Original Article

Comparison between Testicular Volumes as Measured with Prader Orchidometer and Ultrasonography in Healthy Nigerian Newborns

Olakayode Olaolu Ogundoyin, Omolola Mojisola Atalabi[1]

Departments of Surgery and [1]Radiology, College of Medicine, University of Ibadan, Ibadan, Nigeria

Abstract

Background: We compared the testicular volume (TV) measured with Prader orchidometer (PO) to the volume measured with ultrasonography in male neonates and their relationships with some selected neonatal characteristics. **Subjects and Methods:** A cross-sectional study of all term male neonates who had clinical examination of their external genitalia performed and TV was measured using PO and ultrasonography. Information about the gestational age, birth weight, and birth length was also recorded to determine their relationships with TV measured. **Results:** The mean TV measured with PO was 1.06 (standard deviation [SD] ± 0.24) ml for both sides. With ultrasonography, the mean left TV was 0.273 (SD ± 0.081) ml and the mean right TV was 0.272 (SD ± 0.079) ml. There were significant correlations between TV using both methods with the birth weight and length. **Conclusion:** TV measured with the two methods was comparable and correlates well with their birth weight and birth length.

Keywords: Measurement, neonates, Prader orchidometer, testicular volume, ultrasonography

Introduction

The assessment of the external genitalia is an essential part of the neonatal physical examination in newborn males.[1] Abnormalities of penile dimensions and testicular volume (TV) can be revealed by genital examination, and this can be managed successfully with prompt investigations. Approximately 90% of TV is made up of seminiferous tubules and germ cells while the testicular tissue consists of Sertoli cells in infancy. A reduction in the number of these cells is manifested by a reduction in TV.[2,3]

Testicular size correlates well with the quality of spermatogenesis,[4] and the relationship between TV and semen quality in infertile adult patients has been established.[5] The TV is considered largely useful in the evaluation of some problems such as the consequences of cryptorchidism and orchidopexy, varicocele, abnormal testicular development, torsion of the testis, and Klinefelter syndrome in adolescents and young adults.[6] At birth, androgen deficiency and abnormal genital development in the male are closely related to TV,[7] thus it is necessary to determine the normal TV at birth since the fetal testes secrete testosterone that is required for virilization of the male newborn and continued penile growth.[8,9]

Measurement of TV is commonly carried out in the outpatient, and several methods have been used and compared in adults. These ranged from Prader orchidometry, the most popular method used in clinical practice but not very accurate,[10] to the more accurate ultrasonography and the use of ruler in adults which is quite cheap and simple to use.[11] Ultrasound is not widely available in the consultation room and where available has a financial implication and also needs expertise. The aim of this study is to compare the TV measured with Prader orchidometer (PO) to the volume measured with ultrasonography in male neonates in a typical African population and compare their relationships with some selected neonatal characteristics such as the gestational age, birth weight, and birth length.

Address for correspondence: Dr. Olakayode Olaolu Ogundoyin, Department of Surgery, College of Medicine, University of Ibadan, Ibadan, Nigeria.
E-mail: kayogundoyin@gmail.com

Access this article online

Quick Response Code:

Website: www.afrjpaedsurg.org

DOI: 10.4103/ajps.AJPS_32_17

How to cite this article: Ogundoyin OO, Atalabi OM. Comparison between testicular volumes as measured with prader orchidometer and ultrasonography in Healthy Nigerian Newborns. Afr J Paediatr Surg 2018;15:93-6.

Subjects and Methods

This is a cross-sectional study of male neonates which was conducted over a year period from July 2014 to June 2015 in Ibadan, South-West Nigeria, after an ethical approval was obtained from the Hospital Ethical Committee. A total of 411 healthy male newborns were recruited into the study from among the neonates delivered at the University College Hospital and Adeoyo General Hospital in Ibadan, Nigeria. Furthermore, recruited into the study were neonates who were brought to these hospitals for circumcision. Informed consent was obtained from the mothers of these neonates after the procedure had been explained to them in the language they understood. Excluded from the study were patients with anomalies of testicular descent, inguinoscrotal swellings, and disorders of sexual differentiation. Furthermore, excluded were neonates whose mothers refused to give consent to carry out an examination of the external genitalia on their babies. Under room temperatures with the examining hands kept warm, all other participants had complete physical examination and examination of their external genitalia conducted on them while perinatal history was obtained from the mothers and these were entered into a pro forma. The examination of the external genitalia of all the neonates was performed only by the first author (OOO) for consistency and to improve the reliability of the measurement of TV. Similarly, the second author (AMO) used ultrasonography to measure the TV of all the neonates on the same day of the physical examination of their external genitalia to minimize weight-related changes in the TV. Examination of the external genitalia was carried out using PO in which the testis was identified, and the scrotal skin stretched over it to properly define the edges of the testis. The beads of the orchidometer were placed side by side with the testes for comparison of their sizes and to identify the bead most similar in size to the testes; this indicated the TVs. The same set of participants irrespective of their center of birth also had ultrasound scan within the first 30 days of life.

Ultrasonography was performed by a board-certified radiologist using the Chison Ultrasonic portable machine with 7.5–10 MHz linear array transducer. Each baby was placed in the supine position on the examination table with their legs in the frog lateral position. The room was maintained at room temperature to prevent the testes from retracting. The hands were rubbed together to provide a little warmth, and the gel was kept in a gel warmer at 30°C. The scrotum was supported by a rolled towel placed below the scrotum to stabilize the testes, and coupling gel was applied generously to minimize surrounding air interference. The testes were further stabilized by placing a finger on the median raphe of the scrotal skin before gently scanning to avoid distortion of the shape and dimension. The longitudinal plane of the testis was obtained by placing the probe on the scrotal skin over the testis and rotated until the mediastinum testis was visualized in the same plane. The image was then frozen in this position to measure the length and the height of the testis. The transverse diameter was also measured while the testis was in the transverse position. Testicular mean volume was obtained using the Lambert formula (length × width × height × 0.71). Analysis of the data was carried out using the IBM Statistical Package for Social Sciences (SPSS) Version 21, Chicago, U.S.A. The mean and standard deviation (SD) of the TVs measured by both methods were determined, and the means were compared using the paired *t*-test. The Pearson's correlation coefficient was used to express the relationships between these TVs and gestational age, birth weight, and birth length.

Results

A total of 411 male newborns were recruited into the study. The mean age of the babies was 1.8 (SD ± 0.2) days with a range of 1–15 days and the gestational age at delivery ranged from 34 to 42 weeks with a mean of 39.4 (SD ± 1.7) weeks. The mean birth weight was 3.09 (SD ± 0.45) kg, and the mean birth length was 47.93 (SD ± 2.71) cm. The mean TV using the PO was 1.06 (SD ± 0.24) ml for both right and left. With ultrasonographic measurement, the left TV ranged from 0.13 to 0.61 ml with a mean of 0.273 (SD ± 0.081) ml and the mean right TV was 0.272 (SD ± 0.079) ml with a range of 0.13–0.53 ml [Table 1]. Comparing the means using the paired *t*-test, the difference in means was found to be − 0.78 ml ($P = 0.00$) for both sides.

There was no correlation between the TV measured with PO and the gestational age of the babies at delivery ($r = -0.026$ and $P = 0.598$) but there was a strong correlation between the TV measured with PO and the birth length ($r = 0.103$ and $P = 0.038$) and a very strong correlation between the TV measured with PO and the birth weight ($r = 0.206$ and $P = 0.000$). Using ultrasonography, there was no significant correlation between the TV and the gestational age of the neonates at delivery (left testis – $r = 0.053$ and $P = 0.143$ and right testis – $r = 0.018$ and $P = 0.356$) but there were strong and significant correlations between the TV on both sides and the birth weight (left testis– r = 0.253 and $P = 0.143$ and right testis – $r = 0.237$ and $P = 0.000$) and birth length (left testis – $r = 0.171$ and $P = 0.000$ and right testis – $r = 0.172$ and $P = 0.000$) [Table 2].

Discussion

The measurement of TV is often carried out in the outpatient using several methods. These include the ruler, PO, and

Table 1: Characteristics of the neonates

Parameter	Mean values ± SD	Range
Age (days)	1.8±0.2	1-15
Gestational age (weeks)	39.4±1.7	34-42
Birth weight (kg)	3.0±0.4	1.9-4.5
Birth length (cm)	47.9±2.7	36-56
Left testicular volume (USS)	0.273±0.081	0.13-0.61
Right testicular volume (USS)	0.272±0.079	0.13-0.53
Testicular volume (PO [right=left])	1.06±0.235	1-2

SD: Standard deviation, PO: Prader Orchidometer, USS: Ultrasonography

Table 2: Relationship between testicular volume measured by both methods and selected neonatal characteristics

Characteristics	PO		USS			
	Left=right		Left testicular volume		Right testicular volume	
	r	*P*	*r*	*P*	*r*	*P*
Gestational age	−0.026	0.598	0.053	0.143	0.018	0.356
Birth weight	0.206	0.000	0.253	0.000	0.237	0.000
Birth length	0.103	0.038	0.171	0.000	0.172	0.000

PO: Prader Orchidometer, USS: Ultrasonography

ultrasonography, however, none of these methods have been standardized as the instruments used to measure testicular dimensions are not standardized.[4] Therefore, differences exist between the values of TV measured with these methods on the same individual. This was the observation in this study where there was a difference between the mean TV measured by PO and ultrasonography. The difference was attributed to the fixed sizes of the beads used in prader orchidometry making it difficult to estimate volumes in between two consecutive beads; in addition, the epididymis, tunica vaginalis, spermatic fascia, and other structures surrounding the testis are included when PO is used to measure TV. This, however, does not allow for accuracy, especially in the measurement of TV in small testes of the newborn with undescended testis. TV measurement in the neonate where the testis is small is often fraught with some problems and there is a tendency to overestimate the volumes measured due to the above reasons. For example, the smallest bead in the PO is 1 cm^3 and this may not allow for accurate measurement of the testis that is smaller in size to the bead in the newborn and the observer will be forced to confer a higher volume to such testis. Similarly, overestimation of TV using the PO and ruler may be a problem in neonatal and smaller testes because of the relatively large size of the epididymis compared to the total TV.[10-14] In spite of all these problems, the PO is still the most popular of the various methodologies of TV measurement and can be used readily in the initial assessment of the small and neonatal testes in the outpatient. However, scrotal ultrasound offers the potential for greater accuracy in testicular measurement compared to the PO.[14-16] Ultrasound is a more valid method of measuring TV in smaller testes because it is able to detect small biologically relevant changes in TV in relation to established physiological changes in the newborn period and the first year of life.[10] Furthermore, it is able to detect associated anomalies of the testis and other structures within the scrotum, therefore, ultrasonography can be used for further assessment of the testes in the newborn.

This study did not observe a significant relationship between TV using the two methods and the gestational age of the babies. This, however, disagrees with previous reports[9,17] where a significant correlation was observed between TV and the gestational age of the participants. The increase in the level of maturity and organization of the interstitial tissue of the testis with increasing gestational age was, however, suggested to be responsible for this. We observed a significant linear relationship between the TV using the two methods and the birth weight and length of the participants at delivery and these findings are similar to previously reported findings.[9,18,19] Hormonal changes and maturity of the pituitary-hypothalamic axis as GA progresses have, however, been used to explain these findings.[1]

Conclusion

In spite of the various problems associated with the use of PO in the measurement of TV, especially in the neonates and individuals with small testis making it less accurate compared to ultrasonographic measurement, prader orchidometry is still very useful as the measurements are comparable to ultrasonographic measurement and can be used in the initial assessment of the small testes of the newborn. Its accuracy can, however, be improved on with appropriate standardization of PO. Ultrasonographic measurement is more accurate and devoid of any radiation making it to be used repeatedly for TV measurements, but it is not readily available in the outpatient, especially in low- and middle-income countries compared to PO. However, it can be used to measure the TV when further evaluation of the testis is needed. Efforts should, therefore, be directed into making it available, equally cheap to use with appropriate training on its use to avoid inter-observer errors.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Semiz S, Küçüktaşçi K, Zencir M, Sevinç O. One-year follow-up of penis and testis sizes of healthy Turkish male newborns. Turk J Pediatr 2011;53:661-5.
2. Setchell BP, Hertel T, Söder O. Postnatal testicular development, cellular organization and paracrine regulation. Endocr Dev 2003;5:24-37.
3. Takihara H, Consentino MJ, Sakatoku J, Cockett AT. Significance of testicular size measurement in andrology II: Correlation of testicular size with testicular function. The J Urol 1987;137:416-419.
4. Lin CC, Huang WJ, Chen KK. Measurement of testicular volume in smaller testes: How accurate is the conventional orchidometer? J Androl 2009;30:685-9.
5. Andersen AG, Jensen TK, Carlsen E, Jørgensen N, Andersson AM, Krarup T, *et al.* High frequency of sub-optimal semen quality in an unselected population of young men. Hum Reprod 2000;15:366-72.
6. Sotos JF, Tokar NJ. Testicular volumes revisited: A proposal for a simple clinical method that can closely match the volumes obtained by ultrasound and its clinical application. Int J Pediatr Endocrinol 2012;2012:17.
7. 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 Womens Med 1998;43:40-7.
8. Low LC, Wang C. Disorders of sexual development in the paediatric and adolescent male. In: Lavin N, editor. Manual of Endocrinology and Metabolism. 4th ed. New Delhi: Lippincott Williams and Wilkins; 2009. p. 276-8.
9. Chikani UN, Ibekwe MU, Chinawa JM, Adimora GN. Testicular volume of healthy term neonates: Determination of normative values among Igbo babies in South-Eastern Nigeria. Niger J Clin Pract 2016;19:85-90.

10. Kuijper EA, van Kooten J, Verbeke JI, van Rooijen M, Lambalk CB. Ultrasonographically measured testicular volumes in 0- to 6-year-old boys. Hum Reprod 2008;23:792-6.
11. Taskinen S, Taavitsainen M, Wikström S. Measurement of testicular volume: Comparison of 3 different methods. J Urol 1996;155:930-3.
12. Aritürk E, Ozateş M. Measurement of testicular volume by ultrasonography. Turk J Pediatr 1993;35:177-80.
13. Fuse H, Takahara M, Ishii H, Sumiya H, Shimazaki J. Measurement of testicular volume by ultrasonography. Int J Androl 1990;13:267-72.
14. Rivkees SA, Hall DA, Boepple PA, Crawford JD. Accuracy and reproducibility of clinical measures of testicular volume. J Pediatr 1987;110:914-7.
15. Paltiel HJ, Diamond DA, Di Canzio J, Zurakowski D, Borer JG, Atala A, *et al.* Testicular volume: Comparison of orchidometer and US measurements in dogs. Radiology 2002;222:114-9.
16. Goede J, Hack WW, Sijstermans K, van der Voort-Doedens LM, Van der Ploeg T, Meij-de Vries A, *et al.* Normative values for testicular volume measured by ultrasonography in a normal population from infancy to adolescence. Horm Res Paediatr 2011;76:56-64.
17. Cicognani A, Alessandroni R, Pasini A, Pirazzoli P, Cassio A, Barbieri E, *et al.* Low birth weight for gestational age and subsequent male gonadal function. J Pediatr 2002;141:376-9.
18. Mondal R, Ray S, Chatterjee K, Sabui TK, Hazra A, Das S, *et al.* Penile length and testicular volume in newborns. Indian J Pediatr 2016;83:1398-404.
19. Atalabi MO, Adeniji-Sofoluwe AT, Aremu IO. Sonographic evaluation of testicular volume in neonates in Ibadan, Nigeria. J West Afr Coll Surg 2015;5:41-59.