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Splenic lymphoma: differentiation from splenic cyst with ultrasonography

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Abstract
Background and Methods: Lymphoma can be nearly anechoic and mimic a cyst on ultrasonography (US). To investigate whether this phenomenon occurs at the level of the spleen, we analyzed the US findings of 38 cases of splenic lymphoma and 16 cases of splenic cyst.
Results: (1) With regard to shape, echogenicity of the lesion, and mode of posterior echo, there was no difference between splenic lymphomas and splenic cysts. However, the boundaries of the lesions were indistinct in splenic lymphomas and distinct in splenic cysts. (2) Blood flow signals and vascular penetration were seen exclusively in splenic lymphomas.
Conclusion: The mode of boundary echo (distinct or indistinct) distinguishes splenic lymphomas from splenic cysts. Color Doppler US increases the diagnostic confidence of US.

Key words: Spleen—Sonography—Doppler—Lymphoma—Cyst.

Ultrasonography (US) is the initial diagnostic tool for abdominal exploration, and this technique is especially useful for differentiating cystic from solid lesions [1, 2]. However, regardless of the affected organs, lymphomas can be nearly anechoic with acoustic enhancement and mimic a cyst on US [3–5], although they are in completely different pathologic categories.

US findings in a wide range of splenic focal diseases have been reported [6–9]. Among them, cysts and lymphomas are encountered most frequently, but the potential diagnostic problem concerning lymphomas has not been fully investigated at the level of the spleen.

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The aim of this study was to determine whether this diagnostic problem occurs at the level of the spleen and then find any US signs that might solve it based on a comparative analysis of US findings of a series of 38 cases of splenic lymphoma and a series of 16 cases of splenic cyst.

Patients and methods

Over 5 years, we encountered 38 patients with splenic lymphoma associated with histologically confirmed widespread involvement (confirmed by histologic evidence of bone marrow or cervical lymph nodes: Hodgkin's disease in five patients and non-Hodgkin's disease in 33 patients). These 38 patients consisted of 12 men and 26 women, ranging in age from 35 to 84 years, with a mean age of 62.8 years. We did not include any patient with splenic lymphoma without histologic evidence. This patient selection process made the diagnosis highly appropriate.

The indications for abdominal US were general fatigue in 21 patients, part of a precise examination of anemia in five, and part of a general screening of systemic malignant lymphoma in 12. Abdominal US was performed in 38 patients and color Doppler US in 31 patients. The US and color Doppler US were performed with a Toshiba 380 A system (3.75 MHz) or with a GE logiq 700 system (4 MHz). We used a pulse repetition frequency of 2–4 kHz and a filter of 50–100 Hz, with slight adjustments as needed for appropriate signal acquisition.

For each patient, splenic US and color Doppler findings were reviewed with regard to these findings:

1. gray-scale US: (a) shape (round, oval, or irregular), (b) mode of boundary between the lesion and the surrounding tissue (distinct or indistinct), (c) echogenicity

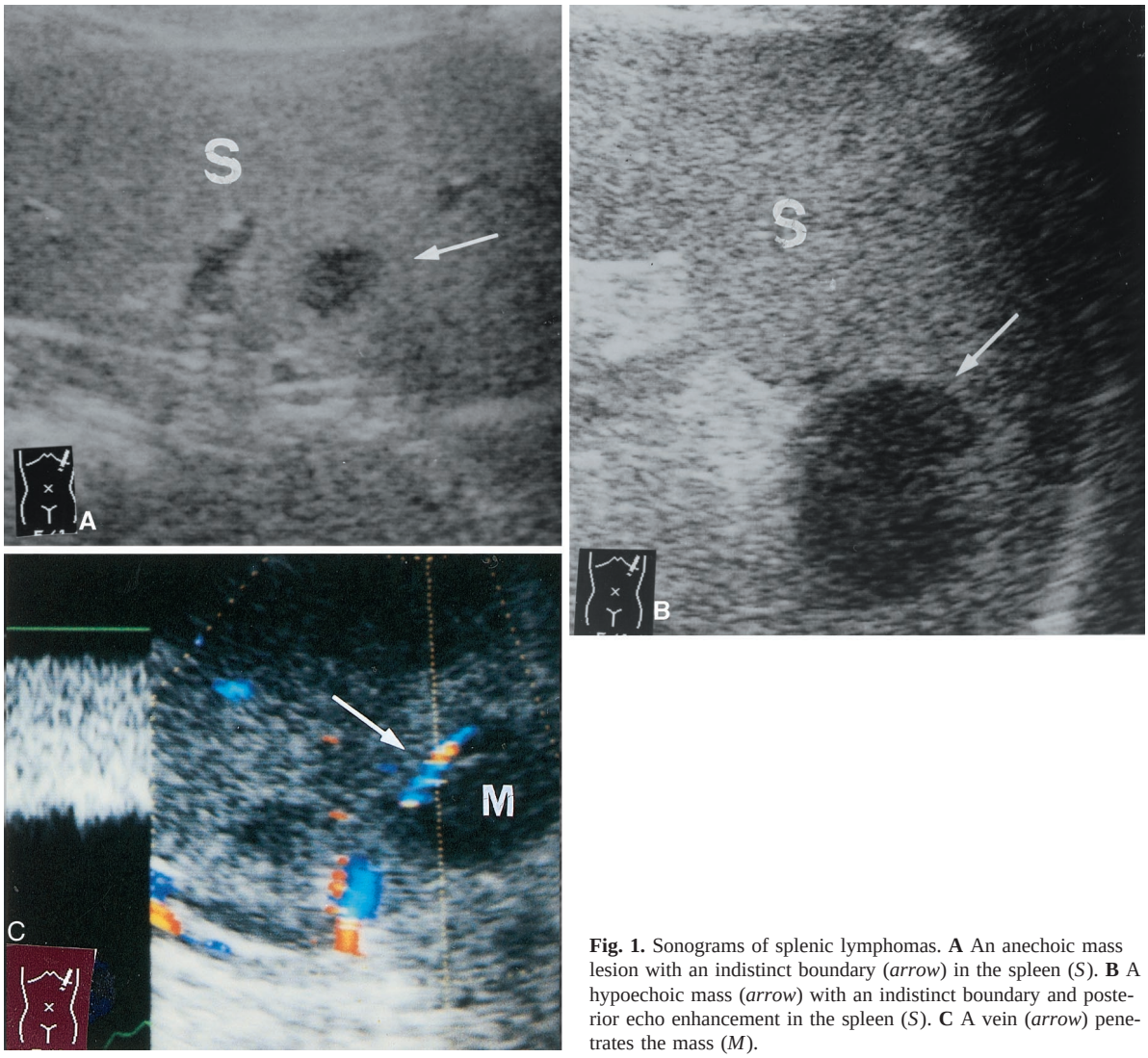

Fig. 1. Sonograms of splenic lymphomas. **A** An anechoic mass lesion with an indistinct boundary (*arrow*) in the spleen (*S*). **B** A hypoechoic mass (*arrow*) with an indistinct boundary and posterior echo enhancement in the spleen (*S*). **C** A vein (*arrow*) penetrates the mass (*M*).

of the lesion (anechoic, hypoechoic, or echogenic), (d) presence or absence of lateral shadowing, and (e) mode of posterior echo (attenuation or enhancement);
2. color Doppler US: (a) presence or absence of blood flow signals and (b) velocity of blood flow.

If the spleen had multiple lesions, we evaluated only the one that was most clearly visualized by US. Therefore, we reviewed 38 lesions in 38 patients. The lesions were 7–58 mm, with a mean of 24.3 mm.

For a comparison, we reviewed the US findings of 16 patients with splenic cysts. In these patients the final diagnosis of splenic cyst was established on the basis of the computed tomographic value (water density) of the lesion and no change of US findings during follow-up. If the spleen had multiple lesions, we evaluated only the one that was most clearly visualized by US. Therefore, we reviewed 16 lesions in 16 patients. The lesions were 5–48 mm, with a mean of 22.1 mm. For each lesion, we evaluated the gray-scale US and color Doppler US findings.

Results

Splenic lymphoma (Fig. 1)

Gray-scale US

(a) The lesions were round in 28 cases (74%), oval in eight (21%), and irregular in two (5%). (b) The boundary was indistinct in 37 cases (97%) and distinct in one (3). (c) The lesion was anechoic in 15 cases (39%), hypoechoic in 23 (61%), and no cases were echogenic. (d) No cases showed lateral shadowing. (e) Three cases (8%) showed posterior echo enhancement, 35 (92%) showed

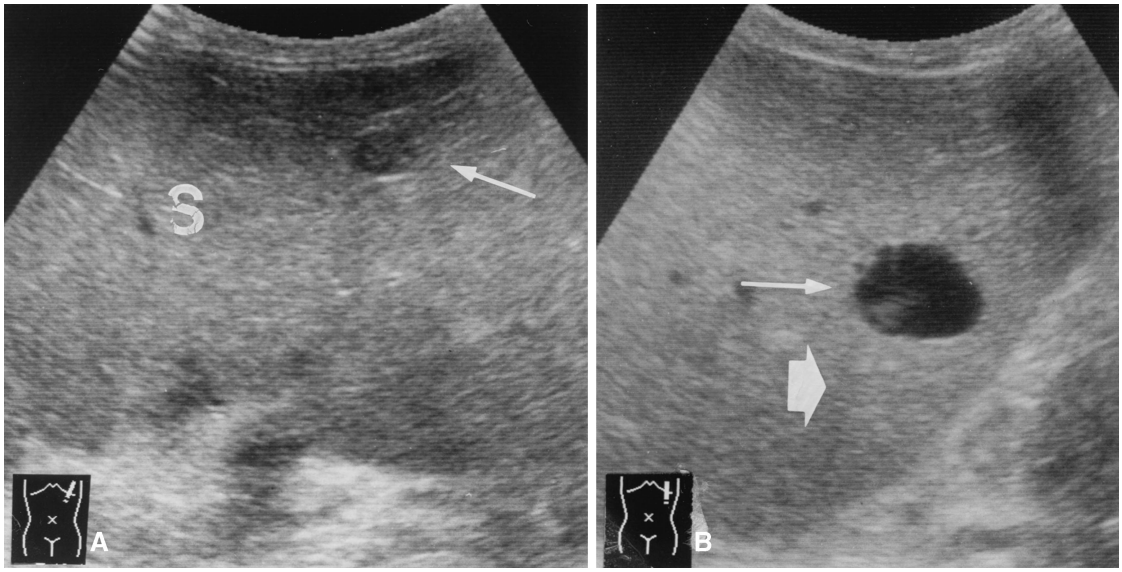

Fig. 2. Sonograms of splenic cysts. **A** A hypoechoic lesion with a distinct boundary (*arrow*) in the spleen (*S*). **B** An anechoic lesion (*arrow*) without posterior echo enhancement (*arrowhead*) but with a distinct boundary.

no change in posterior echo, and no cases showed posterior echo attenuation.

Color Doppler US

Blood flow signals (arterial and/or venous) were seen in 22 cases (58%), and a penetrating vessel was seen in 12 (32%). The penetrating vessel was seen exclusively in lesions larger than 15 mm, and the Doppler analysis showed the vessel to be a vein in all 12 cases. Velocities ranged from 4 to 18 cm/s.

Splenic cyst (Fig. 2)

Gray-scale US

(a) The lesions were round in 14 cases (88%), oval in two (12%), but no cases were irregular. (b) The boundary was indistinct in one case (6%) and distinct in 15 (94%). (c) The lesion was anechoic in 11 cases (69%), hypoechoic in five (31%), and no cases were echogenic. (d) Three cases showed lateral shadowing (19%). (e) Four cases (25%) showed posterior echo enhancement, 12 (75%) showed no change in posterior echo, and no cases showed posterior echo attenuation.

Color Doppler US

No cases showed blood flow signals or a penetrating vessel in the lesion.

With regard to boundary, there was a statistical difference between the splenic lymphoma and splenic cyst groups. Otherwise, there was no difference between groups.

Discussion

Malignant lymphoma is a very common disease. Interest in the early and precise diagnosis of this disease has increased. It is roughly divided into Hodgkin's disease and non-Hodgkin's disease [10]. Regardless of the histologic type, the spleen is commonly involved in systemic lymphoma [10, 11], and US patterns of splenic involvement have been reported, ranging from simple splenomegaly, diffuse coarse echoes throughout the spleen, to intrasplenic multiple focal lesions [6, 7], but there is a relative paucity of detailed US results in the literature. In our series of splenic lymphoma, most cases showed markedly hypoechoic lesions and some showed anechoic focal lesions. As has been reported in other organs [3–5], our results show that splenic lymphoma also can mimic a splenic cyst. Generally speaking, malignant lymphomas tend to grow without developing many fibrous septa [10, 11]. This homogeneous histologic structure provides very few interfaces to produce internal echoes and is believed to produce a hypo- or anechoic internal echo pattern of the lymphomatous nodule. The precise pathomechanism of this US finding is not known.

The classic US findings that suggest a cyst, regardless of the affected organ, are (a) round shape, (b) smooth margin, (c) absence of internal echoes, (d) presence of

lateral shadowing, and (e) presence of posterior echo enhancement [12, 13]. Our cases of splenic cyst frequently did not show findings (c), (d), or (e), which differs slightly from what one expects for a cyst, renal or hepatic [12–14]. Although the pathomechanism of these US findings was not clarified, this difference might be caused in part by the difference in acoustic conditions between the spleen and kidney or liver. Generally speaking, there is a marked overlap of US findings between lymphomas and cysts at the level of the spleen, and this presents a diagnostic dilemma in a clinical setting. For this differentiation, our study showed that the mode of boundary echo and the echogenicity of the boundary (interface) between the mass and the surrounding splenic tissues are very useful. When US scanning a plane that contains masses with an acoustic impedance different from that of surrounding tissue, sound reflection occurs at the interface between the mass and the surrounding tissue [15, 16]. Roughly speaking, the degree of reflection depends on the ratio of the acoustic impedances of these two media, and the reflection coefficient (RC) is defined as $RC = (Z_2 - Z_1/Z_2 + Z_1)^2$, where Z_1 is the impedance of medium 1 and Z_2 is the impedance of medium 2 [15, 16]. The precise acoustic impedances in the spleen and lymphomas are unknown, but both values have been estimated to be close to those of soft tissues (e.g., 1.65×10^6 rayls for liver, 1.63×10^6 rayls for kidney), and the impedance of cystic fluid has been estimated to be similar to that of water (1.48×10^6 rayls) [15, 16]. The RC between the spleen and a cyst was computed as approximately 0.002–0.003, whereas the RC between the spleen and a lymphoma was below 0.00005. This large difference in RC in part explains why the echogenicity of the boundary between the spleen and a lymphoma is much less distinct than between the spleen and a cyst. As shown in our series, the mode of boundary is the most useful US sign for differentiating splenic lymphomas (indistinct boundary echo) from cysts (distinct boundary echo). In fact, in reviewing the literature, we noted that many textbook illustrations of lymphomas support our result of boundary echo [6, 7, 17–19]. Thus, it is important to pay particular attention to it when encountering hypoechoic or anechoic nodules in the spleen.

Color Doppler US is useful for visualizing fine vessels and is used as part of a routine examination for abdominal exploration [20]; it also has been used for the diagnosis of focal splenic lesions [6, 7, 9]. In our series of splenic lymphomas, fine vessels penetrated the lesion without deviation and excluded the possibility of a cyst. The color Doppler results are usually machine dependent and do not yield absolute diagnostic confidence, but they can increase the diagnostic confidence of US.

In conclusion, splenic lymphoma can mimic a splenic cyst on US. To differentiate between them, we should look at the mode of boundary echo (interface between the mass and surrounding tissue). Indistinct boundary echo was an important diagnostic clue indicating splenic lymphomas. Awareness of this US sign will prevent a hazardous misdiagnosis.

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