Original Article

Comparison of Ultrasound Scanning and Operative Findings of Undescended Testis in Children

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DOI: https://doi.org/10.3329/jafmc.v21i2.84080

Abstract

Background: Undescended testis in male infants, linked to complications like torsion and infertility, now see earlier orchiopexy recommendations, emphasizing the importance of prompt diagnosis and intervention.

Objective: To evaluate the presurgical diagnostic accuracy of ultrasonography in the localization and volume of undescended testis in children.

Methods: This cross-sectional study was carried out in the Department of Pediatric Surgery, CMH Dhaka and BSH&I, Dhaka, from March 2022 to August 2023. A total of 47 pediatric patients with undescended testis were enrolled in this study. Ultrasonography of both inguinoscrotal regions was done in every sample to see the length, width and location of the testis. Ultrasonography was performed before orchiopexy by experienced radiologist. Statistical analyses of the results were obtained using window-based computer software devised with Statistical Packages for Social Sciences (SPSS v26).

Results: There was a significant measure of good agreement with a Kappa Value of 0.806 between the USG position and the per-operative position. Strong positive correlations were found between USG and per-operative lengths (r=0.998; p=0.001), widths (r=0.996; p=0.001) and volumes (r=0.999; p=0.001).

Conclusion: Preoperative timed ultrasonography reliably identifies anatomical positions and volumes of undescended testes in children, demonstrating noteworthy diagnostic concordance.

Keywords: Undescended testis, Orchiopexy, Testicular volume, Testicular localization.

Introduction

Undescended testis represents the most prevalent congenital anomaly among boys, occurring in about 3% of term and 33-45% of premature or low birth weight male infants.[1] As primary male sex organs, the testes are crucial for producing sperm and sex hormones. Their descent into the scrotum during embryonic development is vital for proper function and development, since normal spermatogenesis requires a scrotal temperature 2 to 3 degrees cooler than body temperature.[2] While most testes descend by six months, the failure of this process can impair spermatogenesis, increasing the risks of infertility, malignancy, and torsion in adulthood. Early orchiopexy significantly mitigates these risks.[3] UDT diagnosis in children primarily relies on parental history and clinical examinations, distinguishing between palpable (80%) and non-palpable (20%) types, as well as unilateral or bilateral presence.[4]

The ideal age for orchiopexy is debated, with studies indicating that degenerative changes in cryptorchid testicular tissue appear by 18 months.[5] The transformation of neonatal gonocytes into type A spermatogonia during "mini puberty" (3-12 months) is critical for future fertility, as these stem cells drive spermatogenesis. This process may be disrupted in undescended testes, with a notable decline in germ cells from around 15 months.[6] The recommended orchiopexy age is 6-12 to 6-18 months to preserve spermatogenic potential and enable early cancer detection.[2,3] At birth, testes are small but enlarge significantly at puberty. Pre-pubertal normal testicular volume is 1-3ml; volumes less than 1ml indicate reduced size and nonpalpable testes smaller than 1ml are considered atretic. During puberty, an average testicular size is 4ml or more, with 2-3 ml indicating reduced size and less than 2ml with soft testes deemed atretic.[7]

Accurate measurement of testicular size and volume is vital for evaluating testicular function in children, with seminiferous tubules constituting 80-90% of the testicular mass, thereby reflecting spermatogenesis.[8] Various techniques such as orchidometry, rulers, calipers and ultrasonography (USG) assess testicular volume. USG emerges as the standard, providing accurate, affordable and non-ionizing measurements compared to other methods, which may overestimate testicular volume. CT scans and MRI, despite their accuracy, are less favored due to their cost, limited availability, and the ionizing radiation associated with CT scans.[9] Early diagnosis and treatment of undescended testis (UDT) are crucial to prevent morbidity and mortality, with orchiopexy before two years showing satisfactory testicular growth.[3] Determining UDT's pre-operative location is essential for planning surgical approaches and minimizing complications. Ultrasonography serves as an ideal diagnostic tool due to its accuracy, availability, affordability and safety. This study aimed to compare testicular location and volume in UDT across different age groups using ultrasonography and operative findings, evaluating its feasibility statistically.

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Materials and Methods

This cross-sectional study, conducted between March 2022 and August 2023, involved 47 patients suspected of having undescended testis (UDT) who were seen at the Department of Pediatric Surgery, CMH Dhaka and BSH&I, Dhaka. It included pediatric patients up to 14 years of age diagnosed with UDT. Exclusions were made for syndromic children, those with retractile, ectopic, or intra-abdominal testis, UDTs associated with other pathologies such as trauma, torsion, tumor or iatrogenic UDT (e.g., post-Herniotomy) and cases where parents were unwilling to participate. Ethical approval was secured from the Institutional Review Board (IRB) of AFMI before the study began. All patients and their parents received counseling regarding their diagnosis, treatment alternatives, the surgical procedure, potential complications during and post-surgery and the follow-up process. Following counseling and obtaining consent, necessary investigations were conducted, including ultra-sonography of both inguinoscrotal regions and assessments for general anesthesia suitability. Prior to inclusion in the study, written informed consent was acquired from the parents of the patients who were reassured about the confidentiality of their information. Additionally, the study's objectives were clearly communicated to the potential participants. The study employed a non-probability purposive sampling method.

In the outpatient department, comprehensive antenatal and postnatal histories were collected, followed by detailed clinical examinations. The findings were documented on a pretested data collection sheet. Ultrasound exams were conducted at rest and during straining with a linear-array 7.5 MHz transducer to determine the testicle's length, width and position. Following this, a pre-anesthetic checkup was carried out, and standard orchiopexy was performed under the direct supervision of a guide, with peroperative measurements and locations noted.

The recruitment of research participants was carried out with great care and strict oversight, in strict compliance with the predetermined criteria for inclusion and exclusion. To maintain the reliability and caliber of the data gathered, we established a consistent system of supervision, confirmation and observation.

In the concluding six months, I had weekly sessions with my mentor to focus on drafting the thesis and preparing for its submission.

The statistical examination was conducted utilizing SPSS v26. Categorical variables were represented through frequency and percentage, while continuous variables were denoted by their mean and standard deviation. These findings were displayed in tables. The Chi-square test was applied to the categorical variables, whereas the Mann-Whitney U test, a nonparametric method, was employed for the analysis of continuous variables, as detailed in cross-tabulations. A p value of less than 0.05 was deemed to indicate statistical significance.

Results

The mean age was 48±37 months ranging from 8 to 168 months and almost two thirds (63.8%) of subjects belonged to age >24 months. Almost two thirds 28(59.6%) subjects had right empty scrotum and 24(51.1%) subjects had impalpable. Nearly two thirds 28(59.6%) subjects had testis in inguinal canal followed by 15(31.9%) in superficial inguinal ring and 4(8.5%) in deep inguinal ring by Ultrasonography location. The mean length was 1.2±0.36 cm which ranged from 0.3 to 2.3cm and mean width was 0.95±0.32cm which ranged from 0.25 to 1.5cm evaluated by Ultrasonography. More than half (55.3%) of subjects had testis in inguinal canal, followed by 16(34.0%) in superficial ring and 5(10.6%) in deep ring during peroperative location. The mean length was 1.2±0.36cm which ranged from 0.25 to 2.3cm and the mean width was 0.95±0.32cm which ranged from 0.25 to 1.5cm during peroperative findings. The majority 25(96.2%) subjects who had testis in inguinal canal USG was confirmed at operation, 2(12.5%) had superficial ring and 2(40.0%) in had deep ring with and agreement 88.2%. The difference was statistically significant (p<0.05) with per-operative position (Table-I). The mean volume for 0-18 month age was 0.56±0.37 ml in USG position and 0.56±0.37 ml in per-operative followed by (18-24 month) 0.84±0.68ml in USG and 0.84±0.67 ml in per-operative and (>24 month) 0.75±0.65ml in USG 0.74±0.65ml in per-operative. The difference was statistically not significant (p>0.05) (Table-II).

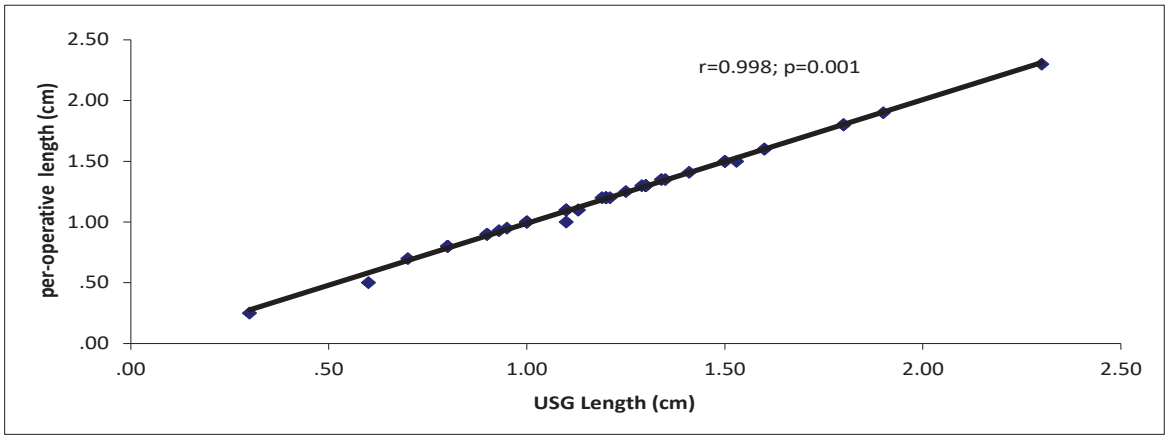

Figure-1: Scatter diagram showing positive significant correlation (r=0.998; p=0.001) between USG length and operative length.

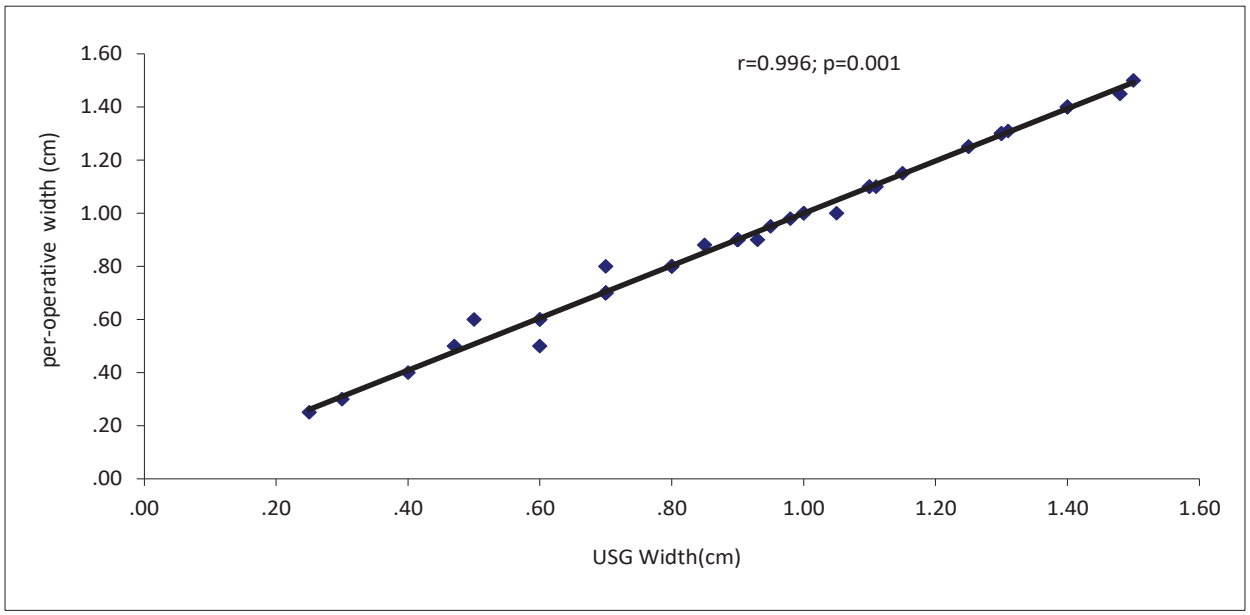

Figure-2: Scatter diagram showing positive significant correlation (r=0.996; p=0.001) between USG width and operative width.

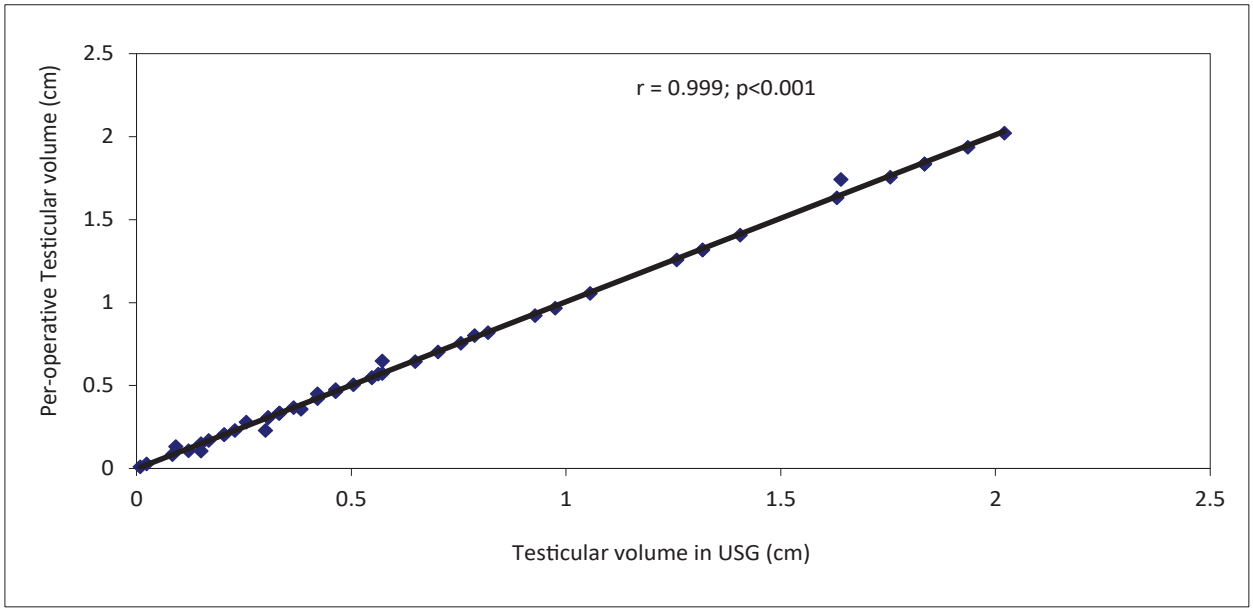

Figure-3: Scatter diagram showing positive significant correlation (r=0.999; p=0.001) between USG volume and operative volume.

Table-I: Association between USG position and per-operative position (n=47)

USG position	Per-operative position							kappa statistic	P value
	Inguinal canal (n=26)			Superficial ring (n=16)		Deep ring (n=5)			
	n	n	%	n	%	n	%		
Inguinal canal	29	25	96.2	2	12.5	2	40.0		
Superficial inguinal ring	14	0	0.0	14	87.5	0	0.0	0.806	0.001[s]
Deep inguinal ring	4	1	3.8	0	0.0	3	60.0		

s= significant

Table-II: Comparison between USG and per-operative volume in different age groups (n=47)

Age group	USG volume (ml)	Per-operative volume(ml)	P value
	Mean±SD	Mean±SD	
0-18 month	0.56±0.37	0.56±0.37	1.00[ns]
18-24 month	0.84±0.68	0.84±0.67	1.00[ns]
>24 month	0.75±0.65	0.74±0.65	0.940[ns]

ns= not significant

Discussion

The increasing incidence of Undescended Testis (UDT) in male infants and pediatric populations underscores the importance of early diagnosis to mitigate the risks associated with potential complications arising from untreated cases.[10,11] Ultrasound imaging, celebrated for its non-invasive nature, emerges as a preferred diagnostic tool, facilitating the evaluation of cryptorchid testes both pre and post-repositioning.[12-14]

The present study finding indicates a majority of undescended testis (UDT) cases are identified in children older than 24 months, reflecting a wide age range from 8 to 168 months. This aligns with findings from[15-17] underscoring a consistent age pattern in UDT diagnoses and emphasizing the critical role of early detection and ultrasonography[18] found that 57.7% of undescended testes are not detectable through physical examinations. The present study noted that over half of the patients (51%) had testes that were impalpable, while the remainder had palpable testes, demonstrating compatibility with their findings.

Surgical intervention is established as the definitive approach for true undescended testes, supported by ultrasound diagnostics for accurate preoperative localization. The present study's findings indicate that 55.3% of subjects had a right empty scrotum, followed by 44.7% with a left empty scrotum. This research parallels findings from[19], noting a predominant occurrence of right-side undescended testes and similarly[16] highlight the prevalence of both unilateral and bilateral conditions. Such studies significantly advance our insight into the distribution and diagnosis of undescended testes across patient demographics.

The diagnosis of undescended testis (UDT) is pivotal for devising appropriate treatment strategies. This study revealed a near-even split between impalpable (51.1%) and palpable (48.9%) testes.[20] found that despite palpability, ultrasound only accurately identified a fraction of testes. Moreover[21], highlighted ultrasound's limitations in sensitivity and specificity, especially in cases of non-palpable testes, underscoring the challenges in UDT diagnosis.

This study's ultrasonography results reveal that 59.6% of undescended testes were located within the inguinal canal, 31.9% in the superficial inguinal ring and 8.5% in the deep inguinal ring, aligning with[16] who found similar distribution patterns in their ultrasound examination of 24 testes. These findings correspond with earlier research by[20,22] which reported that a significant proportion of clinically undescended testes are either intra-abdominal or atrophic.

This study revealed that undescended testes had an average length of 1.2±0.36 cm, ranging from 0.3 to 2.3 cm, and an average width of 0.95±0.32 cm, with a range of 0.25 to 1.5 cm. The minimal variation observed underscores the effectiveness of ultrasound in detecting abnormal testicular sizes, aiding surgical decision-making. Precise preoperative measurements are crucial for choosing the correct surgical approach and improving outcomes for children with undescended testes (UDT). In this study, 55.3% of undescended testes were found in the inguinal canal, 34% in the superficial ring, and 10.7% in the deep ring, underscoring ultrasound's utility in locating undescended testes, particularly within the inguinal canal. The notable discovery rate in the superficial ring calls for enhanced diagnostic precision and clarity in definitions.

This study's findings highlight the efficacy of ultrasound scanning (USG) in accurately determining the position of undescended testes within the inguinal canal, as confirmed in 93.1% of cases through per-operative assessment. Such a high concordance rate underscores USG's reliability as a pre-operative diagnostic tool. Additionally, USG demonstrated capability in distinguishing between the superficial and deep inguinal rings, with a 3.4% confirmation rate for each at surgery.

This study included a total of 47 patients examined and show ultrasound scanning (USG) closely aligns with surgical findings, achieving a Kappa value of 0.806, indicative of strong agreement. This mirrors outcomes from similar research by[15,23] who recorded Kappa values of 0.512 and 0.940, respectively, reinforcing USG's utility in preoperative assessment of undescended testis despite varying accuracy levels. Such consistency across studies highlights USG's critical role in informing surgical decision-making.

This investigation uncovered a strikingly high correlation between the per-operative and ultrasound (USG) measurements of undescended testes lengths, with a correlation coefficient of $r=0.998$ ($p<0.001$), indicating almost perfect agreement. Such a significant correlation underscores the reliability of USG as a diagnostic tool for pre-surgical evaluation.

Conclusion

This study evaluated real-time ultrasonography's preoperative accuracy in pinpointing undescended testes in children, revealing a notable consensus. The method proves satisfactory for accurately determining the testes' anatomical positions pre-surgery. This study recommended large-scale studies for further implication and may be carried out by high resolution ultrasonography machine and single experienced radiologist.

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