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MRI for evaluation of scrotal pathology

D. Schultz-Lampel[1], G. Bogaert[1], J. W. Thüroff[1], E. Schlegel[2], and B. Cramer[2]

Departments of [1]Urology and [2]Radiology, Barmen Clinic, Wuppertal, FRG

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Summary. Since 1986, 205 patients, age 2–84 years, mean age 33 years, with scrotal pathology were examined by magnetic resonance imaging (MRI). A 1.5-T Siemens Magnetom and specially designed external coils were used for obtaining T1- and T2-weighted images. Of these, 88 patients underwent MRI studies for suspicion of testicular cancer, and 117 for a variety of benign scrotal lesions. MRI studies yielded excellent diagnostic information of scrotal pathology: predictive value for diagnosing testicular cancer was 100% with 62% of correct differentiation between seminoma and non-seminomatous tumors. In future, the incidence of diagnostic surgical explorations of scrotal pathology can be reduced by MRI studies.

Key words: Magnetic resonance imaging – Testicular cancer – Benign scrotal disease

Before the era of ultrasound and magnetic resonance imaging (MRI), history and clinical examination were the mainstay in the evaluation of scrotal pathology. In cases suspicious for testicular cancer, diagnostic surgical exploration was mandatory. Scrotal ultrasound has become a powerful diagnostic tool for testicular evaluation. However, ultrasound diagnosis depends largely on the technical equipment and experience of the examiner. We have performed MRI studies for the evaluation of scrotal contents since 1986. In a retrospective study, results of 205 consecutive MRI studies were correlated to clinical and histopathological findings for evaluation of the sensitivity and specificity of MRI studies in diagnosis of scrotal pathology.

Materials and methods

We used a 1.5-T Siemens Magnetom and custom-designed, high-resolution surface coils to obtain T1-weighted (TR = 500 ms/TE = 17 ms) and T2-weighted (TR = 3.000 ms/TE = 23–30 ms and 60–120 ms) images. Slice thickness was 4–5 mm. Multiple planes of imaging were obtained in axial, coronary, and sagittal orientation. In several cases gadolinium diethylenetriamine pentaacetic acid (Gd-DTPA) was applied for image enhancement. The age of the 205 patients ranged between 2 and 84 years, with a mean age of 33 years. Of these, 88 patients underwent MRI studies for suspicion of testicular cancer, and 117 for a variety of suspected benign scrotal pathology.

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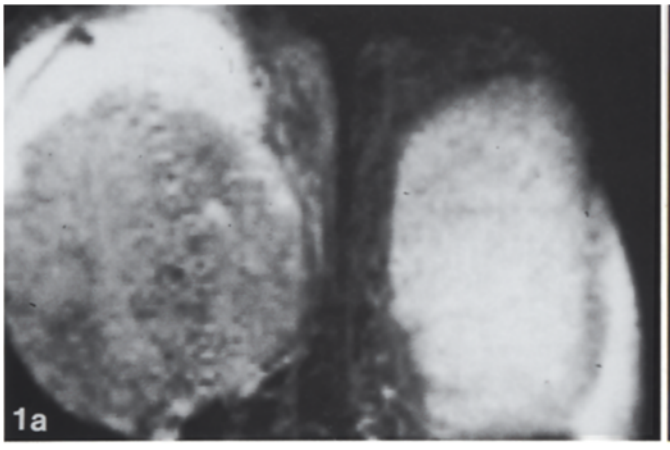
Results

MRI allowed assessment of both normal and pathological scrotal structures greater than 1 mm. In general, coronal sections were adequate for diagnosis. Additional sagittal and transverse sections became necessary only when the lesion was located on the ventral or dorsal surface of the testicle. The highest contrast of signal intensity and best identification of extratesticular and intratesticular structures were obtained on T2-weighted images.

In all 88 patients in whom MRI studies were done for clinical suspicion of testicular cancer, open surgery was performed and histology results were available. In only 67 of 88 patients was the MRI diagnosis testicular cancer, which proved correct in all cases (sensitivity of MRI = 100%). In 42 of 67 (62%) patients with testicular cancer, MRI yielded correct preoperative differentiation between seminomas and non seminomatous tumors. Histology revealed 33 nonseminomatous and 34 seminomatous tumors. Thus, 28 of 33 (85%) nonseminomatous and 14 of 34 (41%) seminomatous tumors were diagnosed correctly by MRI. Some 16 of 67 tumors were incorrectly classified, of which were atypical human chorionic gonadotropin (β-HCG)-positive seminomas. Only 2 nonseminomas were misread as seminoma. In 9 of 67 (14%) cases MRI studies were inconclusive in respect of the histological diagnosis.

In 21 of 88 patients with clinical suspicion of testicular cancer, MRI diagnosis suggested a benign pathology, which was confirmed by histology in all cases. In these cases, histology revealed pseudotumor with fibrous thickening of the tunica albuginea ($n = 11$), hydrocele ($n = 3$), orchitis ($n = 2$), spermatocele ($n = 2$), no pathological findings ($n = 2$), and lipoma of the spermatic cord ($n = 1$).

Another 117 patients were studied by MRI for the clinical diagnosis of a variety of benign scrotal lesions: epididymitis ($n = 40$), hydrocele ($n = 19$), orchitis ($n = 13$), old testicular torsion ($n = 9$), spermatocele ($n = 7$), normal findings ($n = 7$), varicocele ($n = 6$), testicular dystopy ($n = 5$), testicular trauma ($n = 4$), scrotal trauma ($n = 4$), and different lesions ($n = 3$). All 117 cases (100%) were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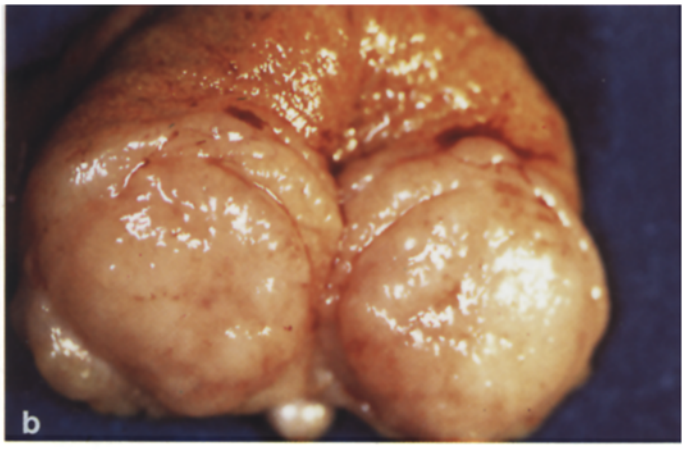
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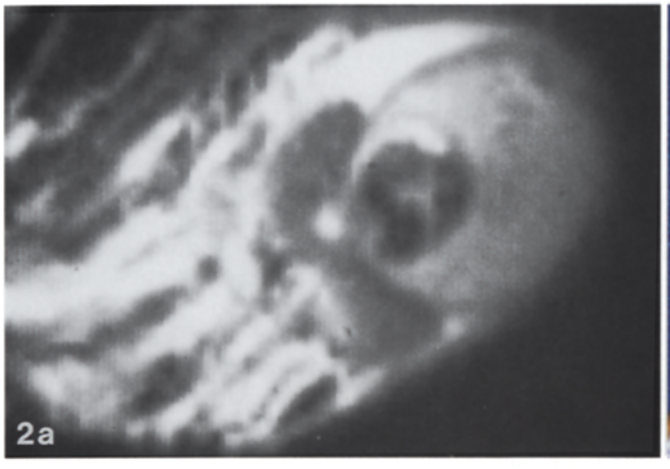
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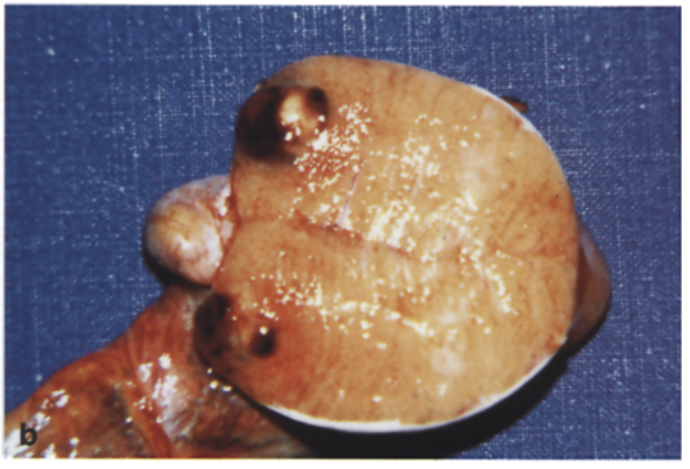
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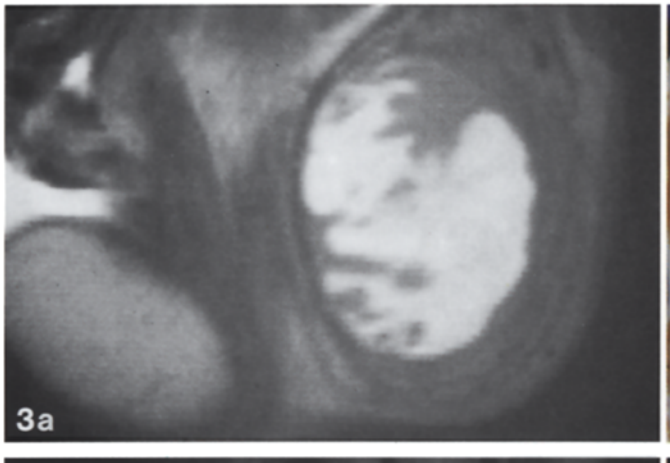
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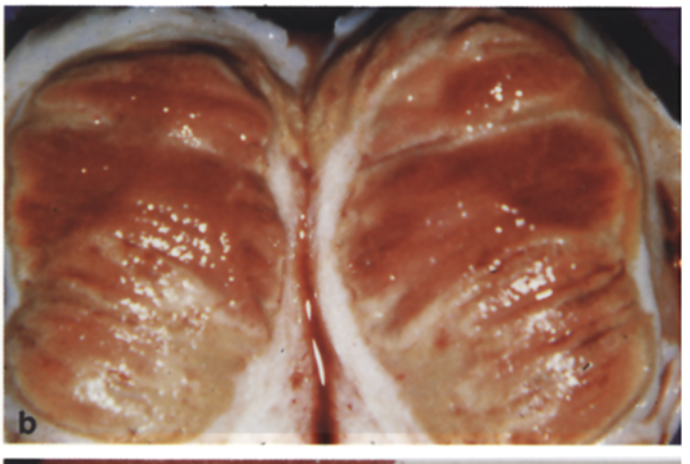
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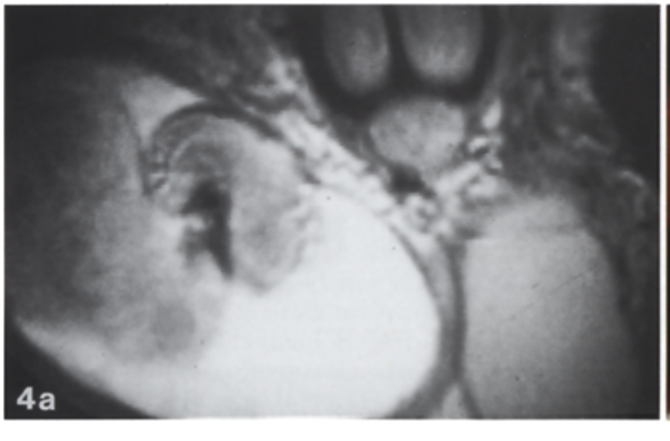
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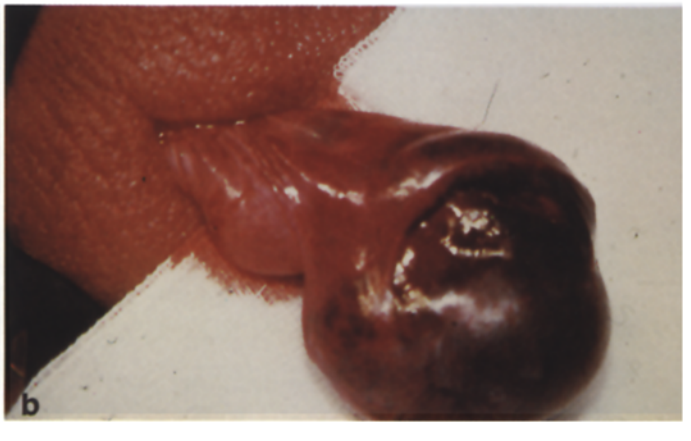
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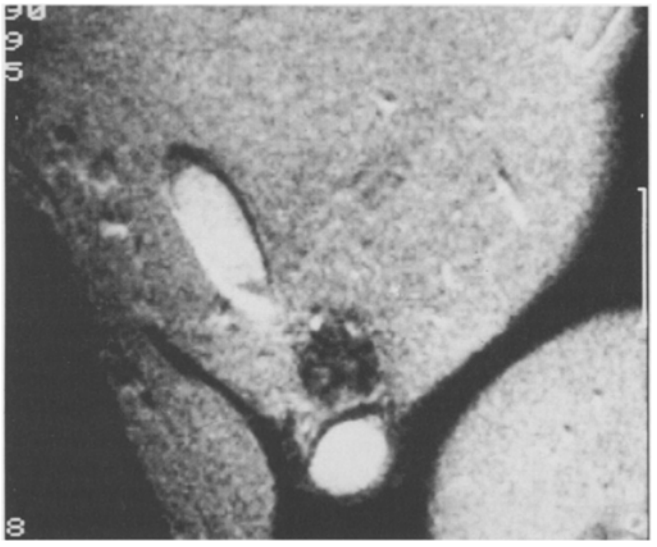

Fig. 5. Dystopic testicle

correctly read as benign lesions on MRI. MRI yielded the correct diagnosis in 114 of 117 cases (97%). In 2 cases a diagnosis could not be given because of technical problems with the studies. In 50 of 117 cases, MRI diagnosis was confirmed by surgery and in the remainder, by repeat clinical, ultrasound, and MRI studies, with pathological findings returning to normal.

Normal testicular anatomy

The normal testicle has an intermediate signal intensity on T1-weighted pictures and homogenous high intensity on T2-weighted images. Signal intensity of the epididymis is rather low in comparison. The tunica albuginea and testicular septa present as signal-free structures. The vessels of the spermatic cord show up as tubular structures. Pathological lesions have specific signal intensity and characteristic appearance on MRI images.

Testicular cancer

Intratesticular malignant pathology presents with low signal intensity on T2-weighted images and disappearance of the testicular septa. Typical for nonseminomatous tumors is the inhomogenicity of signal intensity within a lesion as caused by hemorrhage (Fig. 1). Seminoma reveals a homogenous low signal intensity (Fig. 2), whereas β-HCG-positive seminoma has all the characteristics of a nonseminomatous tumor. Invasion of the tunica albuginea and epididymis can easily be recognized on MRI images.

Fig. 1a, b. Nonseminomatous testicular tumor

Fig. 2a, b. Seminomatous testicular tumor

Fig. 3a, b. Orchitis

Fig. 4a, b. Old testicular torsion

Epididymitis and orchitis

Acute epididymitis is characterized by enlargement of the epididymis, giving a homogenous, mostly high signal intensity. Enlargement of a testicle and homogenous decrease of signal intensity with preservation of testicular septa are typical findings of orchitis (Fig. 3). Chronic inflammation of the epididymis is characterized by low signal intensity or even disappearance of the signal.

Hydrocele, spermatocele, and varicocele

A lesion with fluid characteristics of high intensity on T2-weighted images identified itself by its typical location and configuration as a spermatocele or hydrocele. A varicocele presents inhomogenous vermiform structures of the spermatic cord with increased signal intensity due to venous blood flow.

Trauma

Trauma of the testicle is characterized by an inhomogenous signal pattern on MRI. High signal intensity on T1-weighted images indicates hemorrhage or hematocele. In rupture of the testicle, continuity of the tunica albuginea is interrupted.

Testicular torsion

Acute torsion of the testis is not an indication for MRI study because a delay in treatment would result. However, an old torsion of the testicle may cause diagnostic problems. On MRI, a torsion of the spermatic cord presents as an area of low signal intensity and an atypical relationship between epididymis and testicle, commonly associated with a hydrocele (Fig. 4).

Dystopic testis

Because of the high signal intensity of the tesis, MRI clearly depicts a dystopic testis greater than 0.5–1 cm in size. MRI may fail to identify a highly atrophic dystopic testis (Fig. 5).

Discussion

MRI offers the choice of variable imaging planes and sequences, which emphasize different tissue characteristics. T2-weighted images provide the highest contrast of signal intensity [6]. The normal testicle shows a homogenous high signal intensity, whereas pathological lesions have a lower signal intensity. Minimal changes in architecture of the testicular parenchyma cause decreased proton density of the testicle [1, 2, 7]. Variation of proton density over a 10%–20% range produces impressive changes in signal intensity [4]. Use of high resolution surface coils allows identification of structures as small as 1 mm in diameter [7]. Our results support the conclusions of other

investigators [1, 2, 6, 7, 8, 10] that MRI allows assessment of all important intratesticular and extratesticular structures. However, results of excellent differentiation between malignant and benign lesions have not yet been reported: In our group of 88 patients with clinical suspicion of testicular cancer, MRI diagnosed cancer in 67 of 88 patients, which was confirmed in all cases by histology. The resulting sensitivity of MRI diagnosing testicular cancer is 100%. Furthermore, in 42 of 67 (62%) patients MRI succeeded in preoperative correct differentiation between seminomas and nonseminomatous tumors. Some 14 of 16 incorrectly classified tumors were β-HCG-positive seminomas which were misread on MRI as nonseminomatous tumors.

All 117 patients with benign lesions were correctly diagnosed with MRI in respect to the benignity of the lesion (sensitivity = 100%). In 97% (114 of 117) MRI succeeded in giving the specific diagnosis of the pathology.

As compared with ultrasound imaging, MRI exhibits only a small advantage in sensitivity of depiction of intratesticular and extratesticular pathology. However, the 98.5% sensitivity of scrotal ultrasound in evaluation of testicular lesions [3, 6, 7, 9, 10,11] is countered by a significantly lower specificity regarding correct differentiation of benign or malignant intratesticular lesions [5, 11]. Fournier et al. [5] found physical examination to be more specific than scrotal ultrasound. With ultrasound, delineation of the tunica albuginea is impossible and thus also accurate definition of the extent of intratesticular lesions. In another study of scrotal lesions using a 10-MHz transducer, Tackett et al. [12] obtained a false-positive classification as testicular cancer in 50% of cases. As a result, half of the patients were treated by orchiectomy for benign scrotal lesions.

In our experience, the specificity of MRI was 100%. One patient with supraclavicular lymph node metastasis of a teratocarcinoma had an impalpable and by ultrasound undetectable testicular tumor. MRI depicted a small nonseminomatous tumor in the upper pole of the left testicle, which was confirmed by histology. In another patient with clinical suspicion of testicular cancer and equivocal findings on ultrasound, MRI definitively ruled out a malignacy and demonstrated thickening of the tunica albuginea in the presence of normal testicular tissue. Surgery and histology confirmed the diagnosis of pseudofibrinous periorchitis.

Another advantage of MRI is that painful scrotal lesions due to trauma, inflammation, or torsion can be examined pain-free without palpation of the tender area. Simultaneous MRI imaging of the scrotum, inguinal channels, and retroperitoneum and the characteristic signal intensity of a testicle allow easy depiction of dystopic testicles.

However, because of universal availability, lower costs, and shorter examination time, ultrasound will remain the method of choice as a first imaging modality. Nevertheless, the quality of ultrasound diagnosis depends very much on the technical equipment available (e.g., high resolution 7.5 and 10 MHz transducers) and the personal experience of the examiner.

The advantages of MRI are simultaneous imaging of both testicles and inguinal region, high resolution, characteristic signal intensities of testicle and intratesticular lesions, and low dependence on the examiner [6, 7]. Its limitations include restricted availability, expense, and time consumption of the studies.

Conclusion

MRI studies of the scrotal contents offer in assessment of intratesticular and extratesticular lesions comparable sensitivity with scrotal ultrasound but a higher specificity. However, ultrasound will remain the method of choice for routine imaging. In respect to our results with MRI imaging, it has advantages for diagnosing testicular cancer, nonpalpable dystopic testicle, and painful scrotal lesions, which can hinder ultrasound evaluation. However, acute testicular torsion is not an indication for a MRI study because of the resulting delay of treatment. In future, MRI studies may reduce the number of diagnostic surgical explorations in scrotal lesions.

References

1. Baker LL, Hajek PC, Burkhard TK (1987) MR-imaging of the scrotum: normal anatomy. Radiology 163:89
2. Baker LL, Hajek PC, Burkhard TK (1987) MR-imaging of the scrotum: pathologic conditions. Radiology 163:93
3. Bockrath JM, Schaeffer AJ, Merrill SK, Neimann HL (1983) Ultrasound identification of impalpable testicle tumor. J Urol 130:355
4. Crooks LE (1986) Image contrast mechanism in MRI. In: Budinger, Margulis (eds) Medical magnetic resonance imaging and spectroscopy, Society of Magnetic Resonance in Medicine, Berkeley, p 36
5. Fournier GR, Laing FC, Jeffrey RB, McAnnich JW (1985) High resolution scrotal ultrasonography: a high sensitive but nonspecific diagnostic technique. J Urol 134:90
6. Hajek PC (1987) Magnetische Resonanztomographie (MRT) des Skrotum – erste Ergebnisse und Vergleich mit der Sonographie. Teil I. Normale Anatomie und extratesticuläre Pathologie. Radiologe 27:522
7. Hajek PC (1987) Magnetische Resonanztomographie (MRT) des Skrotum – erste Ergebnisse und Vergleich mit der Sonographie. Teil II. Intratestikuläre Pathologie. Radiologe 27:529
8. Kenneth SR, Lee JK, Ling D, Heiken JP, Glazer HS (1987) MR imaging of the scrotum with a high-resolution surface coil. Radiology 163:99
9. Nachtsheim DA, Scheible FW, Gosink B (1983) Ultrasonography of testis tumors. J Urol 129:978
10. Rifkin MD, Kurtz AB, Pasto ME, Goldberg BM (1985) Diagnostic capabilities of high resolution scrotal ultrasonography: prospective evaluation. J Ultrasound Med 4:13
11. Sohn M, Neuerburg J, Bohndorf K, Sikora R, Daus HJ (1989) The value of magnetic resonance imaging at 1.5 T in the evaluation of the scrotal content. Urol Int 44:284
12. Tackett RE, Ling D, Catalona WJ, Melson GL (1986) High resolution sonography in diagnosing testicular neoplasms: clinical significance of false positive scans. J Urol 135:494

Dr. D. Schultz-Lampel
Urologische Abteilung
Klinikum Barmen
W-5600 Wuppertal
Federal Republic of Germany