Sonographic Evaluation Of Male Testicular Volume Amongst Patients With Fertility Challenges: A Cross-Sectional Retrospective Study

Ezenwaka Augusta Amarachi*[1,ORCID], Ezema Onyebuchi Okechuwku[1], Ihedioha Chizoba[1], Nwadike Uchechukwu Innocent[1]

[1]University of Nigeria, Enugu Campus, Faculty of Health Sciences and Technology, Department of Medical Radiography and Radiological Sciences, Enugu State, Nigeria

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Abstract

Background
Male infertility is a significant health issue affecting approximately 15% of couples worldwide. Testicular volume has been suggested as a potential predictor of fertility issues in men, but no study has correlated testicular volume amongst men with infertility challenges in our environment. The purpose of the study is to evaluate the relationship between testicular volume and male fertility profile in subjects with fertility challenges.
Methods
The research involves a cross-sectional retrospective analysis of records of male patients that presented to the teaching hospital with fertility concerns. Records containing age, Ultrasound measurement of testicular volume, sperm count, and sperm motility were taken into account. Sample size used was 50 records of male patients that presented with infertility. Independent samples t-test and Pearson correlation were employed at a 5% level of significance.
Results
Our results suggest that patients with lower testicular volume may have compromised sperm production and quality, thus contributing to infertility. There was a significant difference between the testicular volume of infertile males and fertile males [RT. Volume (p = <0.0001) & LT. Volume (p < 0.0001)]. Findings in correlating testicular volume with sperm parameters shows there was a significant relationship between sperm motility sluggish and left testicular volume (r = 0.301, p = 0.034) and between sperm count and left testicular volume (r = 0.317, p = 0.025). For sperm motility activeness (r = 0.092, p = 0.532) and sperm motility deadness (r = 0.031, p = 0.828), there was no significant relationship.
Discussion
The result from the analysis showed there was a positive significant difference in the values of the testicular volumes of infertile and fertile male patients with the testicular volume for infertile males lesser than the normative volume for fertile males.
Conclusion
This study showed that the mean testicular volume in male with fertility challenges are lesser. Smaller testicular volume was associated more with lesser sperm motility sluggishness and reduced sperm count. This implies that clinicians could include testicular volume measurements as part of routine fertility assessments to help identify individuals at risk for infertility.

Keywords: *Infertility, Asthenozoospermia, Azoospermia, Oligospermia, Varicocele, Enugu, Nigeria.*

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Introduction

1. Background of the study

Male infertility is a significant health issue affecting approximately 15% of couples worldwide (1). Testicular volume has been suggested as a potential predictor of fertility issues in men, but no study has correlated testicular volume amongst men with infertility challenges in our environment (2). The purpose of this study is to investigate the association between testicular volume and male infertility and whether testicular volume can be used as a predictor of fertility issues in this population. The objective of this study is to determine and compare the testicular volume between infertile male patients and fertile male

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subjects, and to evaluate the correlation between testicular volume and male infertility.

While couples frequently express fear about infertility, the majority of tests and examinations over the years have been centered around women (1, 2). Although men are not given much attention, Infertility has been proven to also affect men (3). According to a multicenter World Health Organization study conducted between 1982 and 1985, 20% of infertility cases involved male predominance, 38% involved female predominance, 27% involved abnormalities in both partners, and 15% involved no obvious reason for infertility (4). Pre-testicular reasons for male infertility include hormonal, genetic, testicular, and post-testicular factors such as blockage (4, 5). If infertility is suspected, it is crucial to examine the testis (6). The testes have an oval form, are 12.5–19 mL in volume, and are each around 4-5 cm long, 2-3 cm (about 1.18 in) wide, and 3 cm thick (5, 7). The most frequently used radiological test for male infertility is ultrasound (Fig. 1), although MRI may be used occasionally (8).

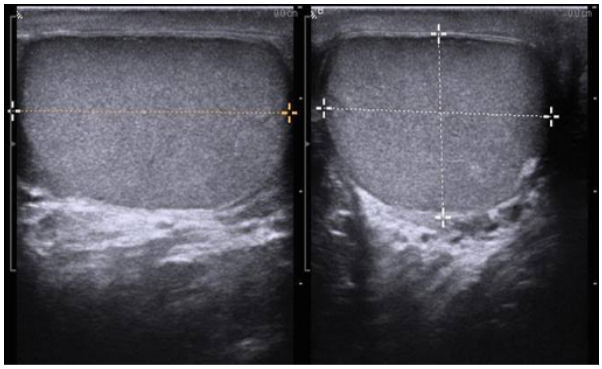

Figure 1: *Ultrasound measurement of testicular volume.*

2. Patients and Methods

This study was carried out in the University of Nigeria Teaching Hospital (UNTH), and a cross-sectional retrospective study design was used. Data of 50 patients that presented with infertility at the University of Nigeria Teaching Hospital (UNTH) and performed scrotal ultrasound in the past five years (2017-2022) were taken from the hospital records.

The inclusion criteria include medical records containing ultrasound reports and semen analysis from January 2017 to December 2022, of male patients between the age of 18 and 55 years with fertility challenges which may be due to Asthenozoospermia, Azoospermia, Oligospermia, or Varicocele. Medical records of men with fertility challenges who have a history of previous testicular surgery or trauma were excluded. Approval for the study was granted by the hospital research and ethics board.

2.1 Method of Data Collection

A well-structured data extraction form was used to collect data from the medical records. A total of 50 data samples were collected between 2017 and 2022. The information gathered was extracted and analyzed.
The forms contain the patient demographics, clinical history and testicular volume measurements.

2.2 Data Analysis

Both descriptive and inferential statistics were used to analyze the data. The item parameters were summarized using the mean and standard deviation. An independent samples t-test and Pearson correlation were employed at a 5% level of significance to determine objectives 2 and 3, respectively. Therefore, there is significance if the p-value is lower than 0.05; otherwise, the results are statistically insignificant and cannot be generalized. Microsoft Excel and the Statistical Package for the Social Sciences (SPSS) version 25 were used to conduct these analyses.

3. Results

3.1 Demographics

A total of 58 patient reports presenting with fertility challenges were evaluated from the Department of Records at the University of Nigeria Teaching Hospital, Ituku Ozalla (UNTH). Only 50 reports were included in this study because the remaining reports had missing ultrasound data or semen analysis.

According to Table 1, the age distribution of the sample population ranges from 18 to 55 years, with a mean age of 37.42 years and a standard deviation of 8.63 years. The age groups with the highest frequencies are 31-35 years and 36-40 years, each comprising 26% of the sample. The next most common age group is 46-50 years, accounting for 20% of the sample. The age groups 18-20 years, 21-25 years, and 26-30 years each represent 4% of the sample, while the 41-45 years group makes up 12%. The least represented age group is 51-55 years, with just 2%. This distribution indicates a relatively balanced representation across mid-adult ages, with fewer participants at the youngest and oldest ends of the range.

Table 1: Age of patients

Table 1: Age of Patients

n = 50

Age	Frequency	Percent	Range 18-55	M±SD 37.42±863
18-20	3	6.0		
21-25	2	4.0		
26-30	2	4.0		
31-35	13	26.0		
36-40	13	26.0		
41-45	6	12.0		
46-50	10	20.0		
51-55	1	2.0		

Chart 1 shows that all patients aged 18-20 years and 26-30 years, as well as the majority aged 36-40 years and 46-50 years, had a history of varicocele. Similarly, majority aged 31-35 years and 41-45 years had a history of azoospermia. Furthermore, a history of asthenozoospermia was predominantly found among those aged 46-50 years, a history of azoospermia and bilateral varicocele was mostly seen in those aged 31-35 years, while oligospermia was common among those aged 36-40 years. Unilateral varicocele was mainly observed in those aged 36-40 years and 46-50 years.

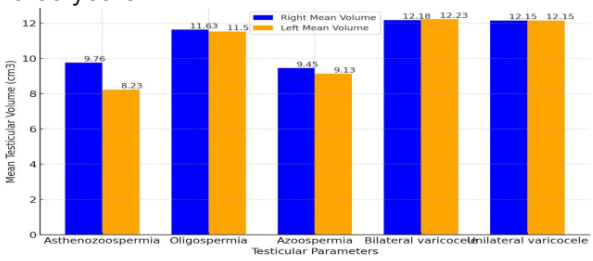

Chart 1: Mean volumes across Infertility conditions.

3.2 Objective 1:

To determine the mean testicular volume in male patients with fertility challenges.

The study analyzed mean testicular volumes for various testicular conditions, as shown in **(Chart 2)**, finding that differences between right and left testicular volumes were generally minimal. For asthenozoospermia, the mean volumes were 9.76 cm³ (right) and 8.23 cm³ (left). Oligospermia showed nearly identical volumes with 11.63 cm³ (right) and 11.53 cm³ (left). Azoospermia had mean volumes of 9.45 cm³ (right) and 9.13 cm³ (left). Bilateral varicocele exhibited mean volumes of 12.18 cm³ (right) and 12.23 cm³ (left), while unilateral varicocele had identical mean volumes of 12.15 cm³ for both testicles. Overall, varicocele conditions were associated with higher testicular volumes, whereas asthenozoospermia had the lowest volumes. From this, we deduced that the mean testicular volume for our sample population was 11.03 cm³ on the right and 10.65 cm³ on the left.

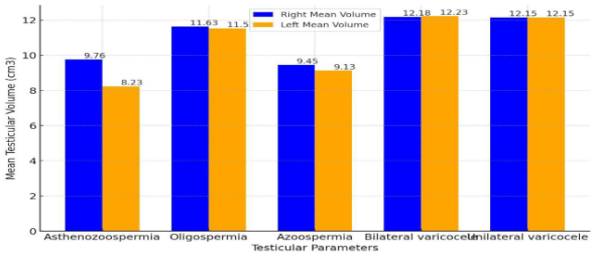

Chart 2: Mean volumes across Infertility conditions.

3.3 Objective 2:

To compare the testicular volume between infertile male patients and fertile male subjects.

Table 2 compares testicular volumes between infertile and fertile males, revealing significant differences. The right testicular volume in infertile males (M±SD: 11.03±1.33) is substantially lower than in fertile males (19.84), with a mean difference of -8.81, a t-value of -14.84, and a p-value of less than 0.0001, indicating a highly significant result. Similarly, the left testicular volume in infertile males (M±SD: 10.65±1.85) is significantly lower than in fertile males (19.69), with a mean difference of -9.04, a t-value of -10.92, and a p-value of less than 0.0004. These results suggest that testicular volumes are markedly reduced in infertile males compared to fertile males.

Table 2: Comparing Testicular Volume of Infertile Male Patient and Fertile Male Subjects

	Infertile male M±SD	Fertile male M±SD	Mean difference	T	p-value
Right Volume	11.03±1.33	19.84	-8.81	-14.84	< .0001
Left Volume	10.65±1.85	19.69	-9.04	-10.92	< .0004

3.4 Objective 3:

To evaluate the correlation between testicular volume and male infertility.

Findings in **Table 3** show a significant relationship between sluggish sperm motility and left testicular volume (r = 0.301, p = 0.034), as well as between sperm count and left testicular volume (r = 0.317, p = 0.025). Smaller testicular volume was more associated with reduced sluggish sperm motility and lower sperm count. For active sperm motility (r = 0.092, p = 0.532) and dead sperm motility (r = 0.031, p = 0.828), no significant relationship was found. There was also no significant relationship between right testicular volume and infertility parameters: active motility (r = 0.119, p = 0.411), sluggish motility (r = 0.151, p = 0.295),

dead motility (r = 0.106, p = 0.464), and sperm count (r = 0.165, p = 0.252).

Table 3: Relating Testicular Volume and Male Infertility

	Right Volume	Left Volume
Sperm Motility Active		
- Pearson Correlation	.119	.092
- p-value	.411	.523
Sperm Motility sluggish		
- Pearson Correlation	.151	.301*
- p-value	.295	.034
Sperm Motility Dead		
- Pearson Correlation	.106	.031
- p-value	.464	.828
Sperm Count (x10^6 cells/ml)		
- Pearson Correlation	.165	.317*
- p-value	.252	.025

** indicates item with significant relationship*

4. Discussion of Findings

From Table 1, it can be seen that the age distribution of the patients under study spans the range of 18 to 55 years. The computed mean age is determined to be 37.42 years, and the standard deviation around the mean is calculated to be 8.63.

Notably, the age groups denoted as 31-35 and 36-40 years emerge as the modal categories, each representing a frequency of 26.0%.

4.1 To determine the mean testicular volume in male patients with fertility challenges.

The result from the analysis depicted that the mean testicular volumes for Asthenozoospermic patients was 9.76cm^3 and 8.23 cm^3 on the right and left respectively while patients with Oligospermia had mean testicular volume of 11.63 cm^3 on the right and 11.53 cm^3 on the left. The mean testicular volume for Azoospermic patients was 9.45 cm^3 on the right and 9.13 cm^3 on the left. These values were not in tandem with the values Amit Bellurkar et al (9) who found the mean testicular volume for Azoospermic patients to be 10.3 ml and that of oligospermic patients to be 13.2 ml. E.W Ugboma (10) also concluded in his research that Oligospermic patients had volumes of less than 7cm^3.

Patients with bilateral varicocele had right testicular volume of 12.18 cm^3 and 12.23 cm^3 on the left. While patients with unilateral varicocele had mean testicular volumes of 12.15 cm^3 on the right and 9.22 cm^3 on the left.

4.2 To compare the testicular volume between infertile male patients and fertile male subjects.

The result from the analysis showed there was a positive significant difference in the values of the testicular volumes of infertile and fertile male patients with the testicular volume for infertile males lesser than the normative volume for fertile males. This result is in tandem with K.H Tijani's study (11) where he made a conclusion mean testicular volume was generally higher for each age group of the fertile group when compared to the infertile group.

4.3 To evaluate the correlation between testicular volume and male infertility.

The result from the analysis demonstrated there was a significant relationship between sperm mortality sluggish and left testicular volume (r = 0.301, p = 0.034) and between sperm count and left testicular volume (r = 0.317, p = 0.025). This result is in tandem with the findings of Jason P. Van Batavia et al (12) which revealed a significant positive correlation between total motile sperm count and total testicular volume (r = 0.35, p = 0.01).

5. Recommendation from the Study

Treatment strategies could be tailored based on the severity of testicular volume reduction. Clinicians may include testicular volume measurements as part of routine fertility assessments to help identify individuals at risk for infertility. Understanding the biological and physiological factors driving this correlation could lead to more effective fertility treatments in the future.

6. Areas for further research

Evaluation of the reports of patients with infertility challenges as the clinical indication attending the department and the mechanisms underlying the relationship between testicular volume and fertility should be studied.

Conclusion

The study revealed that the volume of the testes of infertile male are lower than that of fertile males. The study found a correlation between mean testicular volume and fertility parameters.

Correspondence to:

Ezenwaka Augusta Amarachi

https://orcid.org/0009-0004-6732-5990

University of Nigeria, Enugu Campus, Faculty of Health Sciences and Technology, Department of Medical Radiography and Radiological Sciences, Enugu State, Nigeria

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Declarations

Consent for publication: The author clarifies that written informed consent was obtained and the anonymity of the patient was ensured. This study submitted to Swiss J. Rad. Nucl. Med. has been conducted in accordance with the Declaration of Helsinki and according to requirements of all applicable local and international standards. All authors contributed to the conception and design of the manuscript, participated in drafting and revising the content critically for important intellectual input, and approved the final version for publication. Each author agrees to be accountable for all aspects of the work, ensuring its accuracy and integrity. Written informed consent was obtained from the patient's legal guardians for the publication of this case report and any accompanying images.

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