BMC Medical Imaging

RESEARCH

Open Access

Magnetic resonance imaging features of epididymal and/or testicular tuberculosis: a case series

Bowen Yang[1†], Renbing Zhou[1†], Xiaohong Wang[2†], Yan Li[1], Panxia Wang[3], Yue Hao[1], Wenwen Li[4], Lei Zhang[5], Wenjing Su[1], Jie Qin[2*], Ya Qiu[1*] and Junyang Luo[1,2,6*]

Abstract

Background Tuberculosis (TB) is a global health burden, and extrapulmonary TB, particularly urogenital TB, is a significant concern in males. Given the nonspecific clinical manifestations of epididymal and/or testicular TB, this study characterizes the MRI features of this condition to facilitate earlier and more accurate diagnosis.

Methods This retrospective study was approved by the ethics committee. We included 14 patients with epididymal and/or testicular TB (diagnosed between January 2015 and September 2024) who underwent contrast-enhanced MRI scans on a 1.5-T scanner. MRI features and clinical characteristics were analyzed by two experienced radiologists.

Results Among these 14 patients (median age, 44.5 years), 78.6% of them had epididymal TB with or without testicular involvement, while 21.4% had isolated testicular TB. The most common local symptom was a painful scrotal mass (85.7%), and 64.3% reported fever. TB in other sites was identified in 71.4% patients. T lymphocyte spot test was positive in 57.1% patients, and pathological confirmation was obtained in 42.9%. Most lesions (71.4%) were unilateral. On T1-weighted images, 50% of lesions were isointense and 42.9% were mildly hyperintense. T2-weighted imaging showed hypointense signals in 64.3% of cases. All lesions appeared hyperintense on diffusion-weighted imaging, with 92.9% showing restricted diffusion. Heterogeneous or annular enhancement was observed in 85.7% of lesions. Hydrocele was present in all patients, and 21.4% had abscess formation or fistula.

Conclusions MRI provides valuable soft-tissue characterization for diagnosing epididymal and/or testicular TB.

Clinical trial number Not applicable.

Keywords Tuberculosis, Magnetic resonance imaging

†Bowen Yang, Renbing Zhou and Xiaohong Wang contributed equally to this work.

*Correspondence:
Jie Qin
qinjie@mail.sysu.edu.cn
Ya Qiu
qiuy68@mail3.sysu.edu.cn
Junyang Luo
luojy58@mail.sysu.edu.cn
[1]Medical Imaging Center, The First People's Hospital of Kashi, 120 Yingbin Avenue, Kashi City 844000, Xinjiang, P.R. China
[2]Department of Radiology, The Third Affiliated Hospital of Sun Yat-sen University, 600 Tianhe Road, Guangzhou 510630, Guangdong, P.R. China
[3]Department of Endocrinology and Metabolism, People's Hospital of Kashi City, 5 Jiankang Road, Kashi City 844000, Xinjiang, P.R. China
[4]Department of Trauma Intensive Care Unit, The First People's Hospital of Kashi, 120 Yingbin Avenue, Kashi City 844000, Xinjiang, P.R. China
[5]Department of Pathology, The First People's Hospital of Kashi, 120 Yingbin Avenue, Kashi City 844000, Xinjiang, P.R. China
[6]Department of Interventional Radiology, The Third Affiliated Hospital of Sun Yat-sen University, 600 Tianhe Road, Guangzhou 510630, Guangdong, P.R. China

Introduction

Tuberculosis (TB) remains a significant global health challenge, particularly in developing countries [1]. In 2021, TB caused an estimated 10.6 million incident cases worldwide, resulting in 1.6 million deaths [2]. While pulmonary TB is widely recognized for its severity, extrapulmonary TB should not be underestimated. Extrapulmonary TB is equally contagious and potentially fatal, often causing greater quality-of-life impairment than pulmonary TB [2].

Urogenital TB represents the second most prevalent form in high-burden countries and ranks third in low-prevalence regions. Male genital TB manifests as prostatic TB, seminal vesicle TB, testicular/epididymal TB, and penile TB [3]. The epididymis is the most commonly affected site in males, typically through hematogenous spread or retrograde extension from the seminal vesicles and prostate [4]. Testicular involvement usually occurs via contiguous spread from the epididymis, while isolated testicular TB through hematogenous dissemination remains rare [5]. Although bead-like or nodular epididymal masses on physical examination may suggest tuberculosis rather than malignancy, diagnosis remains challenging due to nonspecific clinical presentations and potential overlap with more common conditions like testicular tumors or epididymitis.

Imaging plays a pivotal role in diagnosis. Scrotal ultrasonography serves as the most accessible and standard imaging modality, with well-documented characteristics [6]. Contrast-enhanced computed tomography (CT) demonstrates calcification and hypodense or cavitary lesions secondary to necrosis and caseation [6]. Magnetic resonance imaging (MRI) has emerged as a valuable diagnostic tool due to its superior soft-tissue contrast and multiplanar capabilities, yet relatively few studies have detailed MRI findings of epididymal and/or testicular TB [6].

Hence, this retrospective single-center study characterizes the MRI features of epididymal and/or testicular TB to enhance radiologists' diagnostic awareness.

Materials and methods

This retrospective study received approval from the Ethics Committee of the First People's Hospital of Kashi Prefecture (Approval No. 2024-75), with waiver of individual consent requirements. All study procedures complied with the ethical principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments.

We included patients who underwent MRI at our hospital between January 2015 and September 2024 and had either a pathological diagnosis, laboratory-proven TB, or a positive response to empirical anti-TB therapy. The medical records of these cases were reviewed retrospectively.

MRI protocol and imaging acquisition

All examinations were performed using a 1.5-T MRI scanner (Magnetom Aera, Siemens Healthineers, Germany) with an 18-channel body coil. Patients were positioned supine in head-first orientation, with the scrotum stabilized between the thighs to minimize motion artifacts. The MRI imaging protocols were as follows: axial and coronal fast spin-echo T2-weighted imaging (a repetition time/echo time range of 3,000–6,000/50–80 ms); axial spin-echo T1-weighted imaging (a repetition time/echo time range of 500–750/7–10 ms); 3D T1-weighted spin-echo gadolinium contrast-enhanced acquisition (a repetition time/echo time range of 500–750/7–10 ms in axial, coronal and sagittal after intravenous injection of 0.1 mmol of gadolinium/ kilogram of the patient's weight). The field of view measured 23 cm × 32 cm and a matrix size of 256 × 320, with the slice thickness/intersection gap = 4/0.8 mm. Axial diffusion-weighted imaging (DWI) was performed using a 3 mm slice thickness with no gap, employing b-values of 0 and 800 s/mm². The apparent diffusion coefficient (ADC) map was calculated from the b = 800 s/mm² images.

Imaging analysis.

The following features were studied and recorded: location (unilateral or bilateral), boundary (clear and unclear), the involvement of adjacent tissues. The signal intensity of the lesion was compared with normal testicular parenchyma. The degree of enhancement was classified as none, mild, moderate or marked. Two experienced radiologists, B.Y. and R.Z., with over a decade of experience in abdominal and urogenital imaging, analyzed the images.

Statistical analyses

Mean ± standard deviation, or median with the range were used for reporting quantitative variables as appropriate. Frequency (percentage) were used for presenting qualitative variables.

Results

Clinical data (Table 1)

This retrospective study included 14 male patients aged between 27 and 68 years (median age, 44.5 years). The diagnosis of epididymal and/or testicular TB was confirmed by pathological examinations in 42.9% of patients (6/14), and positive clinical responses to empirical anti-TB treatment in 57.1% cases (8/14). Among these 14 patients, 64.3% (9/14) of them complained of fever. On the other hand, the most common local symptom was a scrotum mass with pain (85.7%, 12/14), while 14.3% (2/14) patients suffered from a scrotum mass without pain and 28.6% (4/14) patients with frequent micturition and dysuria. On physical examination, 71.4% (10/14) of patients presented with bead-like or nodular palpable

Table 1 Baseline clinical characteristics

Variable	Cases (*n* = 14)
Age (years), median (range)	44.5 (27–68)
Clinical symptoms	
Scrotum mass with pain, n (%)	12 (85.7)
Scrotum mass without pain, n (%)	2 (14.3)
Frequent micturition/ odynuria, n (%)	4 (28.6)
Initially presented with isolated scrotum complaints	5 (35.7)
Physical examinations	
Palpable as beads or small lumps, n (%)	10 (71.4)
Body temperature	
Elevated, n (%)	9 (64.3)
Normal, n (%)	5 (35.7)
Tuberculosis of other sites, n (%)	12 (85.4)
Pulmonary, n (%)	8 (57.1)
Renal, n (%)	2 (14.3)
Bladder, n (%)	1 (7.1)
Seminal vesicle, n (%)	1 (7.1)
Diagnosis approach	
Pathological examination, n (%)	6 (42.9)
Laboratory tests and positive response to medicine, n (%)	8 (57.1)
Treatments	
Anti-tuberculosis drugs alone, n (%)	7 (50)
Drugs and drainage, n (%)	1 (7.1)
Drugs and surgery, n (%)	6 (42.9)
Orchiectomy, n (%)	3 (21.4)
Epididymectomy, n (%)	3 (21.4)

Data presented as number of cases (percentage) or median (range) where appropriate

Table 2 Laboratory tests

Variable	Cases (*n* = 14)
Erythrocyte sedimentation rate	
Elevated, n (%)	6 (42.9)
Normal, n (%)	5 (35.7)
Not available, n (%)	3 (21.4)
C-reactive protein	
Elevated, n (%)	1 (7.1)
Normal, n (%)	5 (35.7)
Not available, n (%)	8 (57.1)
T lymphocyte spot test	
Elevated, n (%)	8 (57.1)
Normal, n (%)	6 (42.9)

Data presented as number of cases (percentage)

masses. Notably, TB in other sites was revealed in 71.4% (10/14) patients, including 57.1% (8/14) with pulmonary TB, 14.3% (2/14) with renal TB, 7.1% (1/14) with bladder TB and 7.1% (1/14) with seminal vesicle TB. However, only 35.7% (5/14) of patients initially presented with isolated scrotal complaints. All patients received anti-TB medical therapy. Additionally, 7.1% (1/14) underwent drainage procedures, while 42.9% (6/14) required surgical intervention: three patients underwent orchiectomy and three underwent epididymectomy.

Laboratory tests (Table 2)

Elevated erythrocyte sedimentation rate and C-reactive protein levels were found in 42.9% (6/14) and 7.1% (1/14) of patients, respectively. However, not every patient received these two tests above. It should be noted that the T lymphocyte spot test was positive in 57.1% of patients (8/14).

MRI features (Tables 3 and 4)

The MRI features in all patients are presented and summarized in Tables 3 and 4, respectively. Epididymal TB with or without testicular involvement was observed in 78.6% (11/14) of patients (Fig. 1A-H), while testicular TB alone in 21.4% (3/14) of patients (Fig. 2A-H). Unilateral involvement was observed in 71.4% (10/14) of patients, with right-sided lesions in 42.9% (6/14) and left-sided lesions in 28.6% (4/14). All the patients presented with hydrocele and 21.4% (3/14) of patients were combined with abscess or fistula. On T1-weighted images, 50% (7/14) of the lesions presented as isointense and 42.9% (6/14) were mildly hyperintense, while only 7.1% (1/14) were hypointense. Additionally, 64.3% (9/14) of the lesions presented with hypointense and 35.7% (5/14) were hyperintense on T2-weighted images. All lesions in 92.9% (13/14) of patients demonstrated restricted diffusion (hyperintensity on DWI with corresponding hypointensity on ADC maps), while only one patient's lesion exhibited isolated DWI hyperintensity without ADC value reduction. Moreover, heterogeneous and annular enhancement was found in 85.7% (12/14) of the lesions. However, marked enhancement was observed in the other 2 patients with testicular TB.

Discussion

TB remains a significant global health concern, particularly in developing countries, and its extrapulmonary manifestations, including male genital TB, are increasingly recognized. Accurate diagnosis of epididymal and/or testicular TB can facilitate prompt initiation of anti-TB treatment, potentially preventing unnecessary surgery [7]. In the past decade, male genital TB has been documented as a relatively rare condition [8], while reports have indicated an increase in its incidence in certain regions globally [9], thus underscoring the need for heightened awareness. However, many radiologists lack awareness of the imaging features of epididymal and/or testicular TB. Some previous studies have revealed certain clinical and imaging features, though they focused on ultrasound or CT. Regarding MRI features, these studies were based on small cohorts, mostly individual case reports [10]. Our study retrospectively analyzed

Table 3 MRI features for individuals

Patients NO.	Age (years)	Laterality of involvement	Main lesion	Size of the largest lesion (mm × mm × mm)	Hydrocele	Abscess formation	Fistula	T1-weighted signal intensity	T2-weighted signal intensity	Post-contrast T1 weighted enhancement	Diffusion-weighted imaging	Restricted diffusion	Misdiagnosis at initial MRI
1	27	Right	Epididymis	17 × 14 × 13	Yes	No	No	Mild, high	Mild, low	Heterogeneous, annular	high	No	No
2	33	Right	Testicle	52 × 40 × 51	Yes	No	No	Iso	Mild, low	Significant	high	Yes	Malignancy
3	50	Bilateral	Epididymis	26 × 17 × 24	Yes	No	No	Iso	Mild, low	Heterogeneous, annular	high	Yes	No
4	45	Left	Epididymis	26 × 21 × 23	Yes	No	No	Iso	Mild, low	Heterogeneous, annular	high	Yes	No
5	32	Right	Epididymis	36 × 34 × 21	Yes	No	No	Mild, high	Mild, low	Heterogeneous, annular	high	Yes	No
6	46	Bilateral	Epididymis	34 × 25 × 45	Yes	Yes	Yes	Mild, high	Mild, low	Heterogeneous, annular	high	Yes	No
7	35	Bilateral	Epididymis	38 × 39 × 53	Yes	No	No	Iso	Mild, low	Heterogeneous, annular	high	Yes	No
8	52	Left	Testicle	32 × 33 × 41	Yes	Yes	No	Low	Mild, high	Heterogeneous, annular	high	Yes	No
9	44	Left	Testicle	72 × 60 × 74	Yes	No	No	Iso	Mild, high	Marked	high	Yes	Malignancy
10	45	Right	Epididymis	26 × 21 × 27	Yes	No	No	High	Mild, high	Heterogeneous, annular	high	Yes	No
11	28	Bilateral	Epididymis	20 × 10 × 10	Yes	No	Yes	Mild, high	Mild, high	Heterogeneous, annular	high	Yes	No
12	68	Right	Epididymis	20 × 12 × 11	Yes	Yes	Yes	Iso	Mild, low	Heterogeneous, annular	high	Yes	No
13	60	Left	Epididymis	25 × 15 × 29	Yes	No	No	Mild, high	Mild, high	Heterogeneous, annular	high	Yes	No
14	40	Right	Epididymis	28 × 20 × 18	Yes	No	No	Iso	Mild, low	Heterogeneous, annular	high	Yes	No

Table 4 Summarization of MRI features

Variable	Cases (*n* = 14)
Side	
Bilateral, n (%)	4 (28.6)
Left side alone, n (%)	4 (28.6)
Right side alone, n (%)	6 (42.9)
Hydrocele, n (%)	14 (100)
Abscess formation, n (%)	3 (21.4)
Fistula formation, n (%)	3 (21.4)
T1-weighted signal intensity	
Iso, n (%)	7 (50)
Mild high or high, n (%)	6 (42.9)
Low, n (%)	1 (7.1)
T2-weighted signal intensity	
Mild low, n (%)	9 (64.3)
Mild high, n (%)	5 (35.7)
Post-contrast T1 weighted enhancement	
Heterogeneous, annular, n (%)	12 (85.7)
Diffusion-weighted imaging	
Hyperintensity, n (%)	14 (100)
Restricted diffusion, n (%)	13 (92.9)

Data presented as number of cases (percentage)

MRI features in 14 patients over the past decade - to our knowledge, the largest such cohort undergoing MRI.

Since scrotal mass with pain was the most common clinical presentation at admission in both this study and prior research [10], distinguishing tuberculosis from tumor remains challenging. Moreover, only 57.1% of the patients in our study presented with a elevated T lymphocyte spot test, which has been the main interferon-gamma release assay method for TB infection [11]. This highlights the limitations of relying solely on laboratory findings for diagnosis and emphasizes the importance of imaging modalities in the diagnostic process. As a result, effective imaging examinations are crucial. MRI can provide more insightful diagnostic details in the differential diagnosis due to its superior soft-tissue contrast resolution compared to other imaging modalities [10], and it has been demonstrated that testicular tumors display unique reactions to MR contrast agents [12].

In our study, the majority of patients presented with iso-intense signal or mildly hyperintense signal on T1-weighted images and mildly hypointense signal on T2-weighted images. These findings are consistent with the MRI characteristics of fallopian tubal TB [13], likely due to the presence of caseous material within the lesions. Caseous material typically appears as mildly hyperintense signal on T1-weighted images and iso-intense or mildly hyperintense signal on T2-weighted images, without marked contrast enhancement. However, in our study, the characteristic manifestation of epididymal lesions was heterogeneous annular enhancement, and marked enhancement was observed in testicular lesions. This

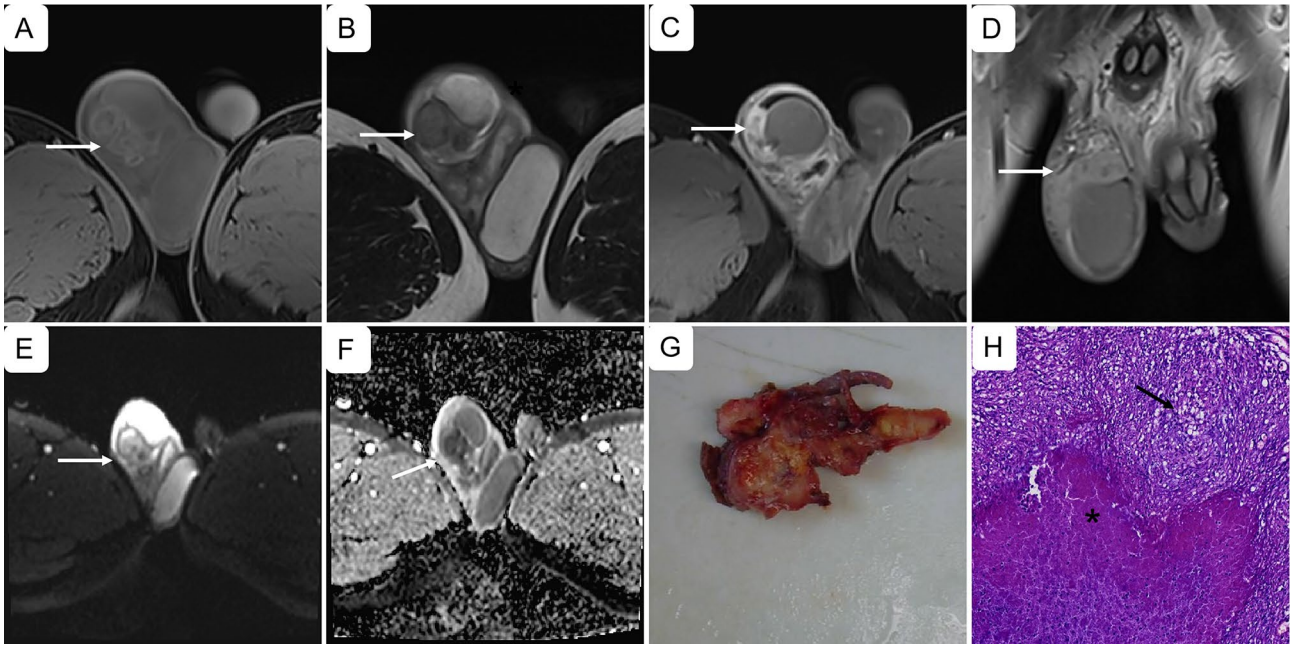

Fig. 1 A patient with fever and right-sided painful scrotum mass, received surgery. (**A**), T1-weighted imaging in axial plane shows right-sided lesion of epididymis with hyperintensity (white arrow). (**B**), T2-weighted imaging in coronal plane shows right-sided lesion of epididymis with hypointensity (white arrow). (**C**, **D**) Post-contrast T1-weighted imaging in axial and coronal plane shows strong enhancement shows heterogeneous and annular enhancement of the lesion (white arrow). (**E**, **F**) On axial diffusion-weighted imaging (b = 800 s/mm^2) and corresponding ADC maps, the lesion demonstrates restricted diffusion (white arrow). (**G**) Right-sided epididymis was resected. (**H**) Photomicrograph (hematoxylin-eosin stain; ×100) of the specimen shows necrotizing granulomatous inflammation with caseation necrosis (black *) and the granulomas contain epithelioid histiocytes (black arrow)

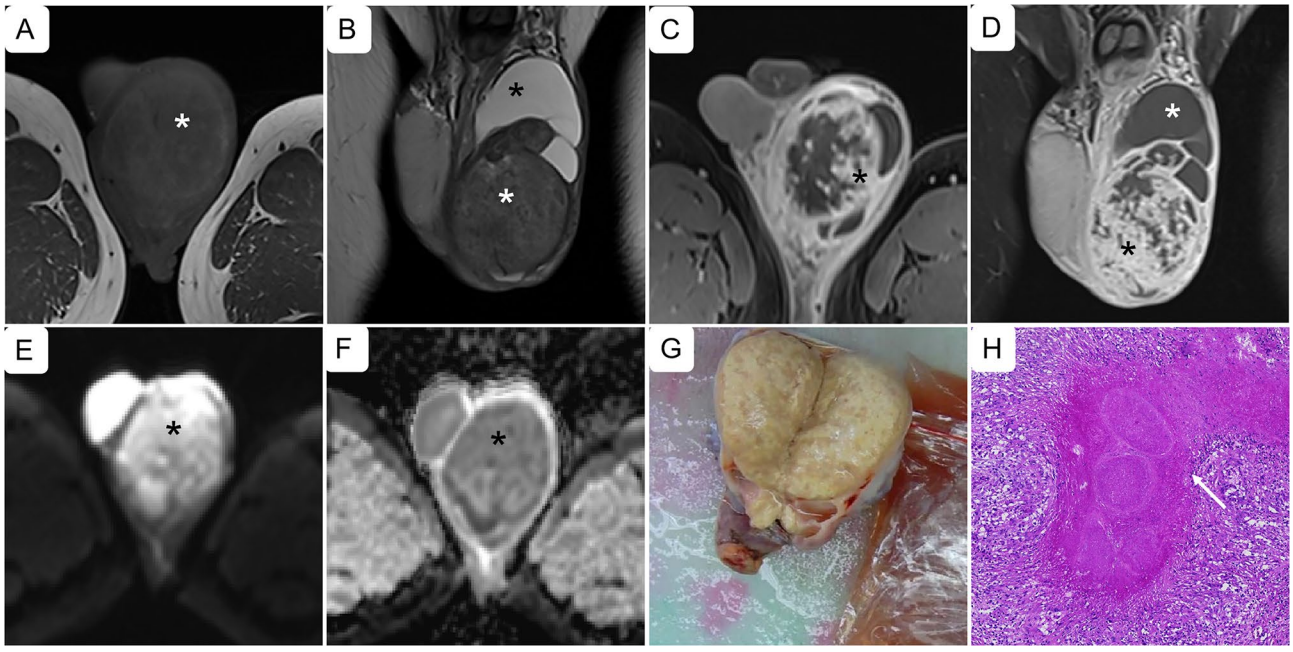

Fig. 2 A patient with fever and left-sided painful scrotum mass, received surgery. (**A**), T1-weighted imaging in axial plane shows left-sided lesion of testicle with iso signal intensity (white *). (**B**), T2-weighted imaging in coronal plane shows left-sided lesions of testicular with mildly hyperintensity (white *) and hydrocele (black *). (**C**, **D**) Post-contrast T1-weighted imaging in axial and coronal plane shows strong enhancement shows heterogeneous and strong enhancement of the lesion (black *) and hydrocele without enhancement (white *). (**E**, **F**) On axial diffusion-weighted imaging (b = 800 s/mm^2) and corresponding ADC maps, the lesion demonstrates restricted diffusion (black *). (**G**) Left-sided testicle was resected. (**H**) Photomicrograph (hematoxylin-eosin stain; ×100) of the specimen shows necrotizing granulomatous inflammation with caseation necrosis (white arrow)

enhancement pattern aligns with findings from previous contrast-enhanced CT studies, further supporting the utility of MRI in characterizing these lesions. Moreover, compared with seminomas, benign testicular masses exhibit greater maximum enhancement and achieve their peak enhancement more quickly [12].

As a functional MRI technique, DWI is a critical MRI sequence that detects differences in the mobility of water molecules between tumors and normal tissues and between benign and malignant lesions [14], and significantly aids in the differential diagnosis of scrotal lesions [15]. Malignant and benign lesions differ in MRI characteristics in terms of the type and pattern of enhancement and the extent of diffusion restriction. According to previous studies, the combination of DWI and ADC maps could significantly reduce the unnecessary biopsy rate for both thyroid and breast nodules, due to the favorable malignant nodule diagnostic efficacy of DWI [16, 17]. Moreover, high b-value DWI has been shown to be feasible in the differentiation between normal and abnormal scrotal tissue and, more importantly, in the discrimination of testicular malignancies from normal testis and benign intratesticular lesions in a previous retrospective study of 39 patients with various scrotal pathologies [18]. In lesions demonstrating annular enhancement, marked hyperintensity on DWI strongly favors an abscess over a neoplastic process [19]. Moreover, the absence of fever in the setting of an abscess should raise suspicion for a 'cold abscess', a key indicator of TB. In our study, most lesions exhibited DWI hyperintensity with restricted diffusion, while 2 cases of testicular TB were misdiagnosed at initial MRI. This might be due to their similar pattern of enhancement and diffusion restriction to testicular malignancies. However, the features of epididymal TB in our study had not been reported before, which is of significant value.

Hydrocele was found in all patients in our study, which is characterized by clear fluid that outlines the testis in an anterolateral position. While hydrocele has traditionally been associated with malignancy, it is also frequently seen in inflammatory conditions, including TB. In fact, approximately 50% of lesions accompanied by hydrocele have been linked to preceding inflammation or fibrous pseudotumors. This underscores the importance of considering clinical context and additional imaging features when interpreting findings such as hydrocele. In our study, the majority of patients presented with unilateral lesions, which is consistent with the typical presentation of testicular tumors. However, bilateral involvement, which occurs in approximately 3–5% of testicular tumors, was rare in our study [20], further highlighting the need for careful differential diagnosis.

Our study has several limitations that warrant consideration. First, certain laboratory tests, including hormone

levels and tumor markers such as alpha-fetoprotein and β-human chorionic gonadotropin, were not consistently recorded. These markers, while typically negative or only slightly elevated in epididymal and/or testicular TB, could provide additional diagnostic information. Second, while MRI excels in soft-tissue contrast resolution, it is less effective than CT in detecting calcifications, which are a significant feature of TB. Future studies should consider incorporating both MRI and CT to leverage the strengths of each modality. Finally, our study was conducted at a single center with a relatively small sample size. Multi-center studies with larger patient cohorts and comprehensive imaging data, including ultrasound, CT, and MRI features, are needed to validate our findings and further elucidate the imaging characteristics of epididymal and/or testicular TB.

In conclusion, MRI plays a pivotal role in the diagnosis of epididymal and/or testicular TB, providing detailed anatomical and soft-tissue information that can aid in differentiating TB from other benign or malignant masses. Radiologists should be familiar with the MRI features of this condition, including the characteristic signal intensities and enhancement patterns, to ensure accurate diagnosis and timely treatment. As the incidence of male genital TB continues to rise in certain regions, increased awareness and understanding of its imaging features are essential to improve patient outcomes and reduce the burden of this disease. Future research should focus on expanding the evidence base through multi-center studies and integrating advanced imaging techniques to refine diagnostic accuracy further.

Abbreviations

TB	Tuberculosis
MRI	Magnetic resonance imaging
DWI	Diffusion-weighted imaging
CT	Computed tomography

Acknowledgements
Not Applicable.

Author contributions
Study concept and design: Bowen Yang; Renbing Zhou; Xiaohong Wang; Yan Li; Panxia Wang; Yue Hao; Wenwen Li; Lei Zhang; Wenjing Su; Jie Qin; Ya Qiu; Junyang Luo. Acquisition of data: Bowen Yang; Xiaohong Wang; Renbing Zhou; Jie Qin; Ya Qiu; Junyang Luo. Analysis and interpretation of data: Bowen Yang; Xiaohong Wang; Renbing Zhou; Jie Qin; Ya Qiu; Junyang Luo. Drafting of the manuscript: Bowen Yang; Renbing Zhou; Xiaohong Wang; Yan Li; Panxia Wang; Yue Hao; Wenwen Li; Lei Zhang; Wenjing Su; Jie Qin; Ya Qiu; Junyang Luo.Critical revision of the manuscript for important intellectual content: Bowen Yang; Renbing Zhou; Xiaohong Wang; Jie Qin; Ya Qiu; Junyang Luo. Statistical analysis: Bowen Yang; Renbing Zhou; Xiaohong Wang; Jie Qin; Ya Qiu; Junyang Luo.Administrative support: Jie Qin; Ya Qiu; Junyang Luo.Study supervision: Jie Qin; Ya Qiu; Junyang Luo.

Funding
None.

Data availability
Data is provided by asking the corresponding author.

Declarations

Ethical approval
The study was reviewed and approved by the ethics committee of the First People's Hospital of Kashi Prefecture (2024-75), and informed consent was waived. All procedures were in compliance with the ethical standards of the institutional and/or national research committee, as well as with the 1964 Declaration of Helsinki and its subsequent amendments, or equivalent ethical standards.

Disclosures
The work described is original research that has not been published previously and not under consideration for publication elsewhere in whole or in part.

Human ethics and consent to participate
Not applicable.

Human experiment
Not applicable.

Consent to participate
Not applicable.

Consent to publish
All participants and patients gave written informed consent for their personal or clinical details along with all identifying images to be published.

Competing interests
The authors declare no competing interests.

Received: 21 February 2025 / Accepted: 28 April 2025
Published online: 12 May 2025

References

1. Bagcchi S. WHO's global tuberculosis report 2022. Lancet Microbe. 2023;4(1):e20.
2. Dheda K, Barry CE 3rd, Maartens G. Tuberculosis Lancet. 2016;387(10024):1211–26.
3. Kulchavenya E, Kim CS, Bulanova O, Zhukova I. Male genital tuberculosis: epidemiology and diagnostic. World J Urol. 2012;30(1):15–21.
4. Yadav S, Singh P, Hemal A, Kumar R. Genital tuberculosis: current status of diagnosis and management. Transl Androl Urol. 2017;6(2):222–33.
5. Sah SP, Bhadani PP, Regmi R, Tewari A, Raj GA. Fine needle aspiration cytology of tubercular epididymitis and epididymo-orchitis. Acta Cytol. 2006;50(3):243–9.
6. Ramachandran A, Das CJ, Razik A. Male genital tract tuberculosis: A comprehensive review of imaging findings and differential diagnosis. Abdom Radiol (NY). 2021;46(4):1677–86.
7. Lee IK, Yang WC, Liu JW. Scrotal tuberculosis in adult patients: a 10-year clinical experience. Am J Trop Med Hyg. 2007;77(4):714–8.
8. Gómez García I, Gómez Mampaso E, Burgos Revilla J, et al. Tuberculous orchiepididymitis during 1978–2003 period: review of 34 cases and role of 16S rRNA amplification. Urology. 2010;76(4):776–81.
9. Kulchavenya E, Kholtobin D, Shevchenko S. Challenges in urogenital tuberculosis. World J Urol. 2020;38(1):89–94.
10. Li S, Chen B, Fang X, et al. A better Understanding of testicular and/or epididymal tuberculosis based on clinical, ultrasonic, computed tomography, and magnetic resonance imaging features at a high-volume Institute in the modern era. Quant Imaging Med Surg. 2021;11(6):2465–76.
11. Li K, Yang C, Jiang Z, et al. Quantitative investigation of factors relevant to the T cell spot test for tuberculosis infection in active tuberculosis. BMC Infect Dis. 2019;19(1):673.
12. Törzsök P, Deininger S, Abenhardt M, et al. Discriminating malignant from benign testicular masses using multiparametric magnetic resonance Imaging-A prospective Single-Center study. J Clin Med. 2024;13(15):4390.
13. Liang ZY, Zou K, Lin TL, et al. Crucial computed tomography and magnetic resonance imaging findings of fallopian tubal tuberculosis for diagnosis: a retrospective study of 26 cases. Quant Imaging Med Surg. 2024;14(2):1577–90.

14. Manganaro L, Saldari M, Pozza C, et al. Dynamic contrast-enhanced and diffusion-weighted MR imaging in the characterisation of small, non-palpable solid testicular tumours. Eur Radiol. 2018;28(2):554–64.
15. Tsili AC, Bertolotto M, Turgut AT, et al. MRI of the scrotum: recommendations of the ESUR scrotal and penile imaging working group. Eur Radiol. 2018;28:31e43.
16. Penn A, Medved M, Abe H, Dialani V, Karczmar GS, Brousseau D. Safely reducing unnecessary benign breast biopsies by applying non-mass and DWI directional variance filters to ADC thresholding. BMC Med Imaging. 2022;22(1):171.
17. Zheng T, Xie X, Ni Z, Tang L, Wu PY, Song B. Quantitative evaluation of diffusion-weighted MRI for differentiating benign and malignant thyroid nodules larger than 4 cm. BMC Med Imaging. 2023;23(1):212.
18. Tsili AC, Argyropoulou MI, Giannakis D, Tsampalas S, Sofikitis N, Tsampoulas K. Diffusion-weighted MR imaging of normal and abnormal scrotum: preliminary results. Asian J Androl. 2012;14(4):649–54.
19. Yao F, Li J, Huang M, Gao X, Zhang Y. Comparison of computed versus acquired readout-segmented diffusion-weighted imaging in visualizing scrotal or testicular lesions. Clin Radiol. 2024;79(11):818–25.
20. Zequi Sde C, da Costa WH, Santana TB, Favaretto RL, Sacomani CA, Guimaraes GC. Bilateral testicular germ cell tumours: a systematic review. BJU Int. 2012;110(8):1102–9.

Publisher's note