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Focal Sparing Around the Gallbladder in Fatty Liver: An Useful Sign for the Diagnosis of Borderline Cases by CT

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脂肪肝CTにおける胆嚢周囲の限局性正常組織の残存

—軽度脂肪肝CT診断における有用性—

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我々は脂肪肝のCTにおいて，脂肪沈着のない正常肝組織の残存が，特に胆嚢周辺部に高率に認められることに注目し，その頻度および脂肪肝診断上の有用性などにつき検討した．脂肪肝CT57例の検討では，focal sparing area（相対的高吸収域）は胆嚢周辺42例（73.7%），肝被膜下13例（22.8%），方形葉8例（14.9%），尾状葉2例（3.5%）と胆嚢周辺部に最も高頻度に認められた．その形状は，点状，帯状，輪状，混合形など様々であった．CT値計測なしでは，脂肪肝と判断できないような軽度の脂肪肝においても，38例中27例（71%）に，この胆嚢周辺部相対的高吸収域が認められ，軽症例の見逃しを防ぐ上で有用な所見であると考えられた．

The role of CT in the diagnosis of fatty liver is well established. CT has been proved to be a useful noninvasive tool for the demonstration of fatty infiltration of the liver[1][2][3][4][5]. The characteristic finding is a diffuse decrease in the attenuation within the liver compared with that of the spleen. Commonly, fatty infiltration of the liver is generalized and both CT scans and sonograms can easily demonstrate changes related to this condition. Sometimes, fatty infiltration of the liver is focal and occasionally, it is generalized with focal sparing of the normal liver tissue creating some problems in the diganosis. Recently, some reports have mentioned the appearance of a focal sparing area in the generalized fatty liver[6][7].

We often found a high attenuation region around the gallbladder bed in the fatty liver patients on CT examination. There appears to be some relationship between the high density around the gallbladder area and the fatty liver. A retrospective study was undertaken to evaluate the relationship. In this paper, we presented the CT scans of 57 fatty liver cases and compared them with the CT scans of 50 normal patients to discuss the possible cause of the phenomenon and its usage in the diagnosis of the fatty liver.

Materials and Methods

In the past two years, 57 cases of fatty liver were found in our department. The criteria of fatty liver in

the study was on the basis of a lower mean CT number for the liver than for the spleen on plain CT scans. There were 39 males and 18 females, ranging in age from 13~82 years (mean, 48.9 years). The reason for CT examination included chronic hepatic disease (27 patients), possible liver metastases from a known primary malignancy (9 patients), gallbladder disease (8 patients), pancreatic disease (3 patients), upper abdominal pain and other abdominal symptoms (10 patients).

All CT studies were performed using a CT W-600 scanner (Hitachi Medical Corporation). Contiguous 10 mm sections were obtained with a scan time of 4.5 sec. 31 cases were examined without contrast enhancement and 26 cases were examined with both plain and enhancement CT. CT attenuation numbers for the anterior and posterior segments of the right hepatic lobe, the medial and lateral segments of the left hepatic lobe, the spleen and the high density area around the gallbladder bed were measured on plain scans. Scans were recorded by the multiformat camera at the usual window (40 HU window level and 200 HU window width) and also at the reduced window widths (about 150 HU) in some of the cases. Sonograms were obtained in 44 of the 57 fatty liver patients using a EUB 340 machine (Hitachi Medical Corporation) with a 3.5 MHz transducer. The time interval between CT and the sonogram was 0 to 15 days.

Normal liver CT scans included 25 males and 25 females, ranging in age from 18~80 years (mean, 56 years). The CT scans had been obtained to exclude the conditions known to be related to fatty liver and the patients with histories of hepatic or splenic disease or with abnormalities on the liver funciton tests. Twenty six patients were examined by plain CT and 24 patients were examined by both plain and contrast CT. The CT attenuation numbers were obtained with the same methods as was mentioned above.

Results

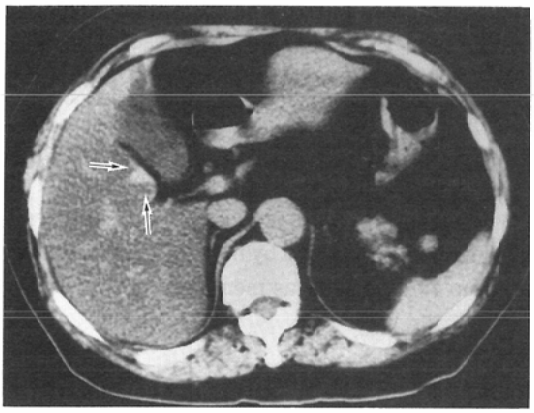
The CT scans demonstrated high density areas around the gallbladder bed in 42 of 57 fatty liver patients. Among the 42 patients, 13 patients had a second high density area in the interlobar fissure or subcapsular area. In 8 patients, a second high density area was noted in the caudate lobe. In another one patient, a high density area was noted in the anterior segment of the right lobe. The incidence and the locations of the focal sparing area in the 57 fatty liver patients are shown in the Table 1. Usaully, the high density area was small and thin, but it was very clearly seen in good contrast to the liver parenchyma with its generalized decrease in attenuation. The margins of the high densities were clearly defined but not as sharply as a space occupying lesion would be, the shape varying from a spot or band to a roughly ovoid shape. The mean length of the high density was 2.1 cm (range from 0.5~4.5 cm). Most of the high density areas could be seen only in one or two slices. The appearances of the high density near the gallbladder bed usually could be demonstrated as spot, band, ring and mixed types (Fig. 1). Sometimes, the high density appeared like a rim around the gallbladder area. In our cases, most of the high densities were classified as spot or mixed types. The sonograms demonstrated small hypoechoic areas, around the gallbladder bed (Fig. 2) in 23 of the 44 fatty liver patients.

Table 1　The incidence of the focal sparing area in the 57 fatty liver patients.

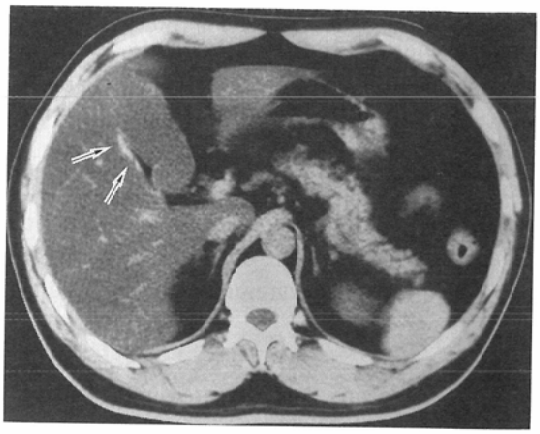
location	No. (%) of cases (n=57)
gallbladder bed	42(73.7%)
Interlobar fissure or subcapsular area	13(22.8%)
quadrate lobe	8(14.0%)
caudate lobe	2(3.5%)
right lobe	1(1.8%)

Types of focal sparing around the gallbladder bed

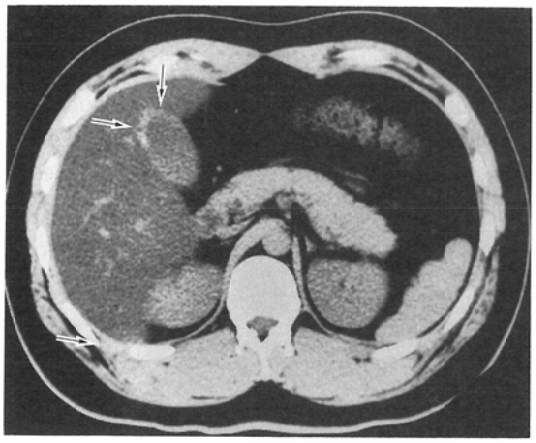
A. Diagrammatic representation of four basic focal sparing types.



B. Spot type: Diffusely reduced attenuation of the right lobe is seen, with the exception of a spot-like high density area (arrow) adjacent to the gallbladder.



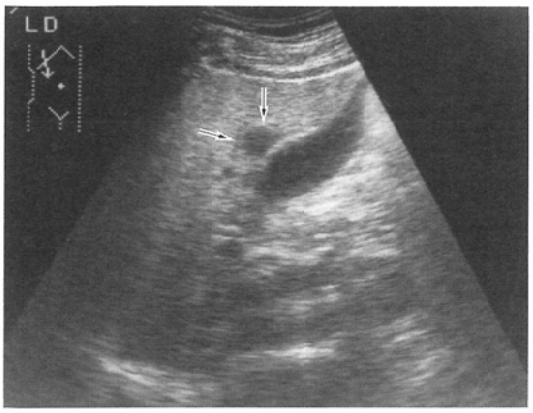
C. Band type: A hyperdense band area (arrow) is present in the reduced attenuation of the liver.



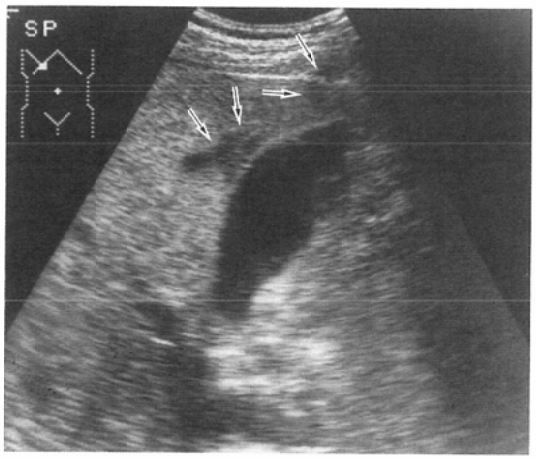
D. Ring type: A ring-like high density area around the gallbladder (arrow) is seen in the generalized fatty liver.

E. Mixed type: Both the band-like and the spot-like high density area (arrow) are demonstrated near the gallbladder bed.

Fig. 1 Four basic focal sparing types around the gallbladder bed.



A. Sonogram of the same patient in the Fig. 1-B, demonstrating a spotty hypoechoic focus (arrow) near the gallbladder bed. Both examinations were performed on the same day.



B. Sonogram of the same patient in the Fig. 1-E, demonstrating the two hypoechoic foci (arrow) around the gallbladder bed in the relative hyperechogenisity of the liver.

Fig. 2　Sonogram of the focal sparing area.

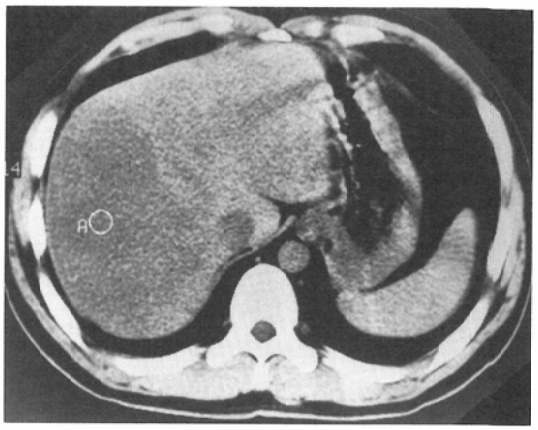


Fig. 3　Fatty liver mainly involving the right lobe. The CT attenuation value of the right lobe is significantly lower than that of the left lobe and the spleen.

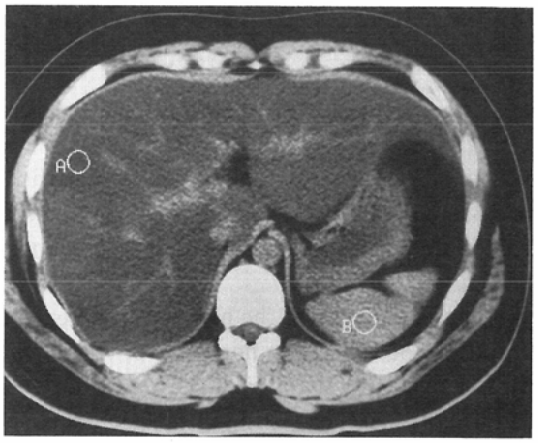


Fig. 4　Generalized fatty liver.
Both the right and the left lobes show reduced attenuation values compared with the spleen.

In mild degree or borderline fatty liver cases, the decreased liver attenuation value can not be identified by the naked eye. If the observer takes a special interest in the gallbladder area, the presence of a high density area around the gallbladder bed should suggest the diagnosis of fatty liver and then measurements of the attenuation number of the liver parenchyma should be made. The observation of a high density area around the gallbladder bed can be seen in 27 of the 38 mild fatty liver cases (71%). There is no statistically significant difference in frequency of the high density area around the gallbladder bed between the mild and severe fatty liver.

The CT attenuation values observed in the fatty liver indicated that the fatty liver mostly involved the right lobe. In 35 cases, the right lobe was mainly involved (Fig. 3), and in 22 cases, both right and left lobes

Table 2 The CT mean attenuation of four liver segments, focal sparing area and spleen in 57 fatty liver patients.

area	mean attenuation
Anterior segment	34.72±13.27
Posterior segment	36.01±13.52
Medial segment	44.65±12.97
Lateral segment	48.40±13.49
focal sparing area	52.00± 9.48*
spleen	46.92± 7.00

*$p<0.01$ versus anterior, posterior and medial segment. Group t-test

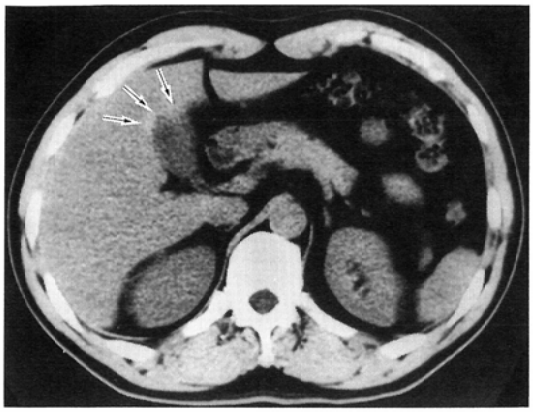
were involved (Fig. 4). The attenuation values of the four segments of the liver, the high density area and the spleen are shown in Table 2. The attenuation of the high density area around the gallbladder bed was much higher than that of the right lobe and higher than that of the medial segment of the left lobe with significant statistical difference. No high density area can be demonstrated around the gallbladder in the normal patients.

Discussion

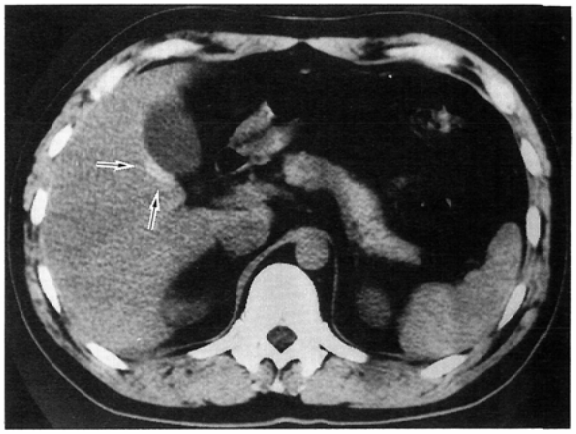
Fatty liver represents a metabolic and functional disorder of the liver with an excessive accumulation of triglycerides within the hepatocytes. It is associated commonly with alcohol abuse, obesity, diabetes mellitus, pregnancy, steroid therapy, malnutrition, chemotherapy or hyperalimentation. In our fatty liver group, more than half patients were overweight and 47.4% patients had a history of chronic hepatitis. It is suggested that fatty liver related to obesity and chronic hepatic disease may be more common than other causes.

The attenuation of the high density area in the fatty liver group was in the range of the normal liver tissue (40~80 HU). As in normal liver tissue, its attenuation was greater than that of the spleen (mean 5 HU greater), therefore, we have reason to believe it represents an area of relatively normal hepatic parenchymal tissue existing in the generalized fatty liver (focal sparing). Several reports have indicated that focal sparing areas exist in the fatty liver located near the periportal area, interlobar fissure area, gallbladder bed and in the quadrate lobe[7][8][9]. Our findings correspond to these locations, but there is some difference from them in their frequencies in our cases. The focal sparing area located near the gallbladder bed had a high incidence and was more common than that of other areas (Table 1). According to our observation, the high density area near the gallbladder bed is a common manifestatin in the fatty liver patients.

Reports about focal sparing areas in the fatty liver have increasd recently[6][7][8][9]. Sauerbrei et al indicated that the demonstration of a pseudotumor of the quadrate lobe in hepatic sonography with incrased echogenisity of the right hepatic lobe would contribute to the diagnosis of the fatty infiltration of the liver[8]. Our material also demonstrated that the high density around the gallbladder bed was a helpful sign in the diagnosis of fatty liver, especially in the mild fatty liver. Though severe fatty infiltration of the liver can be easily diagnosed by the naked eye on CT examination due to the significant difference in density between the hepatic parenchyma and the spleen, the slight or borderline fatty liver usually can not be identified by the naked eye. When the high density area around the gallbladder bed is seen at CT examination, it usually suggests that fatty liver may be present (Fig. 5) and should remind us to pay special attention and measure the CT number of the liver and the spleen and the difference between them. In our



A. The decreased heaptic parenchymal density can not be identified by naked eye, but the high density (arrow) near the gallbladder area is well defined. It usually suggests the fatty liver is present.



B. Another mild fatty liver case shows the high density (arrow) near the gallbladder area.

Fig. 5　Mild fatty liver.

group, the high density area can be noted in more than two thirds (71%) of the mild fatty liver patients. In most of them, the CT numbers were measured after the high density areas had been recognized around the gallbladder bed.

The observation of the CT attenuation values in the fatty liver indicated that the fatty liver mostly involved the right lobe. A focal sparing area existing in the right lobe was much less common than that in the left lobe. The difference in distribution of the focal sparing area is probably related to the tendency of fatty infiltration to involve the right lobe more than the left lobe.

The cause of the focal sparing area in the generalized fatty liver is still unclear. It might be related to the distribution of the intrahepatic blood flow. Some authors have demonstrated in some patients by ultrasound and postmortem angiography, the direct anastomoses between the portal system and the capsular or accessory cystic vein[6]. The communicating vessels causing drainge of the systemic venous blood into the liver sinusoids, may explain the localized sparing in the fatty liver. The outer layers of the parenchyma near the gallbladder area is probably perfused preferentially by systemic blood from the capsula and the gallbladder, rather than by the blood flow from the portal vein. This is a possible reason why the small focal sparing area is usually seen around the gallbladder bed.

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