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Focal Fatty Liver Lesions in Alcoholic Liver Disease: A Broadened Spectrum of CT Appearances

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Abstract. The CT examinations of 26 consecutive alcoholic patients with focal fatty infiltration of the liver were analyzed. Five different patterns of focal fatty infiltration were noted. In most alcoholic patients these appearances present no diagnostic problem and further confirmation can be obtained by repeating the CT scan within 1–2 weeks to see if interval resolution occurs following enforced abstinence. In select instances, more invasive and definitive procedures such as superselective angiography or liver biopsy may be necessary to differentiate these findings from other more serious diseases they may closely resemble, such as primary or secondary liver neoplasms.

Key words: Liver, computed tomography – Liver, fatty – Liver, cirrhosis – Alcoholism, CT findings.

Focal fatty infiltration of the liver is a newly recognized entity that may present diagnostic difficulties on computed tomography (CT). In some instances, the CT findings are indistinguishable from other space-occupying lesions of the liver including primary and secondary neoplasms, abscess, or hematoma.

These foci of decreased attenuation are most commonly seen in the livers of alcoholic patients, though they may be found in patients with a variety of other conditions. In this study, we prospectively analyzed the CT images of 26 alcoholic patients with focal fatty infiltration to document the characteristic patterns of fat deposition and various other features.

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Materials and Methods

From June 1982 to July 1983, CT examinations of the abdomen were performed prospectively on consecutive consenting patients admitted with the clinical diagnosis of alcoholic liver disease. The criteria for inclusion in the study were defined as an intake of greater than 80 g ethanol daily for at least 1 month, with the last drink within 48 hours of admission, as well as an elevated SGOT, total bilirubin, or alkaline phosphatase level, and hepatomegaly or ascites. All patients meeting these criteria were included in the study; the only ones excluded were those unable to undergo an abdominal CT scan within 48 hours of admission.

The CT examinations were obtained on a Picker Synerview whole-body scanner, using 3-second scan time at 95 Ma and 140 Kvp. The scans were performed at 10-mm thickness with 10–15-mm couch increments through the liver.

Most of the patients were examined both before and after the administration of intravenous contrast media, except in rare instances. The CT attenuation values of normal and suspected abnormal regions in the liver as well as the spleen were routinely recorded. Scans were recorded at both wide and narrow window settings. Altogether 26 alcoholic patients demonstrated focal fatty liver infiltration; they had a total of 52 CT examinations. All 26 demonstrating focal fatty lesions had a follow-up scan after 7 days of "enforced" abstinence, or just prior to discharge, or shortly thereafter.

The regions of low attenuation were classified according to their anatomical site (liver lobe or lobes), distribution (lobar or segmental), and margination. Evidence of lobar enlargement, mass effect, and shape (spherical or nonspherical) was also documented. Histologic confirmation of fatty infiltration was obtained in 8 patients: 7 by percutaneous biopsy and 1 at autopsy. In the remaining patients, presumptive confirmation of the CT diagnosis of focal fatty infiltration of the liver was based on partial or complete resolution of the lesions on repeat CT scans, careful correlation with the sonograms and radionuclide scans, and the absence of clinical findings suggesting liver metastases or abscess at the time of diagnosis and on follow-up.

Results

The 26 patients with focal fatty infiltration included 21 men and 5 women, ranging in age from 29 to 72 years with a mean age of 48.5 years. All fulfilled the criteria for alcoholic liver disease. The

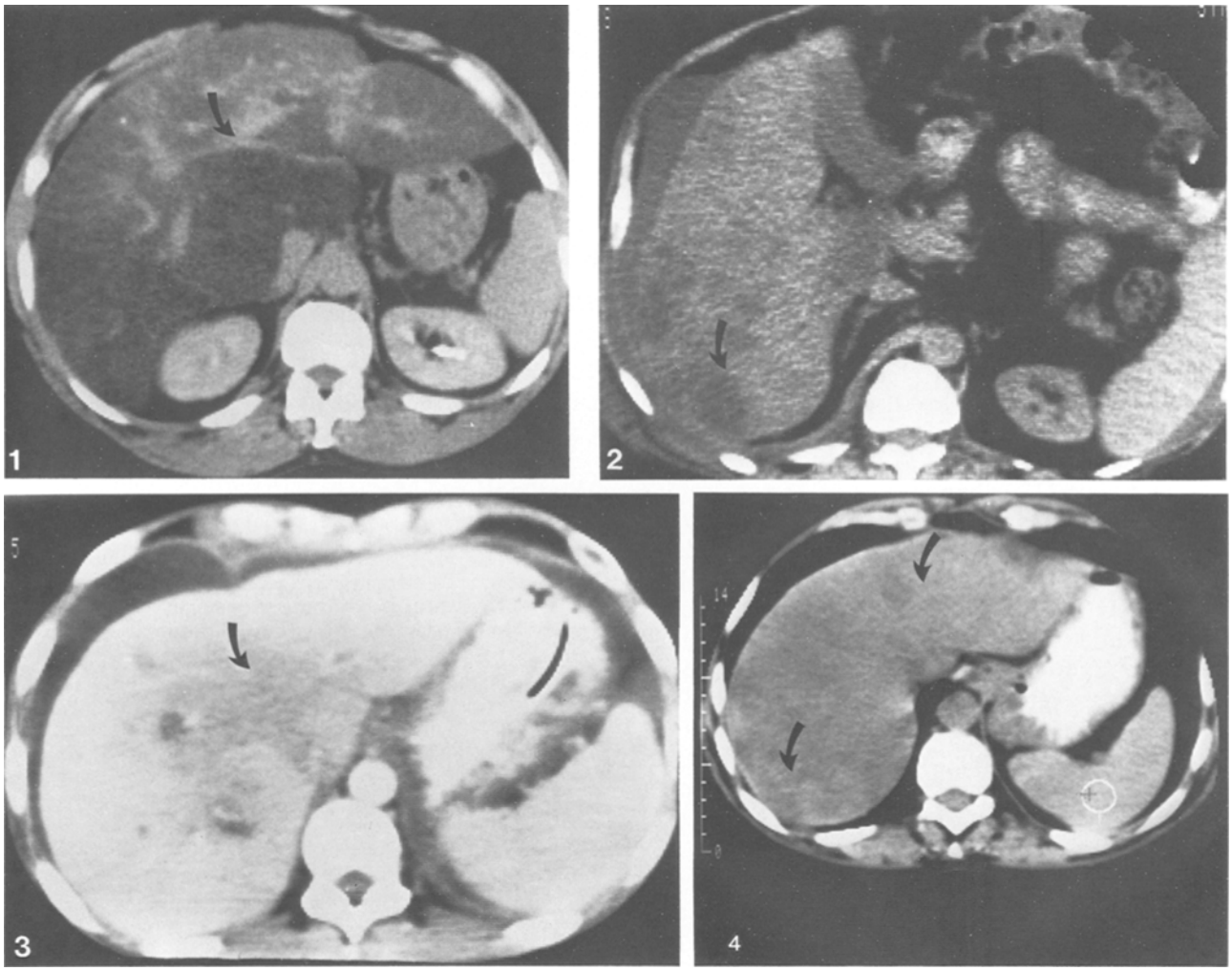

Fig. 1. Type 1 pattern: lobar/segmental uniform lesion. Note mass effect shown by draping of the vascular structures (*arrow*) around a focal fatty lesion

Fig. 2. Type 2 pattern: lobar/segmental nodular lesion. Multiple hypodense nodules are seen in the right lobe of the liver (*arrow*)

Fig. 3. Type 3 pattern: perihilar lesion. Fat deposition is seen primarily in the porta hepatis region (*arrow*)

Fig. 4. Type 4 pattern: diffuse patchy lesions. Multiple ill-defined foci of fatty infiltration are scattered throughout the liver parenchyma (*arrows*)

patients were classified into 5 categories: (1) lobar or segmental uniform lesions (Fig. 1); (2) lobar or segmental nodular lesions (Fig. 2); (3) perihilar lesions (Fig. 3); (4) diffuse patchy lesions (Fig. 4); (5) diffuse nodular lesions (Fig. 5). The results are summarized in Table 1. The most common patterns of focal fatty infiltration were types 1 and 2, present in 22 of 26 patients. The less common patterns were found in a total of 7 patients. Two patients had a combination of a lobar nodular and lobar uniform pattern and 1 patient had a lobar uniform combined with a perihilar pattern.

The lobes of the liver were involved either segmentally or in a lobar fashion as follows: right lobe (22 patients), left lobe (10 patients), caudate lobe (18 patients) and quadrate lobe (11 patients), either singly or in varying combinations. There was bulging of the liver contour and/or mass effect on adjacent vascular structures in 13 of the 26 patients (50%). Well-marginated spherical or oval lesions were seen in 9 patients (35%), with a predilection for the caudate lobe and perihilar region. Poorly defined areas were seen in 17 patients (65%).

The focal fatty regions were more obvious following intravenous contrast administration in 15 patients, while no extra information was noted in the remaining 11.

Resolution of the focal fatty lesions or change

Fig. 5. Type 5 pattern: diffuse nodular lesions. Multiple small nodular hypodensities are seen within the liver parenchyma

in appearance occurred in all the patients within 3–6 weeks. Two of these patients had complete resolution of the low-attenuation regions within 1 week of diagnosis and 1 patient had a normal-appearing liver after 2 weeks. Nine of the patients had varying degrees of ascites.

Discussion

Diffuse fatty change of the liver is a well-recognized entity, most commonly seen in alcoholic liver disease, obesity, and diabetes mellitus; it can also be found in patients on steroids, cases of Reye's syndrome, starvation, after jejunoileal bypass surgery, parenteral hyperalimentation, and fatty liver of pregnancy [1]. CT provided a new technique for the demonstration of fatty infiltration of the liver; the characteristic findings of this process are a diffuse decrease in attenuation within the liver with an attenuation much lower than that of the spleen and prominence of the intrahepatic vessels [2]. With clinical improvement, the CT number of the liver parenchyma rapidly returns to normal [2]. The degree of fatty deposition assessed histologically correlated inversely with the measured CT numbers; the liver triglyceride concentration showed a close linear correlation with the amount of fatty change. These results suggest that CT may provide an alternative, noninvasive method for quantitatively estimating liver fat concentration [2, 3].

Focal hypodense lesions due to fatty infiltration have been noted less frequently. The presence and significance of these focal fatty changes has only recently been suggested in a few preliminary reports [4–7]. The differential fat deposition and resorption in the liver in this entity results in irregular foci of diminished attenuation that may not have fatty density, with values ranging from −15 to +30 HU. These foci of decreased attenuation are often indistinguishable on CT from other clinically more significant space-occupying lesions of the liver including abscess, hematoma, or primary or secondary neoplasms and thus present a diagnostic dilemma.

Table 1. Patterns of focal fatty infiltration

Group	Type of lesion	No. of cases	%
1.	Lobar or segmental uniform	14	54
2.	Lobar or segmental nodular	8	31
3.	Perihilar	3	11.5
4.	Diffuse patchy	3	11.5
5.	Diffuse nodular	1	4

In this study the CT examinations of 26 consecutive alcoholic patients with focal fatty foci were prospectively analyzed. The lobar/segmental uniform and nodular lesions were the most commonly observed forms, seen in 22 of the 26 patients (85%). The perihilar, diffuse patchy, and diffuse nodular lesions were noted in 7 patients only. Two patients had combinations of a lobar nodular and lobar uniform pattern and 1 had a lobar uniform combined with a perihilar pattern. As described in previous reports, the lobar/segmental uniform lesion is the most frequently observed pattern of focal fatty infiltration [4–6]. This pattern and the perihilar lesions present the least diagnostic problems, especially if both pre- and post contrast scans do not show a tumor mass. The less commonly observed lobar nodular, diffuse patchy, and diffuse nodular infiltrations, however, often mimic other focal liver diseases such as metastases, abscesses, or hemangiomas.

Within the liver, mass effect is demonstrated by displacement of vessels and loss of normal vascular branching. Also, if a mass is of sufficient size or situated near the liver periphery it will cause a focal bulging of the liver contour. A previous report claimed that in 16 cases of focal fatty infiltration due to a variety of causes, none showed any evidence of mass effect [5]. The authors used this finding to help differentiate focal fatty infiltration from liver metastases, which often produce a mass effect if they are sufficiently large. In half of the patients in our series (13 of 26) there was CT evidence of mass effect.

In our opinion, the presence or absence of this finding does not aid in differentiating metastases from focal liver infiltration. The mass effect is probably due to differential fat deposition and re-

sorption in these cirrhotic livers, interspersed with scarring, regenerative nodules, and focal lobar hypertrophy, all of which can cause displacement of vascular structures and deform the liver contour.

There was no marked predilection for any particular lobe of the liver. At least one-third of the lesions had well-defined margins and were spherical or oval. The remaining two-thirds had ill-defined borders. In more than half the patients, the focal fatty regions were more obvious following administration of intravenous contrast medium. The involved areas showed slight enhancement after contrast administration but not to the same degree as the normal-appearing liver, indicating that these foci were not as well perfused as the unaffected regions of the liver.

Resolution of the foci of fatty infiltration or change in their appearance occurred in all 26 patients within 3–6 weeks, depending on the degree of severity. Two of our patients had complete resolution of the low-attenuation regions within 1 week of their initial scans. The CT numbers of these foci reverted towards normal values once patients ate more nutritiously and practiced "complete" abstinence from alcohol. These findings agree with of Bashist et al., who showed reversal of fatty infiltration in 1 of their patients within 6 days [8]. Fat deposition can be quite rapid. In studies involving former alcoholics and nonalcoholic volunteers who were fed nutritionally balanced meals modified only by increasing amounts of alcohol as their carbohydrate intake, within 3 weeks both groups showed marked increases in liver fat deposition and hepatic triglycerides on liver biopsy specimens [9, 10].

However, these fatty changes were also rapidly reversible. In the study involving former alcoholics, liver triglyceride levels averaged 7 times the baseline levels after 18 days of ethanol consumption [9]. Repeat biopsy specimens 1 month after complete alcohol withdrawal showed that the liver had reverted to its prestudy appearance: minimal or no steatosis. This complete reversal of changes after enforced abstinence has long been known. In 1 large study, complete mobilization of hepatic lipids was noted within 3–6 weeks after alcohol withdrawal with restoration of normal liver function [11]. If fatty liver persists beyond this stage, it is usually indicative of poor patient compliance.

In the alcoholic patient, fatty infiltration is the most common liver abnormality and alcohol is the most common cause of fatty liver, either diffuse or focal. Fatty liver in the alcoholic has been regarded as a completely benign disorder as it is readily reversible following alcohol withdrawal. More recently, however, fatty liver in the alcoholic patient has assumed greater importance since it is the earliest and a potentially serious form of liver injury [12]. The rapid reversibility of focal fatty infiltration of the liver in abstaining alcoholic patients can be monitored noninvasively and accurately by serial CT examinations. This would obviate the need for liver biopsies in these patients, many of whom have prolonged clotting time.

The varied pattern of focal fatty infiltration observed on the CT scans of these patients poses a differential diagnostic problem because of the nonspecificity of the CT findings. The focal abnormal area may be duplicated by primary or secondary neoplasms, abscesses, or hemangiomas.

An earlier report stated that absence of mass effect helps differentiate focal fatty infiltration from hepatic metastases [5]. However, slightly more than half of our patients had CT evidence of mass effect; this sign was therefore of questionable value. An even more confusing picture may arise when neoplastic tissue is superimposed on a fatty liver with either diffuse or focal infiltration. The tumor tissue may simulate normal hepatic parenchyma because its attenuation value is higher than that of the regions of fatty infiltration. In these few instances of admixture of areas with different attenuation values within the fatty liver, more invasive and definitive procedures such as selective or superselective hepatic arteriography, computed angiotomography, or liver biopsy should be performed to assess accurately the cause and extent of the disease [13].

The vast majority of these alcoholic patients, however, present no problem in diagnosis. In the proper clinical setting, the diagnosis can often be suggested on the CT appearance alone. Further confirmation can be obtained by repeating the CT scan within 1–2 weeks to see if there is any improvement following enforced, complete abstinence and improved nutrition while in hospital. An alternative route would be to perform combined CT–^{133}Xe scanning [1]. Xenon-133 is taken up by fat. When the ^{133}Xe scan matches the questionable CT lesion, it can be assumed the lesion represents focal fatty infiltration.

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