SJIF Impact Factor: 5.464

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

ISSN: 2457-0400
Volume: 6.
Issue: 2.
Page N. 10-14
Year: 2022

Research Article www.wjahr.com

IS SONOGRAPHIC TESTICULAR VOLUME ASSESSEMSNT A FACTOR IN MALE SUBFERTILITY?

Emeka Mgbe[1], Nneka Iloanusi*[1], Chinenye Mgbe[2], Enyereibe Ajare[1], Amaka Nnamani[1] and Emmanuel Obikili[1]

[1]Department of Radiation Medicine, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria.
[2]Department of Public Health, National Open University of Nigeria, Enugu, Nigeria.

Received date: 24 November 2021 **Revised date:** 14 December 2021 **Accepted date:** 04 January 2022

***Corresponding author: Nneka Iloanusi**

Department of Radiation Medicine, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria.

ABSTRACT

Background: There has been a rise in the incidence of subfertility in Nigeria with male causes alone culpable in about 42% in the south-east zone of the country. Obviously, the socio-cultural as well as economic impacts cannot be over-emphasized. Ultrasonography is a readily available, reproducible, non-invasive and cost-effective imaging modality that can fairly accurately evaluate the testes and the rest of the scrotum. **Objective**: To ascertain if testicular volume was a contributing factor in subfertile adult males when compared to fertile adult males. **Methodology**: This was a prospective, comparative study of ultrasonographic testicular findings of fertile and subfertile adult males in Enugu Nigeria. Recruited research participants were scanned using 5.0-7.5MHz linear transducer on a mobile "ALOKA" ultrasound machine. **Results:** Of the 130 subjects studied, the mean ages for normal and subfertile were 42.14years and 41.18 years respectively. The mean testicular volume was 15.53±5.37cm^3 for fertile and 10.01±4.09cm^3 for subfertile subjects. There was significant difference in the testicular volumes of fertile and subfertile subject (P =0.0001). There was positive correlation of testicular volumes with weight as well as BMI in the fertile (control) subjects (Pearson r= +0.32) while correlation was insignificant in the sub-fertile group (Pearson r= +0.09). **Conclusion**: Ultrasonographic evaluation of testis is invaluable in the assessment of male subfertility.

KEYWORDS: *Testicular volume. Sub-fertilitv. ultrasound.*

INTRODUCTION

There has been a rise in the incidence of subfertility in Nigeria with male causes alone culpable in about 42%.[1] Arai et al[2] in a study showed that testicular volume strongly correlates with semen profile. Several factors like race, age, body mass index influence the size of the testicle.[3] As an endocrine organ, it produces testosterone responsible for the development of male sexual characteristics and spermatozoa which are the male gametes.[4] Therefore, accurate testicular volume measurements are crucial in testicular function evaluation.

Testicular volume is largely a reflection of spermatogenesis because the seminiferous tubules make up about 90% of testicular mass.[5,6,7]

Ultrasonography is a readily available, non-invasive, non-ionizing radiation and cost-effective imaging modality that can fairly accurately evaluate organs like the testis.[8,9,10,11]

Paltiel et al[12] observed that length (L) x width (W) x thickness (T) x 0.71 was the most accurate formula for ultrasound assessment of testicular volume.

MATERIALS AND METHODS

This was a prospective comparative study conducted with ethical clearance in a tertiary hospital in Enugu, Southeast Nigeria. A total of one hundred and thirty (130) age, height and weight-matched adult male subjects were recruited for the study- 65 sub-fertile and 65 fertile adult males to act as controls. Subjects who have not been able to achieve pregnancy with their spouses in spite of regular unprotected intercourse for at least 1 year and whose spouses have been medically proven not to be the cause of the subfertility were included in the sub-fertile group. A scrotal ultrasound examination was done using a grey scale real time mobile ALOKA machine with a high frequency 5.0-7.5

MHz linear transducer. The length, width and thickness were measured for each testis in millimeters (Figure 1). Testicular volume was then calculated using the most accurate formula of Lambert[12]: (L) X (W) x (T) x 0.71. Mean testicular volume (MTV) for each subject was calculated by adding the left and right testicular volumes and dividing by 2. For each subject, age, weight and height were taken and the Body Mass Index (BMI) calculated from the latter two variables.

Statistical analysis was done with GraphPad Prism (1992-2017 GraphPad Software Inc, USA). Normality of distribution was verified in both groups (sub-fertile and fertile) with the D'Agostino's and Pearson normality test. Descriptive statistics-mean, median and standard deviation- were calculated for both groups and illustrated with Box Plots. Inferential statistics- comparison of variables in groups- age, Body Mass Index and testicular volume- was done with the unpaired t-test and Pearson Correlation test. A p-value of <0.05 was considered as statistically significant.

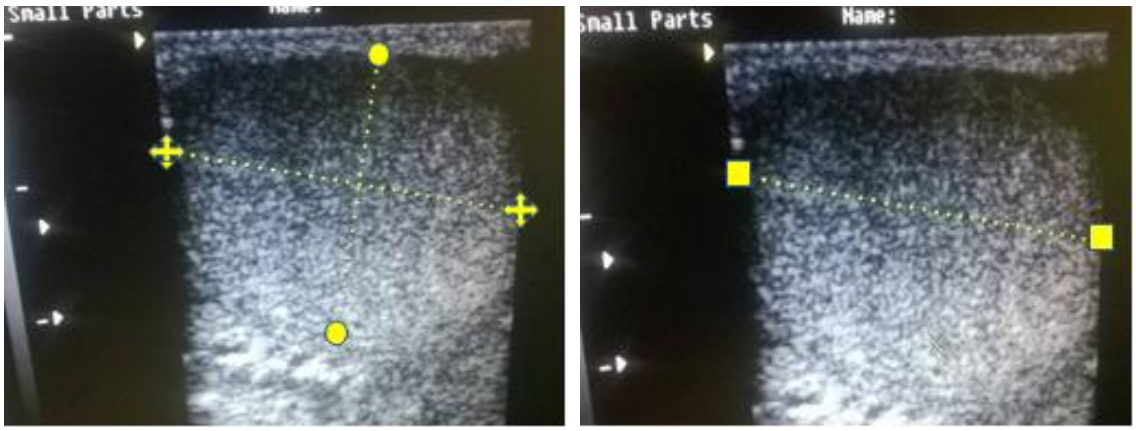

Fig 1: a and b: Transverse (a) and longitudinal (b) images of the testis showing measurement of width and thickness (a) and length (b).

RESULTS

The mean ages of fertile and sub-fertile subjects were 42.1±16.3 years and 41.2±8.5 years respectively. Their mean weights were 68.40±12.47 kg and 71.26±11.38 kg respectively. Their mean heights were 1.69±0.09m and 1.73±0.40m respectively.

Normality of distribution of testicular volume was verified in both groups (sub-fertile and fertile) with the D'Agostino's and Pearson normality test (P= 0.075 and 0.377 respectively). The right and left mean testicular volume of normal adult subjects were 15.65±6.01 cm^3 and 15.40±5.02 cm^3 respectively while that of subfertile subjects were 9.92±4.34 cm^3 and 10.10±4.59cm^3 (Table 1). Average testicular volumes for the fertile and sub-fertile groups ranged from 6.8-29.5cm^3 and 0.8 - 23.2cm^3 with a mean volume of 15.5 +/- 5.4cm^3 and 10.0 +/- 4.1cm^3 respectively(Fig.2) There was a significant difference in mean volumes between the two groups (P= 0.0001). The Body Mass Index (BMI) for the fertile and sub-fertile group ranged from 19.03- 32.03kg/m^2 (mean= 24.06 +/- 3.82kg/m^2) and 17.24 to 37.92kg/m^2 (mean= 24.77 +/- 3.70kg/m^2) respectively. Most subjects in both groups fell within the normal range for BMI- 18.5-24.99kg/m^2. There was a weak positive correlation between MTV and BMI in the fertile (control) group (Pearson r= +0.32; p=0.0098). On the other hand, the correlation was insignificant in the sub-fertile group (Pearson r= +0.09; p=0.4678). There was no significant correlation between age and MTV in both groups (Pearson r= +0.12 and -0.07; p=0.4013 and p=0.5295 respectively) for the fertile and sub-fertile groups respectively.

Table 1: The mean testicular dimensions of fertile and subfertile subjects.

	Right Testis			Left Testis		
	Normal Mean±SD	**Subfertile Mean±SD**	**p value**	**Normal Mean±SD**	**Subfertile Mean±SD**	**p value**
Length(cm)	4.04±0.56	3.32±0.56	0.01	3.82±0.41	3.29±0.55	0.01
Width(cm)	2.49±0.63	2.17±0.47	0.01	2.50±0.47	2.24±0.49	0.01
Height(cm)	2.29±0.44	1.85±0.46	0.01	2.25±0.48	1.85±0.46	0.01
Testicular Volume(cm^3)	15.65±6.01	9.92±4.34	0.01	15.40±5.02	10.10±4.59	0.01
	Both Testis					
	Normal	**Subfertile**				
Average Testicular Vol(cm^3)	15.53±5.37	10.01±4.09	0.002			
Total Testicular Vol(cm^3)	31.05±10.73	20.01±8.18	0.002			

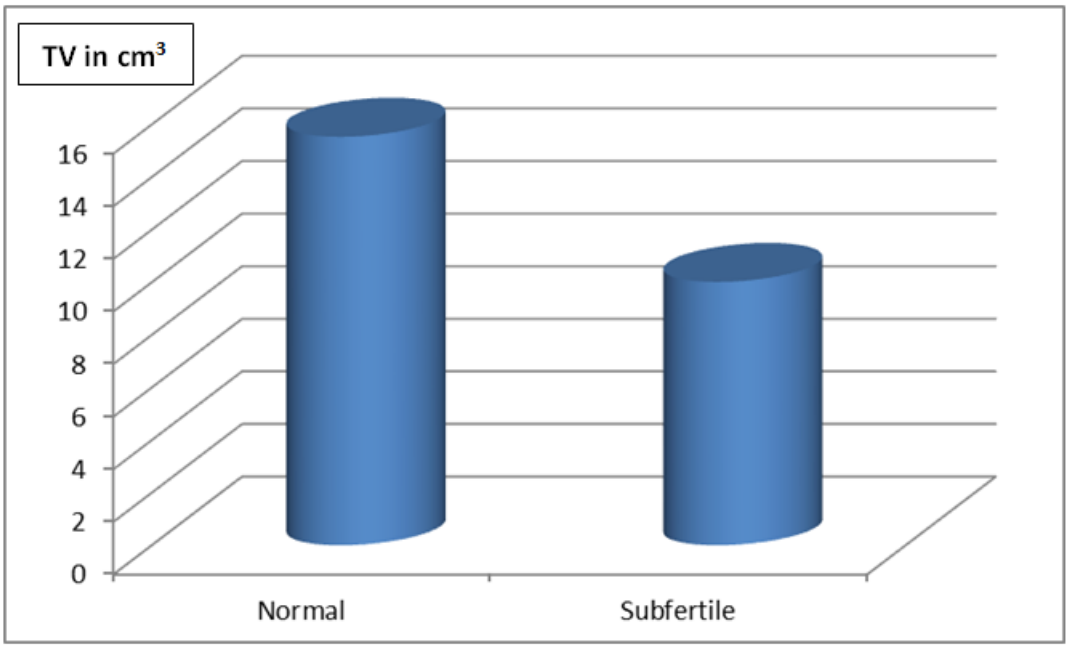

Fig 2: Comparing the average testicular volumes(TV) of normal and subfertile males.

DISCUSSION

Subfertility is a major physical and emotional health burden in africa. There is therefore a yeaning need for a readily available and affordable means of quick assessment which ultrasonologic testicular volume evaluation provides. The subfertile subjects had a lower mean age (41.2±8.5 years) than the normal men (42.1±16.3years). There was no significant difference between normal and subfertile groups in terms of age. The BMI also showed no significant difference between the normal and the subfertile subjects. The mean duration of subfertility was 5.3 years which is similar to the 5 year period observed by Ikechebelu *et al*.[1]

The average of both testes was 15.53±5.37 cm^3 and 10.01±4.09cm^3 for normal and subfertile subjects respectively(Figure 2). The testicular dimensions of the subfertile subjects were significantly lower than that of the normal subjects (p=0.01). This is corroborated by studies by Sigma and Jarow[13], Lenz *et al*[14], Zini *et al*[15], Zucchi *et al*[16] Lipshultz *et al*[17], Kolade *et a*[18] , Pethiyagoda *et al*[19] done in different parts of the world. The reason for this difference agrees with the fact that testicular volume is composed predominantly of seminiferous tubules which are responsible for sperm production which is invariably proportional to fertility.[4, 5]

The values for testicular dimensions disagrees with a local study done in Jos , Nigeria by Ajmani *et al*[20] in which the length of right testis was 4.68 ± 0.05 cm; width of right testis 3.24 ± 0.04 cm; length of left testis 4.60 ± 0.05 cm; and width of left testis 3.14 ± 0.04 cm. The significant difference between these studies (p=0.0001) may be due to difference in methods of measurement as use of meter rule gives increased testicular dimensions due to inclusion of the epididymis.[9,21]

The cut off value for mean testicular volume, 10.16cm^3 corroborates the study by Sakamoto *et al*[8] in Japan in which the following figures were obtained: 10 cm^3 for the ultrasonographic mean testicular volume, 3.5 cm for mean testicular length, 1.5–1.75 cm for mean testicular height and 2.25–2.5 cm for mean testicular width.

This study is in agreement with that carried out in the United States of America by Schiff et al[22] according to which the right testicle is larger than the left. The mean testicular volume for adult males in Enugu was 15.65ml for right and that of left was 15.40ml. Schiff obtained 18.3ml for right and 16.9ml for left. Normal testicular volumes differed significantly by other authors, Sigma and Jarow[13] obtained 20cm^3, in Japan Takihara had 18cm^3 while 30cm^3 was the value by Brooks. The reason for these significant differences may be due to variation of testicular dimensions with ethnic groups as documented by Diamond.[23]

The significance of the correlation of the testicular volumes with weight and BMI for the fertile group is that these variables are directly proportional to testicular volume. Therefore in assessing an individual's testicular volume, the biometric status should be considered. With no significant correlation of testicular volume with age, indicates that age is of minimal consequence in assessing testicular volume once the adult size is attained. Ajmani[20] and Jung[24] both corroborated the positive correlation of testicular volume with weight, height and BMI.

It was observed that the testicular dimensions for subfertile adults males were: Right testicular volume,

9.92±4.341cm^3, left testicular volume:10.10±4.558cm^{3,} Mean testicular volume:10.01±4.090cm^3 and total testicular volume: 20.01±8.180cm^3. This finding agrees with the study done in Denmark by Lenz *et al*[14] who observed that the mean ultrasonic testicular volume of the right testis was 10.30 cm^3, and that of the left 10.26 cm^3. This reduced testicular volume found in subfertile group of this study and corroborated by studies done by Lenz *et al*[14], Zini *et al*[15], Condorelli *et al*[25] Manuel *et al*[26], Bellurkar *et al*[27] and Boeri *et* al[28] strengthens the assertion that reduced testicular volume has a strong link with male subfertility.

CONCLUSION

Ultrasonographic evaluation of testicular volume is a reliable method of assessing fertility as it showed a statistically significant difference between normal and subfertile subjects with the latter being smaller. There is also positive correlation between testicular volume and biometric figures of an individual. Therefore, in order to objectively evaluate testicular volume for subfertility, weight and BMI of the subject should be considered.

RECOMMENDATION

Ultrasonographic testicular volume assessment could be included in the routine investigation for subfertility in males. This is because the result is reproducible and the procedure is non-invasive and less cumbersome than other methods such as prader orchidometry.

More studies could be done in collaboration with the urologists and pathologists in order to correlate ultrasonographic testicular volume values with those obtained post orchiectomy and at autopsy.

REFERENCES

1. Ikechebelu JI, Adinma JI, Orie EF, Ikegwuonu SO. High prevalence of male infertility in southeastern Nigeria. J Obstet Gynaecol, 2003 Nov; 23(6): 657-659.
2. Arai T, Kitahara S, Horiuchi S, Sumi S, Yoshida K. Relationship of testicular volume to semen profiles and serum hormone concentrations in infertile Japanese males. Int J Fertil Women's Med, 1998; 43: 40–47.
3. Jerome H B, Leda C, John T, The Adapted mind-Evolutionary Psychology and the Generation of Culture,1st ed.,New York, 1992; 299.
4. Guyton A, Hall J E, Guyton and Hall Textbook of Medical Physiology, 11th ed., Philadelphia, 2006; 996-1009.
5. MacManus I. Scrotal asymmetry in man and in ancient sculpture. Nature, 1976; 259: 426.
6. Anderson JE. Grant's Atlas of Anatomy, 8th ed., Baltimore MD: Williams & Wilkins, 1983; 860.
7. Lotti F, Frizza F, Balercia G, Barbonetti A, Behre HM, et al. The European Academy of Andrology (EAA) ultrasound study on healthy, fertile men: clinical, seminal and biochemical characteristics. Andrology. 2020;8:1005–20.
8. Sakamoto H, Ogawa Y, Yoshida H. Relationship between testicular volume and testicular function: comparison of the Prader orchidometric and ultrasonographic measurements in patients with infertility. Asian J Androl, 2008; 10: 319–324.
9. Diamond DA, Paltiel HJ, DiCanzio J, Zurakowski D, Bauer SB. Comparative assessment of pediatric testicular volume: orchidometer versus ultrasound. J Urol, 2000; 164: 1111–1114.
10. Costabile RA, Skoog S, Radowich M. Testicular volume assessment in the adolescent with a varicocele. J Urol, 1992; 147: 1348–1350.
11. Carlsen E, Andersen AG, Buchreitz L, Jorgensen N, Magnus O, Matulevicuus V, Nermoen I, Petersen JH, Punab M, Suominen J, Zilaitiene B, Gwercman A. Inter-observer variation in the results of the clinical and urological examination including estimation of testicular size. Int J Androl, 2000; 23: 248–253.
12. Paltiel HJ, Diamond DA, Di Canzio J, Zurakowski D, Borer JG, Atala A. Testicular volume: comparison of orchidometer and US measurements in dogs. Radiology, 2002; 222: 114–119.
13. Sigman M, Jarow JP, Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, editors. Male infertility Campbell-Walsh Urology. Philadelphia, PA: WB Saunders, 2007; 613–614.
14. Lenz S, Thomsen JK, Giwercman A, Hertel NT, Hertz J, Skakkebaek NE. Ultrasonic texture and volume of testicles in infertile men. Hum Reprod, 1994; 9(5): 878-881.
15. Zini A, Buckspan M, Berardinucci D, Jarvi K. Loss of left testicular volume in men with clinical left varicocele: correlation with grade of varicocele.Arch Androl, 1998; 41: 37–41.
16. Zucchi A, Mearini L, Mearini E, Fioretti F, Bini V, Porena M. Varicocele and fertility: relationship between testicular volume and seminal parameters before and after treatment. J Androl, 2006; 27: 548–551.
17. Kim ED, Lipshultz LI, Howards SS., Gillenwater JY. Male infertility. In: Adult and Pediatric Urology. Philadelphia, PA: Lippincott Williams & Wilkins, 2002; 1683.
18. Kolade-Yunusa Oluseyi, Thairu Yunusa. Sonography of scrotal abnormality among subfertile and fertile males in Abuja, Nigeria. Sub- Saharan African Journal of Medicine, 2019; 6(2).
19. Pethiyagoda AU, Pethiyagoda KT. Scrotal ultrasonography in the assessment of subfertile males, International Journal of Scientific and Research Publications, 2017; 7(5): 873 ISSN 2250-3153.
20. Ajmani ML, Jain SP, Saxena SK.Anthropometric study of male external genitalia of 320 healthy Nigerian adults. Anthropol Anz, 1985; 43(2): 179-186.

21. Cassorla FG, Golden SM,Johnsonbaugh RE, Heroman WM,Loriaux DL,Sherins RJ.Testicular volume during early infancy. J Pediatr, 1981; 99: 742-743.
22. Schiff JD, Li PS, Goldstein M. Correlation of ultrasonographic and orchidometer measurements of testis volume in adults. BJU Int, 2004 May; 93(7): 1015-1017.
23. Diamond JM. Ethnic-differences - variation in human testis size. Nature, 1986; 320: 488-489.
24. Bahk JY, Jung JH, Jin LM, Min SK. Cut-off value of testes volume in young adults and correlation among testes volume, body mass index, hormonal level, and seminal profiles. Urology, 2010; 75(6): 1318-1323.
25. Condorelli R, Calogero A E, Vignera S, Relationship between Testicular Volume and Conventional or Nonconventional Sperm Parameters International Journal of Endocrinology, 2013; 6.
26. Manuel BA, Ugboma EW, Nwankwo NC Relationship between Testicular Volume and Sperm Count in Infertile Men in Southern Nigeria. Asian Journal of Medicine and Health, 2017; 4(1): 1-6.
27. Bellurkar A, Patwardhan S, Patil B, Kanbur A, Jain H, et al Role of Testicular Size as a Parameter for Predicting Infertility in Indian Males J Hum Reprod Sci, 2020 13(2): 114–116.
28. Boeri L, Capogrosso P, Ventimiglia E, Cazzaniga W, Pozzi E, Belladelli F, et al Testicular volume in infertile versus fertile white-European men: a case-control investigation in the real-life setting. Asian J Androl, 2021; 23(5): 501-509.