ORIGINAL ARTICLE

Role of Transrectal Ultrasonography in Male Infertility

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ABSTRACT

Background: Male infertility accounts for nearly 50% of all infertility cases. The evaluation of male infertility is complex, with anatomical abnormalities playing a significant role. This study aimed to assess the role of TRUS in diagnosing anatomical abnormalities contributing to infertility in north Indian region.

Methods: This descriptive observational study was conducted over two years in the Department of Radiodiagnosis & Imaging, Sher-i-Kashmir Institute of Medical Sciences (SKIMS), and its associated hospitals. Sixty male patients aged ≥23 years with complaints of infertility and two samples showing oligospermia/azoospermia underwent TRUS examination. TRUS was performed using a 5.5-7.5 Hz transrectal probe, evaluating the prostate, seminal vesicles, ejaculatory ducts, and vas deferens.

Results: The mean age of patients was 32.5 years, with a mean infertility duration of 6.2 years. TRUS detected abnormalities in 93% of patients, including correctable causes such as ejaculatory duct obstruction (25%), seminal vesicle cysts (40%), and prostatic cysts (30%). Irreversible conditions included congenital bilateral absence of the vas deferens (5%) and seminal vesicle hypoplasia (3%). Life-threatening conditions as prostatic abscesses were identified in 3% of cases.

Conclusions: TRUS is a valuable tool for evaluating male infertility, capable of detecting both correctable and irreversible abnormalities, as well as potentially life-threatening conditions. Its routine use in infertility workup is recommended.

Keywords: Male infertility, Transrectal ultrasound, Ejaculatory duct obstruction, seminal vesicle cyst, Prostatic abnormalities.

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INTRODUCTION

Male infertility is a significant concern globally, contributing to nearly 50% of all infertility cases.[1] Despite advances in reproductive medicine, diagnosing male infertility remains complex due to the multifactorial nature of the condition. Causes of infertility in men range from hormonal imbalances to genetic and anatomical abnormalities, infections, and lifestyle influences.[2] One of the key challenges in diagnosing male infertility is detecting anatomical abnormalities in the reproductive system, as these can greatly affect sperm production, transport, and ejaculation.

In India, male infertility is increasingly becoming a public health concern, contributing to half of all infertility cases.[3] However, the focus on female infertility has historically overshadowed the issues men face, and male infertility remains under-researched. Factors contributing to male infertility in India include physiological, genetic, environmental, and lifestyle factors.[4] Common physiological causes include conditions such as varicocele, ejaculatory duct obstruction, and hormonal imbalances. Genetic issues such as chromosomal abnormalities and Y-chromosome microdeletions also contribute significantly to infertility.[5] Environmental and lifestyle factors, including exposure to toxins, smoking, alcohol consumption, and stress, further exacerbate the problem by affecting sperm quality and overall reproductive

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health.[6]

One of the most valuable diagnostic tools available for assessing male reproductive health is Transrectal Ultrasound (TRUS). TRUS provides detailed imaging of the male reproductive organs like the prostate, seminal vesicles, ejaculatory ducts, and vas deferens, enabling accurate identification of abnormalities that may contribute to infertility.[7] As a non-invasive diagnostic modality, TRUS offers a real-time view of the internal structures, making it particularly useful in identifying conditions such as seminal vesicle cysts, ejaculatory duct obstruction, prostatic inflammation, and congenital anomalies that are commonly associated with infertility.[8]

Transrectal ultrasound (TRUS) has become increasingly important for its capability to offer detailed evaluations of the prostate and seminal vesicles, which are frequently involved in cases of obstructive azoospermia (OA).[9] In a study by Chen et al., TRUS revealed that dilation of the ejaculatory duct was the most common cause of OA, and seen in nearly 30% of patients, followed by abnormalities in the seminal vesicles, present in 28.5% of cases.[10] Other studies, such as those by Lotti et al., have emphasized the importance of TRUS in evaluating obstructive versus non-obstructive azoospermia and its ability to detect subtle structural changes within the male reproductive system.[11]

In this context, the present study was conducted in order to identify potentially correctable causes of male infertility within the north Indian population, focusing on anatomical abnormalities that could be addressed through medical or surgical interventions. Additionally, it sought to uncover irreversible conditions that necessitate alternative treatments, such as assisted reproductive technologies. Another objective was to detect life-threatening conditions, like tumours or infections that may contribute to infertility and require urgent attention. The study ultimately sought to identify genetic abnormalities that might impact the health of future offspring, highlighting the critical role of early detection and counselling in managing male infertility.

MATERIALS AND METHODS

Study Design:

This research was conducted as a descriptive observational study in the Department of Radiodiagnosis & Imaging, Sher-i-Kashmir Institute of Medical Sciences, and its associated hospitals. Written informed consent was obtained from all participants. The study involved detailed evaluations using Transrectal Ultrasound (TRUS) to investigate anatomical causes of male infertility, focusing on detecting both correctable and irreversible conditions.

Study Period:

The research was carried out over the course of two years, from September 2022 to September 2024, following approval from the Institutional Ethics Committee.

Inclusion Criteria:

Male patients complaining of infertility who had provided at least two semen samples showing either oligospermia or azoospermia, or those with low ejaculate volume, were included. Participants were also required to be over 23 years of age. Additionally, only patients whose scrotal ultrasound revealed normal results or findings suggestive of distal obstructive azoospermia (e.g., ectasia of rete testis, dilatation of epididymal ductules, intratesticular cysts, or increased testicular volume) were selected for the study.

Exclusion Criteria:

Participants younger than 23 years of age or those with scrotal ultrasound findings suggestive of correctable diagnoses, such as varicocele, were excluded from the study.

TRUS Protocol:

TRUS was performed using a 5.5-7.5 MHz transrectal probe. Participants were advised to abstain from sexual intercourse for one week and were instructed to self-administer a rectal enema prior to the scan. During the procedure, patients were positioned in the left lateral decubitus position. Scanning began from the seminal vesicles and continued toward the prostate apex, in both transverse and sagittal planes. Prostate volume was calculated, and the seminal vesicles were evaluated for shape, echogenicity, and wall thickness, with the

transverse diameter measured to assess any dilatation or hypoplasia. The vas deferens and ejaculatory ducts were also scanned to identify any abnormalities that could contribute to infertility.

Sample Size Calculation:

A sample size calculation was performed using Cohen's formula, with an alpha (α) set at 0.05 and an estimated proportion (p) of 0.041 based on findings from Zargar et al.[12] An estimation error (d) of 0.05 was used to determine a minimum sample size of 60 patients.

Data Management and Statistical Analysis:

Collected data were first checked for completeness and consistency, then entered in the Microsoft Excel for analysis. Statistical analysis was performed using SPSS (IBM version 22). Descriptive and inferential statistics were applied. Continuous data were expressed as means ± standard deviations (SD), while categorical data were represented as proportions. Graphical representations included tables and various types of bar and pie charts.

Ethical Considerations:

This study received approval from the Institutional Ethics Committee of Sher-i-Kashmir Institute of Medical Sciences Srinagar. All participants were fully informed of the study's purpose and their rights, including the voluntary nature of participation and the option to withdraw at any point. Confidentiality was ensured throughout, and data were anonymized and stored in a secure, password-protected file.

RESULTS

The results from the study based on transrectal ultrasound (TRUS) findings reveal significant insights into the underlying anatomical abnormalities in infertile men. The study included 60 patients with an average age of 32.5 years and a mean duration of infertility of 6.2 years. The majority of the cases (70%) were classified as primary infertility, indicating that these patients had never conceived before, while the remaining 30% represented secondary infertility, where patients had previously conceived but were unable to do so again. Semen analysis among the 60 patients revealed a mean semen volume of 1.2 cc, which is below the typical reference range, potentially indicating hypospermia. Additionally, the average sperm count was found to be 8.5 million/ml, a figure significantly lower than the normal threshold, suggesting a prevalence of oligospermia within the studied population.

The TRUS assessment of seminal vesicle parameters showed that the average size of the seminal vesicles was fairly uniform, with the right side measuring 13.4 mm and the left 13.8 mm. Only 5% of patients exhibited asymmetry in the seminal vesicles, and cystic content was detected in 40% of cases. Homogeneous echogenicity was observed in all patients. The TRUS examination of the ejaculatory ducts and vas deferens revealed normal diameters, with the right and left ejaculatory ducts averaging 2.4 mm and 2.3 mm, respectively, and the vas deferens measuring 1.5 mm on the right and 1.6 mm on the left. Analysis of the prostate through TRUS demonstrated that the average prostate volume among patients was 25.8 cc, with 90% patients showing homogeneous prostate echogenicity. However, prostatic cysts were seen in 30% of the cases and prostatic calcifications were detected in 3% of the cases.

Based on the TRUS findings, abnormal diagnoses were made in 93% of the patients, with only 7% showing normal results. Ejaculatory duct obstruction (EDO) was identified in 25% of the patients, indicating that a significant portion of the sample had blockages in the ducts responsible for sperm transport. Dilated seminal vesicles were found in 15% of the cases, while 40% of the patients exhibited seminal vesicle cysts, suggesting that abnormalities in seminal vesicles are a common issue among infertile men. Prostatic cysts were detected in 30% of the patients, adding to the list of structural abnormalities that could hinder fertility. Müllerian duct cysts, which can also impact reproductive function, were present in 10% of the cases. Furthermore, ejaculatory duct calculi, or calcifications, were noted in 23% of the patients, and prostatitis, an inflammation of the prostate, was found in 7%. Irreversible abnormalities included congenital bilateral absence of the vas deferens, seen in 5% of the patients. TRUS detected seminal vesicle hypoplasia or aplasia in 3% patients. Potentially life-

threatening conditions identified through TRUS included prostatic abscess in 3% patients.

DISCUSSION

The study observed a significant prevalence of anatomical abnormalities among the sample of infertile men, as evidenced by abnormal TRUS findings in 93% of patients. Ejaculatory duct obstruction (EDO) was found in 25% of the participants. This aligns with the findings of Chen et al., who similarly reported that EDO was the most common cause of obstructive azoospermia (OA), present in 29.9% of their cohort.[10] The detection of dilated seminal vesicles in 15% of the study population also supports Chen's study, which noted seminal vesicle abnormalities in 28.5% of their sample.[10] The importance of early and accurate diagnosis of these abnormalities cannot be overstated, as they can significantly impair sperm transport and ultimately fertility outcomes.

Further corroborating these findings, Liu et al. found that abnormalities in the ejaculatory duct and seminal vesicles were prevalent in 49.29% of the cases they studied, with 31.72% of patients showing ejaculatory duct cysts.[13] This is comparable to the present study, where seminal vesicle cysts were found in 40% of patients and ejaculatory duct calculi/ calcifications in 23%. This consistency between studies emphasizes the importance of TRUS in diagnosing cystic formations and blockages in the male reproductive system, which are often overlooked in routine fertility assessments.

The detection of prostatic abnormalities, including prostatic cysts in 30% and prostatic calcifications in 3% of patients, further supports the utility of TRUS in identifying structural defects in the prostate. Mohi et al.'s study, which utilized TRUS in 50 infertile patients, found that prostatic cysts were one of the key abnormalities detected.[14] These findings demonstrate the consistency of TRUS across different populations in identifying prostate-related conditions contributing to infertility.

In terms of irreversible conditions, congenital bilateral absence of the vas deferens (CAVD) was identified in 5% of the patients in the present study, a figure consistent with the 7% prevalence reported in a study by Raheem et al..[15] The inability to surgically correct CAVD makes its early detection critical, particularly in populations where infertility often goes undiagnosed until the condition becomes chronic. Moreover, the detection of Müllerian duct cysts in 10% of patients mirrors the findings of studies such as Abdelaal et al., who reported a similar prevalence in their patient population.[16] These cysts, while not always life-threatening, can have a profound impact on reproductive function, particularly when they are large enough to cause physical blockages.

One particularly noteworthy aspect of this study is its identification of potentially life-threatening conditions in infertile men. Two patients were found to have prostatic abscesses. Such findings highlight the broader health implications of infertility evaluations, supporting the conclusions of Armstrong et al., who emphasized the importance of ultrasound in the initial screening for both reproductive and non-reproductive pathologies in men.[17] The detection of malignancies through routine infertility assessments not only aids in timely treatment but also underscores the broader utility of TRUS beyond its conventional reproductive applications.

The correlation between seminal vesicle hypoplasia and infertility observed in this study, affecting 3% of patients, is consistent with Lotti et al., who reported these seminal vesicle abnormalities in a small but significant percentage of infertile men.[18] The accurate measurement of seminal vesicle size and volume using TRUS allows for early intervention, whether through medical or assisted reproductive technologies (ART), depending on the severity of the condition.

In terms of findings consistent with genetic abnormalities, this study found that CAVD, Müllerian duct cysts, and seminal vesicle hypoplasia were some of the important causes of infertility, present in a small percentage of patients. These findings are consistent with the broader literature, including studies by Lotti et al. and Jurewicz et al., which emphasize the importance of recognizing such abnormalities early for counselling and treatment planning.[18]

CONCLUSION

In conclusion, the findings of this study point towards the fact that the use of TRUS in diagnosing these conditions

not only improves treatment planning but also enhances patient outcomes by allowing for early detection and intervention. The high prevalence of abnormalities detected by TRUS highlights its critical role in the diagnostic pathway for male infertility and underscores the need for greater utilization of this tool in both clinical and research settings.

Conflicts of Interest: The authors declare no conflict of interest.

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Written Informed Consent: Taken

Table 1. Clinico-demographic characteristics of patients (n = 60)

Parameters	Mean / frequency	SD / percentage
Age (years)	32.5	7.4
Duration of infertility (years)	6.2	3.8
Type of infertility		
- Primary	42	70%
- Secondary	18	30%
Semen volume (cc)	1.2	0.4
Sperm count (million/ml)	8.5	3.2

Table 2. TRUS findings in patients (n = 60)

Parameters	Mean / frequency	SD / percentage
Seminal vesicle size (right) (mm)	13.4	3.6
Seminal vesicle size (left) (mm)	13.8	3.4
Asymmetric seminal vesicle	3	5%
Homogenous seminal vesicle echogenicity	60	100%
Seminal vesicle wall thickness (mm)	1.2	0.5
Right ED diameter (mm)	2.4	0.6
Left ED diameter (mm)	2.3	0.7
Right vas deferens diameter (mm)	1.5	0.8
Left vas deferens diameter (mm)	1.6	0.7
Prostate volume (cc)	25.8	8.5
Homogenous prostate	54	90%
Heterogeneous prostate	6	10%
Prostatic cysts	18	30%
Prostatic calcification	2	3%

Table 3. Diagnosis of abnormalities as per TRUS (n = 60)

Abnormalities*	Frequency	Percentage
Final diagnosis		
Normal Findings	4	7%
Abnormal Findings	56	93%
Specific diagnoses		
Ejaculatory Duct Obstruction (EDO)	15	25%
Dilated seminal Vesicles	9	15%
Seminal Vesicle Cysts	24	40%
Prostatic Cysts	18	30%
Müllerian Duct Cysts	6	10%
Ejaculatory Duct calcifications / Calculi	14	23%
Prostatitis	4	7%
Congenital Bilateral Absence of Vas Deferens	3	5%
Seminal Vesicle Hypoplasia or Aplasia	2	3%
Extensive Prostatic Calcifications	2	3%
Prostatic Atrophy	1	2%
Prostatic Abscess	2	3%

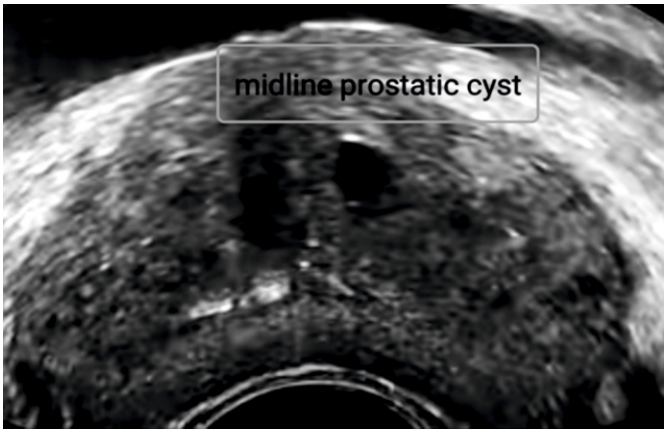


Fig. 1. Axial transrectal scan in a 40 year old male depicts midline prostatic cyst.

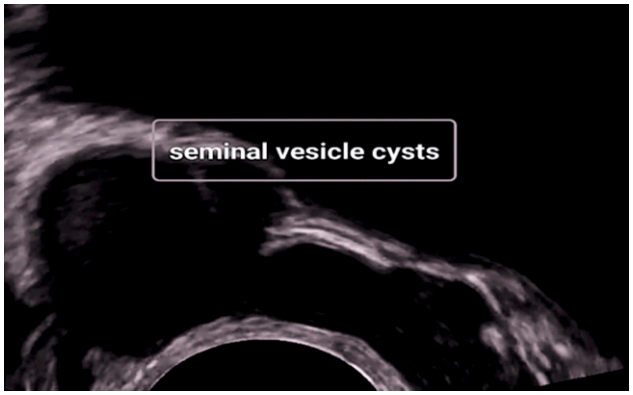


Fig. 2. Axial transrectal scan in a 33 year old infertile male depicts dilated bulky seminal vesicle with cysts.



Fig. 3. Axial transrectal scan in a 31 year old infertile male, depicts ejaculatory duct cyst.

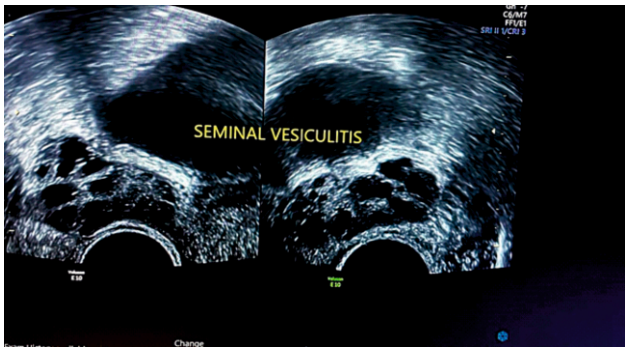


Fig. 4. Axial transrectal scan in a 28 year old infertile patient, showing enlarged seminal vesicles with cysts consistent with seminal vesiculitis.

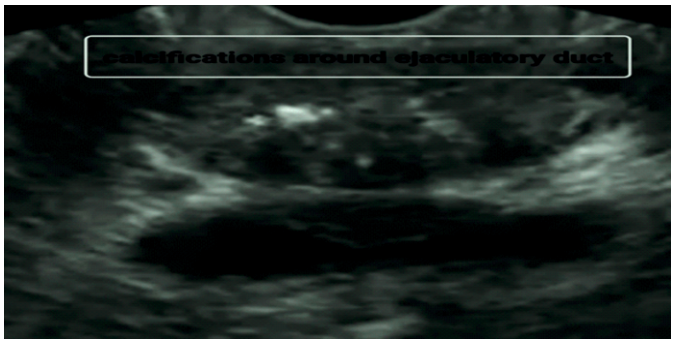


Fig. 5. Axial transrectal scan in a 38 year old male depicts calcification near ejaculatory duct opening.

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