

LAPAROSCOPY IN THE MANAGEMENT OF THE IMPALPABLE UNDESCENDED TESTIS IN PEDIATRIC UROLOGY CENTERS IN IRAQ

Saad Dakhil F. Daraji

Department of Urology, College of Medicine, University of Baghdad, Baghdad, Iraq

Bayar Abdullah Ahmed

Directorate of Health, Erbil, Iraq

Abstract: Introduction: Undescended testis (UDT), or Cryptorchidism, is one of the popular congenital anomalies, with significant involvement for future fertility and testicular tumour. Our study evaluates the effectiveness of laparoscopic management for non-palpable UDT in pediatric patients across three major urology centers in Iraq.

Methods: A retrospective analysis was handled on 42 pediatric patients with non-palpable UDT diagnosed with intra-abdominal cryptorchidism and treated at Al Sader Teaching Hospital, Al Najaf Teaching Hospital, and Baghdad Medical City. Our cases were distributed according to ages into three groups, and they underwent laparoscopic exploration with general anesthesia. Surgical interventions included Single-Stage Procedure and Two-Stage Fowler-Stephens Procedure for normal and small size testicles, and Orchiectomy for atrophied testicles. Pre-operative information, intra-operative findings, postoperative results, and complications were documented and analyzed. Chi-square tests, utilized with the significance limit established at $p < 0.05$.

Results: We analysed 42 cases (age range: 9 to 72 months; median age: 19 months) the majority of UDT cases (52.4%) occurred in cases age group 13-24 months, with a left-sided slightly predominance (57.1%). during laparoscopic explorations, more than half of the testicles (54.8%) were located near the iliac vessels, and the majority testicles were of normal size (76.2%). The Single-Stage Procedure was the most commonly performed (54.8%), followed by the Two-Stage Fowler-Stephens procedure (38.1%). Furthermore, complication subdivided into early and late. Early complications were observed only in 11.9% of cases, scrotal hematoma accounting the most frequent causes, while late complications, testicular atrophy detected most frequently, were detected in 16.7% of cases. The majority of testicles (65.2%) reached the lower scrotum postoperatively, with a hospital stay of one day in majority of cases.

Conclusion: Laparoscopic management of non-palpable UDT is a safe and helpful procedure in pediatric urology, with the Single-Stage Procedure being highly successful in appropriate cases. Early intervention is essential to achieve best testicular positioning and function result..

Keywords: Laparoscopic orchiopexy, Undescended testis, impalpable testicle, Pediatric urology.

Introduction

Cryptorchidism, or undescended testis (UDT), is a common congenital abnormality where the testis fails to descend into the scrotum.¹ Classified into palpable and nonpalpable types based on the ability to feel the

testis outside the scrotal sac,² using the Hay and Abou Zeid classifications nonpalpable testes are classified based on their location relative to the deep ring into 4 types.³ Furthermore, UDT occurs in 2-8% of full-term infants and up to 45% of preterm or underweight infants. ^{4,5} Most testes descend spontaneously within the first 6-12 months, reducing the incidence to 1-2% by one year of age.⁶ Associated with premature birth, low birth weight (<2.5 kg), and prenatal exposure to endocrine-disrupting chemicals regarding as risk factor for undescended testis.⁷ Familial predisposition noted, with 7% of siblings of affected boys also having cryptorchidism.⁸

Historically UDT First described in 1786 by Hunter; first surgical attempt in 1820 by Rosenmerkal, with the first successful orchiopexy performed in 1877 by Annandale.⁹

Diagnostic exploratory laparoscopy is considered the gold standard for identifying and potentially treat impalpable undescended testes due to its high sensitivity and specificity.¹⁰ Early surgical intervention (around 6-18 months) is recommended to optimize testicular growth and fertility, early surgery around 6 months is often preferred.⁷ Orchiopexy Techniques for non-palpable testis include:⁷

- **Laparoscopic orchiopexy preserving the vessels:** the testis is dissected off a triangular pedicle containing the gonadal vessels and the vas.
- **Fowler-Stephens (FS) Orchiopexy:** Involves dividing testicular vessels to achieve adequate length for relocation to the scrotum, either as one-stage or two-stage procedures.
- **Shehata Technique (ST):** Involves traction on the spermatic pedicle without dividing the vessels, allowing gradual elongation and subsequent relocation of the testis to the scrotum.

Outcomes of FS technique known to be 85% success rate in achieving a scrotal position with a 10% risk of testicular atrophy.¹¹ While in Shehata technique shows promise with negligible atrophy rates due to intact vascular supply but has a longer operative time and higher slippage complication rate.¹² Overall complication rates for laparoscopic orchiopexies are around 5%, with potential complications including testicular atrophy and vascular injury. Long-term implications include increased risk of infertility and testicular cancer if untreated. ^{13,14}

This study evaluates the role of laparoscopy for managing the intra-abdominal testis. This article is the first to describe the efficacy of this approach in our pediatric urology centers in Iraq.

Patient and method

We retrospectively analysed cases at Al Sader Teaching Hospital, Al Najaf Teaching Hospital in Najaf City, and Baghdad Medical City in Baghdad- Iraq, focusing on pediatric patients diagnosed with intra-abdominal cryptorchidism. A total of 42 pediatric cases were included in our study, with age confined from 9 to 72 months and a median age of 19 months. The patients were categorized according to ages into three groups: Group 1 (0-12 months), Group 2 (13-24 months), and Group 3 (>24 months). Inclusion Criteria was pediatric patients diagnosed with impalpable undescended testis (IUT), in age range from 1 to 9 years. While exclusion Criteria includes patients who received hormonal treatment for undescended testis and patients diagnosed with syndromes related to undescended testes (e.g., prune-belly syndrome, persistent Mullerian duct syndrome) and those with incomplete medical records or follow up less than three months.

All patients underwent laparoscopic exploration under general anesthesia, then Inguinal and scrotal examination was done for confirming nonpalpable testis. We found that eight cases with nonpalpable UDT were felt palpable under general anesthesia with enough muscle relaxation. These testicles became palpable and, hence, underwent open orchidopexy. Intraoperative findings were documented, including the location of the testis (near the iliac blood vessels or internal ring), testicular size (normal, small, or atrophic), and

whether the processus vaginalis was open or closed. Depending on the intraoperative findings, three types of procedures were performed:

1. **Single-Staged Procedure:** The testis was mobilized and brought down to the scrotum in one surgical session without ligation of blood supply.
2. **Two-Stage Fowler-Stephens Procedure:** The testis was initially ligated and divided from its blood supply in the first stage, followed by its mobilization and descent in the second stage after neovascularization.
3. **Orchiectomy:** This was performed in cases where the testis was found to be significantly atrophic.

Postoperatively, testicular locations are distributed into the lower scrotum (situated in the lower part of the scrotum), the middle scrotum (situated inside the scrotum but not in the lower part of the scrotum), and the neck of the scrotum and above (situated in the inguinal area). (7, 15) Both early and late Complications, and duration of hospital stay were documented. The follow-up protocol included - All patients underwent regular outpatient follow-up at postoperative 1, 3, +/- 6 months. The definitive testicular location was affirmed by clinical evaluation, and doppler ultrasonography was carry out by 3 months.

The collected data were analyzed to compare outcomes based on the type of surgical procedure performed. Statistical analyses were achieve utilizing the chi-square test to evaluate the differences, with a p-value of <0.05 regarded statistically significant.

Result

The study includes 42 cases, age distribution range between 9 to 72 months, with median 19 months of age, majority of cases (52.4%) were between 13-24 months old, which accounting for over half of the total cases. Most cases (57.1%) involve the left testis, with a small proportion involving both testes. A significant majority of cases (86.5%) did not have any associated anomalies and most common congenital anomaly was cardiac (as displayed in table 1).

Table 1: distribution of Demographic and Clinical Data.

Parameter	Number of Cases (n=42)	Percentage (%)
Age Group		
- Group 1 (0-12 months)	9	21.4%
- Group 2 (13-24 months)	22	52.4%
- Group 3 (>24 months)	11	26.2%
Testicular Side		
- Left	24	57.1%
- Right	14	33.3%
- Bilateral	4	9.5%
Associated Anomalies		
- Cardiac abnormalities	4	9.5%
- Hypospadias	1	2.4%
- Down syndrome	3	7.1%
- Hematological abnormalities	1	2.4%

Table 2. Perioperative result and clinical outcomes of the intra-abdominal UDT.

Parameter	Number of Cases (n=42)	Percentage (%)
Initial Testicular Location:		
Near the iliac blood vessels	23	54.8%
Near the internal ring	19	45.2%
Initial Testicle Size		
- Normal	32	76.2%
- Small	7	16.7%
- Atrophy	3	7.1%
Procedure Type		
- Single-Staged Procedure	23	54.8%
- Two-Stage Fowler-Stephens	16	38.1%
- Orchiectomy	3	7.1%
Processus Vaginalis		
- Open	32	76.2%
- Closed	10	23.8%
Operative Time: (minutes)	56.73 ±9.1	
- Mean	42.5 minutes	
Early Complications		
- None	37	88.1%
- Poor wound healing	1	2.4%
- Infection	3	7.1%
- Scrotal haematoma	1	2.4%
Late Complications		
- None	35	83.3%
- Testicular atrophy	6	14.3%
- Hernia	1	2.4%

Intraoperatively, 54.8% testicles were located near the iliac blood vessels, most of them found normal in size (76.2%), with a smaller proportion being small or atrophied. The majority of procedures performed were Single-Staged Procedure (54.8%), followed by two-stage Fowler-Stephens, with a few cases requiring orchiectomy due to small atrophy testis. In nearly three quarter of the cases processus vaginalis were open that needed repair. The operative time was 56.73 ±9.1 minutes.

Regarding complication, early complication rate was 11.9% and the most common early complication was scrotal hematoma, followed by infection and poor wound healing, with no bowel and vascular injury were recorded. While late complications rate was 16.7%, testicular atrophy was the most frequent late complication (*as shown in table 2*).

In twenty-eight patients the testicles were reached the lower scrotum postoperatively. Regarding hospital stay, majority (35) of our cases had a just one day hospital admission. The follow up scheme was one, three and six months with the majority of cases were followed up for three months (*as displayed in table 3*).

Table 3. Postoperative findings and follow up.

Parameter	Number of Cases (n=42)	Percentage (%)
Postoperative Testicular Position		
- Neck of the scrotum	6	14.3%
- Lower scrotum	28	66.7%
- Middle scrotum	7	16.7%
- Not available (orchietomy)	1	2.4%
Hospital Stay:		
- 1 day	35	83.3%
- 2 days	7	16.7%
Follow-up Duration:		
- 3 months	28	66.7%
- 6 months	14	33.3%

Regarding table 4, Based on procedure types compared to age, Group 2 (13-24 months) contains the majority of patients, with 56.5% in the Single-Stage Procedure group, 43.8% in the Two-Stage Fowler-Stephens group, and 66.7% in the Orchiectomy group. The left testicle is affected in 47.8% of patients in the Single-Stage Procedure group, 37.5% in the Two-Stage Fowler-Stephens group, and 66.7% in the Orchiectomy done for left testis.

Regarding patients with associated anomaly, in cardiac abnormalities, two cases underwent of the Single-Stage Procedure, other two cases the Two-Stage Fowler-Stephens performed, and one case the Orchiectomy done. For hypospadias patient, the Single-Stage Procedure done. For three cases of down syndromes, the Two-Stage Fowler-Stephens perform for two of them and Orchiectomy for third case.

Most testicles are normal-sized, Single-Stage procedure perform for majority of them (87.0%). Orchiectomy was done only for testis. The average surgery time is similar across all groups, around 54-56 minutes. Furthermore, early complications, mainly in the Two-Stage Fowler-Stephens and orchiectomy groups, while later complications nearly equal for both the Single-Stage and Two-Stage Fowler-Stephens groups. The lower scrotum is the most common postoperative position, with 65.2% of the Single-Stage Procedure group and 75.0% of the Two-Stage Fowler-Stephens group. The Initial Testicle Size and Postoperative Testicular Position show statistically significant differences across the groups, with p-values less than 0.05. The other characteristics do not show significant differences, indicating that the distributions across the groups are likely similar for those parameters (*as shown in table 3*).

Table4: Comparative Analysis of Outcomes Based on Procedure Type

Parameter	Single-Stage Procedure (n=23)	Two-Stage Fowler-Stephens (n=16)	Orchiectomy (n=3)	P-value
Age Group				
- Group 1 (0-12 months)	4 (17.4%)	4 (25.0%)	1 (33.3%)	0.767
- Group 2 (13-24 months)	13 (56.5%)	7 (43.8%)	2 (66.7%)	
- Group 3 (>24 months)	6 (26.1%)	5 (31.2%)	0 (0.0%)	
Testicular Side				
- Left	11 (47.8%)	6 (37.5%)	2 (66.7%)	0.075
- Right	11 (47.8%)	10 (62.5%)	0 (0.0%)	

- Bilateral	1 (4.3%)	0 (0.0%)	1 (33.3%)	
Associated Anomalies				
- Cardiac abnormalities	2 (8.7%)	2 (12.5%)	1 (33.3%)	0.544
- Hypospadias	1 (4.3%)	0 (0.0%)	0 (0.0%)	
- Down syndrome	0 (0.0%)	2 (12.5%)	1 (33.3%)	
- Hematological abnormalities	1 (4.3%)	0 (0.0%)	0 (0.0%)	
Initial Testicle Size				
- Normal	20 (87.0%)	9 (56.2%)	0 (0.0%)	0.007
- Small	3 (13.0%)	4 (25.0%)	0 (0.0%)	
- Atrophy	0 (0.0%)	3 (18.8%)	3 (66.7%)	
Processus Vaginalis				
- Open	18 (78.3%)	10 (62.5%)	3 (100.0%)	0.307
- Closed	5 (21.7%)	6 (37.5%)	0 (0.0%)	
Operative time (minutes)				
- Mean	54.9	56.6	53.0	0.437
- Median	51.5	52.5	56.0	
- Standard Deviation	11.05	8.54	5.77	
Early Complications				
- None	22 (95.7%)	13 (81.2%)	2 (66.7%)	0.237
- Poor wound healing	1 (4.3%)	0 (0.0%)	0 (0.0%)	
- Infection	0 (0.0%)	2 (12.5%)	1 (33.3%)	
- Scrotal haematoma	0 (0.0%)	1 (6.3%)	0 (0.0%)	
Late Complications				
- None	19 (82.6%)	13 (81.2%)	3 (100.0%)	0.807
- Testicular atrophy	3 (13.0%)	3 (18.8%)	0 (0.0%)	
- Hernia	1 (4.3%)	0 (0.0%)	0 (0.0%)	
Postoperative Testicular Position				
- Neck of the scrotum	3 (13.0%)	3 (18.8%)	0 (0.0%)	0.000015
- Lower scrotum	15 (65.2%)	12 (75.0%)	0 (0.0%)	
- Middle scrotum	4 (17.4%)	1 (6.3%)	0 (0.0%)	
- Not available	1 (4.3%)	0 (0.0%)	3 (100.0%)	

***The chi-square test used for all comparisons.**

Discussion

Laparoscopy is the mainstay for both diagnosing and treating intra-abdominal undescended testes (UDT). The recommended age for intervention is between 6 months and 2 years to maximize best outcomes and minimize hazards, such as testicular atrophy or fertility concerns. 16 Nowadays different operative techniques are available to manage this congenital anomaly. High intra-abdominal UDT could be managed with various techniques like, one-stage or two-stage laparoscopic Fowler-Stephens orchiopey or staged laparoscopic traction orchidopexy (Shehata technique). For low intra-abdominal and intracanalicular testes, numerous authors recommend performing primary laparoscopic orchiopey. 17, 18 With this concern, Shehata (19) technique using traction on the high intra-abdominal testis. Although the principle of traction on testicular vessels appears exciting, a high incidence of stretch-associated testicular atrophy in the above-mentioned techniques is worrisome for surgeons. The important factors in judging the success of orchiopey are the location and viability of the testis. 7, 20 These were basically reason that's not widely

used in our centers. In our cohort, the age distribution, with a median age was 19 months and children in group 2 form more than half of the cases (52.4%), this affiliates with the general agreement regarding that early childhood intervention is the optimal time for addressing non palpable UDT. This age group is particularly crucial as delayed intervention has been associated with increased risks of testicular atrophy and potential fertility issues later in life. Our data also revealed a left-sided dominance (57.1%) of non-palpable testes is similar to prior literature, that mentions the left side non-palpable UDT are slightly more prominence than right side. 21 Interestingly, only 13.5% of our patients had associated anomalies, with cardiac abnormalities being the most common as Cheng et al. (22) documented 7 with cardiovascular anomalies. We had a total of 3 cases of Down syndrome, similarly, several studies highlighted the higher incidence of undescended testis with cases of Down syndrome.²³⁻²⁵ Due to the lack of standardized classification of the testicular position in the abdomen, some authors adopted their own specific definitions for the testicular position. Therefore, Samadi et al. mentioned that those testicles situated between the iliac vessels and the internal inguinal ring regarded as low-intra-abdominal-testicles, while those testicles located more proximal to the iliac vessels consider as High-intra-abdominal testicles.²⁶ But Baker et al. regarding the testicular location according to testicular distance to the internal ring, whether <2 cm and >2 cm from the internal ring.²⁷ Moursy et al. defined the testicular locations as whether low or high, based on whether the testis could be pulled over to reach the contralateral internal inguinal ring.^{28,29} In our study, cases distributed into whether near the iliac blood vessels or near inguinal canal. Our data displayed that more than half (54.8%) of the testes were located near the iliac blood vessels. At the time of surgery, majority of testes were normal in size (76.2%), and only (7.1%) found to be atrophic, especially in older age group, that emphasizing the importance of early intervention. The choice between a single-stage or a staged procedure is affected by the position of the testicles and the surgeon's priority. 30 In our study, the most commonly performed procedure was the single-stage procedure (54.8%), and (38.1%) performed two-stage Fowler-Stephen's procedure. Collectively our data revealed that the single-stage procedure is highly effective when the testis is near the internal ring, with a significant number of these testicles found in the lower scrotum after surgery (65.2%). During the laparoscopic exploration, 78.6% cases had patent processus vaginalis, which exhibited that the open of the processus vaginalis should not certainly lead to clinical hydrocele and hernia. 31 In our study nearly three quarter of the cases processus vaginalis were open that needed repair. Nevertheless, several Arthurs have revealed that simply transection of the processus vaginalis does not elevate the chance of postoperative hydrocele or inguinal hernia (32,33). Regarding outcome, we have achieved results comparable to those reported in the literature for laparoscopic orchiopexy, with a success rate of 78.5% for the staged Fowler-Stephens technique and 90% in the primary orchiopexy without vascular transection.^{23,27,34} We are not in favor of the one-stage Fowler-Stephens procedure because of the well-documented lower rate of success than the two-stage procedure.²⁷ The overall complication rates in our study were low, with an early complication rate of 11.9% and a late complication rate of 16.7%. Scrotal hematoma was the most frequent early complication, while testicular atrophy was the most frequent late complication that observed in 14.3% of cases. The higher rate of atrophy in the older age group and in cases where the Two-Stage Fowler-Stephens procedure was performed suggests that earlier intervention might reduce this risk. Testicular atrophy defined as a decrease of $>50\%$ of the post-operative testicular volume compared to preoperative testicular volume (35). Interestingly, in our data no cases of bowel or vascular injury were documented, emphasizing the safety of laparoscopy in experienced hands. For hospital stay, most patients had a short hospital stay, usually one day, which reflects the minimally invasive nature of the procedure. The postoperative follow-up revealed that the majority of testes were positioned in the lower scrotum at three months. The statistically significant association between age and postoperative testicular position, with older children having a less favorable position, suggests that age at the time of surgery may influence outcomes. This emphasizes the necessity for early surgical intervention to optimize function and position of the testicular. Generally, in our study follow-up plan was for one, three- and six-months visits, 66.7% of our patients had at least three months of follow-up and rest of patients had six months follow-up.

The study published by Tian and colleagues (2023) displayed only 6 months follow-up recommended. Likewise, the results of Elzeneini et al. (20) showed that there was no difference in testicular viability and position at 6 months postoperatively and at 12 or 36 months follow-up. Our comparative analysis of the Single-Stage Procedure, Two-Stage Fowler-Stephens, and Orchiectomy groups revealed important differences. The Single-Stage Procedure was associated with the highest rate of normal-sized testes and the lowest complication rates, particularly in younger children. While the Two-Stage Fowler-Stephens procedure helpful for high intra-abdominal testes, but had a higher incidence of testicular atrophy, specifically in cases where the testes were small at the time of surgery. Orchiectomy was reserved for cases with severe atrophy and was performed exclusively in patients over 24 months of age. These findings suggest that while the Single-Stage Procedure may be preferable for most patients, particularly younger ones with more favorable intraoperative findings, the Two-Stage Fowler-Stephens procedure remains a valuable option for more challenging cases. The significant association between initial testicular size and postoperative position with the type of procedure highlights the importance of individualized surgical planning based on intraoperative findings. Unfortunately, our study has limitations include, the study was done retrospectively, the sample size was somewhat small, surgeons determined their own results, which were based on subjective assessments of testicular location and size. To improve future studies, a prospective, randomized approach with larger samples and long-term follow-up using objective measures like ultrasound would be ideal.

Conclusion

The laparoscopic management of non-palpable UDT remains a cornerstone of pediatric urology, with techniques continually evolving to optimize outcomes and minimize complications. Our study highlights the effectiveness of different surgical techniques, including the Single-Stage, and Two-Stage Fowler-Stephens laparoscopic orchiopexy, for high intra-abdominal UDT. The statement also highlights the significance of early intervention in preventing complications like testicular atrophy, especially in older children. Additionally, we discuss the incidence of associated anomalies, including Down syndrome and cardiovascular anomalies. The analysis of the surgical outcomes shows a high success rate for the Single-Stage Procedure, particularly for cases where the testis was near the internal ring. The study also notes the higher complication rates associated with the Two-Stage Fowler-Stephens procedure, especially in older patients or those with more challenging intraoperative findings.

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