

# Lymphoma and Leukemia Involving the Testicles: Findings on Gray-Scale and Color Doppler Sonography

Dianne Mazzu<sup>1</sup>  
R. Brooke Jeffrey, Jr.<sup>1</sup>  
Philip W. Ralls<sup>2</sup>

**OBJECTIVE.** The purpose of this study was to determine the gray-scale and color Doppler sonographic appearance of testicular lymphoma and leukemia to aid in its differentiation from primary testicular neoplasms and inflammatory processes.

**MATERIALS AND METHODS.** We retrospectively reviewed the testicular sonograms of eight male patients 5–74 years old (mean age, 43 years) with pathologically proved testicular leukemia or lymphoma. All patients presented with testicular enlargement. Gray-scale sonograms were obtained to determine the presence or absence of a mass, focal nodule, or diffuse infiltration, as well as the degree of parenchymal echogenicity. Color Doppler sonography was applied in each case to determine the degree of vascularity compared with normal ipsilateral or contralateral testicular parenchyma. In patients with focal, measurable lesions, the size was correlated with its color Doppler sonographic appearance.

**RESULTS.** Gray-scale sonograms showed either homogeneously hypoechoic testes in patients with diffuse round-cell infiltration or multifocal hypoechoic lesions of various sizes. Five patients had a total of 11 focal lesions that ranged in size from 8 mm to 26 mm in maximum diameter (mean diameter, 16 mm). Color Doppler sonography revealed increased intralesional flow in all areas of lymphomatous or leukemic involvement irrespective of lesion size.

**CONCLUSION.** Our results show that testicular lymphoma and leukemia are hypervascular on color Doppler sonograms regardless of the size of the tumor. Although color Doppler sonography may provide useful information, differentiating round-cell infiltration from inflammatory processes of the testes remains difficult.

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The differentiation of neoplastic from inflammatory diseases of the testes is important in patients with testicular enlargement. Malignant lymphoma represents 1–7% of all testicular tumors and is one of the most common causes of testicular enlargement in men over 50 [1]. Leukemic involvement of the testes is most often seen in childhood and is rarely clinically evident in adults.

Testicular infiltration is seen in up to 8% of children with leukemia. Regardless of the patient's age, round-cell testicular infiltration most commonly occurs when the disease is disseminated, and it is often the first site of extramedullary relapse [2]. Sonographic evaluation of the testes is often the first diagnostic procedure performed in patients with testicular enlargement and can aid in localizing intratesticular versus extratesticular abnormalities. Further characterization of intratesticular abnormalities can then be based on the gray-scale and color Doppler sonographic appearance, both of which have been well described [3, 4]. Color Doppler sonography can also be used to increase the sensitivity of lesion detection.

Previous reports have examined the role of color Doppler sonography in the evaluation of primary testicular tumors [3]. Few investigators have focused on the color Doppler findings in round-cell infiltration of the testes resulting from lymphoma and leukemia. Distinguishing these neoplastic processes from orchitis and epididymo-orchitis is essential for effective management of patients. Previous

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<sup>1</sup>Department of Radiology, Stanford University Medical Center, 300 Pasteur Dr., Stanford, CA 94305. Address correspondence to R. B. Jeffrey, Jr.

<sup>2</sup>Department of Radiology, Los Angeles County–University of Southern California Medical Center, 1200 N. State St., Los Angeles, CA 90033.

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investigators have emphasized the relationship between the size of the testicular tumor and its vascularity, noting that small tumors (<1.6 cm) are typically hypovascular [3]. Our experience with round-cell tumor infiltration suggests that these lesions are hypervascular regardless of size. We studied the degree of vascularity on color Doppler sonograms in eight patients with testicular lymphoma or leukemia.

### Materials and Methods

We retrospectively reviewed the color Doppler sonograms of eight male patients with proved testicular lymphoma or leukemia. The patients were 5–74 years old (mean age, 43 years; median age, 47 years). All patients had painless enlargement of either one or both testes. The diagnosis of testicular leukemia or lymphoma was established by biopsy or orchiectomy in seven patients and by compelling clinical evidence including CNS relapse and response to radiation therapy in one additional patient. Of the eight patients, six had lymphoma and two had leukemia. Six of the patients had previously established diagnoses of lymphoma or leukemia.

All patients were scanned with either a 5.0- or 7.0-MHz linear array transducer on an Acuson 128 unit (Mountain View, CA) with color Doppler imaging optimized for low-flow sensitivity. Specific parameters for color Doppler imaging included the following: maximum power (309 W/cm<sup>2</sup>), gate of 2 (increased sample volume for increased Doppler sensitivity), filter of 1 (for low-volume flow sensitivity), and scale ranging from 6 to 23 cm/sec. Gain settings were adjusted to just below background noise levels. Conventional gray-scale and color Doppler evaluations were done in all cases. Gray-scale sonograms were evaluated for the presence or absence of a mass and parenchymal echogenicity. Lesions were defined as either hyperechoic or hypoechoic, nodular or diffuse. Color Doppler sonograms were evaluated for the presence or absence of flow as well as for an increase in number and concentration of detectable vessels within and about the lesion. The determination of vascularity was based on comparison with the normal ipsilateral or contralateral testis. Hypervascularity was defined as a subjective increase in the concentration of vessels within the affected portion of the testis.

### Results

Gray-scale sonograms showed enlargement of the involved testis in all cases. Five patients had bilateral involvement, and

three had unilateral involvement. Four patients had generalized decreased echogenicity throughout the entire involved testis. Eleven focal lesions were found in five patients. These appeared as hypoechoic rounded lesions of various sizes from 8 mm to 26 mm (mean maximum diameter, 16 mm; median maximum diameter, 12 mm). One patient had diffuse involvement of one testis and a focal nodule in the other. All testes were smoothly contoured. One patient had marked epididymal enlargement. Small hydroceles were present in three patients.

Color Doppler sonographic evaluation showed increased intratesticular flow within all areas of leukemic or lymphomatous involvement relative to normal testicular parenchyma (Fig. 1). Six of the lesions were quite small, measuring 8–12 mm in greatest diameter (Figs. 2 and 3). The single patient with epididymal enlargement also had epididymal hypervascularity shown by color Doppler sonography (Fig. 4). There was no correlation between the tumor size and the degree of vascularity at color Doppler sonography.

### Discussion

Testicular lymphoma is the most common primary and secondary testicular neoplasm in men 60–80 years old [5]. The testes may be the site of initial presentation, but they are commonly the site of extramedullary relapse after chemotherapy-induced remission. The testis is a "sanctuary organ" because of the blood-gonad barrier that inhibits the accumulation of chemotherapeutic agents. This phenomenon is most commonly described in children with acute lymphoblastic leukemia [6, 7]. Recurrence of testicular lymphoma is an important consideration in the evaluation of testicular enlargement (and its differentiation from inflammatory processes) as well as in the differentiation of intratesticular from extratesticular abnormality.

Pathologically, lymphoma behaves similarly to leukemia, with abnormal cells diffusely infiltrating the interstitium with compression, but not destruction, of the seminiferous tubules. In leukemia, the infiltrating cells have the appearance of the primary underlying cell type [1].

Gray-scale sonograms of lymphoma and leukemia typically show diffuse or focal regions of decreased echogenicity

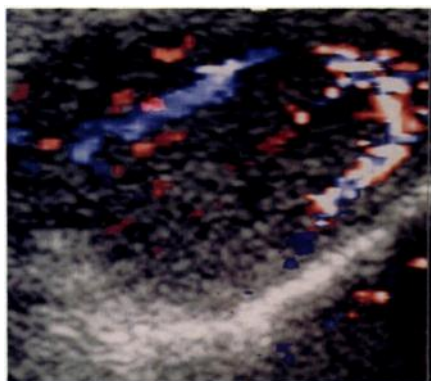


Fig. 1.—42-year-old man with history of non-Hodgkin's lymphoma. Longitudinal color Doppler sonogram shows generalized diminished echogenicity and marked hyperemia within smoothly contoured right testis. The application of color Doppler sonography helps to make this abnormality more conspicuous.

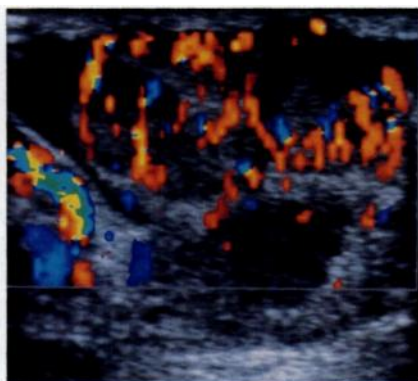


Fig. 2.—74-year-old man with painless bilateral testicular enlargement proved to be diffuse large-cell lymphoma. Longitudinal sonogram of testes shows rounded, nodular, hypoechoic foci with strikingly increased vascularity.

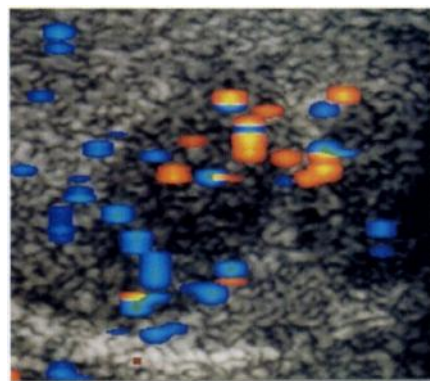
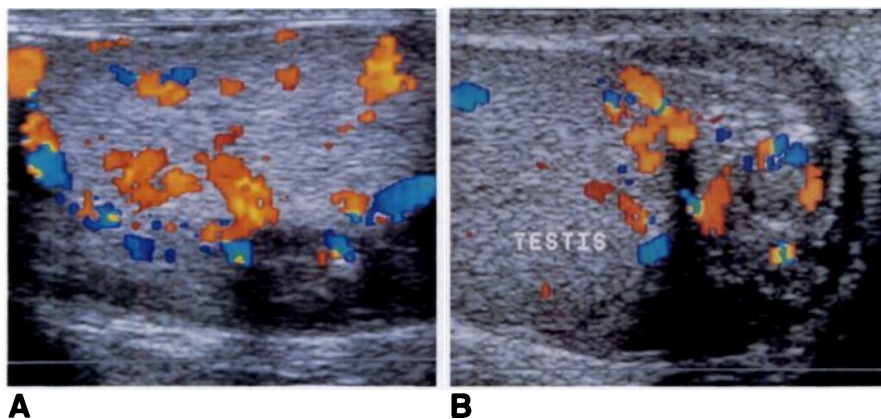


Fig. 3.—22-year-old man with AIDS-related lymphomatous involvement of testes. Color Doppler sonogram shows hypoechoic nodule with diameter of less than 1 cm and hyperemia, confirming that small lesions may be hypervascular.

Fig. 4.—A and B, 27-year-old man with acute lymphoblastic leukemia and testicular and epididymal relapse.

A, Longitudinal color Doppler sonogram of testis shows hypervascularity throughout testis, which has subtle decreased echogenicity.

B, Color Doppler sonogram shows that adjacent epididymis, also infiltrated by leukemic cells, is enlarged, hypoechoic, and has increased flow. Lack of pain helps to distinguish this from inflammatory process.



with maintenance of the normal ovoid testicular shape. These findings are often subtle, especially in cases of diffuse involvement of the testes. Although primary testicular tumors may be hypoechoic, they also tend to be more focal and well circumscribed with irregular lobulated contours [8]. Nevertheless, the typical gray-scale findings of lymphoma and leukemia do not allow confident differentiation from other entities such as primary testicular tumors or focal orchitis.

Color Doppler sonography allows simultaneous interrogation of gray-scale tissue appearance and evaluation of blood flow. Although abnormalities were noted on gray-scale sonograms in all patients in this series, many were quite subtle, especially those in which there was diffuse testicular infiltration by lymphoma or leukemia. In these patients, color Doppler sonography can be helpful. In our series, diffuse round-cell infiltration became more apparent following the application of color Doppler sonography, owing to increased vascularity.

Horstman et al. [3] reported that the vascularity of primary testicular tumors shown by color Doppler imaging correlated with tumor size. Lesions greater than 1.6 cm were typically hypervascular [3]. Primary testicular tumors smaller than 1.6 cm were noted to be hypovascular with color Doppler imaging [3]. Similarly, a recent study of testicular tumors in children revealed hypervascularity in neoplasms of at least 2 cm maximal diameter [9]. In contradistinction, all of the round-cell tumors in our series were strikingly hypervascular without regard to the size or extent of the neoplasm. In fact, visualization of subtle, hypoechoic (8–12 mm in size) foci was aided by the use of color Doppler sonography because of the marked intralesional flow detected within these lesions.

Any vascularity within the epididymis is abnormal and thus indicates hypervascularity [10]. Both testicular and epididymal hypervascularity in association with gray-scale hypoechogenicity were noted in one patient in our series. Testicular hypervascularity without associated epididymal hyperemia is more suggestive of a neoplastic process than of orchitis. The epi-

didymal involvement in our patient suggests the presence of inflammation. Round-cell testicular infiltration may cause hypervascularity that is indistinguishable from that seen in orchitis or epididymo-orchitis.

Patients who have testicular enlargement pose a difficult diagnostic challenge. Sonographic findings may aid in the diagnosis, but the nonspecific sonographic appearance of testicular round-cell tumor infiltration mimics the appearance of inflammatory processes of the testes. However, the lack of clinical findings such as pain, epididymal enlargement, and thickening of scrotal skin narrows the considerations [11]. In the proper clinical setting of painless testicular enlargement, lymphoma and leukemia should be considered in the differential diagnosis of hypervascular lesions. Even relatively small lesions are hypervascular with color Doppler imaging.

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