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Research article

# Prostatic abscess and seminal vesicle abscess: MRI findings and quantitative analysis of apparent diffusion coefficient values

Jing Ren [a,1], Xufang Huang [a,1], He Wang [b], Huijia Liu [a], Fang Ren [a], Zhuoli Zhang [c], Yong Yang [a], Hong Yin [a], Yi Huan [a,*]

[a] *Department of Radiology, Xijing Hospital, Fourth Military Medical University, Changle West Road 127#, Xi'an City 710032, People's Republic of China*
[b] *Department of Urology, Tangdu Hospital, Fourth Military Medical University, Xinsi Road 1#, Xi'an City 710038, People's Republic of China*
[c] *Department of Radiology, Feinberg School of Medicine, Northwestern University, Robert H. Lurie Comprehensive Cancer Center, 737 N. Michigan Ave, 16th Floor, Chicago, IL 60611, USA*

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**Abstract**

*Purpose*: To investigate the conventional magnetic resonance imaging (MRI) and diffusion-weighted imaging (DWI) findings of prostatic abscess (PA) and seminal vesicle abscess (SVA), and to evaluate the qualitative and quantitative diagnostic value of apparent diffusion coefficient (ADC) for these conditions.

*Materials and methods*: Ten patients with PA and 2 patients with SVA who underwent MRI and DWI examinations ($b = 0$ and 1000 s/mm$^2$) at our institution were enrolled in this study. The diagnoses of all the patients were pathologically and clinically proved. Their conventional MRI and DWI images as well as ADC values were analyzed. The ADC values between PA and surrounding prostate tissues were compared using $t$ test. Statistical significance was inferred at $P < 0.05$.

*Results*: Six patients were revealed with multiple foci. The other 6 showed singular lesion, including the 2 with SVA. A total of 23 focal abscesses were demonstrated with iso-low T1WI signal as well as hyperintense T2WI and DWI signals. Four patients with PA presented air within the lesions by both T1WI and T2WI. The mean ADCs of PA, $(0.618 \pm 0.192) \times 10^{-3}$ mm$^2$ s$^{-1}$, were significantly lower than that of surrounding prostate tissues, $(1.417 \pm 0.147) \times 10^{-3}$ mm$^2$ s$^{-1}$ ($P = 0.000$).

*Conclusion*: PA and SVA can be characteristically demonstrated by MRI, and the lesions show especially restricted diffusion by DWI with low ADC values. These demonstrations facilitate their qualitative and quantitative diagnosis.



*Keywords:* Apparent diffusion coefficient; Diffusion weighted imaging; Magnetic resonance imaging; Prostatic abscess; Seminal vesicle abscess

## 1. Introduction

Both prostatic abscess (PA) and seminal vesicle abscess (SVA) are clinically rare conditions whose diagnoses are challenging [1–4]. Due to inadequate treatment of bacterial prostatitis, PA can be complicated and presents as dysuria, frequent urination, perineal pain, fever, chills and lower back pain [5,6]. Because of their nonspecific and similar clinical symptoms, the diagnosis and differential diagnosis between PA and SVA are extremely difficult on clinical grounds. Since both the conditions require drainage in addition to antibiotics, the early recognition is vitally important.

Many radiological modalities, such as CT (computed tomography), MRI, transrectal ultrasound (TRUS) and fluorine-18 fluoro-deoxyglucose PET, have been widely used in the diagnosis of prostate and seminal vesicle diseases [7]. MRI has been recognized as an excellent examination since it favorably distinguishes tissue of the prostate and seminal vesicle [8]. MRI diffusion-weighted imaging (DWI) is sensitive to the

* Corresponding author. Tel./fax: +86 029 84775380.
*E-mail address:* huanyi3000@163.com (Y. Huan).
[1] Jing Ren and Xufang Huang contributed equally to this study.

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microscopic self-diffusion of water protons and therefore captures the water diffusion microenvironment at the cellular level. DWI measures the apparent diffusion coefficient (ADC) quantitatively, providing an absolute assessment of the average water diffusion per voxel [9]. Therefore, DWI is believed to be a quantitative biomarker to identify malignancy [10]. Previous studies have demonstrated that ADC values calculated from DWI data may have clinical significance in diagnosis of prostate cancer (PCa) and seminal vesicle invasion (SVI) [11]. Moreover, DWI can diagnose both cerebral and abdominal abscess with high accuracy. Data from recent studies indicated that DWI is more sensitive than conventional MRI imaging in distinguishing abscesses and cystic tumors [12–14].

To the best of our knowledge, DWI data of only 2 cases of PA was reported by Singh et al. in 2011 [15]. MRI data of SVA has not been reported yet, and the diagnostic value, both qualitatively and quantitatively, of DWI and ADC for PA and SVA remains unclear. The purpose of our study was to investigate the conventional MRI and DWI data of PA and SVA, and to evaluate the qualitative and quantitative diagnostic value of ADC for PA and SVA.

## 2. Materials and methods

### 2.1. Patients

From August 2006 to February 2014, 10 patients with PA and 2 patients with SVA aged 28–67 years (with a mean of 46.9 years) who underwent MRI examination in our institution were enrolled in this study. The diagnoses of all the patients were pathologically and clinically proved. The protocol of this study was approved by the research review board of our institution. After the risks and possible benefits of the research were fully explained, all enrolled patients gave their written informed consent.

### 2.2. MRI examination

MRI examination was performed using a clinical 3.0 T whole-body magnetic resonance system (Siemens Magnetom Trio, Erlangen, Germany). The system is capable of working at a maximum slew rate of 200 mT/m/ms and a maximum gradient strength of 40 mT/m. Integrated system body coils were used for radiofrequency excitation and a phased array coil was used for signal reception. The patients were scanned in the supine position following scout scans to determine optimal imaging planes. Axial and coronal T1W and T2W fast spin-echo scans were performed using the following parameters: T1W, repetition time/echo time: 550/15 ms, field of view (FOV): 140 mm × 140 mm; slice thickness: 3 mm; matrix size: 320 × 256; and T2W, repetition time/echo time: 4430/78 ms, FOV: 140 mm × 140 mm; slice thickness: 4 mm; matrix size: 320 × 256. Axial orientation DWI was then performed using the following parameters: single-shot SE echo planar imaging sequence, *b*-values were 0 and 1000 s/mm$^2$, repetition time/echo time: 7500/80 ms, FOV: 400 mm × 400 mm, slice thickness: 5 mm, matrix size: 128 × 256. The slices for DWI were aligned in an identical orientation to that used for the acquisition of T2W images (essentially to permit coregistration for subsequent comparisons).

### 2.3. MRI image reading

For each DWI series, ADC maps were reconstructed on a voxel wise basis according to the following relation:

$$\mathrm{ADC} = -(\ln[S_1] - \ln[S_0])/b_1 - b_0$$

where $S_1$ is the signal intensity of a voxel after application of the diffusion gradient and $S_0$ is the signal magnitude without diffusion gradients applied ($b = 0$ s/mm$^2$) [16]. The diffusion sensitivity is determined by the difference between $b_1$ and $b_0$, which, in this study, was 1000 s/mm$^2$.

Two radiologists retrospectively reviewed all MR images independently, with no informed information about the patients. They reviewed the T2W images, DW images and ADC maps for each patient and selected abscess lesions and normal surrounding prostate tissues for evaluation by using the semiautomatic software MR MedFIA 1.0 (independently designed and developed in our department) for three-dimensional registration, segmentation, and ADC value analysis of multi-parametric MR imaging data.

### 2.4. Clinical and pathological assessments

Physical examinations, including a digital rectal examination (DRE), were performed. Midstream urine and urine culture were analyzed. After MRI examination, all the patients received antibiotic therapy. The patients underwent CT, ultrasound (US) or MRI examination at least once during the 4–12 months follow-up.

### 2.5. Statistical analysis

All data were expressed by mean ± standard deviation and tested for normal distributions. ADC values for prostatic abscess and the normal surrounding prostate tissues were compared using Student's *t* test. $P < 0.05$ was considered to indicate a statistically significant difference. Data analyses were performed with SPSS statistical software (version 17.0 for Windows; SPSS, Inc., IL, USA).

## 3. Results

### 3.1. Clinical data

Six patients showed high risk factors: 3 with diabetes, 1 with PA after a prostatic biopsy and 2 with double J ureteral stent replaced after ureteroscopy. All the patients presented with urinary urgency, frequency, dysuria, and fever. Four patients showed perineal pain, and 1 with tenesmus. DRE examination presented enlarged and tender prostate in all 12