamboni G. PEC and sugar. Am J Surg Pathol 1992;16:307–308.
12. Pan CC, Chung MY, Ng KF, et al. Constant allelic alteration on chromosome 16p (TSC2 gene) in perivascular epithelioid cell tumour (PEComa): genetic evidence for the relationship of PEComa with angiomyolipoma. J Pathol 2008; 214:387–393.
13. Terris B, Fléjou JF, Picot R, Belghiti J, Hénin D. Hepatic angiomyolipoma. A report of four cases with immunohistochemical and DNA-flow cytometric studies. Arch Pathol Lab Med 1996; 120:68–72.
14. Wang SN, Tsai KB, Lee KT. Hepatic angiomyolipoma with trace amounts of fat: a case report and literature review. J Clin Pathol 2006; 59:1196–1199.
15. Banshodani M, Ishiyama K, Amano H, et al. Hepatic angiomyolipoma with minimal intratumoral fat content. Case Rep Gastroenterol 2009; 3:324–331.
16. Ahmadi T, Itai Y, Takahashi M, et al. Angiomyolipoma of the liver: significance of CT and MR dynamic study. Abdom Imaging 1998; 23:520–526.