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**Original Research Article**

# Diagnostic value of high-resolution ultrasound in localization and status of non-palpable undescended testis in children

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## ABSTRACT

**Background:** In male children, undescended testes are a common genitourinary anomaly. Localization of the testis by clinical examination and most imaging studies. Ultrasonography and MRI play diagnostic era. The study goal was diagnostic accuracy of sonography to localization and status of non-palpable undescended testis.
**Methods:** This cross-sectional type of observational study was carried out from January 2018 to April 2019 (16 months duration) in the department of pediatric surgery, Mymensingh Medical College Hospital, Mymensingh. Among the 36 patients with non-palpable undescended testis who meet the inclusion and exclusion criteria, the patients' medical histories were recorded in a data collection sheet following the parents or guardians informed written consent. Data was processed using statistical package for social sciences (SPSS) version 24.
**Results:** Total 36 non palpable undescended testis patients were included in this study. Age range 6 months to 12 years with mean age of 3.06±2.58 years. Among 36 patients 20 were left sided, 10 were right sided and 6 were bilateral. Sonographic localization in inguinal canal were 20 (55.55%), proximal to deep ring were 8 (22.22%) superficial inguinal rings were 4 (11.11%) and unlocated 4 (11.11%). Per operative localization of testis in inguinal canal were 19 (52.78%) proximal to deep ring were 7 (16.66%), abdominal were 5 (13.88%), superficial inguinal ring was 3 (8.33%), and unlocated were 2 (5.55%). Mean length and breadth of per operative measurement of testes were 11.2±2.6 mm and 7.9±1.8 mm respectively. Sensitivity, specificity and efficacy of this study were 94.11%, 40%, 81.81% respectively.
**Conclusions:** Abdominoscrotal sonography is safe, non-invasive, accurate and bed side diagnostic tool in the detection of non-palpable testis in children.

**Keywords:** Non-palpable undescended testis, Ultrasound, Diagnosis, Children

## INTRODUCTION

Undescended testis is a clinical condition characterized by the absence of the testis from the base of the ipsilateral hemiscrotum due to arrest along the path of embryologic descent during development.[1] It is a common genitourinary anomaly in male infant with an incidence of 4% at birth which decrease to about 1% of boys at age 1 year.[2]

The most useful classification of undescended testis is into palpable and non-palpable testis and clinical management

is decided by the presence and location of the testis. Approximately 80% of all undescended testis are palpable. 20% of undescended testes are not palpable; they are either located in the abdomen or the canaliculi or completely absent.[3]

Among the non-palpable testis, 80% are found in inguinal canal, 20% are intra-abdominal and 20-40% non-palpable testis is absent upon surgical exploration. Pre-operative testicular localization is beneficial in the management of undescended testis. Confirmation of the existence of the testis is reassuring to the patient and his guardians. The extent of surgical exploration may also be determined by the site of the testis. If the testis is not present in the inguinal-perineal region, the treatment option laparotomy or laparoscopy can be rationally discussed with the parents pre-operatively.[4,5]

Early diagnosis and management of the undescended testicle are needed to preserve fertility and improve early detection of testicular malignancy. The undescended testis is more prone to undergo torsion than a normal testis because of poor fixation. Surgery is required for repositioning or removal of undescended testes and early intervention is preferred for optimal outcome. If left, the undescended position has an increased risk of neoplasia, which is even higher if the testis is in the abdomen. UDT has 48 times higher chance to undergo malignancy chance than the normally descended testis.[6]

Localization of the testes may be achieved by various diagnostic techniques including physical examination, radiology and imaging study and laparoscopy. Laparoscopy is highly sensitive in detecting non-palpable undescended testis. However, it is not widely available. Physical examination may fail to localized the undescended testis in obese children particularly when the testis intra-abdominal or intra-canaliculi. Abdominal and inguinal sonography for evaluation of undescended testis is preferred because it is cheap, non-invasive, rapid information, with or without sedation and does not require general anaesthesia.[7]

So, the objective of the study was to evaluate the diagnostic value of high-resolution ultrasound in accurately localizing and determining the status of non-palpable undescended testis in pediatric patients.

## METHODS

This cross-sectional study was carried out in the department of pediatric surgery, Mymensingh Medical college hospital, Mymensingh during January 2018 to April 2019. A total number of 36 cases of patients with non-palpable undescended testis included in this study who were admitted in pediatric surgery department in Mymensingh Medical College Hospital on routine basis. The study will include male children aged 6 months to 12 years who have a clinical diagnosis of non-palpable undescended testis (NPUT) and patients will be excluded if they have previously undergone surgical intervention for undescended testis, as this could alter the anatomical landscape and confound the results. Informed consent will be obtained from the parents or guardians of all participating children. This consent process will include detailed explanations about the study's purpose, procedures, potential risks, and benefits, ensuring that guardians are fully aware of what participation entails. Confidentiality of all patient information will be strictly maintained throughout the study. High-resolution ultrasound, performed by a trained pediatric sonographer or radiologist, will focus on the inguinal canal, abdomen, and scrotal regions to locate the testis, with images and videos documented for analysis. Data will be recorded and statistically analyzed to assess the ultrasound's diagnostic accuracy, with surgical findings used for correlation if surgery is subsequently performed. Follow-up appointments will monitor the testis status, and all patient data will be anonymized and stored securely. The primary outcome is to determine the diagnostic value of ultrasound in localizing NPUT, with findings disseminated through peer-reviewed publications and conference presentations. Ethical considerations include maintaining patient confidentiality and reporting any adverse events to the IRB/ethics committee and parents/guardians. Statistical analyses of the results were obtained by using window-based Microsoft excel and statistical packages for social sciences (SPSS-24).

## RESULTS

Table 1 showed age of the patients ranged from 6 months to 12 years. Patients were grouped in 6 months to 1 year, 1 to 2 years, 2 to 5 years, 5 to 12 years. The majority of patients were 2 to 5 years age group and 6 to 12 months age group were second highest incidence, The mean age value was 3.06±2.58 years.

**Table 1: Age distribution of the study population.**

| Age range | No. of patients (n=36) | % | Mean±SD |
|---|---|---|---|
| **6 months-1 year** | 10 | 27.78 | 3.06±2.58 |
| **1-2 years** | 06 | 16.67 | |
| **2-5 years** | 16 | 44.44 | |
| **5-12 years** | 4 | 11.11 | |
| **Total** | 36 | 100.0 | |

Table 2 showed 4 in right, 4 in left and 2 in bilateral in the age ranges of 6 month to 1 year; 1 in right, 4 in left and 2 in bilateral in the age ranges of 1to 2 years; 3 in right, 10 in left and 2 in bilateral in the age ranges of 2 to 5 years and 2 in right, 2 in left in the age ranges of 5 to 12 years. Total 20 patients having left sided and 10 patients had right sided and 06 patients had bilateral non-palpable testis.

Table 3 showed associated anomalies with non-palpable undescended testis in the study population. 10 (27.78%) with contralateral inguinoscrotal swelling, 4 (11.11%)

hypospadias and 1 (2.78%) left sided renal agenesis and sonographic localization 20 (55.55%) were in inguinal canal, 8 (22.22%) were in proximal to the deep ring, 4 (11.11%) were in superficial inguinal ring and 4 (11.11%) unlocated.

**Table 2: Side involvement of non-palpable undescended testis in respect of age of the patients among the study population.**

| Age ranges | Side involvement | | | | | | P value |
|---|---|---|---|---|---|---|---|
| | Right | | Left | | Bilateral | | |
| | N | % | N | % | N | % | |
| 6 months-1 year | 4 | 40 | 4 | 20 | 2 | 33.33 | 0.001 ** |
| 1-2 years | 1 | 10 | 4 | 20 | 2 | 33.33 | |
| 2-5 years | 3 | 30 | 10 | 50 | 2 | 33.33 | |
| 5-12 years | 2 | 20 | 2 | 10 | 0 | 00.00 | |
| Total | 10 | 100 | 20 | 100 | 6 | 100 | |

$\chi 2$ test** means p<0.001, 1% significant

**Table 3: Associated anomalies with non-palpable undescended testis and ultrasonographic localization of the study population.**

| Associated anomalies | No. of patients (n=36) | % |
|---|---|---|
| Contralateral inguinoscrotal swelling | 10 | 27.78 |
| Hypospadias | 04 | 11.11 |
| Renal agenesis | 01 | 2.78 |
| Ultrasonographic location | | |
| Inguinal canal | 20 | 55.55 |
| Proximal to deep ring | 08 | 22.22 |
| Superficial inguinal ring | 04 | 11.11 |
| Unlocated | 04 | 11.11 |

Table 4 showed 19 (52.78%) were in inguinal canal, 07 (19.44%) were in proximal to the deep ring, 05 (13.88%) were in abdomen, 03 (8.33%) were in superficial inguinal ring and 2 (5.55%) were unlocated.

**Table 4: Per operative finding of study population.**

| Per operative location | No. of patients (n=36) | % |
|---|---|---|
| Inguinal canal | 19 | 52.78 |
| Proximal to deep ring | 07 | 19.44 |
| Abdominal | 05 | 13.88 |
| Superficial inguinal ring | 03 | 8.33 |
| Unlocated | 02 | 5.55 |

Table 5 showed 20 (55.55%) were in inguinal canal sonographycally but 19 (52.78%) were in that of per operatively; 8 (22.22%) were in proximal to the deep ring sonologically but 7 (19.44%) were in that of preoperatively; 4 (11.11%) were in superficial inguinal ring sonologically but 3 (8.33%) in that of preoperatively; 5 (13.88%) were in abdomen preoperatively and 4 (11.11) were unlocated sonologically but 2 (5.55%) were unlocated preoperatively.

**Table 5: Comparison of USG finding with per operative finding of non-palpable undescended testis among the study population.**

| Site | Ultrasonographic finding (number) | | Per operative findings | |
|---|---|---|---|---|
| | Count | % | Count | % |
| Inguinal canal | 20 | 55.55 | 19 | 52.78 |
| Proximal to deep ring | 08 | 22.22 | 07 | 19.44 |
| Superficial inguinal ring | 04 | 11.11 | 03 | 8.33 |
| Abdominal | 00 | 00.00 | 05 | 13.88 |
| Unlocated | 04 | 11.11 | 02 | 5.55 |
| P value | 0.002** | | 0.002** | |

$\chi 2$ test** means p<0.001, 1% level of significant

Table 6 showed testicular mean volume (CC) at the age range from 6-11 months were 0.486. 12-23 months were 0.280. 24-47 months were 0.413 >47 months were 0.678.

**Table 6: Change of the testicular volume in comparison with age.**

| Age in months | Mean vol. (CC) | Range | Total |
|---|---|---|---|
| 6-11 | 0.486 | 0.280-0.608 | 10 |
| 12-23 | 0.280 | 0.212-0.397 | 6 |
| 24-47 | 0.413 | 0.250-0.630 | 16 |
| >47 | 0.678 | 0.170-0.156 | 4 |
| Total | | | 36 |

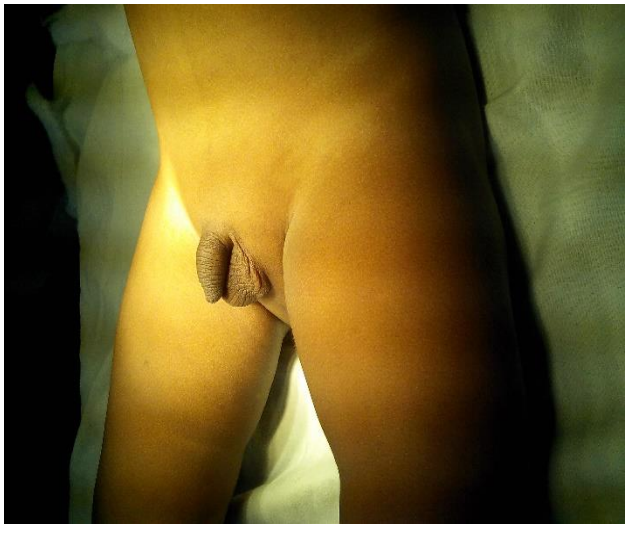

**Figure 1: A patient with left sided non palpable UDT.**

**Table 7: Testicular volume in relation with location of the testis.**

| Location of testis | Mean vol. (CC) | Total no. of testis |
|---|---|---|
| **Inguinal canal** | 0.540 | 20 |
| **Proximal to deep ring** | 0.480 | 8 |
| **Superficial inguinal ring** | 0.228 | 4 |
| **Abdominal** | 0.211 | 4 |

Table 7 showed testicular volume in relation with location of the testis. It observes that, mean volume of inguinal canal, proximal to deep ring, superficial inguinal ring and abdominal were 0.540, 0.480, 0.228 and 0.211.

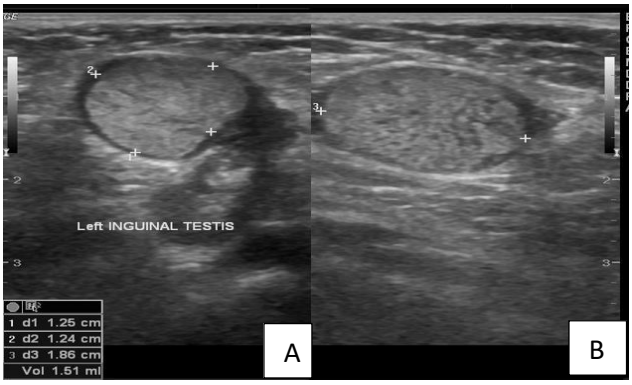


**Figure 2 (A and B): Ultrasonogram findings of testis at the deep inguinal ring.**

**Figure 4: Per operative finding of same patient.**

## DISCUSSION

Undescended testis one of the most common genital anomalies in boys. The incidence is slightly less than 1% at the age of one year.[8] Most undescended testicles are palpable, but a significant number are non-palpable for varied reasons and these represent a major controversial issue as to both diagnosis and management. Numerous radiologic studies have been used to try to localize the non-palpable testis preoperatively, including sonography, computerized tomography (CT), and magnetic resonance imaging (MRI).[9]

This cross-sectional type of descriptive observational study was carried out from January 2018 to April 2019 in the department of pediatric surgery, MMCH. Total 36 patients were included in this study. They were analyzed carefully.

Age at presentation of the patients range from 6 months to 12 years. Peak incidence was observed within 2 to 5 years of age group, which was 16 (44.44%) in number and lowest incidence observed within 5 to 12 years of age group. Average age of presentation was 3.06±2.58 years. Kirschi reported in their series that average patients age at presentation was 34 months with 63% presenting before age 48 months.[9] The causes of delayed presentation in this series are probably because most patients of this group were from low socio-economic background and lack of awareness of disease and its consequence.

Side of involvement in this study were 10 (27.78%) in right sided, 20 (55.55%) in left sided and 6 (16.68%) bilateral with left sided predominance Kirsch et al study shown non palpable testis were 58% on the left site 35% on the right side and 7% bilateral. Kanemoto et al study showed left sided predominance.[10]

Associated anomalies in the present study were contralateral inguinoscrotal swelling 10 (27.78%), hypospadias 4 (11.11%), and unilateral renal agenesis 1 (2.78%). Daghighi et al study found contralateral inguino scrotal swelling 2.41%, Khuri et al reported their study hypospadias 4% and savage reported his study epsi-lateral agenesis was 2%.[11]

In this study sonographic localization 20 (55.55%) were inguinal canal, proximal to the deep ring 8 (22.22%), superficial inguinal ring 4 (11.11%) and unlocated 4 (11.11%) and preoperative findings were 19 (52.78%) inguinal canal, proximal to the deep ring 7 (16.66%), abdominal 5 (13.88%), superficial inguinal ring 3 (8.33%) and unlocated 2 (5.55%). In Kogan series non palpable testis in inguinal canal were 80% both in sonographic and preoperative findings and that of in Cain study 57%.[12,13] Sonographic and preoperative localization of non-palpable testis in the present series not consistent with other study.

In this study measurement of non- palpable testis in terms of length and breadth were 12.5±3.6 mm and 8.8±2.9 mm respectively sonologically and that were 11.2±2.66 mm and 7.9±1.8 mm respectively preoperatively. So, this study more or less consistent with other study.

Changes of mean testicular volume in different age group were analyzed. Less than 1-year age group showed better preservation of testicular volume. Older age group showed relatively smaller volume of testis. Change of the testicular volume with site were also analyzed. It showed that, inguinal testis maintained better testicular volume in comparison to abdominally located testis (after through search any reference about normal volume of testis in different age group could not be found).

Accuracy of sonographic evaluation of non- palpable testis by sensitivity, specificity, positive predictor value (PPV), negative predictor value (NPV) and efficiency of the test. Sensitivity, specificity, PPV, NPV and efficiency of the test were 94.11%, 40%, 84.21%, 66.66% and 81.81% respectively in this study. Opeoluwa et al study shown sensitivity and specificity were 89.8% and 86.5% respectively.[14] Komine et al obtain sensitivity and accuracy were 82.6% and 84.6% respectively.[15] Phewolung et al reported a sensitivity and accuracy 82% and 72% respectively. Specificity in this study lower than other study thereby efficiency in this study also lower in abroad study.[16] This is due to limitation of sonographic evaluation of non-palpable testis. Sensitivity, specificity and overall accuracy study lower than that of present study. Results of this study varied and superior to other study.

### *Limitations*

The present study was conducted in a very short period due to time constraints. The purposive sampling and small sample size was also a limitation of the present study.

## CONCLUSION

Abdominoscrotal sonography is safe, non-invasive, accurate and bed side diagnostic tool in the detection of non-palpable testis in children.

### *Recommendations*

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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