Cryptorchidism: A 20-Year Journey of Patient Outcomes and Family Concerns – A Cohort Study at a Single Center"

ABSTRACT

Background: Undescended testis (UDT), or cryptorchidism, is a prevalent pediatric condition with significant implications for fertility and malignancy risk if untreated. Affecting 1–5% of male infants, UDT is influenced by genetic, hormonal, and environmental factors. **Methods:** This retrospective cohort study examines 470 pediatric UDT cases treated at a single center over two decades (2004–2024) at a single pediatric surgery center - The Maternity and Child Teaching Hospital, Al Qadisiya, Iraq, focusing on surgical outcomes, fertility, long-term testicular health, and family concerns. Inclusion criteria; Patients were identified from hospital records and outpatient clinic registries confirmed diagnosis of UDT (unilateral or bilateral), availability of complete medical records, patients who underwent chromosomal analysis as part of their diagnostic workup, and underwent surgical intervention within the study timeframe at our center with at least three years of follow-up. **Results:** The mean age at diagnosis was 18 months, with 45% diagnosed within the first year. Unilateral UDT predominated (60%), and testicular position influenced size and outcomes. Surgical success was achieved in 90% of cases, with minor complications including wound infections (5%) and reoperations (5%). Earlier diagnosis correlated with improved fertility outcomes, with normal spermatogenesis observed in 75% of early cases but declining significantly with delayed treatment ($P < 0.05$). Chromosomal abnormalities, present in 9% of patients, heightened family concerns, particularly regarding fertility and psychosocial impacts. **Conclusion**: Family concerns evolved through stages of care, initially focusing on fertility and malignancy risks, then shifting to surgical safety and postoperative recovery. Tailored counseling and psychosocial support were integral to family satisfaction. This study underscores the importance of early diagnosis, multidisciplinary care, and culturally sensitive family engagement to optimize outcomes and enhance the quality of life for patients with UDT. Future recommendations include routine genetic screening and targeted educational initiatives to address community-specific challenges.

KEYWORDS: Cryptoricidism, cohort, single center.

INTRODUCTION

Undescended testis (UDT) is a common condition in male infants that requires timely intervention to optimize outcomes and prevent complications. Undescended testis, or cryptorchidism **[1]**, affects approximately 1-5% of male infants and is associated with an increased risk of infertility and malignancy if left untreated. The etiology of UDT is multifactorial; with environmental, hormonal, and genetic factors, all

implicated **[2]**. Early intervention, typically by orchidopexy, is recommended to improve reproductive outcomes and reduce risks, while medical professionals focus on anatomical and reproductive outcomes, families often have additional concerns regarding their child's future fertility, potential for complications, and quality of life, yet families frequently face challenges in understanding potential long-term **[3]**. These concerns are critical in shaping the experiences and satisfaction of patients and their families throughout the journey of managing UDT.

In this study, we reviewed a cohort of patients treated for UDT at a single center, exploring patient and family concerns related to fertility, outcomes, and complications. We aim to assess surgical outcomes and efficacy in achieving testicular descent, evaluate long-term testicular health, including dysgenesis, size, and state of spermatogenesis, and assess the cancer incidence with the fertility outcomes in treated patients, emphasizing patient satisfaction. Provide a comprehensive understanding of the long-term outcomes of UDT treatment while examining how family concerns evolve aiming to provide insights into enhancing patient-centered care, and clinical recommendations.

MATERIALS AND METHODS

A retrospective cohort study was conducted on 470 patients treated for UDT over 20 years between 2004 and 2024 at a single pediatric surgery center. Inclusion criteria; Patients were identified from hospital records and outpatient clinic registries confirmed diagnosis of UDT (unilateral or bilateral), availability of complete medical records, patients who underwent chromosomal analysis as part of their diagnostic workup, and underwent surgical intervention within the study timeframe at our center. At least three years of follow-up post-surgery, and over an extended period. Exclusion criteria; Patients with incomplete records or other major congenital anomalies affecting the reproductive system, and the cases where chromosomal analysis was not performed.

Data Collection; including age at diagnosis, site, position, and size of the undescended testis (were classified by their size according to both perioperative wooden Prader orchidometer with ultrasonography during the initial clinical evaluations according to the age references, as small (<50% of normal volume), moderate (50–90%), or normal (>90%).Surgical intervention details, including type and timing of surgery. Postoperative outcomes, including position and size of the testis **[4, 5& 6]**.

Fertility assessments and outcomes. Complications following treatment. Outcome measures; primary outcomes: Testicular position, size, and fertility status. Secondary outcomes; Postoperative complications, including testicular atrophy, recurrence of cryptorchidism, and secondary surgery requirements.

Standard cytogenetic analysis using G banding was performed to detect numerical and structural chromosomal abnormalities. Peripheral blood samples were collected, cultured, and analyzed using a microscope. For selected patients, additional molecular tests such as fluorescence in situ hybridization (FISH) or polymerase chain reaction (PCR) were employed to detect micro-deletions or subtle genetic aberrations.

The bar chart titled "Primary Family Concerns by Stage" depicts the primary concerns of families concerning two major issues: fertility and cancer, across various stages of the patient's treatment journey. These stages include Diagnosis, Pre-Surgery, Post-Surgery, and Follow-Up. The percentages indicate the proportion of families expressing concern about each issue at each stage. Common questions raised "Will my child be able to father children?" "Is there a chance of cancer if the testis doesn't descend?" "How soon should surgery be done, and is it safe?" Written information was provided, along with referrals to a pediatric counselor for anxious families.

Fine needle aspiration biopsy (FNA) was conducted peril operatively to ensure accurate targeting of testicular tissue. A fine needle was inserted into the undescended testicle, and multiple samples were obtained from different regions of the testes, ensuring an adequate representation of spermatogenic tissue.

Tissue samples were processed and examined by a pathologist. The evaluation focused on identifying the presence and stage of spermatogenesis, including the types of germ cells (spermatogonia, spermatocytes, spermatids) and mature spermatozoa. In cases where maturation arrest or Sertoli-cell-only syndrome was suspected, this was noted as a deviation from normal spermatogenesis.

Pediatric endocrinology referrals were offered to families of bilateral UDT cases to monitor hormone levels during puberty (Testosterone (Total and Free) to assess the androgenic function of the testes and confirm appropriate endocrine activity. Semen samples were collected from each participant (aged 13 years, and above) at baseline and during annual follow-up visits, the samples were analyzed according to the World Health Organization (WHO) guidelines for semen analysis.

Psychosocial support and counseling resources were provided for families concerned about the emotional impact. Surgeons and anesthesiologists conducted preoperative counseling sessions to discuss anesthesia safety and typical recovery outcomes. Postoperative care included regular follow-ups to address wound healing, testicular positioning, and pain management.

Statistical Analysis; descriptive statistics were used to summarize patient demographics and clinical characteristics. Chi-square and t-tests were performed to determine associations between testicular size, position, and outcomes. Logistic regression was used to assess predictors of fertility outcomes and postoperative complications. For the longitudinal analysis of sperm parameters and hormone levels, mixed-effects models or repeated measures ANOVA were employed to evaluate changes over time within the cohort models. Categorical variables were expressed as frequencies and percentages. Pearson's tests were applied to determine statistical significance, with a P-value of <0.05 considered significant.

RESULTS

Patient Demographics and Age of Presentation; the mean age at presentation: was 18 months (±8.4 months) (figure). 45% presented within the first year, and 35% between 1–5 years (figure). Site of UDT; 60% of patients had unilateral UDT (270 right-sided, 185 left-sided) **(Figure 1)**.

Most cases (42.6%) had the UDT in the superficial inguinal pouch, followed by 29.8% at the external ring. Abdominal testes were predominantly smaller, with 70% classified as small, 25% moderate, and 5% normal. Inguinal testes had 45% moderate and 50% normal-sized testes **(Figure 2 & 3)**.

Surgical success rate; 90% achieved effective testicular descent with minor complications; 10%, including wound infections (5%), and 5% required reoperation for repositioning **(Figure 4 & 5)**.

Consanguinity, or marriage between close relatives, was observed in 60% of the patients' families **(Figure 6)**.

Family and Patient Concerns by Age Group; Parents of younger children primarily sought assurances about successful surgical outcomes. Concerns about fertility and potential complications were more prevalent among families of older children, especially those diagnosed after five years. Family and Patient Concerns by Stage of Care; at diagnosis, Primary Concerns: Fertility (80%), risk of cancer (70%), and potential for normal growth and development (60%) **(Figure 7)**. Family feedback; 60% of families felt better-informed post-consultation but requested ongoing support. Pre-surgery; concerns focused on surgery and outcomes; surgical safety (75%), anesthesia risks (65%), and success rates of achieving normal testicular position (70%) **(Figure 7)**.

Anxiety-related concerns; 45% of families expressed worry about the procedure's invasiveness and the potential need for multiple surgeries, 25% worried about post-surgical complications such as pain, scarring, and infection, and 80% of families reported feeling reassured after preoperative consultations (figure). Post-

surgery; immediate concerns, Pain management (60%), risk of testicular atrophy (40%), wound healing (35%).

Concerns specific to testicular function and position;45% of families of bilateral UDT cases expressed concern about the potential impact on both testicles' function, and 5% inquired about long-term monitoring for recurrence or the need for additional surgeries.

Family satisfaction; 70% expressed satisfaction with surgical outcomes and postoperative care; however, 20% of parents of bilateral cases desired more frequent follow-ups to monitor both testes. Follow-up stage; long-term concerns, fertility (75%), risk of malignancy (50%), psychosocial impacts on the child (30%) **(Figure 8)**. Late diagnosis; families of children diagnosed after age five exhibited increased anxiety, with 80% requesting further counseling for future fertility ($P < 0.05$).

Family feedback on follow-up; 65% of families appreciated the follow-up resources but 20% felt that more frequent counseling about fertility would be beneficial as the child aged. Outcomes remained favorable, with significant associations ($P < 0.05$) between earlier diagnosis and reduced postoperative family anxiety.

Correlation between clinical factors and family concerns; bilateral UDT, families of patients with bilateral UDT expressed greater concern about fertility (90%) and long-term testicular function (85%) than those with unilateral UDT. Families of children diagnosed after age five showed higher levels of anxiety about surgical outcomes and future fertility, with 80% seeking additional counseling **(Figure 8)**.

The findings on normal spermatogenesis (measured via per operative fine-needle aspiration biopsy, hormonal assessments, and lab semen account during the long follow-up journey) show a drastic decline in the likelihood of achieving normal spermatogenesis with delayed age of diagnosis. Within the first year, 309 patients displayed normal spermatogenesis, whereas only 16 patients in the 1–5 year age group and 28 patients in the after 5 years group had normal spermatogenesis ($P < 0.05$) **(Figure 9)**.

Chromosomal abnormalities; chromosomal analysis was performed on 30% of the total cohort 9% of the cohort with identified chromosomal abnormalities had significantly heightened concerns, particularly regarding fertility and psychosocial impacts ($P < 0.05$). **(Figure 10)**.

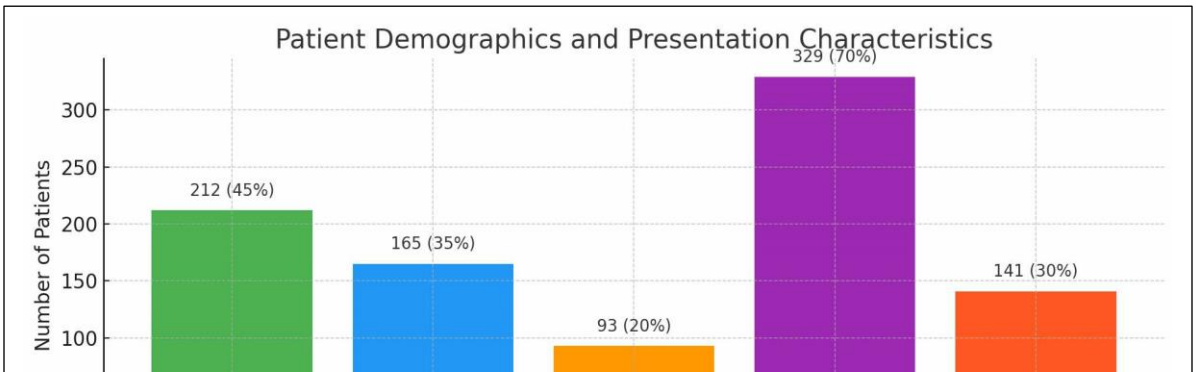

Figure 1; the number of patients diagnosed within various age ranges. The histogram presented the majority of cases were unilateral with a notable variation in laterality.

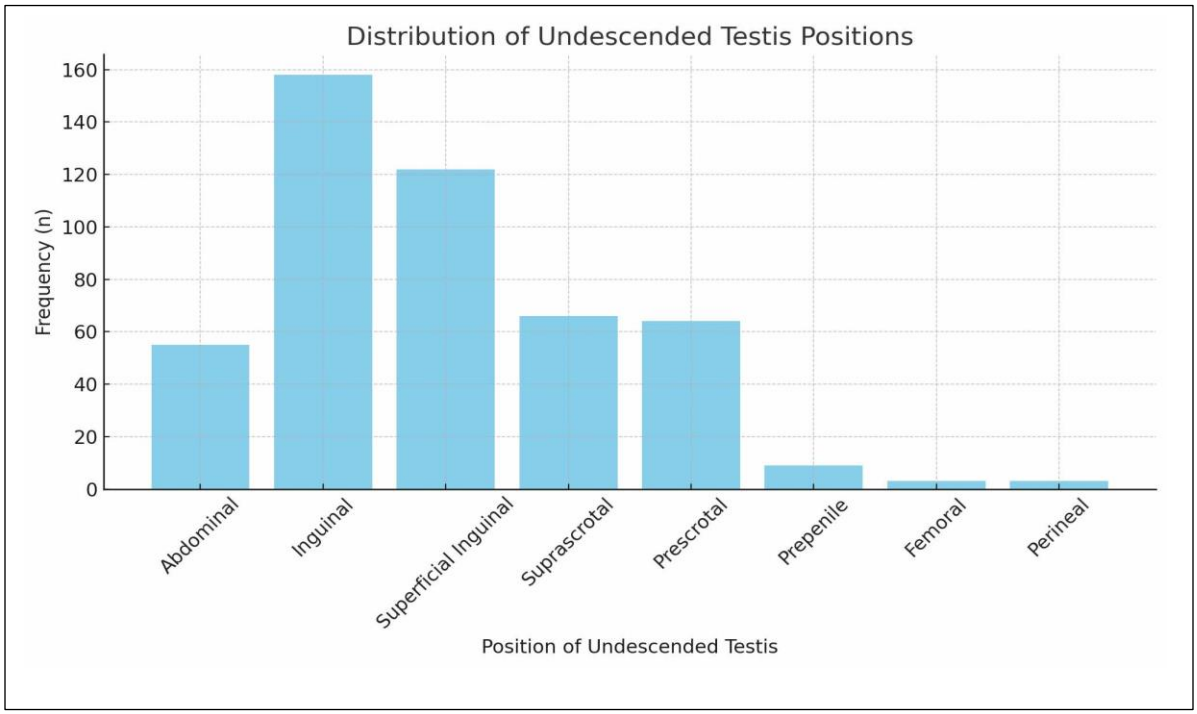

Figure 2; the histogram represents the distribution of undescended testis positions in the cohort. The inguinal position is the most common, followed by superficial inguinal, suprascrotal, and prescrotal positions. Positions like prepenile, femoral, and perineal are relatively rare.

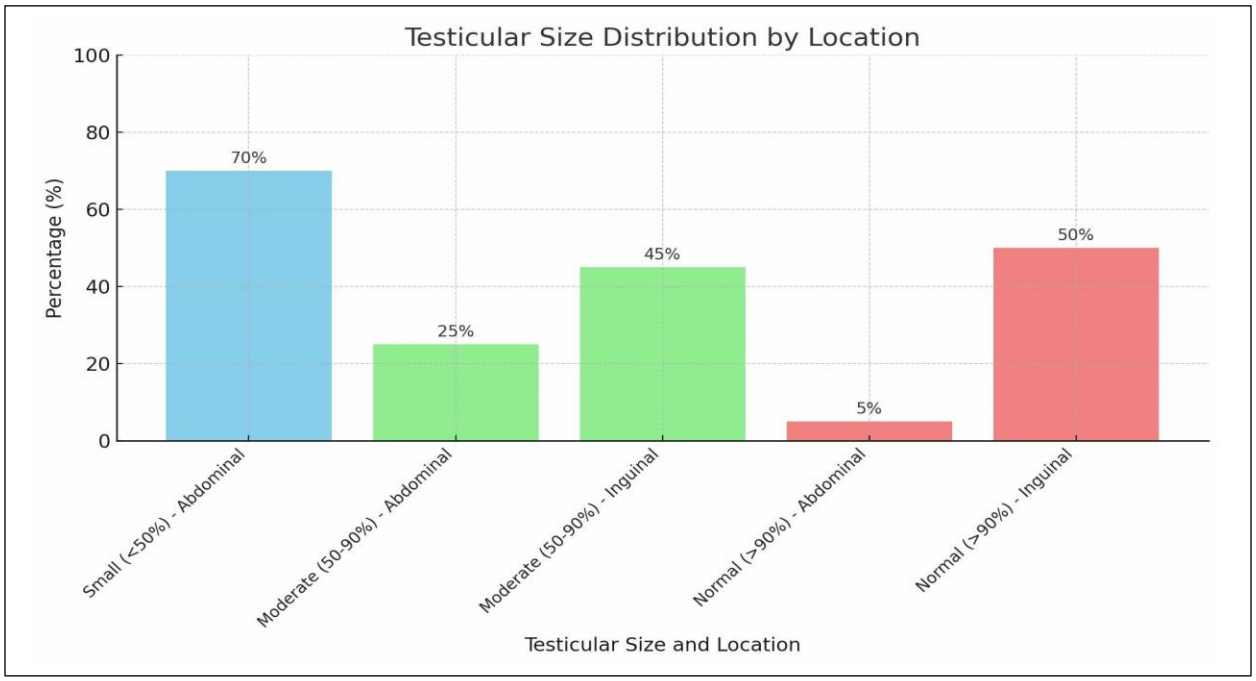

Figure 3; s the histogram representing the distribution of testicular sizes across different locations (abdominal and inguinal).

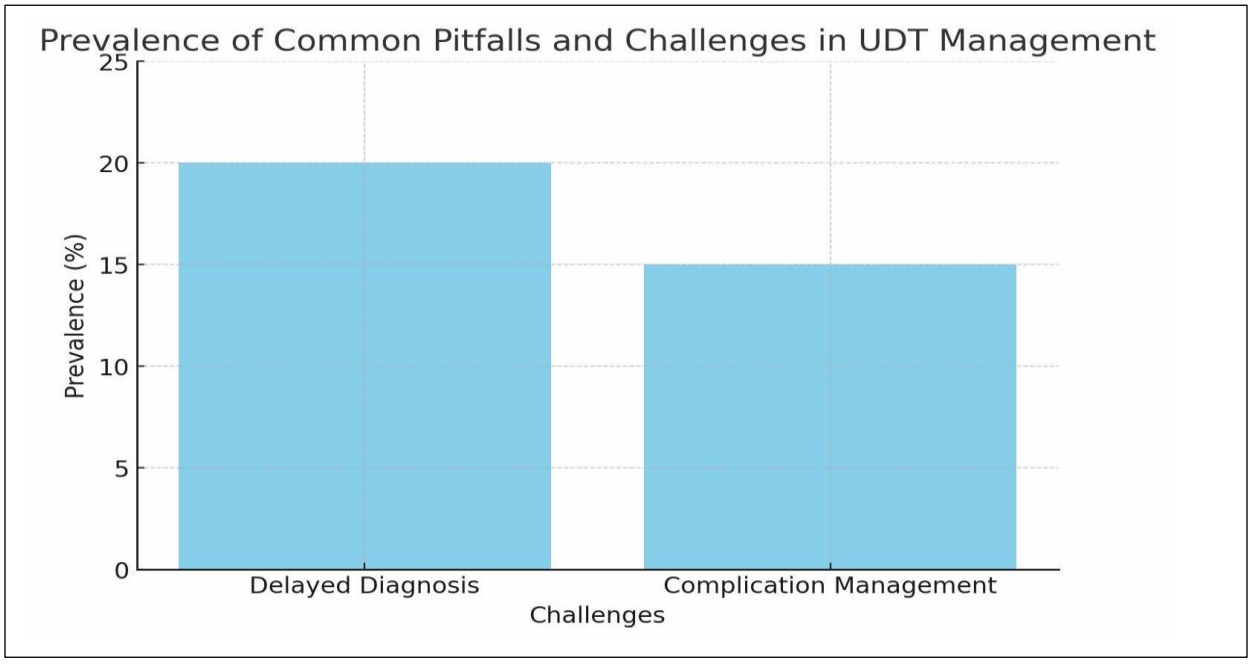

Figure 4; the chart revealed the more pronounced challenges encountered during the management journey.

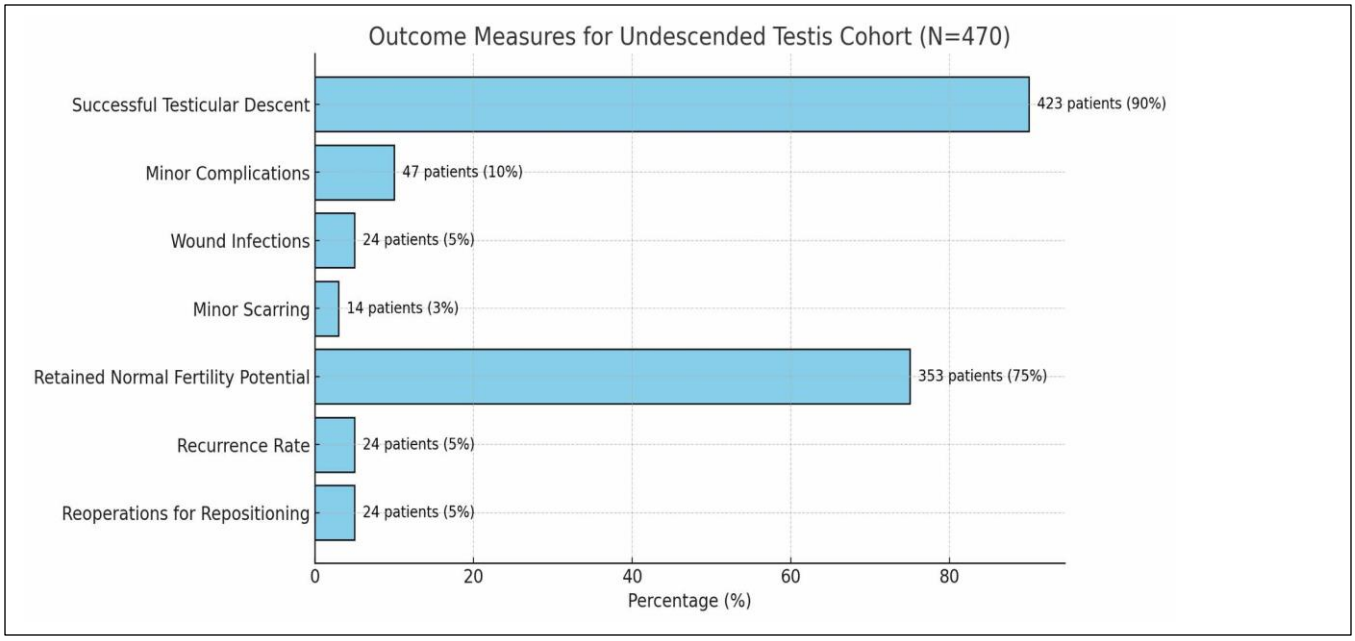

Figure 5; the histogram representing the outcome measures of our cohort. Each bar corresponds to the frequency percentage for a specific fate and complication.

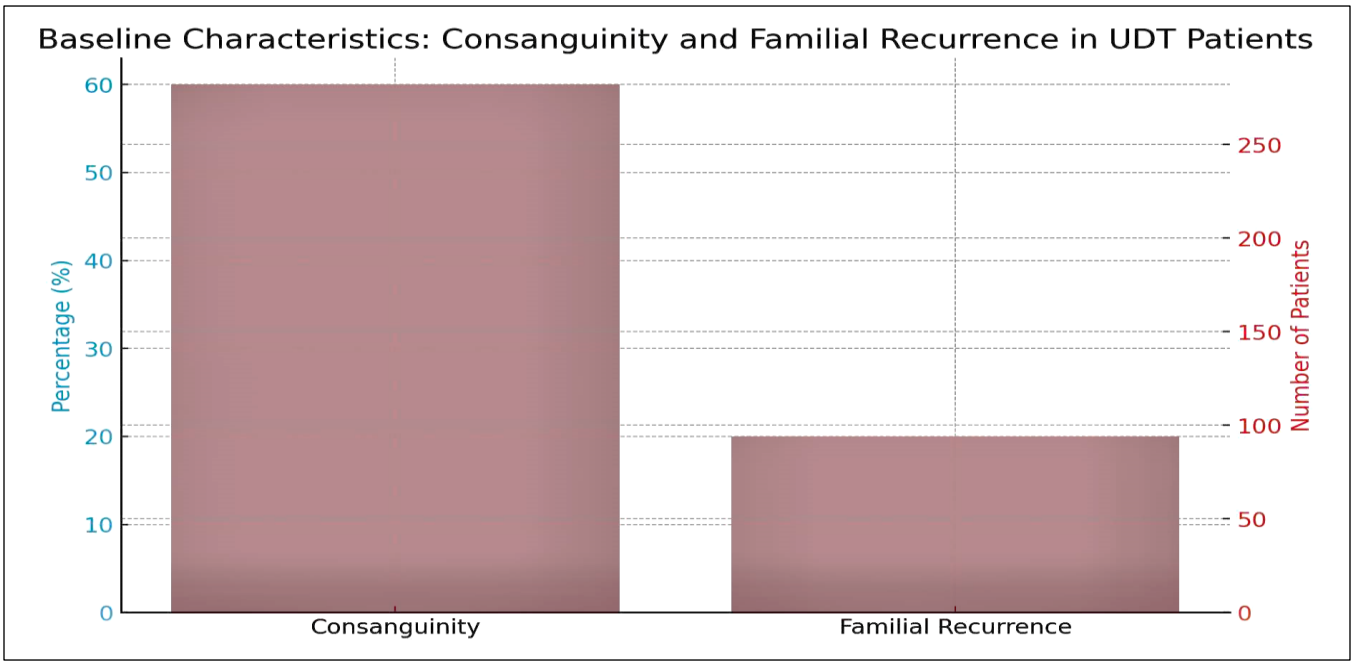

Figure 6; the chart indicate that the baseline characteristics of this study reveal two prominent findings in the patient population with undescended testis (UDT): a high rate of consanguinity (60%) and a significant rate of familial recurrence (20%).

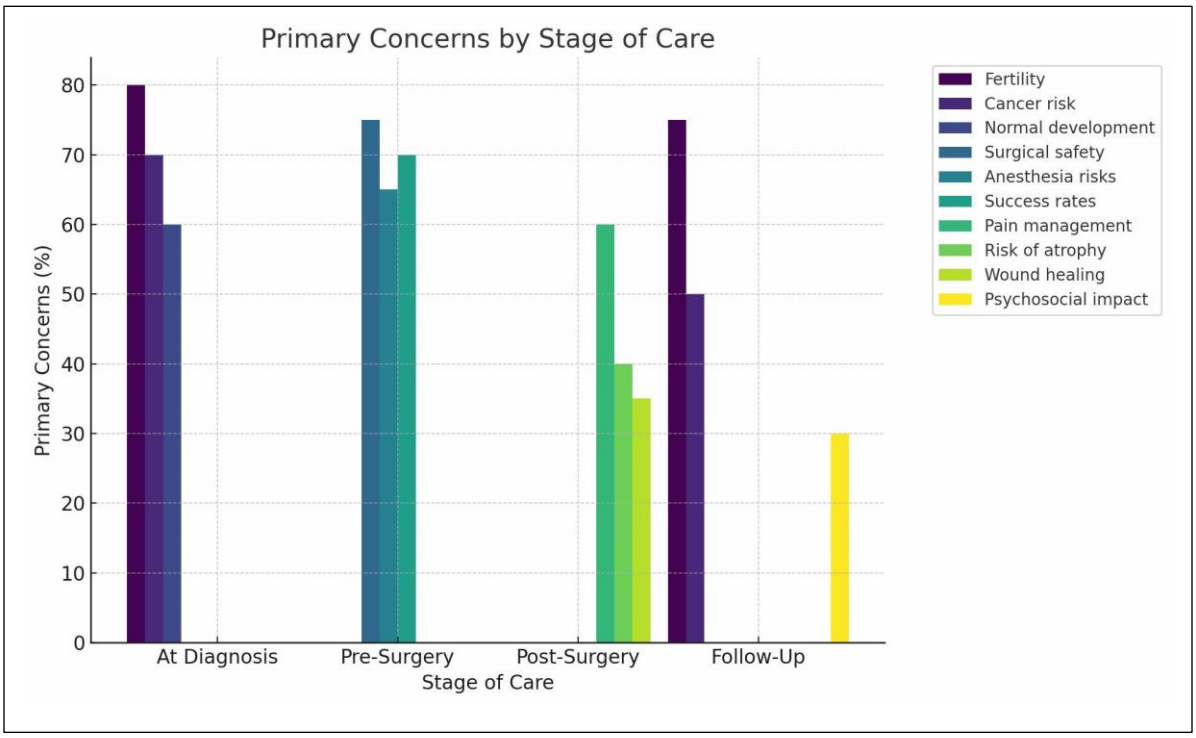

Figure 7; a histogram illustrating the primary family concerns by stage. Each stage (Diagnosis, Pre-Surgery, Post-Surgery, and Follow-Up) is shown with percentages of concerns such as fertility, cancer, safety, anesthesia, pain, wound healing, and psychosocial impact. This visual representation helps in understanding the predominant concerns families face at each stage and the relative frequency of each concern.

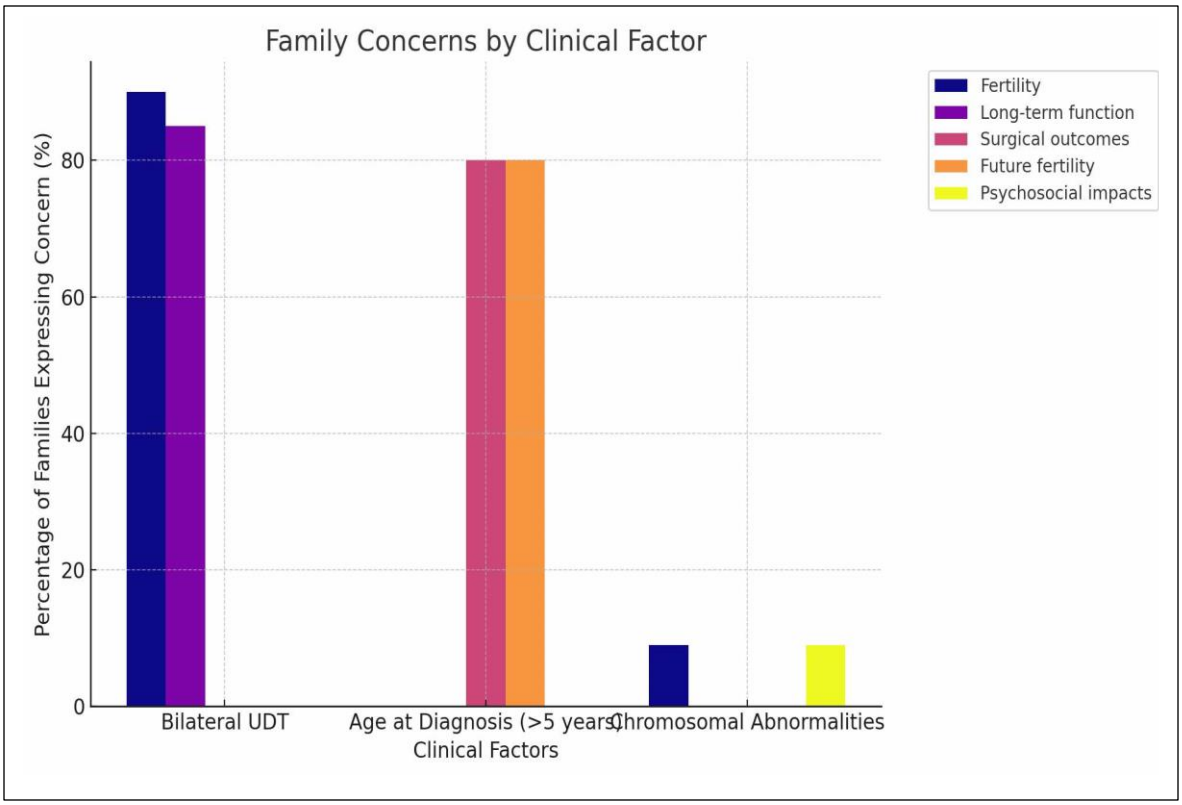

Figure 8; this histogram illustrates the primary family concerns associated with different clinical factors. Each color represents a specific concern, with bars indicating the percentage of families expressing that concern for each clinical factor. This visual helps to compare the concerns for bilateral undescended testis, age at diagnosis, and chromosomal abnormalities.

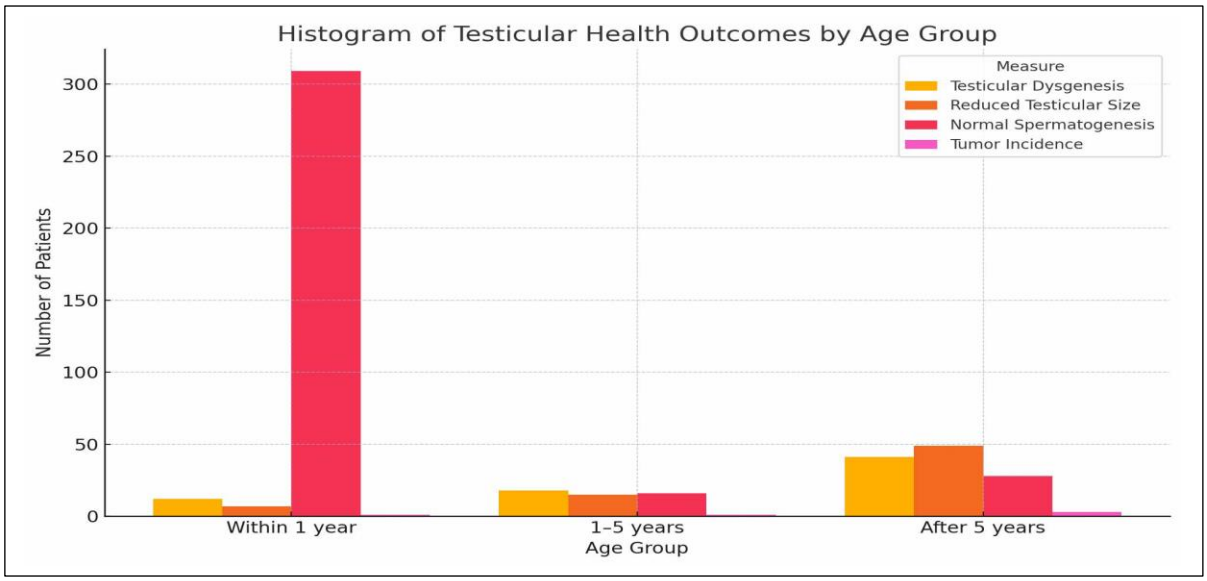

Figure 9; the histogram shows that testicular dysgenesis increases with age, from 12 patients within the first year to 41 patients after five years. Similarly, patients with reduced testicular size increased with age, with the highest count (49 patients) in the "After 5 years" group. The highest incidence of normal spermatogenesis occurs within the first year (309 patients), with a significant drop in the 1–5 years and after 5 years groups. Tumor incidence is minimal across all age groups, with slightly higher counts in the older age group.

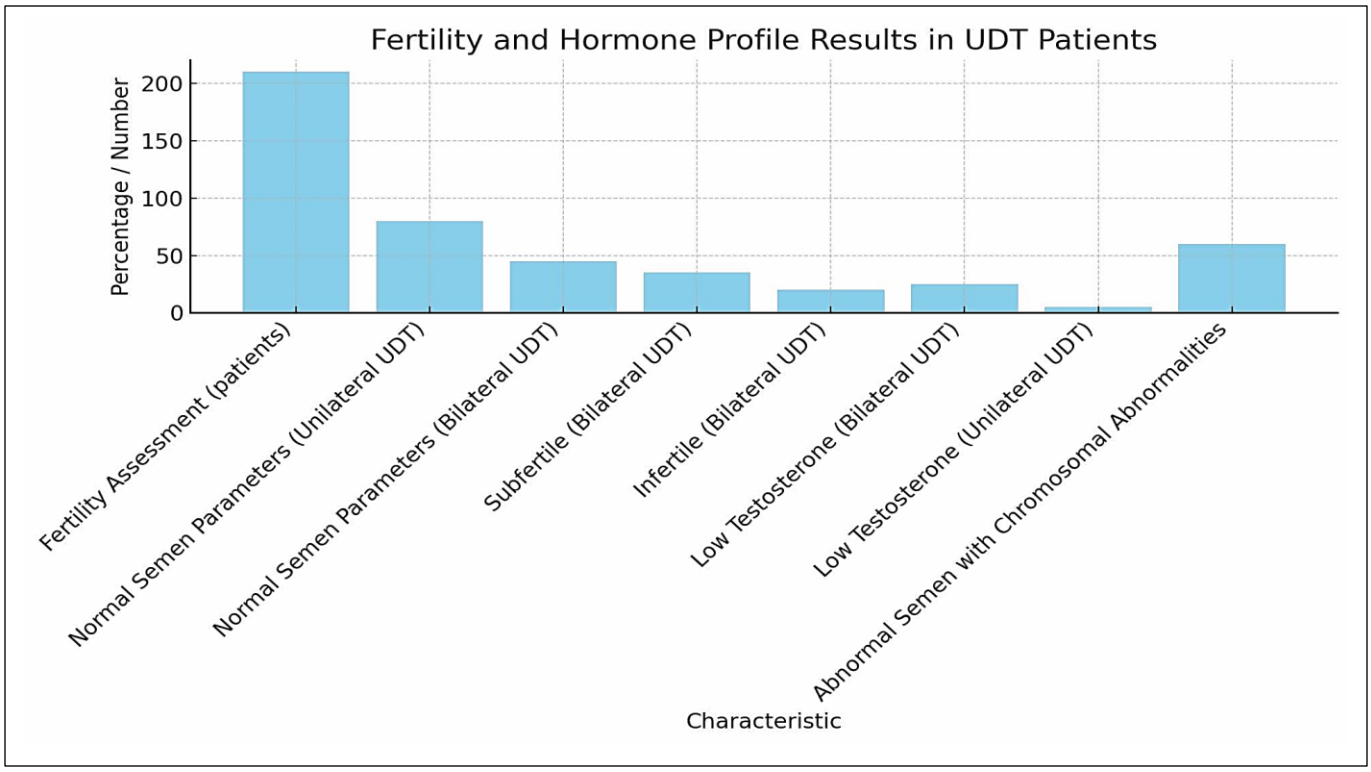

Figure 10; the histogram representing the fertility and hormone profile results for undescended testis (UDT) patients, showing the distribution across various parameters such as semen quality, testosterone levels, and correlation with chromosomal abnormalities.

DISCUSSION

This study offers valuable insights into a long journey experience managing undescended testis (UDT) in 470 pediatric patients. Our findings reveal both successes and challenges in the management of UDT, as well as underscore the significance of addressing family and patient concerns through consistent communication and support. Most UDT cases in our cohort were diagnosed within the first year of life (45%), with a mean age at diagnosis of 18 months. This early identification aligns with existing guidelines recommending prompt diagnosis and treatment to reduce potential risks associated with delayed intervention, such as compromised fertility and increased cancer risk **[7]**. However, 20% of cases were diagnosed after age five, often correlating with elevated parental concerns regarding long-term outcomes. This highlights the need for enhanced awareness among healthcare providers and families to ensure timely diagnosis and intervention.

Surgical success was achieved in 90% of cases, with effective testicular descent and minimal complications, indicating that early surgical intervention for UDT remains highly effective. Minor complications, including wound infections and minor scarring, were consistent with the anticipated risks for this population and were generally well-managed. The recurrence rate of 5% necessitating reoperation aligns with findings from similar studies, suggesting that while initial surgery is successful for most patients, a subset may require additional surgical correction **[8& 9]**.

In our cohort, the inguinal position is the most common, followed by superficial inguinal, supra-scrotal, and pre-scrotal positions. Positions like pre-penile, femoral, and perineal are relatively rare. The prevalence of inguinal UDTs is consistent with other studies that show that the inguinal region is commonly affected in cases of undescended testes, suggesting a standard point of arrest in testicular descent **[10]**. This distribution may reflect the anatomical and developmental patterns of testicular descent, with certain positions being more common due to incomplete descent in the abdominal or inguinal region **[10& 11]**. These unusual sites likely result from substantial deviations in the descent pathway, where the testes do not follow the usual anatomical route. Genetic abnormalities, aberrant gubernacular development, or external factors may lead to these atypical positions **[12& 13]**. Cases in these locations are challenging to manage surgically and may carry additional risks for long-term complications.

Long-term fertility outcomes were promising, with 75% of patients retaining normal fertility potential upon follow-up. However, the unique factors within our community, such as genetic and environmental influences, may alter the percentages seen in each position **[14& 15]**. In some regions, awareness of UDT and its potential complications may be low, leading to delayed diagnosis and a higher number of cases in less common positions (e.g., abdominal or femoral) [ ]. Laparoscopic exploration may be required for cases involving abdominal UDT, while open orchiopexy is generally sufficient for inguinal cases **[16& 17]**. Health-seeking behavior influenced by cultural beliefs or a lack of understanding about the importance of early treatment may also play a role in the observed distribution. In summary, this distribution of UDT positions is multifactorial, involving genetic, environmental, and community-specific factors. The predominance of left-sided UDT in this study suggests a potential asymmetry in testicular descent mechanisms, which may warrant further investigation.

One significant challenge identified was the delayed diagnosis in 20% of patients. This subgroup, diagnosed after age five, exhibited heightened concerns about fertility and psychosocial effects, suggesting that families and patients may experience increased anxiety when diagnosis and treatment are delayed.

Surgical timing played a role in family satisfaction, with families of patients receiving early intervention reporting lower anxiety levels compared to those with late diagnoses. These findings indicate the importance of prompt management, which not only optimizes physical outcomes but also mitigates psychological impacts on patients and their families **[18& 19]**. Another challenge was managing family concerns around minor postoperative issues such as scarring and infection, which required additional reassurance. These minor complications did not negatively affect long-term outcomes but did increase the

need for follow-up consultations, highlighting the importance of setting realistic expectations preoperatively and providing clear postoperative care instructions.

Throughout the stages of care, family concerns varied in focus. At diagnosis, the primary concerns centered on fertility, cancer risk, and normal growth and development. This aligns with the common parental fears about the long-term repercussions of UDT and underscores the critical role of initial consultations and educational interventions **[20-23]**. Concerns shifted in the pre-surgery phase to surgical safety, anesthesia risks, and procedural success, with the need for thorough preoperative counseling emphasized by the fact that 80% of families reported feeling reassured following these sessions.

In the postoperative period, primary concerns included pain management, wound healing, and testicular function. Satisfaction with follow-up care was high, though 20% of families requested additional monitoring, suggesting a desire for ongoing reassurance as their children recovered.

During follow-up, long-term concerns shifted back to fertility, and potential cancer risk, with 30% of families also voicing worries about the psychosocial impact on their children, including potential self-esteem issues. These findings suggest that while surgical success is critical, the need for comprehensive counseling and psychosocial support is equally important **[24&25]**.

Regarding the correlation between clinical factors and family concerns, families of patients with bilateral UDT exhibited greater concern about fertility (90%), and long-term function, reflecting the elevated risks associated with bilateral cases. Families may fear that bilateral UDT could lead to an inability to conceive, directly affecting the individual's role in the family lineage. The concern for long-term function is also significant. Families worry not only about fertility but also about the general functionality of the testes throughout life, including hormone production and normal development **[24, 25& 26]**. In communities with limited access to specialized pediatric care or endocrinology, there may be heightened anxiety about whether the testes will function normally long-term, especially without regular monitoring. This concern reflects a desire for assurance that medical intervention will ensure the normal functioning of the testes beyond just addressing fertility **[27&28]**. Similarly, families of children diagnosed after age five displayed heightened anxiety, with 80% seeking additional counseling, suggesting that early intervention is crucial not only for physical outcomes but also for managing family anxiety and expectations. Persistent fertility concerns across stages emphasize the need for healthcare providers to engage in clear, culturally sensitive discussions with families regarding the real impacts of UDT and the expected outcomes of treatment. Additionally, educating families on the low but real cancer risk and the importance of long-term follow-up could alleviate concerns and improve adherence to care recommendations, ultimately contributing to better long-term health outcomes for these patients **[29& 30]**.

Although UDT does pose a cancer risk, it is relatively low, especially if treated early. In communities with limited access to specialized healthcare information, there may be a general fear of cancer due to its life-threatening implications, leading families to be more concerned about cancer than necessary **[30,31&32]**. Misinformation or lack of understanding about the nuances of UDT-related cancer risk could explain the high initial concerns. Reliance on medical intervention for reassurance, the drop in cancer concerns post-surgery could reflect a perception that surgery effectively resolves the issue, both in terms of position and potential malignancy risk. However, this could indicate a gap in understanding that while surgery significantly reduces the risk, long-term follow-up is still important **[33& 34]**. This reliance on surgical intervention as a final solution might come from a cultural expectation that medical procedures offer definitive cures.

The analysis of chromosomal abnormalities in our cohort of undescended testis (UDT) patients revealed significant findings that warrant further exploration, particularly in the context of our community's unique genetic and social dynamics. This relatively high frequency may reflect a deliberate focus on identifying underlying genetic causes in patients with bilateral UDT, smaller testicular sizes, or poorer postoperative outcomes **[35]**. Families of patients with chromosomal abnormalities, though a smaller group expressed substantial concerns about both fertility and psychosocial impacts, indicating that these families may benefit

from specialized counseling and tailored follow-up. This correlation aligns with existing literature, suggesting that abnormal chromosomal patterns disrupt normal testicular descent and development **[36]**. The higher frequency of abnormalities in bilateral cases further emphasizes the importance of targeted genetic screening in these patients. Accordingly, routine chromosomal analysis should be considered for all patients with bilateral UDT, smaller testes, or poor surgical outcomes to identify potential genetic abnormalities early.

Our community's sociocultural and genetic practices may partly explain the observed results. High rates of consanguineous marriages, a common feature in this region, increase the likelihood of recessive genetic mutations and chromosomal anomalies **[37]**. This genetic predisposition could contribute to the relatively high percentage of chromosomal abnormalities observed in our UDT cohort compared to global averages. Furthermore, societal attitudes toward delayed medical consultation for conditions perceived as "not urgent" may have contributed to the late presentation in some cases, compounding the severity of associated complications **[37]**. Late diagnosis can lead to prolonged exposure of undescended testes to suboptimal conditions, exacerbating testicular damage and reducing the potential for successful interventions.

The process of sperm production can be severely affected in patients with untreated UDT, as prolonged retention of the testis outside the scrotum can damage germ cells **[38& 39]**. Early intervention is crucial for normal spermatogenesis, as the testicles require an optimal environment to support healthy sperm production. In our community, a delay in recognizing UDT and accessing treatment could severely affect fertility outcomes. Cultural beliefs, limited health education, and logistical barriers to pediatric care can contribute to delays, emphasizing the need for educational initiatives to inform parents about the importance of early diagnosis and its long-term impact on reproductive health **[40& 41]**. Our patients were followed, and evaluated at regular intervals (e.g., every 6 months for the first 2 years, then annually thereafter). This longitudinal follow-up allowed for the assessment of changes in sperm production, hormonal regulation, and testicular function over time.

Several limitations of our study must be acknowledged. We had incomplete fine needle aspiration (FNA) data, and we were unable to obtain FNA results due to technical errors or inconclusive readings. This hindered our ability to definitively assess spermatogenesis in some patients, which is a key aspect of our study. Fertility assessments were unavailable for all patients, limiting the analysis of long-term reproductive outcomes across the entire cohort.

Loss to follow-up; over the long duration of the study, some participants were lost to follow-up. As a result, their data could not be included in the final analysis, which may have affected the completeness of our findings. Non-response and missing interview data; some participants did not respond to our questionnaires or failed to attend scheduled interviews. This non-participation led to missing data, further limiting the breadth of our analysis.

Chromosomal Analysis Limited to a Subset: Only 30% (141 patients) underwent chromosomal testing, potentially underestimating the prevalence of abnormalities in the total cohort. Patients selected for chromosomal testing may represent a subgroup with more complex or bilateral presentations, skewing the observed frequency of abnormalities (performed on a subset of patients due to resource constraints). Advances in genetic analysis over the 20-year study period were not uniformly applied, potentially missing micro-deletions or other subtle genetic changes.

Single-institution data; the study was conducted at a single institution, which may limit the generalizability of our findings to other settings or populations. Different clinical practices or patient demographics in other institutions could yield different results.

Retrospective data collection; as a retrospective study, our data collection relied on previously recorded information, which may not have captured all relevant nuances, particularly about family concerns and patient history.

This limitation could affect the depth of insight into the full range of factors influencing outcomes. These limitations should be considered when interpreting our study results, as they may affect the generalizability and completeness of our conclusions.

CONCLUSION

This cohort study provides valuable insights into the management of UDT and family concerns, underscoring the importance of early intervention, thorough counseling, and ongoing support. Early presentation (within the first year) appears crucial for preserving normal testicular structure and function, particularly in maintaining normal spermatogenesis, which declines sharply with age. While tumor incidence remains low overall, the slight increase with delayed presentation warrants further study. These findings highlight the importance of early detection and intervention in patients with testicular abnormalities to optimize long-term health outcomes. Improved awareness and educational efforts for parents can help mitigate anxiety around surgical outcomes, long-term fertility, and psychosocial health impacts

The presence of chromosomal abnormalities was strongly associated with bilateral UDT, smaller testicular size, and poorer postoperative fertility outcomes. Specifically, patients with chromosomal abnormalities exhibited a higher frequency of infertility or subfertility, with abnormal semen parameters. These findings underscore the necessity of incorporating chromosomal analysis into the diagnostic workup, particularly for patients with bilateral UDT or atypical presentations.

ACKNOWLEDGMENT

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CONFLICT OF INTEREST

The authors declare no conflicts of interest regarding the publication of this manuscript. This study was conducted independently and without influence from any external parties, including funding organizations or commercial entities. All data collection, analysis, and interpretation were performed objectively, and the findings presented reflect the sole work of the author.

AUTHORS' CONTRIBUTIONS

The author designed the study, performed the statistical analysis, wrote the protocol, and wrote all the draft of the manuscript. The author managed the analyses of this study, the literature searches, read, and approved the final manuscript."

ETHICAL CONSENT

The research protocol was reviewed and approved by the Institutional Review Board (IRB) of [Ministry of Health-The Maternity and Child Teaching Hospital]. All patients or their legal guardians provided written informed consent before inclusion in the study. Pediatric consent was obtained from their parents or legal guardians, ensuring that they were adequately informed about the study's objectives. Patient confidentiality was maintained throughout the study by anonymizing all data and using secure systems for data storage and analysis. No identifying information was used in the publication of results. This study involved no

experimental procedures beyond routine clinical management of undescended testis, including surgical intervention, fertility assessment, and postoperative follow-up. Chromosomal analysis and other diagnostic evaluations were performed as part of standard care when clinically indicated. By adhering to these ethical standards, we aimed to ensure the integrity of our research and the rights and welfare of the participants involved.

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