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Preoperative and Intraoperative Scrotal Duplex Ultrasound in the Assessment of Varicocele: A Comparative Study

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Abstract

Background: This study aimed to compare the accuracy of preoperative and intraoperative scrotal duplex ultrasound (SDU) in assessing varicocele, a common cause of male subfertility.

Methods and Results: The study was conducted on 20 male patients scheduled for subinguinal varicocelectomy at a tertiary care hospital from March 2022 to March 2023. We used grey scale ultrasound and Doppler ultrasound to evaluate testicular size, vein diameter, arterial flow parameters, and retrograde flow. We found that the preoperative SDU was a good and accurate method for assessing the grading of varicocele, and there was no significant difference in vein diameter or venous reflux between preoperative and intraoperative assessments. However, we observed a significant increase in the number of veins and testicular volume during intraoperative SDU compared to preoperative SDU.

Conclusion: Scrotal duplex ultrasound is a reliable tool for determining testicular volume and provides objective, accurate, and reproducible measurements of testicular volume.**(International Journal of Biomedicine. 2024;14(1):99-103.)**

Keywords: varicocele • infertility • varicocelectomy • scrotal duplex ultrasound

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Abbreviations

SDU, scrotal duplex ultrasound; **CDU**, color Doppler ultrasound

Introduction

Varicocele is an uncontrolled growth and dilation of the scrotal pampiniform plexus that drains both testes. Varicoceles are clinically important and the most prevalent cause of aberrant semen assay, decreased motility, abnormal shape, and a low number of sperms.[1] Varicocele is a prevalent issue in the field of reproductive medicine. It affects about 15% of healthy males and up to 35% of males with primary subfertility. About 75% of males with secondary subfertility are affected by it.[2]

The exact cause of varicoceles is unknown, but this disorder may be caused by blood flowing backward in the internal spermatic vein, which causes swollen veins that can be felt in the scrotum.[3] Typically, varicoceles are asymptomatic soft swelling on the scrotal left side, if big enough, the patient may characterize varicocele as a “bag of worms”. Bilateral and varicoceles on the right side are possible. Patients may experience heaviness or discomfort in the scrotum. Varicoceles are typically identified during an infertility examination.[4]

Large varicoceles have a ‘bag of worms’ look and are easily recognized. Medium varicoceles are palpable without the patient pressing down. Small varicoceles are seen with a powerful Valsalva maneuver.[5] Following physical examination, varicocele can be confirmed by duplex

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ultrasound, which shows pampiniform plexus vein dilatation (with a diameter typically greater than 3 mm).[6]

Ultrasonography is the examination of choice for investigating varicoceles; it is considered the most practical and the most accurate noninvasive technique that permits precise diagnosis of varicoceles (even subclinical type). Duplex ultrasound can be done at rest and during the Valsalva maneuver.[7] The scrotal veins' dilatation, direction, and flow augmentation during the Valsalva maneuver and period of reflux are evaluated. In this way, color Doppler ultrasound (CDU) is useful in identifying patients for varicocele surgery.[8]

Varicocele can be evaluated as follows: Grade 1, mild reflux (2s) during the Valsalva maneuver; Grade 2, reflux (>2s) during the Valsalva maneuver, but not continuous; and Grade 3, reflux at rest or constantly throughout the Valsalva maneuver.[9]

Varicocele, according to Sarteschi et al.,[10] can be categorized into five classes based on the features of reflux and its duration, as well as alterations during the Valsalva maneuver: Grade 1 is distinguished by the identification of longer reflux in the inguinal blood vessels solely during the Valsalva maneuver, whereas scrotal varicose veins were not detectable in the prior gray-scale research. Grade 2 is marked by a modest posterior varicosity that reaches the superior pole of the testes and whose diameter rises whenever the Valsalva maneuver is performed. The CDU test indicates the existence of venous reflux in the supra testicular area only during the Valsalva maneuver. Grade 3 is defined by vessels that seem dilated to the testicular inferior pole while the patient is upright, but no ectasia is found when the patient is supine. CDU exhibits accurate venous reflux only during the Valsalva maneuver. Grade 4 is determined when the veins seem tortuous and dilated, regardless of the patient's posture, since dilatation rises when standing and during Valsalva. Augmentation of venous reflux following the Valsalva maneuver is the criteria that distinguishes grade 4 from Grade 2 and Grade 5. At this age, testicular hypotrophy is prevalent. Grade 5 is marked by obvious venous ectasia in the standing position of the patient. Considerable baseline venous reflux is seen in CDU, which does not rise after performing the Valsalva maneuver.

This study aimed to compare the accuracy of preoperative and intraoperative scrotal duplex ultrasound (SDU) in assessing varicocele.

Patients and Methods

The study was conducted in accordance with the ethical principles of the WMA Declaration of Helsinki (1964, ed. 2013). The study protocol was reviewed and approved by the Ethics Committee of the Al-Azhar University, Faculty of Medicine in Assiut, Egypt. All participants provided written informed consent.

This prospective cohort study was conducted on 20 male patients scheduled for subinguinal varicocelectomy. It was conducted at the Dermatology and Andrology Department in Azhar-Assiut University Hospital (tertiary care hospital) and carried out from March 2023 to November 2023.

All patients were exposed to a comprehensive medical history, including personal data, such as name, age, marital status, address, employment, number of children, and the smoking index. History of medical diseases (e.g., diabetes mellitus), drug intake, trauma, or surgical operation was also evaluated.

All patients were subjected to general and local examinations in a room with a suitable temperature. The patient did the Valsalva maneuver while standing up. Varicocele severity was clinically categorized as Grade 1 (palpable solely during the Valsalva maneuver), Grade 2 (palpable in upright posture), and Grade 3 (visible varicocele by the naked eye).[11]

Clinically, we obtained the testicular volumes after pulling the scrotal skin in a warm room and comparing the testicles to 12 solid ellipsoid models (Prader orchidometer) varying in volume 1 - 25 cm^3 (1 to 6, 10, 12,15, 20, and 25 cm^3).[12]

As regards Sonographic Technique & Analysis, firstly, we calculated the testicular volume according to the prolate ellipsoid formula (length (L) × width (W) × height (H) × 0.52), expressed in cm^3. For volume computation and statistical analysis, the greatest obtainable measurement for each testicular dimension was employed. Morphological evaluation was performed of both testes, epididymis, spermatic cord, scrotal wall, and pampiniform plexus of veins as regards the number of veins and the maximum diameter of dilated veins. Secondly, the venous component was performed on all patients, including the diameter of the biggest vein of the pampiniform plexus and retrograde flow under both relaxed and Valsalva conditions.[13]

All patients conducted a varicocelectomy operation. First, we prepared the duplex ultrasound for the operation (we used an ultrasound probe cover filled with gel to prevent direct contact between the probe and examined parts and avoid infection). After adequate spinal anesthesia induction, We put the patient on his back. We marked the external inguinal ring placement on the skin. We started with a 3 cm oblique skin incision centered over the external inguinal ring. An artery was used to expand the incision, which was subsequently deepened utilizing Camper's and Scarpa's fascia. The spermatic cord was then grabbed with a Babcock clamp, delivered, and put over a moist dressing, and the testis was pulled out from the scrotum and placed over the same wet dressing.[14] The internal and external spermatic fascia is incised, and the structures of the cord are examined using grey scale ultrasound and Doppler ultrasound to detect the number of veins, venous reflux, vein diameter, and testicular volume.[13]

Statistical analysis was performed using the statistical software package SPSS version 23.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages for categorical variables and mean ± standard deviation (SD) for continuous variables. Inter-group comparisons were performed using Student's t-test. Group comparisons concerning categorical variables were performed using the chi-square test. *P*-values less than 0.05 were considered significant.

Results

The patients' ages ranged from 23 to 45 years, with a mean age of 34.60 ± 8.28 years. Fourteen (70%) patients presented with primary infertility, 6(30%) patients with secondary infertility, 17(85%) patients had bilateral varicocele, and 3(15%) patients had unilateral varicocele. Grade 2 varicocele was presented in 6(30%) patients, and Grade 3 varicocele was presented in 14(70%) patients (Table 1).

Table 1.

Demographic characteristics of the studied patients.

Age of patients, years	
(Range) Mean ± SD	(23-45) 33.8± 8.28
Type of infertility, n (%)	
Primary	14 (70)
Secondary	6 (30)
Side of varicocele, n (%)	
Unilateral	3 (15)
Bilateral	17 (85)
Grade of varicocele, n (%)	
Grade 2	6 (30)
Grade 3	14 (70)

There was a significant increase in testicular volume as well, in the number of veins, pre- and intraoperative SDU (P<0.05), on the other hand, there was no significant difference in vein diameter pre- and intraoperative SDU (P>0.05) (Table 2).

Table 2.

Testicular and venous parameters in preoperative and intraoperative SDU.

	Preoperative SDU	Intraoperative SDU	P-value
	(Range) Mean ± SD		
Testicular volume, cm^3			
Right testes	(8-18) 12.23 ± 1.62	(9-20) 14.83 ± 1.93	0.000
Left testes	(7-16) 12.01 ± 1.95	(7-15) 13.95 ± 1.96	0.003
Number of veins			
Right testes	(0-5) 3.75 ± 1.28	(3-7) 4.50 ± 1.0	0.046
Left testes	(4-10) 5.35 ± 1.56	(5-10) 6.65 ± 1.22	0.006
Vein diameter, mm			
Right testes	(1.2-3.8) 2.52 ±0.63	(2-4) 2.63 ± 0.56	0.563
Left testes	(2.7-5.7) 3.95 ± 0.79	(3-6) 4.09 ± 0.80	0.581

As regards venous reflux, there was no significant difference in venous reflux pre and intra-operative SDU on both sides (Table 3).

Table 3.

Venous reflux in preoperative and intraoperative SDU.

	Preoperative SDU	Intraoperative SDU	P-value
	n (%)		
Right side			
Severe reflux	1 (5)	0 (0)	0.737
Moderate reflux	7 (35)	8 (40)	
Minimal reflux	4 (20)	3 (15)	
No reflux	8 (40)	9 (45)	
Left side			
Severe reflux	15 (75)	14 (70)	0.727
Moderate reflux	5 (25)	6 (30)	
Minimal reflux	0 (0)	0 (0)	
No reflux	0 (0)	0 (0)	

Discussion

Ultrasonography is considered to be the most accurate and useful technique for diagnosing varicocele. The presence of veins with a diameter greater than 2 mm is an established US diagnostic criterion for varicocele.[13] To date, there is a lack of or few published studies that are concerned with the benefit of intraoperative Doppler US in the reassessment of grading of varicocele. Numerous researchers have used various assessment criteria to compare varicocele grade on physical assessment and vein diameter on color Doppler and observed venous reflux.

In a study by Gonda et al.,[15] sonography was considered positive for subclinical varicocele in 95% of patients. Chiou et al.[16] developed a scoring system that included the maximum diameter of the veins (score 0 to 3), the presence of a venous plexus and the sum of the diameters of the veins in the plexus (score 0 to 3), and the change in blood flow during the Valsalva maneuver (score 0 to 3). Using a total score of ≥4 to define the presence of a CDU-positive varicocele, investigators observed a sensitivity of 93% and specificity of 85% compared with physical examination (55%).

Kocakoc et al.[17] have highlighted that the flow volume of reflux assessment, which reflects a combination of the vein diameters, duration and velocity of reflux, is deemed more valuable than measuring venous diameters alone.

In our study, we found that there was no significant difference in the vein diameter and venous reflux between preoperative and intraoperative SDU assessments. Meanwhile, we noticed a significant increase in the number of veins and testicular volume during intraoperative SDU compared to preoperative SDU.

Özkaptan et al.[18] reported a strong correlation between using Doppler US and the number of veins in their study. The findings of prior studies support our own. These researchers noted more veins with the use of Doppler ultrasonography. Intraoperative Doppler ultrasonography enables more exact

identification of tiny veins during a varicocelectomy; more veins of the thick network of adhering veins around the artery can be removed effectively under the direction of Doppler ultrasonography.

In a study by Juho et al.,[19] a total of 24 male patients underwent subinguinal varicocelectomy with intraoperative vascular Doppler ultrasonography because of symptomatic varicocele or infertility. The authors concluded that subinguinal varicocelectomy with intraoperative vascular Doppler ultrasonography is an effective treatment for symptomatic varicocele.

Testicular volume can be assessed clinically using various orchidometers, calipers, and rulers or by ultrasound measuring the length, width, and height of the testicles followed by multiplication by a constant. The theoretical advantage of ultrasound over orchidometers or testicular models for assessing testicular volume is its ability to distinguish the testis from adjacent soft tissue, providing more accurate volumes.[20] Hsieh et al.[20] and Paltiel [21] found that among the commonly used ultrasound formulas, the empirical formula of Lambert ($L \times W \times H \times 0.71$) provided better accuracy.

In a study by Mbaeri et al.,[22] the mean testicular volume of the 121 testes was 10.60±3.5 ml and 13.26±5.2 ml for water displacement and Prader orchidometer measurements, respectively. The study showed that measuring the testicular volume with a Prader orchidometer overestimated the actual testicular volume by 25.10%. Behre and colleagues[23] showed that comparing Prader orchidometer measurements performed by four clinical investigators and ultrasonography in 256 patients revealed a significant correlation of 0.91. Still, the correlation degree depended on the investigator's clinical experience. Schiff et al.[24] concluded that in the hands of an experienced examiner, orchidometer measurements can provide an accurate, rapid, and inexpensive assessment of testicular volume. In a study by Sakamoto et al.,[25] Prader orchidometry morphometrically and functionally overestimated the testicular volume compared to ultrasound. Fuse et al.[26] showed that the testicular volume measured by slide calipers on scrotal skin was also found to be incorrect. The testicular volume measured by ultrasonography was closer to and correlates well with the actual volume and was considered the best method.

Thus, it can be concluded that ultrasonography is a reliable tool for determining testicular volume and provides objective, accurate, and reproducible measurements of testicular volume.

The current study had some limitations, such as a small sample size. The larger sample size will help determine the importance of preoperative and intraoperative SDU in the evaluation of varicoceles.

Conclusion

The preoperative SDU is a good and accurate method for assessing the grading of varicocele. There is no significant difference in vein diameter or venous reflux between preoperative and intraoperative assessments. However, a significant increase in the number of veins and testicular volume during intraoperative SDU compared to preoperative SDU is found.

Competing Interests

The authors declare that they have no competing interests.

Acknowledgments

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