Magnetic resonance imaging for intratesticular and extratesticular scrotal lesions

Jeffrey M. Woldrich, MD, Ronald D. Im, MD, Fiona M. Hughes-Cassidy, MD, Lejla Aganovic, MD, Kyoko Sakamoto, MD

Division of Urology, University of California San Diego Medical Center, San Diego, California, USA

WOLDRICH JM, IM RD, HUGHES-CASSIDY FM, AGANOVIC L, SAKAMOTO K. Magnetic resonance imaging for intratesticular and extratesticular scrotal lesions. *Can J Urol* 2013;20(4):6855-6859.

Introduction: *To evaluate magnetic resonance imaging (MRI) utility in intratesticular and extratesticular scrotal diseases.*

Materials and methods: *Two radiologists retrospectively reviewed images of patients who underwent ultrasound followed by MRI, categorizing them as intratesticular or extratesticular and malignant, benign, indeterminate, or inadequate study. For patients who underwent surgical excision, pathologic results were also correlated to the presurgical ultrasound and MRI diagnoses.*

Results: *Of 69 cases, 38 were intratesticular lesions and 31 were extratesticular lesions. MRI and ultrasound diagnoses were discordant in 21 (55.32%) intratesticular and 19 (61.3%) extratesticular lesions. MRI diagnosis was malignant after an indeterminate ultrasound in 0 and 4 (12.9%) intratesticular and extratesticular lesions, respectively. MRI diagnosis was benign after an indeterminate ultrasound in 18 (47.43%) and 14 (45.2%) intratesticular and extratesticular lesions, respectively. A malignant ultrasound diagnosis was reversed to benign MRI diagnosis in one (2.6%) intratesticular and one (3.2%) extratesticular lesion. In no case was a benign lesion on ultrasound read as malignant on MRI in either group. The cohort of patients with intratesticular lesions received a mean clinical and radiographic follow up of 2.49 ± 1.97 and 1.85 ± 1.46 years, respectively. The patients with extratesticular lesions received a mean clinical and radiographic follow up of 1.30 ± 1.08 and 2.00 ± 1.28 years, respectively. In no case did repeat imaging change the diagnosis after initial MRI and ultrasound evaluation.*

Conclusions: *MRI was effective at characterizing both intratesticular and extratesticular lesions in the majority of cases.*

Key Words: magnetic resonance imaging, scrotum, ultrasound, intratesticular, extratesticular, testicular mass

Introduction

Ultrasonography is commonly performed to evaluate scrotal diseases. Infrequently, ultrasound results are inconclusive, leaving the diagnosis unclear. Magnetic resonance imaging (MRI) has been touted as an adjuvant to ultrasound for scrotal pathology. However, there is a paucity of current studies that critically address clinical situations in which MRI demonstrates utility.[1-3] In addition, the majority of studies do not differentiate between extra- and intratesticular lesions or have a very small number of subjects with extratesticular lesions. To our knowledge, our study includes the largest number of patients with extratesticular lesions to date. We compare the concordance rate of MRI with ultrasound to evaluate the utility of MRI in intratesticular and extratesticular scrotal diseases.

Accepted for publication March 2013

Address correspondence to Dr. Kyoko Sakamoto, Division of Urology, Moores Cancer Center, 3855 Health Sciences Drive, Mail Code: 0987, La Jolla, CA 92093-0987 USA

Materials and methods

After obtaining institutional review board approval, radiology archives at the San Diego Veterans Administration Hospital and the University of California at San Diego Medical Center were retrospectively reviewed for patients that underwent scrotal ultrasound followed by scrotal MRI from January 1, 2000 to June 1, 2008 for any reason. Sonography was performed using high resolution linear (10 MHz transducer) units (Power Vision, Toshiba; or Logiq 500, GE Healthcare). Gray-scale and color-flow Doppler sonography were used to examine each testis for lesions as well as the presence or absence of intratesticular blood flow. MRI was performed on a 1.5T scanner (General Electric Medical System, Milwaukee, WI, USA). A 5 inch general purpose circular surface coil was placed over the scrotum. Patients were imaged in a supine position. Axial, coronal, and sagittal images were obtained with T1-weighted spin-echo sequences (TR/TE, 500–650/13–15) and a T2-weighted fast spin-echo sequence (4,000/100–120) with 3 mm to 4 mm slice thickness and a 0.5 mm gap. Axial precontrast T1 images were acquired with fat supresion, followed by postcontrast images in axial, coronal and sagittal planes. All images were acquired with a small filed of view (200 mm). All patients received intravenous contrast material (Omniscan, GE Healthcare or Multihance, Bracco Diagnostics). The entire examination took approximately 20 minutes. Two different attending radiologists interpreted the ultrasound and MRI images specifically for this analysis. They were blinded to each other's readings and the original clinical interpretations. Each study was classified into one of four categories: 1) suspicious for malignancy, recommend surgical intervention; 2) benign, no follow up necessary; 3) indeterminate; or 4) inadequate study. An attending urologist reviewed the images and radiologic interpretations to determine whether the MRI results would alter clinical management compared to the ultrasound results alone. If the patient went on to surgical excision, we compared the pathological and radiographic diagnoses for correlation. Clinical follow up either in the urology clinic or via additional imaging was also documented, defined as time after initial MRI evaluation.

Results

Sixty-nine patients underwent both ultrasound and MRI during the study period: 39 patients with intratesticular lesions and 30 with extratesticular lesions. The interval between initial ultrasound and MRI ranged from 6-460 days (mean 99.6 days, median 47 days) for extratesticular lesions and from 0-912 days (mean 102, median 44 days) for intratesticular lesions. Table 1 demonstrates clinical demographics and follow up of these two groups. Both blinded radiologists agreed on the characterization of lesions in all cases.

MRI accurately localized one extratesticular lesion that ultrasound could not definitively localize. MRI results led to a change in radiologic diagnosis in 21 (55.3%) intratesticular lesions and 19 (61.3%) extratesticular lesions. MRI assisted in determining a malignant lesion after an indeterminate ultrasound in 0 and 4 (12.9%) intra- and extratesticular lesions, respectively. Of these four extratesticular lesions however, only one was removed and proved to be an adenomatoid tumor. The other three were followed clinically for 0.7 to 3.7 years. Repeat ultrasound evaluation in one patient revealed no interval change at 1.5 years. There were no pathologically confirmed malignant lesions that were not identified with ultrasound. MRI assisted in determining benign lesions after an indeterminate ultrasound result in 17 (44.7%) and 14 (45.2%) intra- and extratesticular lesions, respectively. A malignant ultrasound diagnosis was reversed to a benign MRI diagnosis in one (2.6%) intratesticular lesion and one (3.2%) extratesticular lesion. In no case was a benign lesion on ultrasound read as malignant on MRI in either group. A total of 10 patients with intratesticular lesions underwent interval repeat imaging, either with MRI or ultrasound. Patients with intratesticular lesions received a mean clinical follow up for a mean of 2.49 ± 1.97 years and repeat imaging at a mean follow up of 1.85 ± 1.46 years. A total of nine patients with extratesticular lesions underwent interval repeat imaging, either with ultrasound or MRI. Patients with extratesticular lesions received a mean clinical follow

TABLE 1. **Patient demographics and clinical follow up**

	Intratesticular	**Extratesticular**
Age (n)	35	27
Mean ± SD	53.9 ± 14.1	52.3 ± 14.4
Median (range)	56 (14-76)	52 (21-74)
Radiologic F/U (n)	10	9
Mean ± SD	1.85 ± 1.46	2.01 ± 1.28
Median (range)	1.44 (0.32-4.15)	1.67 (0.28-4.62)
Clinical F/U (n)	25	19
Mean ± SD	2.43 ± 1.94	1.32 ± 1.10
Median (range)	2.65 (0.01-6.03)	0.92 (0.05-3.76)

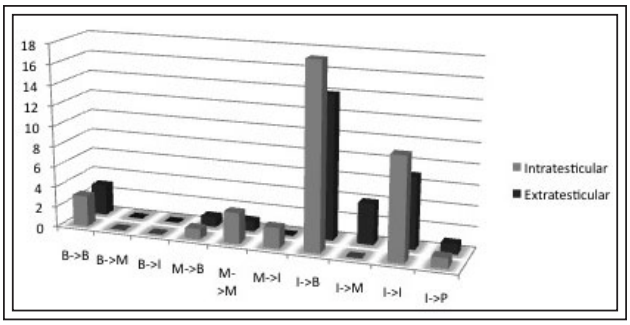

Figure 1. Comparison of ultrasound and magnetic resonance diagnoses.

up of 1.30 ± 1.08 years and repeat imaging at a mean follow up of 2.00 ± 1.28 years. In no case in either group did repeat radiologic testing, either ultrasound or MRI, lead to a change in diagnosis after a patient received an initial MRI and ultrasound. In all cases of suspected intratesticular malignancy on MRI, final pathology revealed malignancy: one lymphoma, one mixed germ cell tumor, and one Sertoli cell tumor. In one indeterminate case, a patient with known retroperitoneal seminoma underwent orchiectomy of an atrophic, heterogenous testicle, which did not reveal cancer. In two extratesticular cases, suspected malignant lesions were excised: one revealed an adenomatoid tumor and the other revealed a myxoid mesenchymal neoplasm of uncertain malignant potential despite review at the Armed Forces Institute of Pathology (AFIP). An epididymal cyst was excised from the benign group. Figure 1 and Table 2 summarize these findings by category and etiology.

TABLE 2. **Magnetic resonance diagnosis after indeterminate ultrasound**

	Intratesticular	**Extratesticular**
Normal	7	4
Fibrosis/trauma	3	3
Epididymorchitis	0	2
Cyst	8	0
Lipoma	0	3
Sperm granuloma	0	1
Polyorchidism	0	1
Tumor	0	4
Total	**18**	**18**

Discussion

Magnetic resonance imaging has been recommended as an adjunct to ultrasonography in the evaluation of scrotal lesions. It has the advantages of clearly defining soft tissue structures, avoiding ionizing radiation, and has less operator dependence than ultrasound. However, the optimal, clinical utilization of this expensive imaging modality remains questionable, particularly as ultrasound is both sensitive and specific for the diagnoses of most common scrotal conditions. In one series, 4.1% of scrotal ultrasounds were non-diagnostic with MRI providing a definitive diagnosis in 82.1% of these cases.[2] To date the majority of studies examining MRI for scrotal pathology have been descriptive, highlighting the characteristic radiographic appearance of scrotal pathology on MRI.[3-8] There have been relatively few studies that have examined the utility of this modality in particular clinical scenarios in which ultrasound was insufficient for diagnosis.[1,2,9]

Our study differs from most prior publications in that it is retrospective and unselected and therefore reflects the actual clinical utilization of MRI at our facility. Descriptive studies either make no reference to ultrasonographic findings or, as in the comparative studies mentioned, compare ultrasound and MRI performed relatively contemporaneously and according to a controlled protocol. Our cohort of patients suggest that MRI may not be as clinically helpful as estimates provided by other authors,[1,2,9] with 37.9% of the intratesticular and 30.7% of the extratesticular indeterminate ultrasounds yielding a subsequent indeterminate or poor quality MRI result.

The reason for this difference may be related to a number of factors. Our cohort of patients and the pathology evaluated on imaging may have differed from these prior reports. Neither of the facilities in our series have emergent access to MRI for scrotal trauma, one of the most definitive situations in which MRI proved to be diagnostically helpful in the study by Muglia et al.[2] We had few pediatric and no preadolescent patients. There may be variations in the frequency of indeterminate ultrasound or MRI readings between radiologists, although there was a 100% correlation between the two attending radiologists involved in our study. Compared to previous studies, we had a larger cohort of patients followed for small, hypoechoic lesions consistent with intratesticular cysts. The natural history of these lesions is not well described in the literature, although it appears that the majority represent benign and nonprogressive findings.[10] Indeed, no patient in

our series with an intratesticular cyst on ultrasound subsequently developed worrisome pathology either at initial MRI or on further clinical or radiographic follow up.

In the majority of situations MRI did provide a definitive diagnosis after inconclusive ultrasound, Table 2. Our findings reiterate those of other authors[1,2,9] regarding the utility of MRI in distinguishing malignancy from either infection or fibrosis. Heterogenous echotexture can be the result of several processes, including malignancy.[11,12] Findings in six patients were characteristic of past trauma and findings in two patients were characteristic of epididymorchitis; thus avoiding surgery. Furthermore, there were two patients, one from each cohort, categorized as definitively malignant on initial ultrasound that had benign findings on MRI; again these patients were spared unnecessary surgery. While few patients with benign findings on ultrasound underwent MRI (three intratesticular and three extratesticular lesions), it is reassuring that MRI uncovered no malignant diagnosis in this group

There are few reports on the utility of MRI for paratesticular pathology,[9,13-15] and to our knowledge, our study is the largest cohort to date of these patients. MRI was useful in precisely localizing one lesion in the epididymis that could not be determined on ultrasound. The majority of lesions identified were benign, however MRI detected four enhancing, solid masses after an indeterminate ultrasound (15.4% of the indeterminate cases). All clinically proved to be benign, consistent with the rarity of paratesticular malignancy.[16] One lesion highly concerning for malignancy on both ultrasound and MRI could not be definitively characterized histologically as malignant despite review at the AFIP. While we do not have enough patients for a meaningful statistical comparison between intra and extratesticular lesions, the technology appears to be diagnostically effective in both clinical contexts.

This study has several limitations. Our sample was selected on the basis of having received both an MRI and ultrasound of the scrotum without reference to the clinical decision process leading to this additional imaging, information that was often unavailable in our review of the medical records. It is therefore unclear how generalizable our findings are to all patients with intrascrotal pathology. Predictably for such a cohort, ultrasound diagnoses were predominantly indeterminate, so this study provides limited information corroborating the accuracy of MRI in comparison to definitive ultrasound evaluation. Additionally, there was often a significant time interval between ultrasound and MRI, and it is therefore unclear whether a repeat ultrasound at this interval could have provided equivalent diagnostic information as MRI given the natural history of the disease process. Since the patients were treated at a variety of clinical practices (e.g., urology and internal medicine clinics, urgent care, etc.), their follow up was not uniform.

Conclusions

MRI is frequently used to further characterize scrotal pathology after a nondiagnostic ultrasound. In the majority of cases in this study, MRI led to a definitive and correct diagnosis in both intratesticular and extratesticular lesions. Ten patients, who would have potentially undergone unnecessary surgery based on ultrasound information alone, avoided invasive intervention based on a diagnostic MRI. On the other hand, MRI is rarely necessary. No pathologically confirmed malignant lesion was missed on ultrasound. The infrequency with which MRI is necessary to diagnose a malignancy is a testament to the sensitivity and specificity of first-line scrotal evaluation by way of physical exam and ultrasound. □

References

1. Parenti GC, Feletti F, Brandini F et al. Imaging of the scrotum: role of MRI. *Radiol Med* 2009;114(3):414-424.
2. Muglia V, Tucci S, Elias J, Trad CS, Bilbey J, Cooperberg PL. Magnetic resonance imaging of scrotal diseases: when it makes the difference. *Urology* 2002;59(3):419-423.
3. Kim W, Rosen MA, Langer JE, Banner MP, Siegelman ES, Ramchandani P. US MR imaging correlation in pathologic conditions of the scrotum. *Radiographics* 2007;27(5):1239-1253.
4. Tsili AC, Tsampoulas C, Giannakopoulos X et al. MRI in the histologic characterization of testicular neoplasms. *AJR Am J Roentgenol* 2007;189(6):W331-337.
5. Akbar SA, Sayyed TA, Jafri SZH, Hasteh F, Neill JSA. Multimodality imaging of paratesticular neoplasms and their rare mimics. *Radiographics* 2003;23(6):1461-1476.
6. Cassidy FH, Ishioka KM, McMahon CJ et al. MR imaging of scrotal tumors and pseudotumors. *Radiographics* 2010;30(3):665-683.
7. Bhatt S, Jafri SZH, Wasserman N, Dogra VS. Imaging of non-neoplastic intratesticular masses. *Diagn Interv Radiol* 2011;17(1):52-63.
8. Cramer BM, Schlegel EA, Thueroff JW. MR imaging in the differential diagnosis of scrotal and testicular disease. *Radiographics* 1991;11(1):9-21.
9. Serra AD, Hricak H, Coakley FV et al. Inconclusive clinical and ultrasound evaluation of the scrotum: impact of magnetic resonance imaging on patient management and cost. *Urology* 1998;51(6):1018-1021.

10. Shergill IS, Thwaini A, Kapasi F, Potluri BS, Barber C. Management of simple intratesticular cysts: a single-institution 11-year experience. *Urology* 2006;67(6):1266-1268.
11. Einstein DM, Paushter DM, Singer AA, Thomas AJ, Levin HS. Fibrotic lesions of the testicle: sonographic patterns mimicking malignancy. *Urol Radiol* 1992;14(3):205-210.
12. Harris RD, Chouteau C, Partrick M, Schned A. Prevalence and significance of heterogeneous testes revealed on sonography: ex vivo sonographic-pathologic correlation. *AJR Am J Roentgenol* 2000;175(2):347-352.
13. Ch Tsili A, Tsampoulas C, Giannakopoulos X et al. Solitary fibrous tumour of the epididymis: MRI features. *Br J Radiol* 2005;78(930):565-568.
14. Gupta R, Alobaidi M, Jafri SZ, Bis K, Amendola M. Correlation of US and MRI findings of intratesticular and paratesticular lesions: from infants to adults. *Curr Probl Diagn Radiol* 2005;34(1):35-45.
15. Aguado A, Grant TH, Miller FH, Garnett J. Radiation-induced fibrosis of the spermatic cord: sonographic and MRI findings. *AJR Am J Roentgenol* 2005;184(3 Suppl):S102-103.
16. Woodward PJ, Schwab CM, Sesterhenn IA. From the archives of the AFIP: extratesticular scrotal masses: radiologic-pathologic correlation. *Radiographics* 2003;23(1):215-240.