

Sonographic Spectrum of Focal Splenic Lesions

DORIT D. ADLER, M.D., BARRY I. SAMUELS, M.D.,*
RICHARD A. BOWERMAN, M.D., TERRY M. SILVER, M.D.

Sonograms of 50 patients with a clinical suspicion of splenic abnormality were reviewed. With the use of high-resolution static and real-time equipment, combined with variable patient positioning, focal splenic lesions were well imaged. A wide variety of pathologic entities was sonographically demonstrated, including traumatic hematomas, primary and metastatic neoplasms, cysts, infarcts, and inflammatory granulomas.

Key words: sonography, spleen, focal lesions.

Sonography can be of value for demonstrating focal splenic disease.¹⁻⁴ Prior to the availability of high-resolution real-time scanners, splenic sonograms were rarely requested, primarily because of technically compromised studies resulting from the high subcostal location of the spleen and image degradation secondary to the air-filled gastrointestinal tract in the left upper quadrant. However, splenic sonography became clinically feasible and diagnostically useful when high-resolution real-time transducers were used in combination with variable patient positioning.⁵ The aim of our study is to report upon our large experience with focal splenic lesions between 1976 and 1984 and to reassess the role of splenic sonography in light of modern technical advances, with emphasis on real-time scanning.

From the Department of Radiology, University of Michigan Medical Center, Ann Arbor, Michigan.

*Current address: Humana Women's Hospital, East Orleans, 600 Bullard Road, New Orleans, LA 70128.

Correspondence: Dorit D. Adler, M.D., Department of Radiology, Box 013, University of Michigan Medical Center, Ann Arbor, MI 48109.

MATERIALS AND METHODS

Fifty patients with clinically suspected splenic abnormalities were scanned with sonography at the University of Michigan Hospitals between 1976 and 1984. This heterogeneous population included 29 male patients and 21 female patients ranging in age from 3 to 80 years. The study group was composed of patients referred for the following reasons: 1) acute trauma, 2) precipitous left upper quadrant pain, 3) diffuse abdominal pain, and 4) suspected splenic abnormalities in patients with known hematologic and neoplastic disorders.

Prior to 1979, splenic sonographic examinations were obtained with conventional static gray-scale equipment (14 patients). Since 1979, real-time scanning has been extensively employed. Twenty-eight of 50 patients were examined only with a high-resolution real-time sector scanner; the other 8 were studied with both real-time and static instruments. Inasmuch as possible, the highest frequency transducer that best demonstrated the pathologic findings was used.

Coronal and transverse scans with the patient decubitus provided the best visualization of the spleen, with conventional longitudinal and transverse supine scans obtained as needed for additional anatomic information. To further improve image quality and to decrease image degradation from ribs and adjacent gas-filled organs, various patient positions were routinely used, including upright, right lateral decubitus, and right posterior oblique.

TABLE 1. Focal Splenic Lesions

	Number of Patients
Hematomas	10
Metastases	8
Granulomas	7
Infarcts	6
Cysts	6
Lymphoma	4
Primary neoplasm	1
Indeterminate	8
Total	50

RESULTS

The nature of the focal lesion(s) imaged is given in Table 1. Correlative imaging combined with clinical information formed the basis for diagnosis in 30 patients. Pathologic confirmation was obtained in 12 patients, and the cause of the sonographic findings was indeterminate in the remaining 8. Within this group of patients, multiple pathologic subgroups became apparent, which will be subsequently discussed. Approximately half of all the lesions were hypoechoic.



FIG. 1. Coronal real-time sonogram in a 30-year-old woman, 7 days after trauma and decreasing hematocrit. Irregular echogenic and echo-free (arrows) intrasplenic foci were seen at surgery to represent hematoma.

Trauma

Seven of ten patients with acute traumatic hematomas demonstrated multiple lesions manifested as foci of both increased and decreased echogenicity on the initial examination, which was generally performed within 72 hours of the acute traumatic episode (Fig. 1). An additional two patients had a solitary fluid-filled area, and one patient had multiple cystic foci. The lesions were scattered throughout the spleen and were irregular in contour. In the patients in whom the lesions were followed to resolution (5/10), the hematomas became smaller, entirely anechoic, and finally resolved. The time range over which the lesions showed resolution on sonography was 5½ weeks to 7½ months after trauma.

Neoplasm

All described patterns of splenic involvement were seen in this group. Solitary echogenic lesions were noted in three patients with known primary ovarian carcinoma, cholangiocarcinoma, and seminoma, respectively. Two unusual entities, pathologically confirmed, a lipomatous hamartoma (Fig. 2) and a solitary plasmacytoma, also presented as



FIG. 2. Sagittal real-time sector scan in a 43-year-old woman demonstrating a focal echogenic lesion that proved at autopsy to be a lipomatous hamartoma.

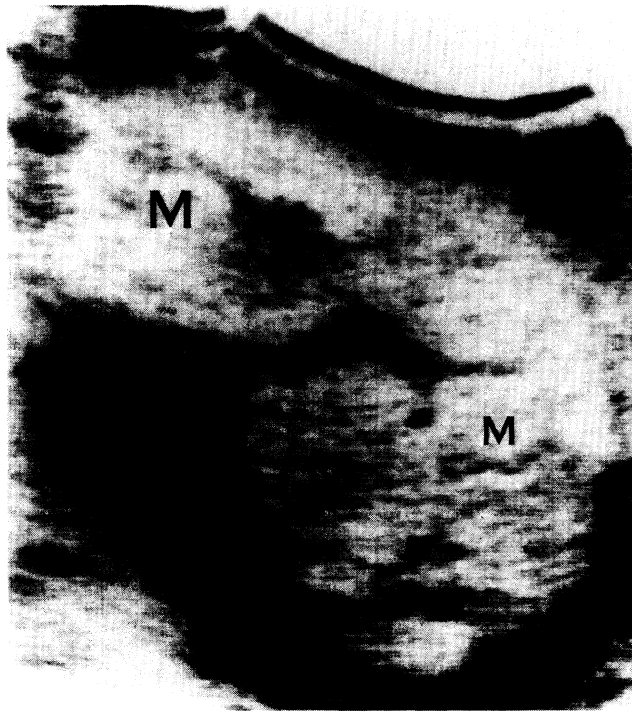


FIG. 3. Coronal scan revealing multiple hypoechoic intrasplenic masses pathologically proven to be deposits of Hodgkin's lymphoma in an 18-year-old woman. *M*, metastasis.

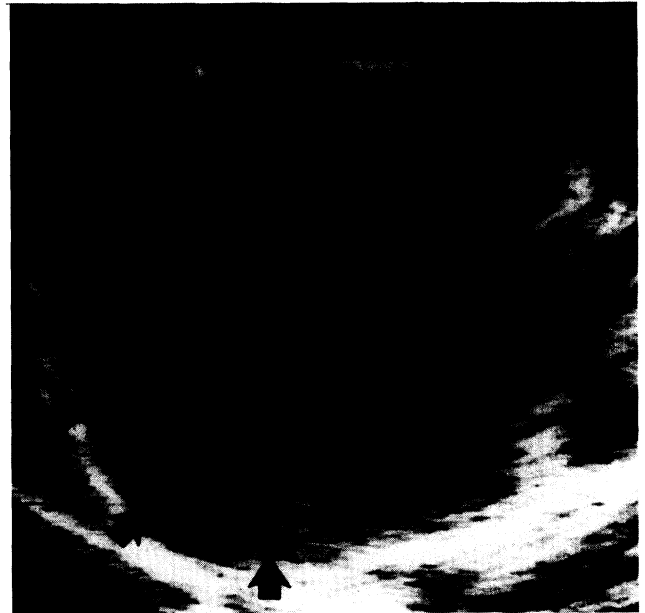


FIG. 4. Coronal real-time sector scan of the spleen in a 15-year-old girl presenting with a left upper quadrant mass and pain. A large, irregularly marginated cystic mass with low-level internal echoes was pathologically proven to be a congenital epidermoid cyst with internal hemorrhage at surgery. Notice the echogenic rind of normal splenic parenchyma peripherally (*arrows*).

solitary echogenic lesions. Multiple focal echogenic lesions were seen in two patients with gynecologic malignancies, and multiple hypoechoic deposits were noted in a patient with metastatic melanoma. Patients with both Hodgkin's (Fig. 3) and non-Hodgkin's lymphoma (NHL) had echo-poor solid lesions. All but one patient (NHL) demonstrated multiple lesions within the spleen.

Cysts

All patients with cysts had solitary lesions. Predictably, the cysts were echo-free, although one of the three pathologically confirmed epidermoid cysts contained multiple low-level internal echoes (Fig. 4), attributable to prior intracystic hemorrhage, which was observed at operation. All three epidermoid cysts were large (10–15 cm in diameter) and occurred in young patients (ages 12, 15, and 32 years, respectively). One cyst, presumably post-traumatic, had a very echogenic rim corresponding to a thick calcified wall, as shown on a computerized tomographic (CT) scan (Fig. 5).

Inflammatory Granuloma

Calcified granulomas showed the expected appearance of multiple punctate echogenic foci associated with variable acoustic shadowing (Fig. 6).

Infarcts

Splenic infarcts were multiple and hypoechoic in five of six patients (Fig. 7). One of these was a young woman with sickle-cell anemia. The abnormal foci in this case were rounder in appearance than the typical wedge-shaped splenic infarct. The clinical history did not support other diagnostic possibilities such as infectious foci or metastatic deposits. Another patient with a solitary hypoechoic lesion had multiple infarcts confirmed at autopsy.

Inconclusive

Eight of 50 patients had splenic lesions of indeterminate cause. The majority of these patients had multiple medical problems, and the sonographic

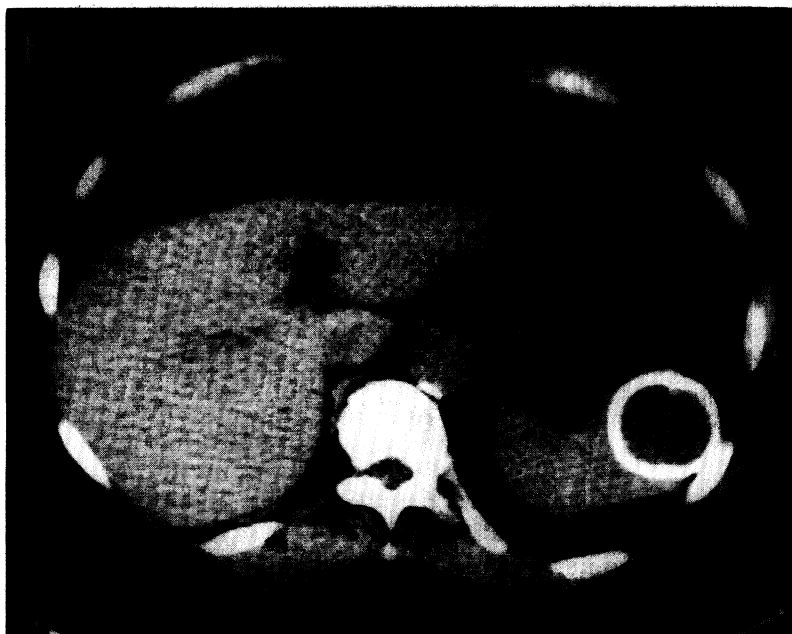
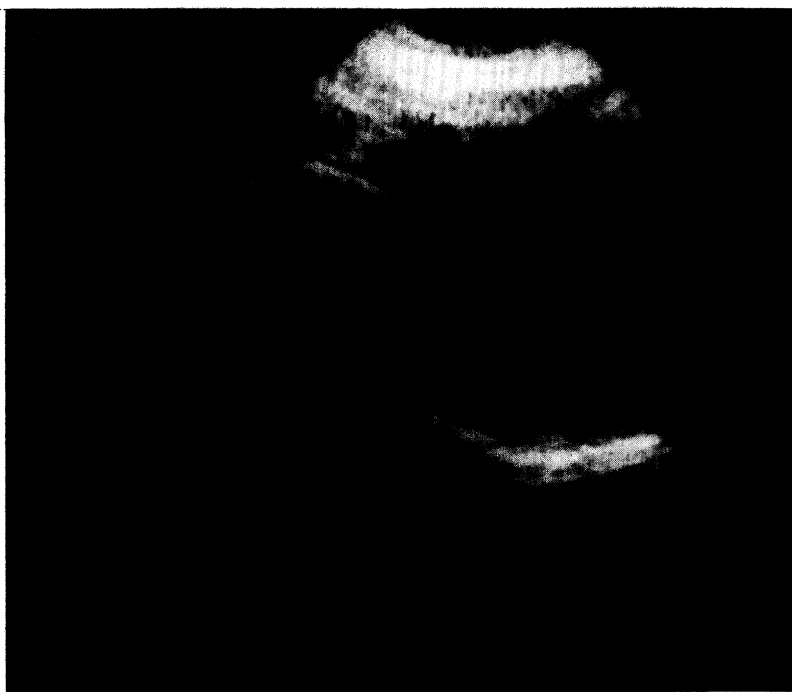


FIG. 5. Asymptomatic 72-year-old man with the incidental finding of left upper quadrant ring calcification on an abdominal radiograph and a previous history of malignancy. A. Coronal real-time sonogram showed intrasplenic arcuate calcification (*arrow*) with posterior shadowing, obscuring the internal structure of cyst. S, spleen. B. A CT scan of the abdomen revealed an intrasplenic cyst with a thick calcified rim.

appearances of the spleen overlapped several different clinical diagnoses. No pathologic or cytologic confirmation could be obtained in this group.

DISCUSSION

The spleen is rarely the site of primary disease. Yet because of its multiple functions, it is often secondarily involved in neoplastic, hematologic, and

infectious processes.⁶ Its rich vascularity and delicate structure make it the most commonly injured organ in blunt abdominal trauma.⁷

Our study indicates that sonography can be useful in demonstrating a wide variety of pathologic entities. Previous reports suggest that the sonographic appearance is not usually specific, but these studies involved smaller patient populations.^{3,8,9} The spectrum of diverse lesions in our large series

did demonstrate some general patterns suggestive of more specific diagnoses. For example, despite the fact that the sonographic appearance of focal traumatic splenic lesions may vary,¹⁰ shortly after trauma, hematomas in our patients characteristically showed a mixed pattern of both increased and decreased echogenicity and became entirely echo-free before resolution.

The majority of splenic infarcts were multiple and hypoechoic lesions. They were usually wedge-shaped and peripheral, similar to infarcts imaged in other organs,¹¹⁻¹³ and were associated with various clinical settings such as sickle-cell anemia, malignant histiocytosis, and hypotension. Focal lymphomatous deposits also tended to be hypoechoic and somewhat more spherical than infarcts, as in previous reports.¹⁴ On the other hand, patients with nonlymphomatous metastatic deposits demonstrated predominant (6/8) echogenic foci. The higher proportion of echogenic metastases in our series, as

compared with a previous report,³ may be attributable to differences in the types of tumors imaged and/or a greater propensity of intratumoral hemorrhage or necrosis in the larger number of tumors we studied. As noted, both cysts and calcified granulomas had very specific sonographic appearances. Congenital epidermoid cysts were large, occurred at a relatively young age, and were manifested clinically as a left upper quadrant mass associated with pain due to complications such as hemorrhage.¹⁵

Our results suggest that focal splenic pathology can be clearly delineated with careful attention to sonographic technique. Although CT resolution may be superior to sonography (particularly in obese patients), in certain clinical settings, such as trauma, serial sonography offers the advantages, in comparison with other modalities such as CT, of being portable, rapid, and relatively inexpensive. Sequential imaging is usually of particular use not only after trauma, but also in monitoring the chemotherapeutic response or lack thereof in patients with known neoplastic disorders. The absence of ionizing radiation associated with the sonographic technique makes it an attractive imaging modality in evaluating problems in children. Preliminary data from our institution indicate that focal splenic



FIG. 6. Coronal real-time sector scan demonstrating multiple bright punctate intrasplenic lesions, typical for calcified inflammatory granulomas. Although no shadowing was present, the plain abdominal radiograph (not shown) showed splenic calcifications.



FIG. 7. Coronal real-time sector scan of the spleen obtained in a 2½-year-old boy with malignant histiocytosis, demonstrating a wedge-shaped hypoechoic area (arrows) superiorly in the spleen, which proved pathologically to represent an infarct.

lesions are generally not as well seen on magnetic resonance imaging, compared with sonography or CT.¹⁶

Our series of focal splenic lesions demonstrates the utility of high-resolution sonography in a large group of patients with diverse abnormalities, ranging from acute trauma to neoplastic disorders. Ultrasound guidance can also facilitate aspiration of focal splenic pathology, as in suspected abscess or patients with known or suspected malignancy, in whom cytologic diagnosis is required before therapy. The use of high-resolution real-time equipment has made the sonographic examination of the spleen not only feasible, but an important tool that deserves greater attention in the evaluation of patients with clinically suspected splenic disease.

REFERENCES

1. Mittelstaedt CA, Partain CL: Ultrasonic pathologic classification of splenic abnormalities: Gray-scale patterns. *Radiology* 1980;134:697-705.
2. Murphy JF, Bernardino ME: The sonographic findings of splenic metastases. *J Clin Ultrasound* 1979;7:195-197.
3. Solbiati L, Chiari BM: Focal lesions in the spleen: Sonographic patterns and guided biopsy. *AJR* 1983;140:59-65.
4. De Graaff CS, Taylor KJ, Jacobson P: Grey-scale echography of the spleen. *Ultrasound Med Biol* 1979;5:13-21.
5. Hicken P, Sauerbrei EE, Cooperberg PL: Ultrasonic coronal scanning of the left upper quadrant. *J Can Assoc Radiol* 1981;32:107-109.
6. Robbins SL: *Pathologic Basis of Disease*. Philadelphia, WB Saunders, 1979, pp 803-813.
7. Jordan GL Jr, Beall AC Jr: Diagnosis and management of abdominal trauma. *Curr Prob Surg* 1971;Nov.:40-42.
8. Mittelstaedt CA: Ultrasound of the spleen. *Semin Ultrasound* 1981;2:233-240.
9. Cunningham JJ: Ultrasonic findings in isolated lymphoma of the spleen simulating splenic abscess. *J Clin Ultrasound* 1978;6:412-414.
10. Kuligowska E, Mueller PR, Simeone JF: Ultrasound in upper abdominal trauma. *Semin Roentgenol* 1984;19:281-295.
11. Erwin BC, Carroll BA, Walter JF: Renal infarction appearing as an echogenic mass. *AJR* 1982;138:759-761.
12. Adler DD, Glazer GM, Silver TM: Computed tomography of liver infarction. *AJR* 1984;142:315-318.
13. Haaga JR, Morrison SC: CT appearance of renal infarct. *J Comput Assist Tomogr* 1980;4:246-247.
14. Carroll BA: Ultrasound of lymphoma. *Semin Ultrasound* 1982;3:114-122.
15. Kaufman RA, Silver TM, Wesley JR: Preoperative diagnosis of splenic cysts in children by gray-scale ultrasonography. *J Pediatr Surg* 1979;14:450-454.
16. Adler DD, Glazer GM, Aisen AM: MRI of the spleen: Normal appearance and findings in sickle cell anemia. *AJR*. 1986;147:843-845.