Multiple liver focal fat sparing lesions with unexpectedly increased ^{18}F-FDG uptake mimicking metastases examined by ultrasound ^{18}F-FDG PET/CT and MRI

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Abstract
Focal fatty liver disease is less common than the diffuse form and may be misdiagnosed as nodular liver lesions or even liver metastases. Here, we report a 19 years old male, asymptomatic with liver lesions detected by ultrasound on routine examination. Further examinations with computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography/CT (PET/CT) showed multiple lesions of varying sizes on the liver, with elevated fluorine-18-fluorodeoxyglucose (^{18}F-FDG) uptake (SUVmax: 4.8-12.5). The diagnosis of metastases or lymphoma was made. *In conclusion*: Histopathology diagnosed focal fatty sparing lesions in the liver. This pattern presented difficult diagnostic challenge. The pathogenesis of multifocal fat deposition and the reasons of the higher accumulation of ^{18}F-FDG in the liver fat lesions have not been up to now fully explained.

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Introduction

Fatty liver refers to a focal area or a diffuse homogeneous fatty liver. Focal lesions have been regarded as pseudolesions [1]. Atypical focal fatty sparing lesions mimic tumors when diagnosed by imaging modalities and thus may cause misinterpretation and a diagnostic dilemma in clinical practice [2, 3]. We present the case of a 19 years old asymptomatic male with multiple lesions in the liver, first detected by ultrasound, and considered as metastatic.

Case Report

A 19 years old male was admitted to our hospital with liver lesions detected by ultrasound on routine physical examination. He had no obvious abdominal pain, bloating, nausea, vomiting, haematemesis, heamatochezia, discomfort, or significant weight loss.

The patient's physical examination was normal. Laboratory tests, including blood cell counts, tumor markers test (including AFP and CEA), autoimmune test, erythrocyte sedimentation rate, and C-reactive protein, were all within normal limits.

Abdominal ultrasound showed multiple hyperechoic areas in the liver with clear borders with no obvious blood flow signal. Abdominal unenhanced CT, (Light speed VCT, GE Medical Systems, Milwaukee WI, USA) showed multiple low density lesions of varying size in the liver, with diameter 0.6 to 3.5cm of which the largest was 4.0cm in length and 3.0cm in width. An enhanced dual-phase CT scan showed that the lesions were of slightly low density on the arterial phase and of low density on the venous phase (Figure 1). Magnetic resonance imaging (MRI, Signa HDx, GE) showed diffused lesions in the liver with clear boundary and high signal on diffusion weighted imaging (DWI) and increased signal intensity on the enhanced MR arterial phase (Figure 2). Fluorine-18-FDG PET/CT (Discovery VCT®, GE) showed high uptake of ^{18}F-FDG on the regions of the low-density lesions of the liver, and maximum standardized uptake value (SUVmax) was 4.8-12.5 (Figure 3A and B). No other lesions with abnormal uptake of ^{18}F-FDG were found on the whole-body PET/CT images (Figure 3C). The primary diagnosis of the lesions in the liver based on the ^{18}F-FDG PET/CT scan was that they were malignant.

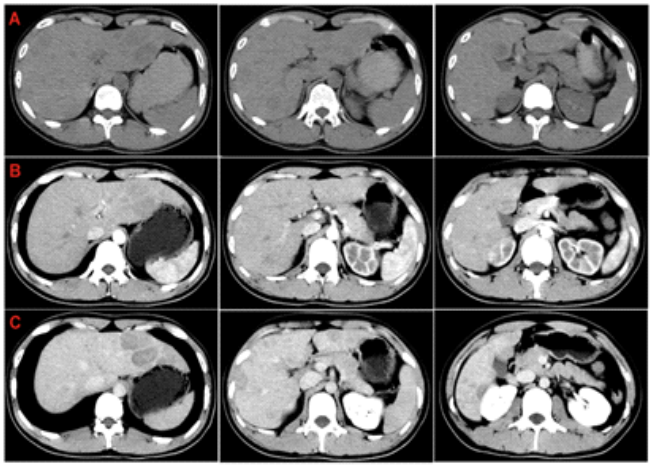

Figure 1. A series images of CT scan. A, B and C indicate CT plain scan, contrast enhanced CT (arterial phase) and contrast enhanced CT (venous phase), respectively. Multiple low density lesions of varying sizes in the liver were found and the lesions had slightly low density on the arterial phase and low density on the venous phase.

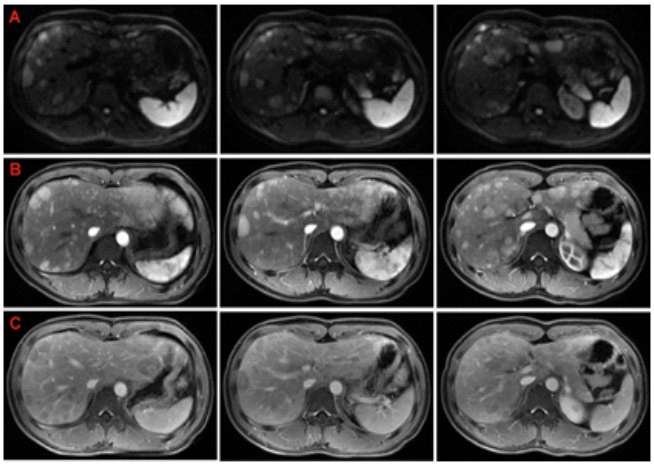

Figure 2. MRI images of the liver. Diffused lesions with clear boundary and high signal on DWI (A) and increased signal intensity on the enhanced MR arterial phase (B).

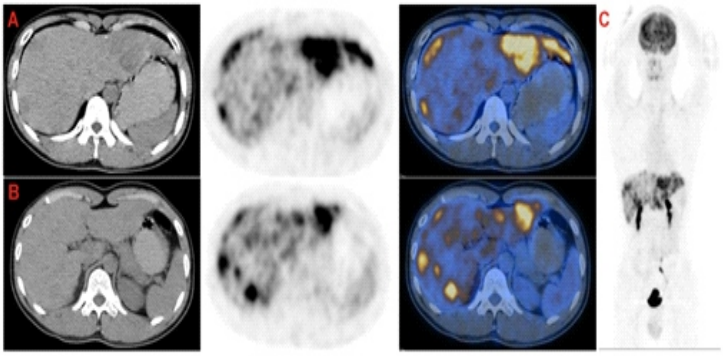

Figure 3. A series images of CT scan. A, B and C indicate CT plain scan, contrast enhanced CT (arterial phase) and contrast enhanced CT (venous phase), respectively. Multiple low density lesions of varying sizes in the liver were found and the lesions had slightly low density on the arterial phase and low density on the venous phase.

After laparoscopic surgery and biopsy of the liver lesions, histopathology showed extensive liver steatosis (Figure 4). The subject was followed-up for a period of 24 months. He recovered well post-surgery, had no adverse symptoms and remained with no treatment.

Discussion

Fatty liver disease is a common condition, with a prevalence of 10%-24% worldwide, and 70% in diabetic patients [4, 5]. Fatty liver infiltration may be diffuse or focal. Modern imaging modalities, such as ultrasound, CT and MRI, have high accuracy for detection and grading of fat deposition in diffuse fatty infiltration of the liver. However, focal fatty liver disease is less common than the diffused form but presents a greater diagnostic quandary and may be misdiagnosed as nodular liver lesions or even liver metastases. The incidence of focal fatty liver disease could not be found in the literature.

The pathogenesis of focal fatty changes within the liver may be related to alterations of vascular supply. Hepatocytes near the central veins tend to be more susceptible to metabolic stress, and accumulate lipid earlier compared to peripheral hepatocytes [4]. The mechanisms involved in focal fatty sparing are considered to be the result of local vascular anatomical variations, for example, aberrant gastric venous drainage decreasing portal perfusion, abnormal gal-

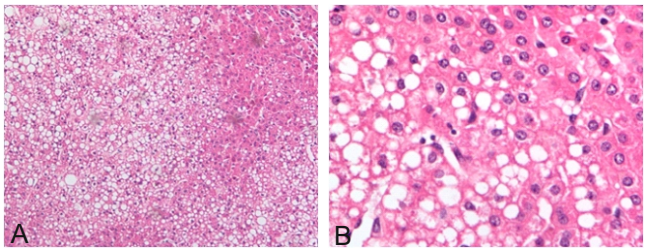

Figure 4. There are many fatty drops in the liver of the patient showing liver steatosis. HE staining (A*100 and B*400)

lbladder venous drainage, abnormal venous drainage around the falciform ligament, etc [5]. This may explain the predominance of occurring of focal fatty sparing in regions

adjacent to the falciform ligament and the gallbladder [6, 7]. A study with 1568 nonalcoholic fatty liver patients showed that focal fatty sparing was usually not arising from preexisting segmental homogeneous fatty liver, and may occur during the process of development of diffuse fatty liver [1]. Although there have been various studies of focal fatty sparing, the mechanism involved in the formation of focal fatty liver has not been fully explained.

Ultrasound is the first-line and simplest imaging method for liver steatosis. Fatty liver appears bright or hyperechoic compared to the adjacent right kidney or the spleen, whereas fatty sparing is isoechoic or hypoechoic. Unenhanced CT could be used for the evaluation of hepatic steatosis, with liver density less than 40 Hounsfield units (HU) or a density difference of more than 10HU between spleen and fatty liver. However, enhanced CT has a limited role due to the influence of contrast injection. Focal fat deposition can mimic other hepatic benign and malignant lesions on ultrasound and CT. The most sensitive and objective imagingtechnique for the identification and quantification of hepatic steatosis is MRI, which appears isointense or hyper intense on the in-phase images and looses signals on the out-of-phase images [8, 9].

Fluorine-18-FDG PET is a valuable tool in oncology. A higher uptake of ^{18}F-FDG is usually found in malignant lesions. Liver uptake of ^{18}F-FDG should not be altered by the presence of steatosis [10]. A total of 142 patients were included in the above study [10] and divided into three groups: control group with no fatty liver, a diffuse fatty liver disease group and a more strictly defined fatty liver disease group. These authors found that no significant difference of average SUVmax existed among the three groups (2.18, 2.03 and 2.07, respectively). However, there had been three reports of focal higher ^{18}F-FDG uptake in the fat spared area of the liver [11-13], and all these cases had malignant tumor history and diffuse fat deposition with one or four focal sparing lesions, which mimicked metastases. In our case report, the multifocal liver lesions had higher uptake of ^{18}F-FDG.

Multifocal fat deposition has been described as multinodular hepatic steatosis, which is randomly distributed throughout the liver [5]. This pattern presents a difficult diagnostic challenge, and the differential diagnosis may include metastases, lymphoma, sarcoidosis, and haemangiomatosis. The pathogenesis of multifocal fat deposition and the higher accumulation of ^{18}F-FDG are unknown.

Some benign hepatic lesions could also concentrate ^{18}F-FDG, such as focal nodular hyperplasia and inflammatory pseudotumors [14-15].

In conclusion, our case of a 19 years old male with focal fatty sparing liver was examined by ultrasound, CT, MRI and ^{18}F-FDG PET/CT and was at first misdiagnosed as metastatic or lymphomatosous liver. Increased uptake of ^{18}F-FDG over the lesions was unexpected for benign lesions. This pattern presents a very difficult diagnostic challenge. The pathogenesis of multifocal fat deposition and the reason of the higher accumulation of ^{18}F-FDG are not fully explained.

The authors declare that they have no conflicts of interest.

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