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Original Article

Apparent Diffusion Coefficient Values of Normal Testis in Middle Aged Indian Population – A Preliminary Study

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ABSTRACT

Aim & Objective: *To evaluate the normal testicular Apparent Diffusion Coefficient values in middle aged Indian population.*

Methods and Materials: *Fifty healthy volunteers were included in this study. Healthy volunteers among the patients with negative urine culture and no genitourinary disease as detected by urine analysis who were admitted to the urology department with various complaintswere taken into the study and finally confirmed by colour Doppler ultrasound. Diffusion Weighted Magnetic Resonance Imaging (DWI) was done for all participants and the data was used to generate ADC maps which were expressed as arithmetic means and SDs. A one-way analysis of variance with a post hoc Bonferroni test was used to analyze normally distributed continuous data. Mean ADC values were calculated for different age group under study.*

Results: *The mean ADC values of various age group were 1.062s/mm^2, 1.055s/mm^2,1.073s/mm^2 and 1.075s/mm^2 for age group of 20-24 years, 25-29 years, 30-34 years and 35-40 years respectively with no statistically significant difference between groups.*

Conclusion: *Based on the results of our study, it may serve as a standard reference value when studying the testicular anatomy and pathology on diffusion weighted imaging for various scrotal abnormalities*

Key Words: *Testicular ADC values, Apparent diffusion coefficient, Diffusion weighted imaging.*

INTRODUCTION

In view of providing information about tissue integrity, DWI is one of the latest upcoming technology[1]. Moreover, it doesn't require an injection of a contrast agent and the imaging time is short[2]. Only few researchers have performed studies related to the application of Diffusion Weighted Imaging on the testis [3-5]. Apparent diffusion coefficient (ADC) measures degree of water proton restriction[6]. Decreased ADC values occur as a result of inflammation, trauma, ischemia, tumour and fibrosis [5,7,8].

Till now, many studies have been carried out in different countries on DWI of scrotal abnormalities. To our knowledge no such study has been carried out in India till now. It is in this context that the present study was done.

Though ultrasonography remains the primary modality of choice in scrotal pathologies [9,10], there has been a tremendous change in the imaging of scrotum in view of improving the diagnosis and management of scrotal pathologies in recent years. Functional MR imaging including DWI, MR Spectrocopy [11,12] provides additional information aiding in the diagnosis of various scrotal pathologies. With respect to DWI, no standard ADC values are being studied in the Indian population. Thus the study was done to provide the normal ADC values in middle aged Indian men.

AIM AND OBJECTIVE

To evaluate the normal testicular Apparent Diffusion Coefficient values in middle aged Indian population.

MATERIALS AND METHODS

Fifty consecutive control were enrolled in the study after taking informed written consent prior to USG and DW-MR Imaging.

INCLUSION CRITERIA

Healthy volunteers amongthe patients with negative urine culture and no genitourinary disease as detected by urine analysis who were admitted to the urology department with various complaints.

EXCLUSION CRITERIA

- Patients with h/o previous scrotal surgery
- Patients with h/o hernia repair
- Patients with h/o urogenital infection (orchitis, epididymoorchitis)
- Patients with a single testis
- Patients with testicular torsion
- Patients with testicular trauma
- Patients with testicular tumors
- Patients using medications that interfere with ADC values (eg. Pentoxifylline)
- Patients contra-indicated for MRI (eg. Patients with implants)

IMAGING

Colour Doppler USG of the patients will be done using a Philips HD11XE ultrasound machine using a 5 - 12 MHz high frequency transducer.

Diffusion weighted Magnetic Resonance Imaging (MRI) will be done using Phillips 1.5T MRI unit with the patient lying in a supine position with a 16-channel body coil placed over the pelvic region. Diffusion weighted images (DWI) directed at the lower abdomen will be collected. Single-shot spin-echo echo-planar DW images with b values of 0, 400 and 800 s/mm2 will be obtained using the parameters: TR/TE, 6000/88; FOV, 180mm; matrix, 128x256; slice thickness, 4mm; interslice gap 1mm; slice number, 20; and number of signals averaged 4.

The DWI data will be used to generate ADC maps. Images will be taken 5mm distally from the capsule to avoid artifacts. The measured circular region of interest areas will be set at approximately 0.5cm2. A total of three measurements will be made from the same level. The mean of the three ADC values will be used for the evaluations and statistical analysis.

T2 weighted axial images will also be taken with TR/TE, 4000/110; FOV, 180mm; matrix, 256x256; slice thickness, 4mm; interslice gap 1mm; slice number, 20; and number of signals averaged 4.

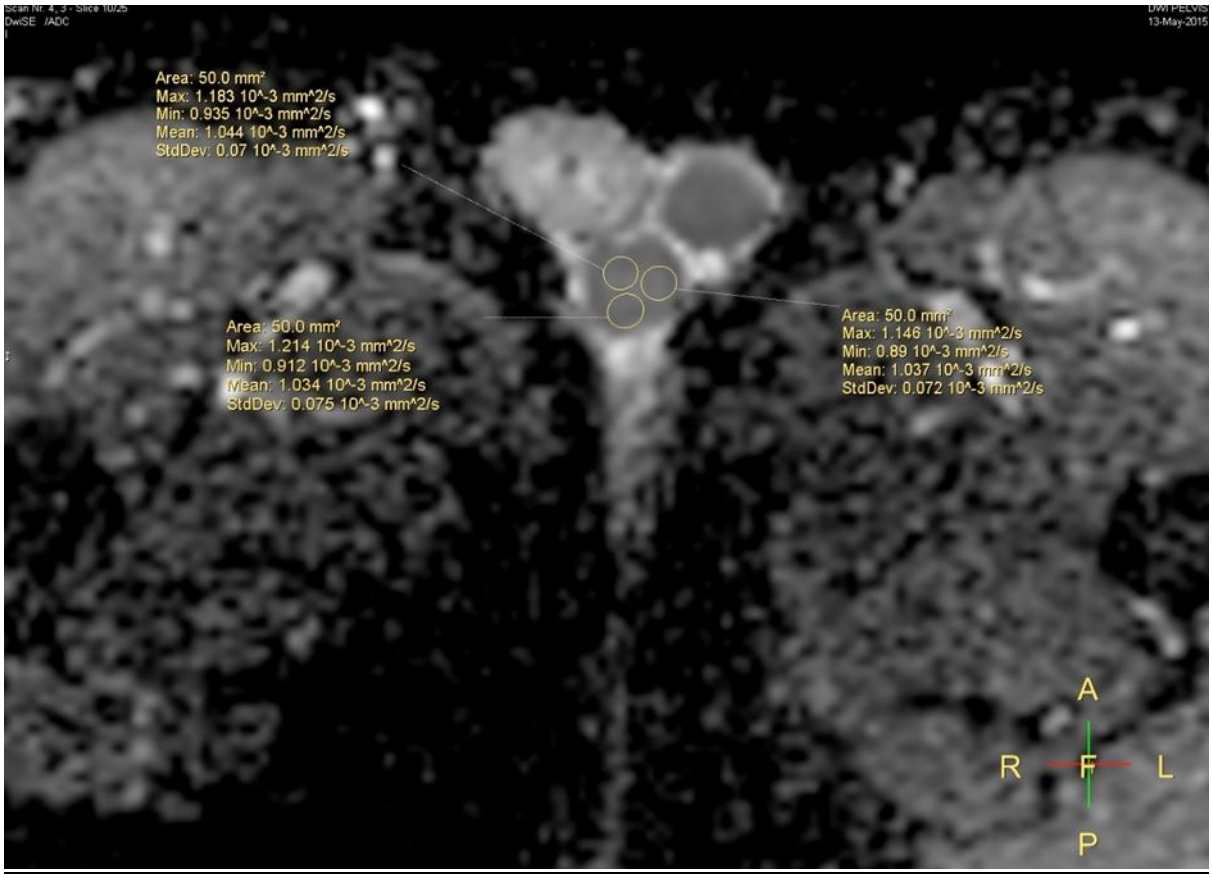
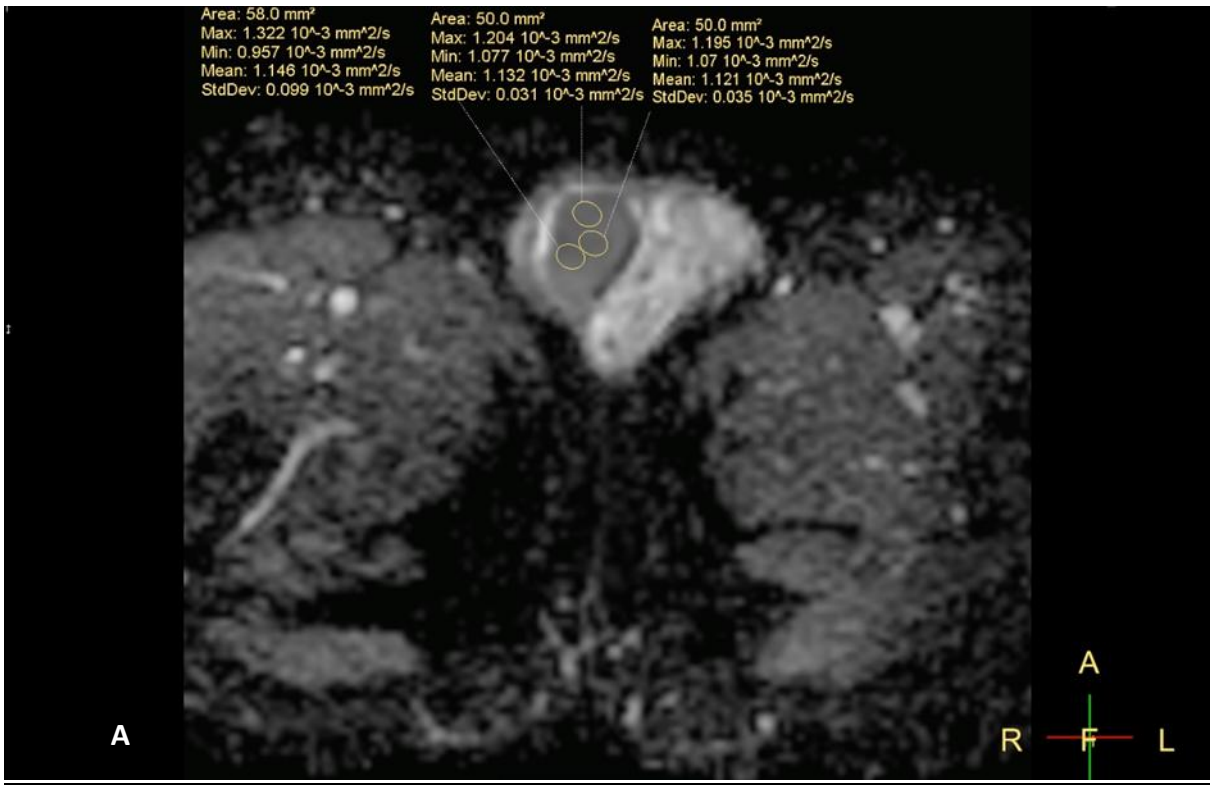


Figure 1: Testicular diffusion weighted image of healthy 28-year-old man . Apparent diffusion coefficient (ADC) map shows ADC values of 1.04 mm2/s in right testicular parenchyma. Min = Minimum, Max= Maximum.



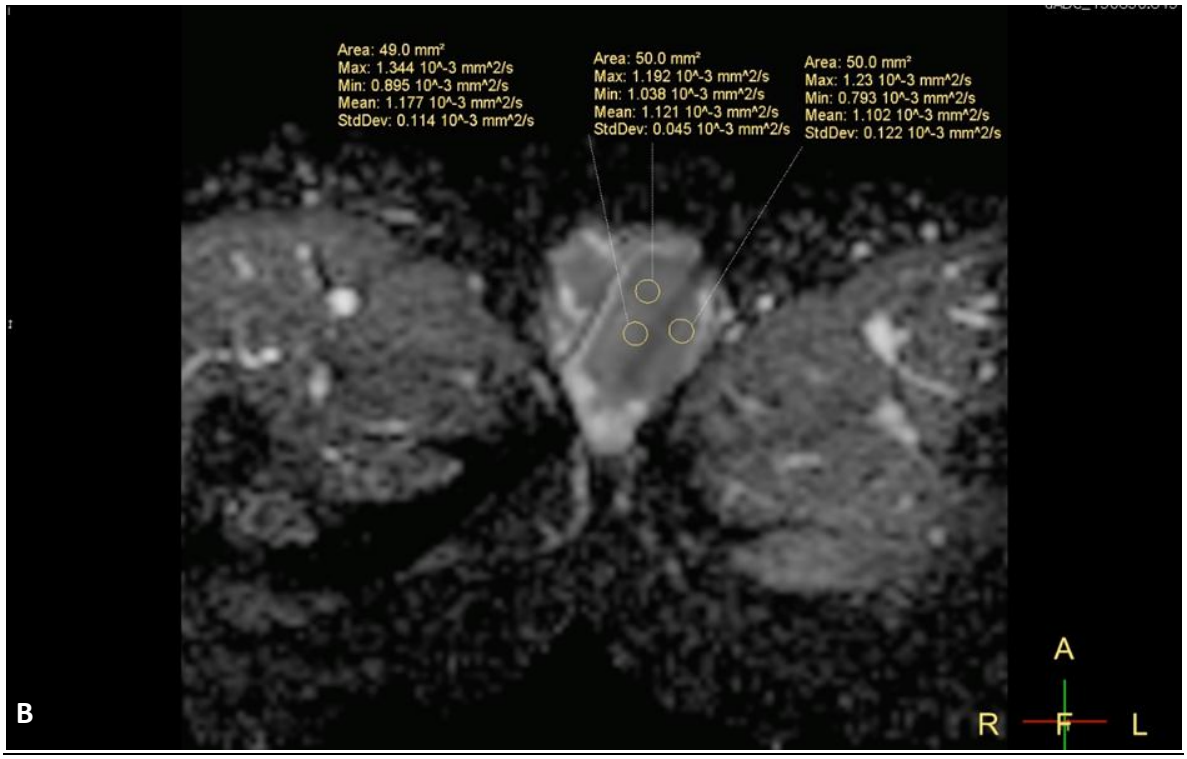
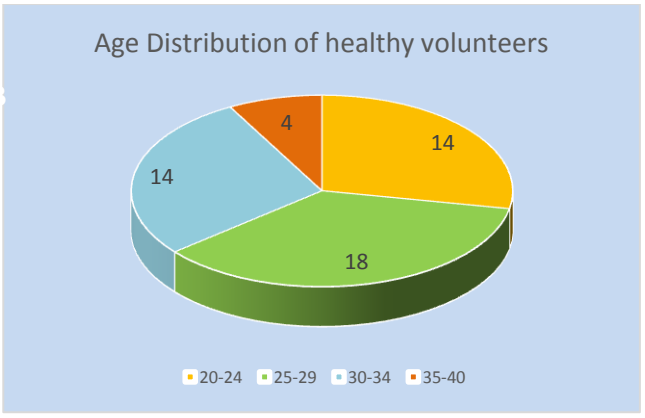


Figure 2 (A-B): Testicular diffusion weighted image of healthy 33-year-old man. Apparent diffusion coefficient (ADC) map shows ADC values of 1.33 mm2/s in right testicular parenchyma and 1.333 mm2/s in left testicular parenchyma . Min = Minimum, Max= Maximum.

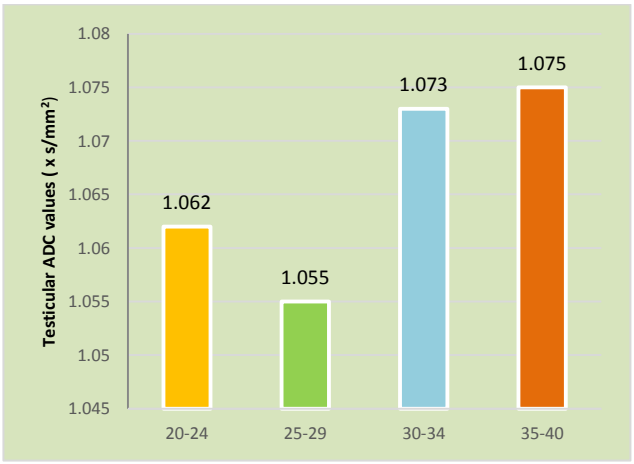
RESULTS



OBSERVATION

In the present study, out of 50 healthy volunteers, 14 belonged to 20-24 years, 18 belonged to 25-29 years, 14 belonged to 30-34 years and 4 belonged to 35-40 years of age.

MEAN ADC VARIATION BY AGE IN HEALTHY VOLUNTEERS



OBSERVATION

The mean ADC values of various age group were 1.062s/mm^2, 1.055 s/mm^2,1.073 s/mm^2 and 1.075s/mm^{2}for age group of 20-24 years, 25-29 years, 30-34 years and 35-40 years respectively.

DISCUSSION

Diffusion Weighted MRI (DW-MRI) or DWI is a specialised technique wherein the diffusion of the

water molecules is exploited to visualize internal physiology. ADC maps also help in quantifying diffusion. Further, the diffusion changes inside the tissue and the signal intensity on ADC map are directly related. Pathological changes can be detected in its early stages using diffusion images of DWI, even when other modes of imaging might not show significant changes in tissues

In the present study, out of 50 controls, 14 belonged to 20-24 years, 18 belonged to 25-29 years, 14 belonged to 30-34 years and 4 belonged to 35-40 years of age. The mean ADC values of various age group were 1.062s/mm^2, 1.055 s/mm^2,1.073 s/mm^2 and 1.075s/mm^{2}for age group of 20-24 years, 25-29 years, 30-34 years and 35-40 years respectively. There was no statistically significant difference in ADC values observed between the groups.

Tsili et al (2014) in another study of 147 normal testes including 71 testes from 53 men aged 20–39 years, 67 testes from 42 men aged 40–69 years and nine testes from six men older than 70 years calculated the mean and standard deviation of the ADC values of normal testicular parenchyma for each age group separately and reported that normal testicular tissue were different among age groups and that ADC values of normal testicular tissue increase with advancing age [13]. In the current study, healthy volunteers were only between 20 to 40 years of age. Compared to the study by Tsili et al, there is not much difference in the ADC values of testis in the age group between 20 to 40 years.

The study can further be extended in all age groups including adolescent and elderly age groups and the variation of ADC values with advancing age can be studied which will further help in the interpretation of scrotal abnormalities with respect to DWI.

CONCLUSION

Based on the results of our study, it may serve as a standard reference value when studying the testicular anatomy and pathology on diffusion weighted imaging for various scrotal abnormalities which may help in further tissue characterization.

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