

The Role of Laparoscopy in Non-palpable Undescended Testicle: Analysis and Review of the Experience from Two Cities in Sudan

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Abstract

Introduction: It is estimated that 1%–2% of male infants have undescended testicles. The reliability of ultrasound (US) to identify the non-palpable undescended testicles (NPUDT) is controversial. Laparoscopy remains the gold standard to diagnose and manage NPUDT. **Objective:** The objective is to highlight the role of laparoscopy in the management of NPUDT in 2 cities from Sudan over the past decade. **Materials and Methods:** Patients presented to Gadarif Teaching Hospital and Almak Nimir University Hospital with NPUDT were assessed by clinical examination and US. The testis, when found during laparoscopy, was either brought down to the scrotum in a single or two-stage or removed depending on the findings. Data were collected and analysed. **Results:** Patients covered the age range between 18 months and 65 years. The average was 12.4. The majority, 94 (67.2%) patients were older than 5 years. The main presenting symptom was either bilateral or unilateral empty scrotum. In 12 (8.4%) patients, the main presenting symptom was primary infertility. US was done in 120 (86.6%) of the patients and failed to see the testis in more than half of them. A single-stage procedure in the form of laparoscopic search assisted with orchidopexy was achieved in 90 (62.9%) patients and orchiectomy in 13 (9.1%) patients, while in 12 (8.4%) patients the testis was not found. Other procedures were applied on the 28 (19.6%) patients who needed staged operation in the form of Fowler Stephen's, in bilateral cases, in 6 (4.2%) patients. Shehata's operation in nine patients (64%) and open orchidopexy for 8 (5.6%) patients. The post-operative complication was encountered in 14 (9.8%) of the patients in this group in the form of bleeding, vassal injury and testicular atrophy. **Conclusion:** Laparoscopy provides the most accurate interventional option for managing patients with NPUDT. Laparoscopic orchidopexy, whether single stage for low or 2-stages for high intra-abdominal testis, is a proven and effective extension of lap-search with minimal complications.

Keywords: Cryptorchidism, Gadarif, laparoscopy, non-palpable undescended testicle, Shandi, Sudan

INTRODUCTION

Cryptorchidism is a unilateral or bilateral failure of the testis to reach processus vaginalis or the scrotum by 10–12 weeks after term.^[1] It is considered to be one of the most common isolated congenital anomalies, and affects up to 30% of premature infants, and about 3% of full-term males.^[2,3] The abnormality may be unilateral or may affect both sides.^[4] Non-palpable undescended testicles (NPUDT) on clinical examination represent approximately 20% of all undescended testicles (UDT), intra-abdominal, inguinal and ectopic or absent all were the differential diagnoses of non-palpable testes. Twenty to forty per cent of non-palpable testes are absent upon surgical exploration^[5] atrophic or absent, mostly

may be due to in utero spermatic cord torsion and are located abdominally, inguinal or scrotal.^[6,7]

Multiple risks factors contribute to the causes behind the UDT, with premature infants at the top. Additional factors include low birth weight for gestational age, and family history which has been associated with genetic mutation likely incriminated.^[8,9] Infertility, testicular trauma, torsion and cancers are the main major and serious complications of cryptorchidism.^[10-12] Several studies showed that as long as the testes remain undescended, fertility parameters decrease.

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On the other hand, the risk of change to malignancy can be greatly reduced by performing orchiopexy before puberty to preserve germ cell loss or reverse and decrease the risk of cancer development. The optimum recommended time for surgery is to between 6 months and 1 year of age.^[13,14]

The use of ultrasound (US) for non-palpable testis is debatable because of its low sensitivity and specificity of approximately 45% and 78%, respectively,^[15-17] and the US does not exclude the necessity for laparoscopy.^[18-20] US used to localise the testis is of little value.^[15] On the other hand, US for non-palpable testis may be justified by cheap non-radiation procedure as well as in few cases may preclude need for laparoscopy if intracanalicular testis.^[21]

Surgery for UDTs generally to achieve three goals, either to bring viable testis down to the scrotum or removal of non-viable testis or finally to confirm the absence of testis.^[22] Laparoscopy is the gold standard preferred clear diagnostic and definitive therapeutic procedure.^[23,24]

MATERIALS AND METHODS

This is a hospital-based, prospective and observational analytic study including all patients who presented with NPUDT in the study areas during 2010–2020. All the patients underwent laparoscopic search for NPUDT then proceeded to different types of operations following the findings.

Study area

This study was conducted in 2 major Sudanese cities outside the capital Khartoum. Started in January 2010 in Gadarif, Eastern Sudan, joined by Shandi, Northern Sudan, in 2015 through to December 2020.

Gadarif is 410 km to the east from Khartoum, the capital of Sudan. It is located near the border with Ethiopia. Gadarif Teaching Hospital is a 170-bed tertiary care facility that serves as a referral centre in Gadarif State. Laparoscopic surgery was introduced in 2006, and the 1st laparoscopic search for NPUDT was performed in January of 2010.

Shandi is one of the major cities in Nahr-Elneel State, Northern Sudan, situated on the east bank of the River Nile 150 km north of Khartoum, inhabited by around 0.7 million residents, mainly farmers. Almak-Nimir is a University Hospital with

a total of 300 beds. Laparoscopic surgery was introduced in 2016, while the 1st laparoscopic search for NPUDT was done in January 2017.

Data collection

The data were collected in a master sheet including patients’ demographics, clinical presentation, symptoms, signs, pre-operative ultrasonography, operative findings and post-operative complications.

Inclusion criteria

All patients who underwent laparoscopic procedure for NPUDT.

Exclusion criteria

No patients who presented with an NPUDT were excluded from this study.

Statistical analysis

The data were analysed using the Statistical Package for the Social Sciences software (SPSS, SPSS Inc, IBM Corp, Armonk, NY), version 22.0. Frequency tables and percentages were generated for all the major parameters.

Ethical approval

The study received ethical approval from the Research Board at the Faculty of Medicine, University of Gadarif, Sudan and Shandi University Ethical Committee. Informed patient consent was obtained. Patient data were reserved confidential and used only for research purposes.

RESULTS

In this study, 143 included patients with UDTs who underwent 169 procedures. The age range was between 1½ and 65 years with an average of 12.25 years and a standard deviation of 11.86 years. The largest group was those under 5 years old in 49 patients accounting for (34.3%), and the smallest group size was 1 (0.7%) patient which was found in the age ranges of 41–45 and 56–60. Two (1.5%) patients were found in the age range 36–40 and the age group above 60 years old. There were no patients in the 46–55 years age group [Figure 1].

While the majority, 125 (87.4%), of patients presented complaining of either right, left or bilateral empty hemi-scrotum, there were 12 patients (8.4%) who were discovered to have

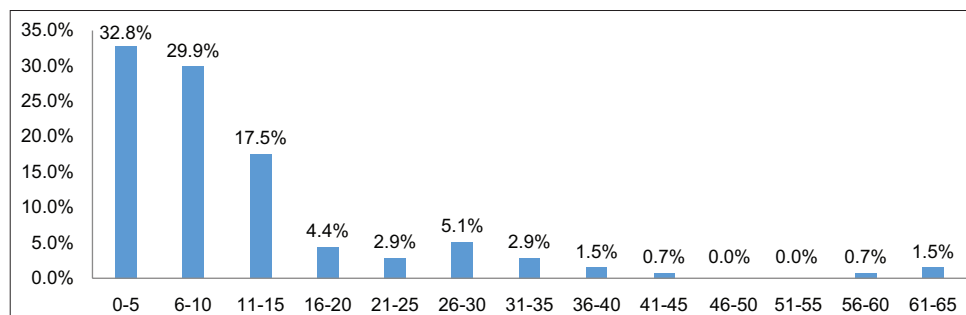


Figure 1: Distribution of patients among age groups

empty scrotum during workup for infertility. At the time of presentation, the NPUDT was more common on the left side, 60 patients (42%), followed by bilateral in 42 (29.4%) patients and on the right in 41 (28.7%) of the patients [Figure 2].

US was done on 120 (83.9%) of our patients. UDT was detected intra-abdominally in 45 (31.5%) patients, one seen and the other not-seen in 10 (7%), and both testicles were seen intra-abdominally in 1 (0.7%). It was unable to visualise the UDT in 64 (44.8%) patients [Table 1].

A single-stage lap-assisted procedure was performed on 115 (80.4%) patients while 28 (19.6%) patients required a second-stage operation. The single-stage procedures were successful in mobilising a low intra-abdominal testis and fix it down into the scrotum for 90 (62.9%) patients, of whom 2 (1.4%) patients were found to have Crossed testicular ectopia (CTE) and underwent laparoscopic mobilisation and then trans-septal orchidopexy.

In 12 (8.4%) of the patients, the UDT was not found during the lapsearch procedure. Seven (7%) of them were labelled as testicular agenesis as there was no detected evidence of gonadal vessels, while the other 5 (3.4%) were labelled as vanishing testis as the vas deference and gonadal vessels were ending blindly at the internal ring.

Unilateral orchidectomy was performed on 13 (9.1%) of the patients. Three (2.1%) of them had bilateral UDT underwent an orchidopexy in on side and orchietomy on the other side. Ten (7%) patients, who are all above 35 years of age, with an intra-abdominal unilateral UDT which is atrophied, had orchietomy straightaway.

A 2nd stages lap-assisted procedure was required for 28 (19.6%) of the patients as the testis was high intra-abdominal and could not be brought down to the scrotum in a single stage. They, whether unilateral or bilateral, were dealt with according to the intraoperative findings, degree of mobility and length of the gonadal vessels.

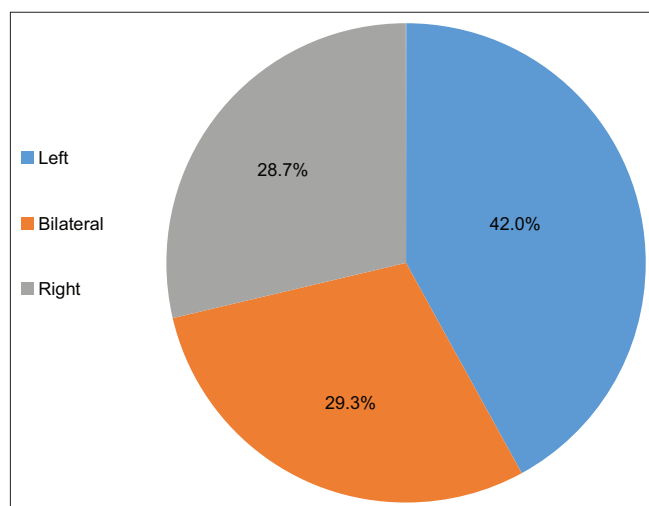


Figure 2: Site of NPUDT

Fowler Stephan’s Operation (FSO) was performed for 11 (7.7%) patients, where gonadal ligation or clipping and division in the 1st stage. Three months later, the testis can be brought down to the scrotum depending on the artery to the vas for the blood supply. Shehata’s operation, describes as gradual controlled traction (GTC), by fixing the testis with a non-absorbable suture to the contralateral anterior abdominal wall in the 1st stage and a lap-assisted orchidopexy was achieved in the 2nd stage was performed on 9 (6.3%) of the patients. In the remaining 8 (5.6%) patients, the testis was mobilised and fixed in the superficial inguinal pouch then underwent open orchidopexy after 8–12 weeks.

The total of bilateral cases performed in 2 stages, was 6 (4.2%) patients. FSO was done bilaterally in 2 (1.4%) patients, FSO in 1 side and lap-assisted orchidopexy on the other 3 (2.1%) and in 1 (0.7%) patient we did an FSO on 1 side combined with GTC on the other side [Table 2].

Follow-up of all patients ranged from 2 to 20 weeks, with an average of 11 weeks. Less than 50% of them showed up after 3 months. Post-operative complications were reported in 14 (9.8%) patients in form of: Significant bleeding and cut vas in single (0.7%) patient for each and testicular atrophy in 12 (8.4%) patients [Figure 3].

Table 1: The ultrasound reporting of 120 out of 143 patients with nonpalpable undescended testicle

US detection of UDT	n (%)
Intra-abdominal (unilateral NPUDT)	45 (31.5)
Not visualised	64 (44.7)
One seen other not (Bil NPUDT)	10 (7)
Both intra-abdominal (Bil NPUDT)	1 (0.7)
Not done	23 (16.1)
Total	143 (100.0)

US: Ultrasound, UDT: Undescended testicle, NPUDT: Nonpalpable UDT

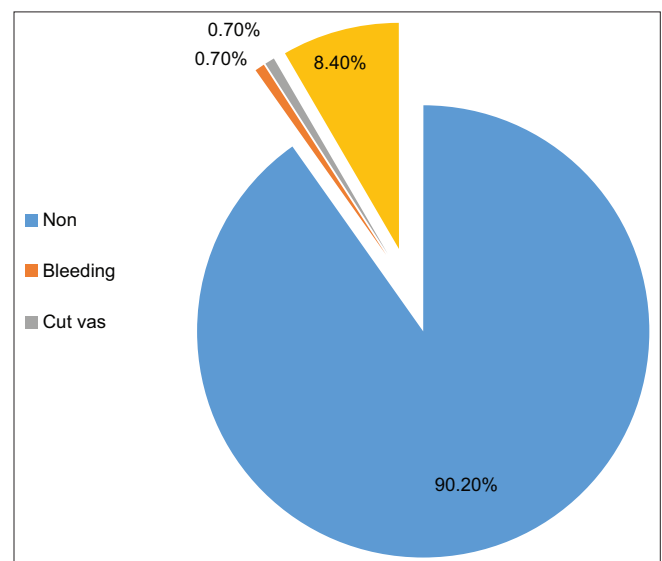


Figure 3: Distribution of complications among 143 patients

Table 2: Distribution of surgical procedures among 143 patients

Procedure	n (%)
Single stage (n=115; 80.4%)	
Orchiopexy (n=90; 62.9%)	
Lap-assisted orchidopexy	88 (61.5)
Trans-septal for CTE	2 (1.4)
Orchiectomy (n=13; 9.1%)	
In bil UDT: 1 side + Orchidopexy the other side	3 (2.1)
Straightaway in unilateral UDT age >30 years	10 (7)
Not found (n=12; 8.4%)	
Agenesis	7 (5)
Vanishing	5 (3.4)
2 Stages (n=28; 19.6%)	
Unilateral UDT (n=22; 15.4%)	
Shehata's	9 (6.4)
Fowler Stephan's	5 (3.4)
Fixed in superficial inguinal pouch	8 (5.6)
Bilateral UDT (n=6; 4.2%)	
Fowler Stephan's + Orchidopexy	3 (2.1)
Bilateral Fowler Stephan's	2 (1.4)
Fowler Stephan's + Shehata's	1 (0.7)
Total	143 (100)

CTE: Crossed testicular ectopia, UDT: Undescended testicle

DISCUSSION

There is increased evidence in recent literature that orchidopexy before the age of 1 year significantly improved the growth and function of UDT.^[25,26] Progressive negative histological impact on Leydig cells, and development of germ cells, increases the risk of malignant transformation as long as the testis remains undescended after the age of 12 months. While the optimal timing of orchiopexy has been recommended to be between 6 months and 1 year old,^[14,27,28] Huston in 2013 advised early correction as early as 3–9 months of age, as germ cell loss commences at 3–6 months in UDT.^[29]

During the study, we encountered patients ranging from 18 months to 65 years of presentation, with an average age of 12.4 years and a median of 8 years. Ismail *et al.*, in their series of 64 patients, the median age was 4.6 years.^[30] In another study from Saudi Arabia, the median age of presentation was 13.7 months, and the median age at the time of orchiopexy was 25 months.^[31] In our study, the situation is completely different, the majority of our patients, 96 (67.6%), presented after 5 years of age. Even more, for those who presented before 5 years and the youngest child was 18 months old [Figure 1]. Different factors attributed to the late presentation of UDT. Strong social believe that congenital anomalies are normal and are “God’s will” that should not be corrected. This may explain why 12 patients (8.4%) presented for the first time with failure to conceive in adulthood after 2 years of marriage and regular sexual activity. Mohamed and Randa in 2008 concluded that empty scrotum in adults is more prevalent than expected in their 104 patients studied in Khartoum.^[32] Another factor is that, for quite a long period of time, the optimum time for

orchiopexy was under debate,^[33] and numerous studies showed that the average age for orchiopexy at time of surgery is still above the recommended age.^[34,35] It has been reported that lack of awareness among population and lack of understanding of the guidelines to perform routine urological examination among health care providers are the main reasons for the delay.^[36,37] Our study was conducted in 2 of the Eastern and Northern main cities of Sudan where there still is shortage of paediatric surgeons and urologists. This makes such services limited to the capital, Khartoum. Despite this, the practice of laparoscopy by general surgeons available introducing it as a diagnostic and, later on, therapeutic tool in the management of NPUDT. Lots of work and health education among health-care providers, especially midwives and outstation general practitioners in primary health centres, is needed to raise the awareness of early post-natal referral to, at least, a surgeon. Bradshaw *et al.*, in their retrospective study done in the UK concluded that early orchidopexy is not yet achieved due to late referral from primary care centres. They also recommend earlier primary care referral directly from the routine post-natal check to a centre prepared and equipped to perform surgeries for this age group.^[38]

We found that 29.4% were bilateral NPUDT, this is consistent with the literature which reports it in 20%–30% of patients with cryptorchidism.^[1,5,34] Bilateral impalpable testes may be associated with other anomalies, such as prune belly syndrome, a posterior urethral valve, abdominal wall defects, or neural tube defects.^[39] In this study, there is one case of Prune Belly Syndrome, one case of down syndrome, and another case of hypospadias; disorder of sex development associated bilateral UDTs.

The only radiological examination done in this series was US; it was actually omitted in some of our patients. The high cost, non-availability and the requirement of general anaesthesia or sedation for children were the main reasons we did not perform a single computed tomography scan or magnetic resonance imaging on our patients, and instead proceeded directly to diagnostic/therapeutic laparoscopy. Moreover, there is no consensus regarding the efficacy of US imaging for patients with non-palpable testes, as the majority of the studies conclude that US is of little value for various reasons.^[6,15,18,20,21] Few studies recommend US as a diagnostic image for non-palpable testes.^[21] In two-thirds of our patients who had a pre-operative US examination, the testes were not visualised, and it was reported as intra-abdominal in the other third [Table 1]. This finding is consistent with the studies which did not recommend US as a diagnostic procedure.^[6,15,18,20,40]

Diagnostic laparoscopy is most often used for non-palpable testes, as it not only allows for the identification of an atrophic or absent testicle but it also provides an opportunity to perform an orchiopexy simultaneously should a viable testis be found. For non-palpable testes, laparoscopy is the gold standard preferred clear diagnostic and definitive therapeutic procedure agreed upon worldwide,^[24] but the variations were in the way

to bring the intra-abdominal testis to scrotum. Length of the testicular vessels, how far the testis from the scrotum and size and texture of the testis (atrophic or not) were the main factors in determining the operations.

Single-stage operation achieved the goal of surgical operation in almost 80% of our patients. In two-thirds of them, the testis was a low intra-abdominal “peeping testis” where a lap-assisted orchiopexy was performed.^[40] In this group, we encountered 2 cases of cross testicular ectopia (CTE) for whom we chose to perform a trans-septal orchidopexy.^[41] Orchidectomy was carried out in 8 patients in our series (5.8%) due to small atrophic testes. Two of them were having unilateral small atrophic testes who were between 10 and 15 years, while 6 were above 20 years. This is consistent with the literature which recommends orchidectomy for atrophic unilateral UDT.^[42,43] During laparoscopic search, we failed to identify a UDT in 11 (8%) of our patients, we labelled those with the blind-ending vessels and vas as complete atrophy “Vanishing” in five patients and when no vessels or vas were found as testicular agenesis in 6 patients. This was <15% which is reported in the literature.^[44,45]

Two-stage operations were performed on 28 patients (19.6%) where a 1st stage was done in different forms. Unilateral high intra-abdominal UDT was the majority. In the beginning of our series, we used to do judicious proximal mobilisation and fix the testis with a prolene 2-0 suture, tension free, in the superficial inguinal pouch when the inner inguinal ring is open, and then 3 months later, an open orchidopexy is performed. This was carried out in eight patients in which we observed 2 have developed testicular atrophy in the 2nd stage. We start doing laparoscopic GCT described by Shehata in 2008 in his preliminary report and demonstrated during The International Conference of Sudanese Association of Pediatric Surgeons in 2012.^[46] The laparoscopic assisted GCT was done in nine patients. On the other hand, five patients of the unilateral UDT group underwent 1st stage laparoscopic FSO.^[47] There were six patients who presented with bilateral NPUDT in whom laparoscopic FSO was performed. Bilaterally in 2 cases, in 1 side with orchidopexy to other side in 3 cases and in a single patient, we did FSO on side and Shehata’s Technique on the other side followed by 2nd stage 3–6 months later. Ghada and Ahmed suggested further studies comparing these known techniques in the laparoscopic management of relatively high UDT.^[36]

Elyas *et al.*, in their 2010 Systematic-Review, favoured 2 stages FSO as it appears to carry a higher rate of success than the single-stage approach.^[48] This was again augmented in 2018 by Chengjun *et al.* Meta-analysis, where they found that 2 stages FSO was better than 1 stage, and the 2 stage laparoscopic FSO is the first choice for treating high intra-abdominal cryptorchidism.^[49]

We encountered a low rate of post-operative testicular atrophy of 8.4% compared to the literature we reviewed. This can be understood if we consider the big number of more than 50%

of patients who quit follow-up after the 1st post-operative visit due to financial, cultural and psychosocial limitations in our country which is more marked in cities outside the capital.

Limitations

1. This study is a facility based, some patients are missed
2. Short duration and quitting post-operative follow-up to evaluate testicular atrophy, semen analysis and other complications.

CONCLUSION

Laparoscopy provides the most accurate diagnostic and interventional option for managing patients with NPUDT. Laparoscopic orchidopexy, whether single stage for low or 2-stages for high intra-abdominal testis, is a proven logical and effective extension of lapsearch with minimal complications.

Recommendation

Early referral and laparoscopy will improve the outcome in remote areas and a longer period of post-operative follow-up.

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Conflicts of interest

There are no conflicts of interest.

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