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LOCALIZATION AND ASSESSMENT OF PEDIATRIC CRYPTORCHIDISM USING ULTRASOUND

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Abstract

Background: *Cryptorchidism, the condition where one or both testes fail to descend into the scrotum, is a common pediatric urological disorder. Early diagnosis and accurate localization of undescended testes are crucial for effective management to prevent potential complications such as infertility or testicular torsion. Sonography, including Doppler imaging and echogenicity assessment, is a non-invasive tool that has been gaining prominence in the evaluation of cryptorchidism, offering detailed insights into testicular morphology and vascularity.* ***Objectives:*** *To evaluate the role of sonographic imaging in the localization and assessment of cryptorchidism in pediatric patients.* ***Materials and Methods:*** *This study involved 37 pediatric patients diagnosed with cryptorchidism, evaluated using sonography to assess the localization, echogenicity, blood flow, and associated findings in the testes. A cross sectional analysis was conducted, with the data being collected from clinical records and sonographic imaging reports.* ***Results:*** *The data were processed using SPSS version 24.0. Among the 37 patients, 73% reported pain, and 18.9% presented with non-palpable testes. Sonographic localization was successful in 91.9% of cases. A majority (86.5%) had an occupied scrotum, with only 13.5% showing an empty scrotum. Abnormal testicular size was observed in 67.6% of patients. Doppler imaging revealed that 75.7% had normal blood flow, with 24.3% exhibiting absent blood flow, indicating potential viability concerns. Associated findings included edema in 29.7% of cases, testicular torsion in 8.1%, and atrophy in 16.2%. Cross-tabulation revealed that non-palpable testes were linked with normal blood flow and echogenicity, and empty scrotum cases showed normal echogenicity with varying associated findings.* ***Conclusion:*** *Sonographic imaging, including Doppler ultrasound and echogenicity assessment, proves to be an effective tool in the evaluation of cryptorchidism. It facilitates accurate localization of the testes, identifies structural and functional abnormalities, and assists in detecting associated conditions like testicular torsion and atrophy. The findings emphasize the importance of using sonography as a diagnostic tool in pediatric patients with suspected cryptorchidism, guiding treatment decisions and*

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reducing the need for invasive procedures.

INTRODUCTION

Cryptorchidism is defined as a condition in which one or both testes fail to descend from the abdomen into the scrotum .[1] The undescended testicle (UDT), also referred to as cryptorchidism, is the incapacity of the testis to descend into the scrotal position. It is conceivable for the testicle to be absent or extra scrotal. Cryptorchidism comes in two forms: congenital and acquired. Congenital cryptorchidism is when a testicle fails to move into the scrotum during fetal development and remains undescended at birth. Acquired cryptorchidism is a condition where a previously descended testicle reascends into an extra-scrotal position, most commonly due to an abnormally short spermatic cord or scar tissue.[2] The incidence of undescended testis (cryptorchidism) in children varies greatly depending on factors like gestational age. For full term babies, the prevalence is 1-4 percent; for preterm babies, it is 10-30 percent. Most cases of undescended testis resolve on their own by the time a boy is six months old, and just 1% of boys present with persistent undescended testis past infancy.[3] The condition, which can lead to issues including infertility and testicular cancer if addressed, is more common in males with a family history.[4] In pediatrics, an undescended testis is typically discovered during a physical examination because males typically don't exhibit certain symptoms. A testicle that does not descend into the scrotum by the age of six months is indicative of the disorder, which can affect one or both testicles. The undescended testicle can be felt in the inguinal canal or in the abdomen, among other locations, along its normal descending route. There is reason for concern over potential adverse effects such infertility, testicular torsion (a painful twisting of the testicle), and an increased risk of testicular cancer in later uncommon locations where the testicle may be found. Children with undescended testicles may undergo an orchiopexy to realign the testicle into the scrotum.[5] Preterm delivery (less than 37 weeks gestation), intrauterine growth restriction, and low birth weight (less than 2.5 kg) are important risk factors for undescended testicles. [6] The likelihood of undescended testis can be increased by a family history of the condition, related penile deformities (like hypospadias), sex development issues, delayed fetal growth (like Down syndrome), and related hormonal diseases (like congenital adrenal hyperplasia). An undescended testis cannot arise in a young mother due of her age. An undescended testis is associated with an older mother's age.[7]A physical examination should be performed to determine the position and form of the testicles. A UDT may occur in more than one location along the course of descent (abdomen, inguinal canal, superficial inguinal pouch, or upper scrotum) or be ectopic (found in the perineum, contralateral scrotum, or femoral area).[8]Ultrasound is the preferred imaging modality for evaluating undescended testis in children since it is non-invasive, easy to use, and capable of differentiating between inguinal, abdominal, and ectopic testicular locations.[9]Unlike CT or MRI, ultrasound provides real-time imaging without the use of ionizing radiation. MRIs are typically reserved for complicated situations due to their higher cost and longer scanning time. On the other hand, CT scans can be used in challenging situations, but they expose users to radiation. Thus, ultrasonography remains the first-line technique in most clinical situations.[10]

Materials and methods:

It was a cross-sectional analytical study conducted in 3 month as BS research from 16th Jan 2025 to 16th Mar 2025 at Services hospital Lahore, Punjab, Pakistan. A total of 37 pediatric patients were included which had cryptorchidism. The study was aimed To evaluate the role of sonographic imaging in the localization and assessment of cryptorchidism in pediatric patients.. Approval was taken from the institutional review board (IRB) and the Ethical Committee of the Superior University. An Ultrasound unit Toshiba Nemio 10 with linear transducer frequency ranging from 7.5-12 MH was used for this study. Patients have been explained the procedure and aim of the research also therefore a written informed consent was signed. AIUM guidelines for pediatrics ultrasound scanning were

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followed in the study. The privacy of the patient was given priority while scanning the patient and publication. The examination begins by identifying anatomical landmarks such as the inguinal ligament and spermatic cord or round ligament. Then systematically scans along the inguinal canal, assessing for the presence of herniated contents, distinguishing between direct and indirect hernias, and evaluating for complications such as bowel incarceration., Sonographic images are acquired in both transverse and longitudinal planes to comprehensively evaluate the hernia and surrounding structures, aiding in accurate diagnosis and surgical planning. Data collection include demographics (age) and clinical presentation, non-palpable testis, empty scrotum, asymmetry, and sonography findings were echogenicity, location, whether intra-abdominal, inguinal, or ectopic, and other testicular dimensions recorded. Statistical Package for the Social Sciences (SPSS) version 25 (SPSS 25, IBM, Armonk, NY, United States of America) software was used for the evaluation of data (Saleem et al., 2022).[11] Descriptive statistics were utilized to summarize and describe the data. For quantitative variables such as age, the results were presented using the mean and standard deviation. In the case of qualitative variables, including categorical data like age groups, frequencies and percentages were calculated and reported. Additionally, a bar graph was included to visually represent the distribution of selected variable.

Results: We included total of 37 pediatric patients in the study. In these 27 (73.0%) presented with pain, while 10 (27.0%) reported no pain. The presence of pain was a common symptom, indicating its relevance in cryptorchidism evaluation through sonography. The participants' ages ranged from 6 months to 13 years, with the largest proportion (43.2%) of patients falling within the 1–3 years age group, followed by those in the 3–5 years (27.0%), 5–8 years (18.9%), and over 8 years (10.8%) categories. The entire cohort comprised male patients (100%), which is consistent with the known gender prevalence of cryptorchidism. Regarding the laterality of undescended testes, 45.9% of cases involved right-sided cryptorchidism, 37.8% involved left-sided cases, and 16.2% were bilateral. This distribution underscores the importance of clinical evaluation and sonographic imaging, particularly for the accurate determination of the undescended testis location, which may not always be evident upon physical examination alone. In terms of clinical palpability, 67.6% of the patients had palpable undescended testes, whereas 32.4% had non-palpable testes, highlighting the need for imaging to complement physical examination, especially in cases where testicular location is uncertain or difficult to ascertain. The sonographic assessment demonstrated the high sensitivity of ultrasound in detecting undescended testes. Ultrasound localization was successful in 34 out of 37 patients (91.9%), emphasizing its significant role in preoperative planning. Among the identified locations, the most frequent was the inguinal canal (54.1%), followed by the superficial inguinal pouch (18.9%), abdominal cavity (13.5%), and pre-scrotal area (5.4%). Notably, 3 patients (8.1%) exhibited no visible testis on ultrasound, indicating vanishing testes or severe testicular atrophy, which can challenge the use of imaging techniques. The assessment of testicular echotexture revealed that the majority of the testes (75.7%) exhibited homogeneous echotexture, which is characteristic of a normal testicular structure. However, a portion of testes (16.2%) demonstrated heterogeneous echotexture, and 8.1% of cases exhibited signs of atrophic changes, suggesting potential damage or diminished testicular function, thus underscoring the utility of sonography in identifying such abnormalities. When analyzing testicular shape, 91.9% of the testes exhibited a normal ovoid shape, which is consistent with typical testicular anatomy. In contrast, 3 testes (8.1%) presented with an irregular shape, which could indicate developmental anomalies or structural defects. 35 Such findings highlight the potential of ultrasound to identify morphological deviations that may impact fertility and future treatment options. The use of color Doppler ultrasonography to evaluate vascular flow in the undescended testes is crucial for determining testicular viability. The findings revealed that 75.7% of the testes demonstrated normal blood flow, while 24.3% exhibited either reduced vascularity or absent flow. The absence of blood flow in some cases strongly correlates with atrophy or non-viable testes, thus assisting in surgical decisionmaking. Together, these

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findings emphasize the diagnostic accuracy of sonography in the comprehensive evaluation of cryptorchidism, particularly in the localization, assessment of structural integrity, and vascular status of the testes. The following tables present the detailed breakdown of these findings, which include the clinical characteristics, sonographic features, and vascular assessments categorized by various factors such as age, laterality, echogenicity, and blood flow on Doppler imaging as shown in tables 1, 2 and 3.

Discussions: Cryptorchidism, or undescended testis, remains a significant pediatric urological condition, and its evaluation requires accurate localization and assessment of testicular viability. This study focused on the role of sonographic imaging in a cohort of 37 pediatric patients, highlighting the effectiveness of ultrasound and Doppler imaging in the diagnosis and characterization of undescended testes. One of the most prominent findings was that 91.9% of undescended testes were successfully localized using ultrasound. This is consistent with prior studies demonstrating that high-resolution sonography is a reliable non-invasive tool for detecting undescended testicles, particularly when clinical palpation fails.[11,12] The presence of non-palpable testes in 18.9% of patients underlines the value of imaging when physical examination is inconclusive. Pain was reported in 73.0% of cases, suggesting that discomfort is a common presenting symptom in cryptorchidism.[13,14] However, groin swelling was observed in only 37.8%, indicating that while some patients may show external symptoms like swelling or a palpable mass, others may not, necessitating imaging for accurate diagnosis. Interestingly, testicular asymmetry and empty scrotum were present in 16.2% and 13.5% of cases, respectively.[15] These lower rates may be explained by the presence of unilateral cryptorchidism, where one testis remains descended, minimizing asymmetry and scrotal emptiness. Even in cases with an empty scrotum, sonographic imaging effectively localized testes and assessed their structural integrity.[17] A notable aspect of the sonographic evaluation was the assessment of testicular size and echogenicity. Abnormal testicular size was found in 67.6% of cases, and abnormal echogenicity in 32.4%, indicating that structural changes are common in undescended testes. Echogenic abnormalities may reflect fibrosis, calcifications, or testicular atrophy, which can compromise fertility and hormonal function if undiagnosed.[18] Doppler ultrasound played a vital role in evaluating testicular viability, with 24.3% of cases showing absent blood flow. This is a crucial finding, as compromised vascularity may indicate testicular atrophy or torsion, both of which require urgent surgical intervention. Importantly, all non-palpable testes and all cases with an empty scrotum demonstrated preserved blood flow, confirming the sensitivity of Doppler imaging in evaluating even clinically elusive testes.[19] Associated sonographic findings were also diverse. While 45.9% of patients had no additional abnormalities, 29.7% exhibited edema, 8.1% had signs of torsion, and 16.2% demonstrated testicular atrophy. 53 These findings reinforce the role of sonography not only in localization but also in identifying potentially life-threatening or fertility-threatening conditions.[20] Cross-tabulations further revealed insightful patterns. For instance, all non-palpable testes and those in patients with an empty scrotum showed positive blood flow and mostly normal echogenicity, suggesting that sonography is highly effective in reassuring viability even in challenging clinical cases. In summary, these findings confirm that ultrasound, supplemented by Doppler imaging, is a powerful diagnostic modality for assessing undescended testes. It is especially valuable when physical examination is limited, and it helps guide timely clinical decision-making.[21,22]

Conflict of Interest:

We believe that this manuscript is appropriate for publication by this journal. We have no conflicts of interest to disclose.

Ethical Statement:

The rules and regulations set by ethical committee of Superior University followed while conducting the research and right of participants are respected.

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Table1: Clinical Characteristics of Cryptorchidism Patients.

Variables	Pain	Non-Palpable Testis	Asymmetry	Empty Scrotum	Groin Swelling
Yes	27 (73%)	7 (18.9%)	6 (16.2%)	5 (13.5%)	14 (37.8%)
NO	10 (27.0%)	30 (81.1%)	31 (83.8%)	32 (86.5%)	23 (62.2%)

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Table2: Sonographic Assessment of Undescended Testes.

Variable	Category	Frequency (%)
Testis Localization	Located	34 (91.9%)
	Not Located	3 (8.1%)
Testicular Size	Abnormal	25 (67.6%)
Echogenicity	Abnormal	12 (32.4%)
Blood Flow (Doppler)	Absent	9 (24.3%)
Associated Findings	Normal	17 (45.9%)
	Edema	11 (29.7%)
	Torsion	3 (8.1%)
	Atrophy	6 (16.2%)

Table3: Correlation Between Clinical & Sonographic Findings.

Correlation Type	Observation
Non-palpable Testis vs. Doppler Flow	All 7 non-palpable testes had detectable blood flow (100%)
Non-palpable Testis vs. Echogenicity	5/7 normal, 2/7 abnormal echogenicity
Non-palpable Testis vs. Findings	Edema (3), Atrophy (1), Normal (3), No torsion
Empty Scrotum vs. Doppler Flow	All 5 showed normal blood flow
Empty Scrotum vs. Echogenicity	All 5 showed normal echogenicity
Empty Scrotum vs. Findings	Edema (1), Atrophy (2), Normal (2), No torsion