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TESTICULAR VOLUME AND TESTICULAR ARTERY RI IN PREDICTING MALE FACTOR INFERTILITY

Radio-Diagnosis

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ABSTRACT

Background- Semen analysis is gold standard method for assessing male factor infertility, USG may be helpful in assessment of testicular volume, tissue elasticity, echogenicity, testicular dysgenesis, testicular macrovascular as well as microvascular blood flow. This study aimed to assess the role of scrotal ultrasound i.e. testicular volume and testicular artery RI in predicting male factor infertility. **Methodology-** This study was conducted as a comparative observational study on a total of 27 males with infertility and 54 controls with normal sperm analysis referred to Department of Radiodiagnosis N.S.C.B. Medical College, Jabalpur for USG scrotum. Doppler ultrasound was performed to assess RI and testicular volume. **Results-** This study was conducted on a total of 27 cases with infertility (abnormal sperm analysis) and 54 healthy controls. Mean testicular volume in right as well as left testis were significantly lower in cases (7.75±1.7 and 7.33±1.07cc respectively) as compared to controls (13.05±2.24 and 13.65±2.15 cc respectively; $p<0.05$).Mean RI of right and left testicular artery was significantly higher as compared to controls ($p<0.05$). At the cut off of 0.55, the sensitivity of testicular artery RI ranged from 92.6% to 96.3% with Area under the curve of 0.924-0.976 ($p<0.05$). **Conclusions-** Color Doppler ultrasound of scrotum is a rapid and cost effective method of assessing the pretesicular, testicular and post testicular causes of infertility among males. Two parameters, particularly testicular volume and testicular artery RI helps in predicting the cases with infertility. Among both these, testicular artery RI can predict infertility with excellent diagnostic accuracy.

KEYWORDS

Scrotal ultrasound, color Doppler, RI, testicular volume, male infertility

INTRODUCTION

Infertility, i.e. inability of the couple to conceive even after one year of unprotected and regular sexual intercourse is reported in approximately 15–20% of couples.[1,2] Male factors alone or in combination with female factors attribute to approximately 20-50% of all the infertility cases.[2] Physical examination, hormonal assessment and semen analysis are useful in evaluation of males with infertility.[2,3] Scrotal abnormalities have been reported in 40 to 65% of the infertile men, which may not be determined in approximately one third of the cases with physical examination alone.[4,5] Though semen analysis is the basic standard for evaluation of infertility,[3] the role of ultrasonography in evaluation of males with infertility have been recommended according to European Association of Urology Guidelines.[6]

Ultrasonography is a safe, non invasive, efficient, easily available, quick method which helps in evaluation of testicular structure and function. USG may be helpful in assessment of testicular volume, tissue elasticity, echogenicity, testicular dysgenesis, testicular macrovascular as well as microvascular blood flow.[7-10] Apart from B mode features of ultrasonography, colour Doppler mode of USG further improve the diagnostic accuracy of the ultrasonography and helps in not only evaluating testicular infection, ischemia, varicocele and trauma, but also differentiating inflammatory etiology from ischemic etiology.[11,12]

Literature suggest a strong relationship between the testicular function and semen profile.[13] Varicocele is one of the major cause of male infertility and the sensitivity as well as specificity of color Doppler in diagnosis of varicocele is reported to be high.[12] Recently, the role of Resistive Index (RI), an ultrasonic parameter have been reported as it helps in revealing testicular microcirculation function and parenchymal perfusion. Higher RI is suggestive of microcirculation disruption, and indicate reduced blood flow in testis, which may be the underlying cause of impaired spermatogenesis.[14-16]

Semen analysis is gold standard method for assessing male factor infertility, it has its own disadvantages.[17-19] This study therefore aimed to assess the role of scrotal ultrasound, which may be more convenient and accurate for assessment of infertility. We evaluated the testicular volume and testicular artery RI in predicting male factor infertility and compared the same with normal men.

METHODOLOGY

This study was conducted as a comparative observational study on a total of 27 males with infertility and 54 controls with normal sperm analysis referred to Department of Radiodiagnosis N.S.C.B. Medical College and Hospital, Jabalpur, Madhya Pradesh for USG scrotum. The male patients with abnormal sperm analysis (oligoasthenospermia) presenting at our Hospital during the study period of 1 year i.e. from 1st February 2022 to 31st January 2023, with no identified female cause of infertility were included as cases whereas males with normal sperm analysis findings were included as controls. However, male patients with history of systemic diseases, previous history of testicular surgery, inguinal hernia and not willing to participate in the study were excluded from both cases as well as control group.

After obtaining ethical clearance from Institute's ethical committee, all the cases and controls fulfilling the inclusion criteria were enrolled and consent was obtained after explaining them the nature and purpose of study. Their detailed sociodemographic data and findings of sperm analysis study were obtained and documented in proforma.All the selected cases and controls were subjected to scrotal ultrasound by a single certified radiologist using high frequency GE LogiqP9 Ultrasound machine with linear transducer with 9 MHz. First, patients were positioned and Doppler ultrasound was performed to assess the blood flow of each testis including capsular and intra-testicular branches of testicular arteries. Initially PSV and EDV was measured in upper and lower pole in each testicle and then RI was calculated using the formula-

$RI = PSV/(PSV - EDV)$.

Apart from PSV, EDV and RI, testicular volume was evaluated using the formula Testicular volume = (length × width × AP diameter) × $\pi/6$.[7]

Statistical Analysis

Data was compiled using Microsoft Excel and analysis was performed with the help of Statistical Package for Social Statistics (SPSS) Version 20 (IBM Corp. Illinois, Chicago). Data was tested for Normality distribution and categorical data was expressed as frequency and proportions whereas continuous data was expressed as mean and

standard deviation. Cases and controls were compared using Chi square test and independent t test for categorical and continuous data respectively. P value of less than 0.05 was considered as statistically significant. Receiver operating curve (ROC) analysis was also done to assess the cut off of USG parameters for diagnosis of infertility.

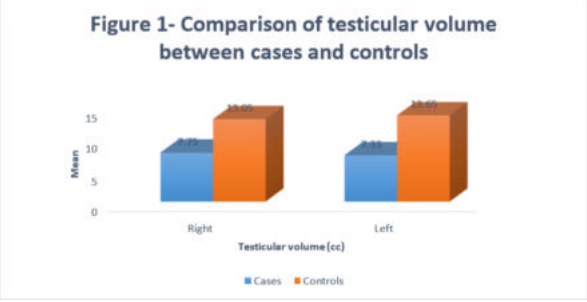
RESULTS

This study was conducted on a total of 27 cases with infertility (abnormal sperm analysis) and 54 healthy controls with normal semen analysis. Mean age of cases was 33.22±3.67 years whereas that of controls was 32.50±3.89 years. The age composition of cases and controls was statistically similar (p<0.05). Mean sperm count in cases was 7.2581±3.13 million. Sperm morphology with reduced sperm count was normal in 66.7% cases. Abnormal sperm morphology was noted in 14.8% cases whereas abnormal motility was reported in 7.4% cases (Table 1).

Table 1- Semen Analysis In Cases

Semen analysis		Frequency (n=27)	Percentage
Sperm morphology and motility	Abnormal morphology	4	14.8
	Abnormal motility	2	7.4
	Antisperm antibodies	1	3.7
	Abnormal morphology and motility	2	7.4
	Normal	18	66.7
Sperm count		7.2581±3.13 million.	

Mean testicular volume in right as well as left testis were significantly lower in cases (7.75±1.7 and 7.33±1.07cc respectively) as compared to controls (13.05±2.24 and 13.65±2.15 cc respectively; p<0.05) (figure 1).



Mean RI of right testicular artery was 0.68±0.08 in cases, which was significantly higher as compared to controls (0.52±0.06). Similarly, mean testicular artery RI of left side was 0.69±0.06 and 0.53±0.06 in cases and controls respectively and the observed difference was statistically significant (p<0.05) (Figure 2).

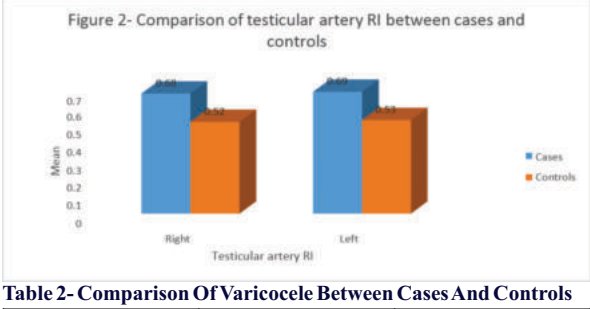


Table 2- Comparison Of Varicocele Between Cases And Controls

Varicocele	Cases (n=27)	Controls (n=54)
Absent	25 (92.6%)	54 (100%)
Present (left)	2 (7.4%)	0 (0%)
P value	0.043	

Varicocele was documented in 7.4% cases and none in controls. The observed difference in proportion of varicocele between cases and controls was statistically significant (p<0.05) (Table 2).

Table 3- Area Under The Curve For Detecting Infertility

AUC of	Area	P value	95% CI		Cut off	Sensitivity	Specificity
			Lower Bound	Upper Bound			
Right testicular Artery RI	0.924	0.0001	0.856	0.992	0.55	92.6	72.2
Left testicular artery RI	0.976	0.0001	0.944	1.000	0.55	96.3	64.8

Above table represent that testicular volume as well as testicular artery RI to be good predictor of testicular dysfunction. At the cut off of 0.55, the sensitivity of testicular artery RI ranged from 92.6% to 96.3% with Area under the curve of 0.924-0.976 (p<0.05)(Table and Figure 3).

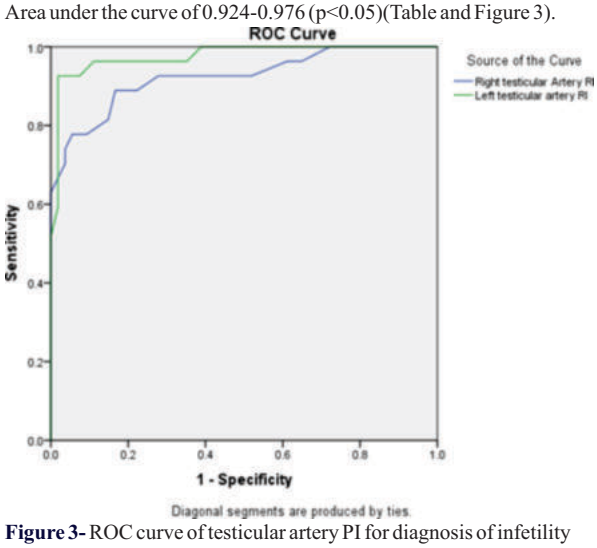


Figure 3- ROC curve of testicular artery PI for diagnosis of infetility

DISCUSSIONS

Infertility is a serious and major issue affecting 15 to 20% couples and male factors are responsible for infertility in approximately 20 to 50% of the cases.[2] The male infertility could be attributed to pretesticular, testicular and post testicular causes.[20] Semen analysis is the gold standard method for assessment of male infertility. However, recently a strong relationship between the testicular function as assessed with ultrasonography and semen profile have been reported.[13] Scrotal US is a preferred mortality for assessment of male infertility, as is safe, non invasive, inexpensive and allow multiplanar imaging. This helps in assessing pretesticular (varicocele, prostatic andepididymal abnormalities), testicular and posttesticular abnormalities. Doppler ultrasound also helps in assessing the blood flow of the testis and vascular impedance.[21] We conducted this study as a comparative study on 27 males with infertility with mean sperm count of 7.2581±3.13 million and 54 controls with normal semen analysis. Both the cases and controls were comparable with respect to age (p>0.05). Sperm morphology was studied in both cases as well as controls following semen analysis, and it was normal in all the controls whereas abnormal sperm morphology was noted in 14.8% cases and abnormal motility was reported in 7.4% cases.

Ultrasonography of the scrotum was performed for all the cases as well as controls. We assessed testicular volume, RI and presence of varicocele in both the testis (p<0.05). These indices depend upon measurement of end diastolic volume, peak systolic volume and mean velocity.[22] In present study, mean testicular volume was found to be significantly lower in cases with abnormal sperm count as compared to controls. Our study findings were supported by the findings of Tijani et al., in which the authors reported mean testicular volume to be significantly lower in infertile men as compared to fertile men and the lower testicular volume in infertile men was associated with reduced sperm density.[23] Zolfaghar-Khaini et al. also showed mean testicular volume to be significantly higher in healthy subjects as compared to infertile men with oligoasthenospermia.[7] The findings of present study were supported by the findings of Vinayaka et al.[24] and Manuel et al.,[25] in which the authors documented a significant positive correlation between the sperm count and testicular size in infertile men.

In our study, we reported significantly higher RI in cases with abnormal semen analysis as compared to controls with normal semen analysis findings (p<0.05). Doppler ultrasound of scrotum was helpful in assessing the varicocele, and we reported significantly higher proportion of varicocele in cases as compared to controls (7.4% vs. 0%; p<0.05). The findings of our study were concordant with the findings of Zolfaghar-Khaini et al., where the authors reported significantly higher RI in intra-testicular as well as capsular arteries among infertile men as compared to the healthy control (p<0.05).[7] Biagiotti et al. showed significantly higher RI in infertile men and the

RI was highest in men with varicocele as compared to normal controls ($p<0.05$) suggesting RI to be reliable marker of infertility.[22] Pinggera et al. also reported significantly higher RI in cases with oligoasthenozoospermia as compared to controls.[26]

ROC analysis was also done using testicular artery RI for detection of infertility and we found. RI to be excellent predictor of infertility with good diagnostic accuracy. At the cut off of 9.2 cc, the diagnostic accuracy of testicular volume for detecting infertility was 100% whereas sensitivity of testicular artery RI ranged from 92.6% to 96.3% ($p<0.05$) for diagnosis of infertility. Zolfaghar- Khaini et al. also showed higher specificity and PPV of intratesticular artery and higher sensitivity and NPP of capsular artery for detecting and predicting male infertility.[7] Similarly, Hillelsohn et al. showed sensitivity of RI at cut off of 0.6 to be 63.27%, with likelihood ratio of 1.56 to predict sperm motility in spermatogenesis.[27]

The present study had certain limitations, the sample size of the study was small, and hence the findings of the study could not be generalized. The ultrasonography is operator dependent procedure and the inter-observer bias was eliminated as all the cases were observed by single observer.

CONCLUSIONS

Color Doppler ultrasound of scrotum is a rapid and cost effective method of assessing the pretesicular, testicular and post testicular causes of infertility among males. Two parameters, particularly testicular volume and testicular artery RI helps in predicting the cases with infertility. Among both these, testicular artery RI can predict infertility with excellent diagnostic accuracy. Scrotal ultrasound must be recommended in evaluation of cases of male infertility as it is rapid, non invasive and easily available procedure for detecting various abnormalities in such cases and predicting male infertility with high accuracy.

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