e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2024; 14(1); 257-261

Original Research Article

Testicular Volumes and Semen Parameters among Healthy Adults Are Evaluated In Relation to One Another

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Received: 10-10-2023 / Revised: 15-11-2023 / Accepted: 24-12-2023

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Conflict of interest: Nil

Abstract

Background: An essential and significant first step in evaluating testicular function is testing testicular size and characteristics of the semen. The most significant radiological method for accurately measuring testicular volume is considered to be ultrasound. Numerous reproductive endocrine factors affect testicular size. Measurements of testicular size and volume are related to the assessment of male fertility. The seminiferous tubules comprise between 70% and 80% of the bulk of the testicular mass. It is believed that testicular size serves as a gauge for spermatogenesis. On the other hand, assessing the testicular volume of teenage boys is crucial in establishing the onset of puberty or pubertal development.

Materials and Method: For our study, we employed a prospective observational category design. It was finished in the radiology department of a medical institution in Central India. The study was conducted between August 2019 and August 2021. The study was conducted between August 2019 and August 2021. Testicular sizes of 200 adult males aged 18 to 70 were measured, and Lambert's formula was used to calculate the volumes of the testicles on each side. Serum hormone analysis and traditional semen parameter evaluations were freely undertaken by all research participants. The relationships between testicular volumes, semen parameters, participant anthropometric measurements, and other characteristics were also evaluated.

Results: The testicular volumes were calculated using Lambert's formula. 200 adult males in total, ranging in age from 18 to 70 (with a median of 38 years old), took part in the study. On the right and left sides of the testis, the mean testicular volumes were measured to be 21.49±5.45 cm3 and 23.29±5.31 cm3, respectively. The discrepancies on either side of the volumes were different, according to statistics. There was a significant negative correlation found between blood hormone levels and the properties of semen and testicular volume. There were statistically significant relationships seen between age, testicular volumes, right and left lengths, and left and right testicular widths.

Conclusions: The results of this study showed that the most reliable method for measuring testicular volume and evaluating the gonadal organs' functioning was ultrasonography.

Keywords: Ultrasonography, Testicular volume, Anthropometric measurements, Gonadal functions.

Introduction

Testing the volume of the testicles in children, adolescents, and adults is crucial for preliminary evaluations of gonadal function since it has a high correlation with several markers of testicular function. [1] The testes are responsible for secreting testosterone and creating spermatozoa in men. Approximately 80–90% of the testicular volume is secreted by seminiferous tubules and germ cells. Thus, a reduction in the quantity of these cells leads to a reduction in the volume of the testicles. [2-5] Testicular volume measurement has been the focus of a lot of study lately. Measurements of testicular volume have traditionally been made using the Prader or punched-out orchidometer. [6] A few of the measurement methods that are currently in use are callipers, orchidometry, and ultrasonography. Ultrasonography is the most accurate and accessible method of measuring testicular volume since it compares the measured volume to the actual volume. [7-10] However, as multiple previous studies have shown, the testicular volume calculated by ultrasonography varies significantly depending on the method used. Accurate and dependable testicular volume measurements are vital for evaluating individuals for issues pertaining to testicular growth, development, and function. Testicular volume, like the simple measurements of testicular length, width, and depth, has been found to be directly connected to seminal fluid and sex hormone tests in studies on infertile men. A total testicular volume (the total of the left and right) of 20 ml or more, as determined by ultrasonography measurements, indicates normal testicular function. [11] Testicular volume is assessed in adult males and is closely correlated with spermatogenic activity. Numerous reproductive endocrine factors affect testicular size. Measurements of testicular size and volume are related to the assessment of male fertility. The seminiferous tubules comprise between 70% and 80% of the bulk of the testicular mass. It is believed that testicular size serves as a gauge for spermatogenesis. On the other hand, assessing the testicular volume of teenage boys is crucial in establishing the onset of puberty or pubertal development. It is also used to evaluate boys with a range of disorders, including varicocele, cryptorchidism, and testicular torsion, that affect the growth and development of the testicles. Numerous anthropometric parameters have been proposed for human subjects. They are frequently used as an index to evaluate nutritional health and to forecast the likelihood of various gonadal dysfunctions as well as the growth, development, and functioning of the gonadal organs. The Lamberts formula needs to be confirmed in order to compute the testicular volume in healthy people with accuracy utilizing ultrasound. For this reason, the goal of the current study is to assess ultrasound's accuracy in detecting testicular volume critically.

Materials and Methods

For our study, we employed a prospective observational category design. The scientific and ethical committee of the institution approved this work. The subjects chosen were: For this inquiry, August 2019 and August 2021 were utilized. Testicular size was assessed in 200 healthy adult males aged 18 to 70, and testicular volumes on both sides were calculated using Lambert's formula. It was also determined whether the characteristics of the other participants and testicular measurements correlated. There were 200 adult males in good health who were between the ages of 18 and 70 (median age of 38) for this study. The study included participants who freely completed the informed consent form and self-reported not having any other metabolic illnesses.

Participants with genital or scrotal anomalies, those undergoing evaluation for infertility, or those who had already undergone scrotal surgery were not allowed to participate in the study. Sufferer position: All subjects underwent a supine ultrasound during the procedure. Biochemical Estimation: Serum hormone analysis was performed by electrochemiluminescence (USA) using the Hitachi-Roche system. Blood was drawn at eight in the morning, after at least eight hours of sleep. Serum levels of prolactin and LH were measured again 30 minutes apart. Semen Analysis: The WHO guidelines were followed for doing the semen analysis. Color, volume, liquefaction time, pH, density, total count, progressive motility, morphology, and leukocytes were among the many criteria studied.

Imaging examination: The 5.5-7.5MHZ linear transducer from a Philips HD11XE ultrasound machine was utilised to evaluate each of the 200 participants. (You can state the specifics of the ultrasound machine used in that hospital here.) We measured the sagittal length, width, and transverse height in centimetres (cm). The echogenic line connecting the superior and inferior poles of the testis was discovered to be the sagittal diameter, which is defined by the mediastinum. The epididymis and testis were projected individually in terms of sagittal diameter. The volume measurement excluded the epididymis. The volume of the right and left testes was then calculated using Lambert's formula44, W x H x L x 0.71. On each day of the assessment, measures were recorded for each patient on the questionnaire (datasheet).

Statistical analysis: The consolidated and compiled data were analysed with SPSS statistics software.

Results

The subjects in this study had a 38-year-old mean (SD) age, with 46 percent of them falling within the 30- to 39-year-old age range. Out of 200 subjects, 114 were married, 62 were single, and 24 had just experienced a divorce or widowhood. Only 18 subjects were uneducated, out of a total of 94 subjects that had been educated all the way up to graduation. A positive family history of gonadal dysfunction or infertility was reported by 24 subjects (Table 1).

Table 1: General Demographic features of adult healthy subjects enrolled in this study.

Parameters		**Subjects (n=200)**
Age (Years)	18-29	44
	30-39	46
	40-49	40
	50-59	38
	60-70	32
Gender	Male	200

Marital Status	Married	114
	Unmarried	62
	Widowed/Divorced	24
Education Level	Illiterate	18
	Up to 10th std.	42
	Graduate	94
	Postgraduate	46
Socioeconomic status	Lower	32
	Middle	146
	Upper	22
Occupation	Student	36
	Service	96
	Self-employed	44
	Retired	24
Residence area	Rural	116
	Urban	84
Family history of Gonadal dysfunction / Infertility	Yes	24
	No	176

As shown in Table 2, the changes in testicular volume in the participants' right and left testis were regularly distributed. Mean right and left testicular volumes were 21.49 ± 5.45 cm3 and 23.29 ± 5.31 cm3, respectively. The average dimensions of the left testis were 3.28 ±0.14 cm, 2.25 ±±0.17 cm, and 2.31 0.15 cm, while the average dimensions of the right testis were 3.26 ±0.15 cm, 2.23± 0.17 cm, and 2.28 ±0.15 cm. The left testis was larger than the right, although the differences in length, breadth, and volume were statistically significant (p> 0.05).

Table 2: Average of measurement of general parameters of testes among all study subjects.

Variables	Left Side	Right Side
Height (cm)	2.31 ± 0.15	2.28 ± 0.15
Width (cm)	2.25 ± 0.17	2.23 ± 0.17
Length (cm)	3.28 ± 0.14	3.26 ± 0.15
Volume (cm^3)	23.29 ± 5.31	21.49 ± 5.45

Data represents Mean ± SD values.

Table 2 compares the volumes of the testicles by age groups on both sides. The right testicular volume was typically greater than the left across all age groups. The results of a paired-samples t-test, as highlighted in the table, did not, however, reveal any significant differences between the right and left sides in any of the age groups (p> 0.05).

Table 3: Relationship between subjects age, height, weight and body mass index (BMI)

Age (Years)	N	Height (m)	Weight (Kg)	BMI (Kg/m^2)
18-29	22	1.49 ± 0.32	63.4 ± 8.2	22.0 ± 1.7
30-39	23	1.56 ± 0.49	64.2 ± 5.7	24.9 ± 1.8
40-49	20	1.53 ± 0.51	69.4 ± 6.8	25.3 ± 2.2
50-59	19	1.64 ± 0.74	73.8 ± 8.4	25.5 ± 1.8
60-70	16	1.49 ± 0.39	59.4 ± 7.2	24.9 ± 2.6

Data represents Mean ± SD values.

The findings of the analysis of variance to find any trends or significant differences in testicular volume when compared to BMI and subject age groups are shown in Table 3. Maximum numbers of underweight and obese patients were seen in the age ranges of 18 to 29 and 40 to 49 and 50 to 59 years, respectively.

Discussion

Adult testicular volume measurement is a crucial factor in determining the health of the testes in a variety of clinical diseases, including undescended testes, torsion, cancer, orchitis, and varicocele. [12-14] Additionally, a crucial component of assessing male infertility is the measurement of testicular volume. Ultrasound has generally been acknowledged as being more accurate than Prader orchidometry or the punched-out orchidometer 10, 12, 39 and testicular volume measurements using the ultrasonographic formula L x W x D x 0.71, which was used in this study, have been reported to be the most accurate for estimating actual testicular volumes in humans. Additionally, since ultrasonography is non-invasive and radiation is not a worry, assessments can be repeated. [15] The parameters used to choose the study's sample are similar to those used in previous research. Inclusion criteria for each of previous studies and the current one were a history of testicular and scrotal surgery or illness. In this study, the average testicular volumes of the right and left were found to be 21.49±5.45 cm3 and 23.29±5.31 cm3, respectively. The results of this study likewise indicated that volumes rose with age, peaked in the late 30s, and then began to fall. This found peak testicular volume at this point in life is in keeping with 114 publications stating that men are fertile at this point in their lives and that serum testosterone and spermatogenesis gradually decrease beyond the age of 50. [16] No statistically significant differences in these tendencies were found for the left or right testes, according to additional research. Additionally, there was a marginally positive connection between age and both the length and breadth of the right and left testicles. A modest negative correlation was found between age and left testicular volume. This is in contrast to earlier research that found no relationship between age and the volume of the left and right testicles. Previous research, albeit limited, had found that the testes peaked at age 18 and continued to grow until age 80, at which point they started to decline.

Additionally, a weak but significant correlation was found between testicular volume and body mass index, and a limited but positive correlation was found between BMI and testicular length, width, height, and volume. However, only a small number of studies consistently found no correlation between BMI and left testicular volume. Furthermore, Sotos and Tokar claimed that testicular volume measurement is not an exact science. Even with ultrasonography's high level of accuracy, there are still some variables to consider, such as the transducer that is used, the possibility of testicular compression, and differences in measurements (width, height, length, and volumes) between observers and among observers. There are other possible causes of these differences, including heredity, food, and environment. Overall, this study found that there was a marginally positive correlation between the testicular volume and height, weight, and BMI; however, none of these relationships were statistically significant. The left testis was larger than the right in terms of volume, length, and width, although these differences were statistically significant. However, there is currently no scientific explanation for the different relationships found between the assessed anthropometric variables and the right and left testes. This variable necessitates more investigation in this area in order to provide a clinical and scientific explanation for the differences in the testicular volumes on the right and left sides. The results of the study show that even in the absence of testicular disease, people with smaller testicles display worse semen parameters. Men with smaller testicles exhibited decreased serum amounts of total testosterone, but none of the study subjects showed overt endocrine problems.

Conclusion

The right testis' volume was smaller than the left testis' volume in this investigation. In individuals in good health, there was no statistically significant link found between any of the two side measurements and height, weight, or body mass index. Further investigation is necessary to validate or invalidate these findings. A commonly asked question about the accuracy of the numerous non-invasive testicular evaluation methods was addressed in this anthropological study. If there is no need for active intervention, a rough testicular size estimate might be adequate. Further investigation is needed to ascertain the correlation between reduced testicular volume and ultrastructural alterations of the testicular parenchyma in patients with decreased testicular volume who do not exhibit any symptoms of disease on clinical examination or ultrasonography. The results of this investigation are congruent with published data, suggesting that ultrasonography is the most objective and accurate in vitro method of evaluating testicular volume.

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