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Laparoscopic Orchidopexy after 4 Weeks of Testicular Traction with Preservation of Blood Supply: A New Concept for the Treatment of Intra-Abdominal Cryptorchidism: Original Article

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Abstract

Background: Testicular atrophy is recurrent after orchidopexy for intra-abdominal cryptorchidism due to damage to vessels. Fowlers-Stephens and Shehata methods proposed staged orchidopexy, but are still associated to a rate of atrophy greater than 10%. **Purpose:** We set out to present a new technique that preserves testicular vessels. Our study is aimed at investigating testicular vitality after surgery. **Patients and Method:** We reviewed files of boys who underwent orchidopexy for 2 years in our department. Those who have been operated for intra-abdominal cryptorchidism with the new technique and aged between 6 months and 14 years old were included in our study. We excluded boys who have been operated before 6 months and after 14 years old and those who did not respect their follow-up plane. Ultrasound (US) outcomes were used to measure testicular volumes and blood flow at each postoperative visit. The Sample population was divided into group A and group B representing testes that were followed respectively for 12 and 24 months. **Results:** 22 boys with 25 testes were included in our study; 11 testes in group A and 14 testes in group B. In each group, we noted a significant difference of UDT volumes from the third month after surgery with respective P-values <

0.05. There was no statistical difference between UDT and contra lateral testes volumes 12 months after surgery in group A and 24 months in group B with respective P-values of 0.07 and 0.72. All volume differential indexes were <27% and total volume lost by each testis was <80%. **Conclusion:** This method offers a new perspective in performing safe orchidopexy for intra abdominal undescended testes.

Keywords

Laparoscopy, Staged-Orchidopexy, Testicar Traction, Testicular Atrophy

1. Introduction

Orchidopexy for intra-abdominal testes (IAT) has constituted a big challenge for Pediatric surgeons because of shortness of testicular vessels to reach the scrotum [1]. Staged-laparoscopic orchidopexy has been adopted as a safe method to descend intra-abdominal testes into the scrotum [2]. Fowlers-Stephens method promoted ligation of collateral vessels and achieved orchidopexy after 6 to 12 months of latency [3]. Shehata preferred to preserve collateral vessels by simple traction of the testis for 12 weeks [4]. However, both techniques are associated with a high rate of testicular atrophy greater than 10% [5] [6]. It has always been the aim of surgeons to decrease this rate of testicular degeneration to a minimum. We present a new concept of orchidopexy that preserves testicular blood supply. The aim of our study was to do a clinical evaluation of this technique and demonstrate that testicular volumes increased significantly after surgery with satisfactory blood supply.

2. Methods

The procedure was explained to parents who gave their verbal consent to perform surgery. No particular consent statement was signed before surgery as staged-laparoscopic orchidopexy with previous methods was already implemented in our department for many decades. This method was approved by the Ethical committee of the First Affiliated Hospital of Gannan Medical University where this research was conducted. The method was carried out in accordance with relevant guidelines and regulations. Patient confidentiality was respected and the study was carried out only for scientific purposes. A preoperative Ultrasound (US) was asked for each patient and aimed to describe different sizes of the testis, the state of testicular vessels and blood flow. The testis was eligible for orchidopexy if it was not atrophic with vessels presenting a good blood flow. The procedure was done with the child lying in the supine position (**Figure 1**) and required 02 surgeons; 01 senior surgeon and his assistant. The assistant was responsible for holding the telescope. One umbilical port was created for the camera and two working ports were placed symmetrically at the junction of the para-umbilical and mid-clavicular lines. The position of working ports was adjusted

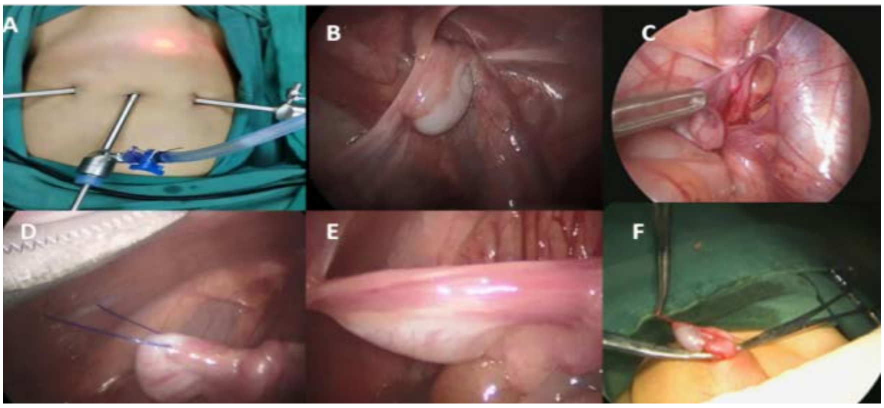

Figure 1. Description of surgical process. (A) Ports disposition, (B) Low intra-abdominal testis, (C) Dissection of the gubernaculums testis, (D) The testis is fixed at the contra lateral abdominal wall, (E) Elongation of testicular vessels, (F) orchidopexy after 4 weeks.

according to the side of the UDT and the dominant member of the surgeon. 7 - 10 bars of Carbon dioxide were insufflated according to the child's age and weight. The surgeon used an endoscopic forceps to expose the testis and pull the gubernaculum testis to release it from the surrounding peritoneum before being excised with an endoscopic knife under coagulation control. The testis was stretched towards the contra lateral internal ring; if it could not reach this ring, it was judged too short to reach the scrotum and eligible for staged-Orchidopexy. There was no ligation of collateral vessels, nor dissociation of spermatic vessels to avoid testicular blood flow decrease due to vessels damage [6] [7]. Then the surgeon redressed the needle of a nylon suture and did a trans abdominal puncture at the lateral point that was previously chosen to fix the testis according to the length of testicular vessels. He received the needle in the abdominal cavity with a needle driver and with the forceps from another hand; he presented the gubernaculum testis tunica and inserted the needle. He returned this needle outside through another point closed to the first puncture site and did an extra corporal hand knot after a small sub dermal incision in order to keep this knot under the skin. The 03 ports were removed after de-insufflation followed by wounds dressing and the child was observed in the hospital for 02 days. The second stage was done laparoscopically after 4 weeks. Ports insertion and insufflation followed the same procedure. The nylon suture was cut in the abdominal cavity with an endoscopic knife and the testis was released in the pelvis. The suture was removed extra corporally through a new incision on the previous scare and this incision was covered with one suture knot using a vicryl 3/0. With forceps, the surgeon did a blind dissection through the ipsilateral inguinal canal to the scrotum. A small incision was made at the button of the scrotum and the testis was passed through this incision and pulled out. Then the testis was fixed under the dartos with a polydioxanone suture 4/0 and the incision was closed with the same suture. The de-insufflation was done followed by wounds dressing and the child stayed on admission for 02 days. A post operative counseling was done before discharge. Each testis was followed with regular US control planned at 1, 3, 6, 12, 24 months and each year after surgery for early detection of testicular sufferance and atrophy.

We retrospectively retrieved files of patients who underwent orchidopexy with this method in our department from January 1st, 2019 to December 31st, 2020 and we followed this cohort until December 31st, 2021. We included in our study, patients who met the following criteria:

- Be diagnosed for intra-abdominal undescended testis
- Present an US result before surgery
- Be operated between 6 months and 14 years old.
- Undergo both operations in Pediatric Surgery Department.
- Present US control results at 1, 3, 6, 12 or 24 months after surgery that described testicular sizes and blood flow.

We excluded boys who underwent orchidopexy with open surgery or laparoscopic orchidopexy before 6 months and after 14 years old and those who did not respect their follow-up plane.

We divided the sample size into 2 groups: group A constituted of testes that were followed for 12 months and group B for those that were followed for 24 months. We calculated the volume of each testis using its length (L), width (W) and height (H) with the Lambert's formula $V\text{ (ml)} = L \times W \times H \times 0.71$. We called the time before surgery 0 and 1, 3, 6, 12, 24 months represented the period of postoperative visits. In each group, each testicular outcome constituted one series. For each outcome, we got a number of series corresponding to the number of testes in this group. We assessed the growth of the testis by comparing the volume of UDT before surgery to the volume at each postoperative visit. We compared also the mean volume of UDT to the mean volume of contra lateral testes at 12 months in group A and 24 months in group B. The Volume Differential Index (VDI %) and Total Volume Lost (TVL %) were used to investigate testicular atrophy. We used VDI for monorchidism (VDI = $[(Vclt - Vudt) \times 100]/Vclt$) and TVL for bilateral UDT (TVL = $[(V_0 - Vudt) \times 100]/V_0$). *Vudt was the Volume of undescended testis, Vclt was the Volume of contra lateral testis and V_0 was Testicular Volume before surgery.* There was atrophy if VDI > 27% and TVL > 80%.

The results were analyzed with Excel software 2021 and we drew figures with Graph pad 8. All values were calculated with a significant threshold $P < 0.05$.

3. Results

3.1. Demographic Data

Twenty two (22) patients met inclusion criteria in our study with a total number of 25 testes. 13 UDT (59%) were on the right side, 6 on the left side (27%) and 3 were bilateral (14%). Four (4) testes (14%) were located high and 21 testes (86%) were located low in the abdomen. In group A, we had 10 patients and 11 testes (1 bilateral UDT) while in group B, we had 12 patients with 14 testes (2 bilateral UDT). All patients were operated by the same surgeon and US was done by 2 operators. All patients were discharged 2 days after surgery both for the first and the second stage. The mean age of our sample was 36.16 ± 18.96 months (Mean ± Standard Deviation) with a median at 27 months.

3.2. Investigation of Testicular Atrophy and Other Complications

The mean Volume of UDT in group A increased from 0.35 ± 15 ml before surgery to 0.68 ± 0.25 ml at 12 months after surgery (Table 1). No statistical difference was observed with UDT volumes 1 month after surgery. A statistical difference was observed from the third to the twelfth month with $P < 0.05$. In group B, the mean volume of UDT increased from 0.24 ± 11 ml before surgery to 0.65 ± 0.24 ml after surgery (Table 2). No statistical difference was observed with UDT volumes 1 month after surgery. A statistical difference was observed from the third to the twenty fourth month with $P < 0.01$. For monorchidism, the mean Volume of UDT at 12 months in group A was 0.64 ± 0.25 ml and the mean Volume of contra lateral testis was 0.70 ± 0.27 ml (Table 3) with P-value = 0.07. In group B, the mean Volume of UDT at 24 months was 0.65 ± 0.24 ml and the mean Volume of contra lateral testis was 0.63 ± 0.15 ml (Table 4) with P-value = 0.72. There was no statistical difference of volumes between UDT and contra lateral testes at 12 and 24 months respectively in group A and group B. For bilateral UDT, the mean volume of testes before surgery in group A was 0.29 ± 0.11 ml, this volume increased after surgery to 0.89 ± 0.11 ml (Table 5), with P-value = 0.03. The mean volume of bilateral UDT in group B before surgery was 0.25 ± 0.05 ml and increased after surgery to 0.61 ± 0.18 ml, with P-value = 0.02. We also noted a statistical difference between volumes of bilateral UDT before surgery and volumes at 12 and 24 months respectively in group A and

Table 1. Comparison of UDT volumes (ml) before and after surgery in group A.

Testes	Months				
N = 11	0	1	3	6	12
1	0.58	0.67	0.65	0.68	0.70
2	0.15	0.18	0.37	0.45	0.54
3	0.37	0.35	0.37	0.42	0.47
4	0.26	0.31	0.84	0.87	0.94
5	0.60	0.98	0.91	1.08	1.15
6	0.21	0.10	0.22	0.35	0.46
7	0.28	0.43	0.40	0.40	0.41
8	0.43	0.38	0.43	0.45	0.54
9	0.43	0.32	0.41	0.47	0.54
10	0.21	0.78	0.82	0.86	0.99
11	0.37	0.67	0.69	0.72	0.79
MV ± SD	**0.35 ± 0.15**	**0.47 ± 0.27**	**0.56 ± 0.16**	**0.61 ± 0.18**	**0.68 ± 0.21**
	P = 0.11	P = 0.02	P < 0.01	P < 0.01	

Table 2. Comparison of UDT volumes (ml) before and after surgery in group B.

Testes	Months					
N = 14	0	1	3	6	12	24
1	0.15	0.16	0.19	0.26	0.31	0.40
2	0.13	0.16	0.16	0.17	0.33	0.49
3	0.22	0.20	0.25	0.34	0.39	0.45
4	0.31	0.19	0.27	0.31	0.39	0.47
5	0.17	0.21	0.47	0.55	0.82	1.04
6	0.14	0.34	0.45	0.50	0.53	0.57
7	0.15	0.12	0.13	0.28	0.29	0.64
8	0.31	0.32	0.37	0.43	0.51	0.57
9	0.53	0.36	0.53	0.67	0.84	1.09
10	0.31	0.50	0.56	0.62	0.67	0.72
11	0.22	0.39	0.40	0.36	0.48	0.51
12	0.21	0.29	0.33	0.38	0.40	0.72
13	0.31	0.37	0.41	0.43	0.44	0.46
14	0.24	0.26	0.29	0.35	0.47	0.84
MV ± SD	**0.24 ± 0.11**	**0.28 ± 0.11**	**0.34 ± 0.14**	**0.40 ± 0.14**	**0.49 ± 0.17**	**0.64 ± 0.22**
	P = 0.25	P < 0.01	P < 0.01	P < 0.01	P < 0.01	

Table 3. Volume differential index (VDI) at 12 months after surgery in group A.

Testes	Testicular volume at 12 months in group A		
N = 9	*VCLT* (ml)	*VUDT* (ml)	VDI (%)
1	0.85	0.70	17.65
2	0.48	0.54	−12.5
3	0.57	0.47	17.74
4	1.07	0.94	12.15
5	1.15	1.15	0
6	0.43	0.46	−6.98
7	0.47	0.41	12.77
8	0.73	0.54	26.02
9	0.54	0.54	0
MV ± SD	**0.70 ± 0.27**	**0.64 ± 0.25**	**7.41 ± 12.10**
		P = 0.07	VDI < 27%

group B. The mean volumes of UDT increased at each post-operative visit in both groups as shown in **Figure 2** & **Figure 3**. All volume differential indexes (VDI) calculated in both groups were less than 27% (**Table 3** & **Table 4**) and the total volume lost (TVL) by each testis in bilateral UDT at 12 months for group

Table 4. Volume differential index (VDI) at 24 months in group B.

Testes	Testicular volume at 24 months in group B		
N = 10	*VCLT* (ml)	*VUDT* (ml)	VDI (%)
1	0.54	0.40	25.9
2	0.62	0.49	20.97
3	0.58	0.45	22.41
4	0.45	0.47	−4.44
5	0.72	1.04	−44.44
6	0.42	0.57	−35.71
7	0.76	0.65	14.47
8	0.57	0.57	0
9	0.93	1.09	−17.20
10	0.68	0.72	−5.88
MV ± SD	**0.63 ± 0.15**	**0.65 ± 0.24**	**−2.39 ± 24.42**
		P = 0.72	VDI < 27%

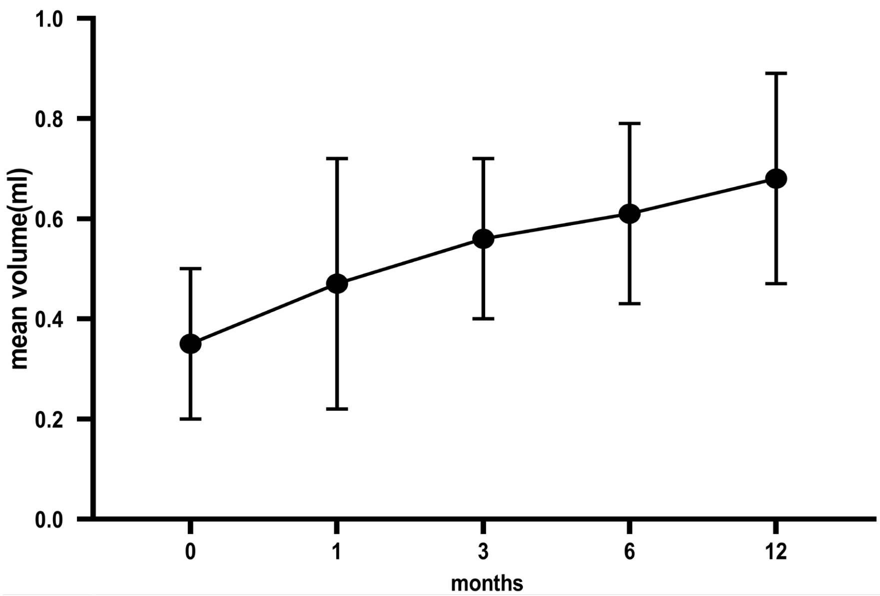

Figure 2. Evolution of the mean UDT volume at each visit in group A. —●— Mean UDT volume ± Standard deviation.

A and 24 months for group B were less than <80%. It does mean that, in each group, volumes of bilateral UDT increased after surgery. No testicular atrophy was detected during our investigation. Testicular vitalities were confirmed by the presence of satisfactory blood flow as shown in Figure 4 & Figure 5. After review of all medical and US reports before and after surgery, no patient presented clinical complications such as operative site infection, scrotal hematoma, slippage, intestinal obstruction, retraction or testicular atrophy.

Table 5. Total volume lost (TVL) in group A and group B.

Testes	Bilateral UDT volumes before surgery, at 12 and 24 months after surgery			
N = 6	V_0 (ml)	V_{12} (ml)	V_{24} (ml)	TVL (%)
Group A				
1	0.21	0.99	-	**−371.43**
2	0.37	0.79	-	**−113.51**
Group B				
1	0.22	-	0.51	**−131.81**
2	0.21	-	0.72	**−242.86**
3	0.31	-	0.46	**−48.39**
4	0.24	-	0.84	**−250**
				TVL < 80%

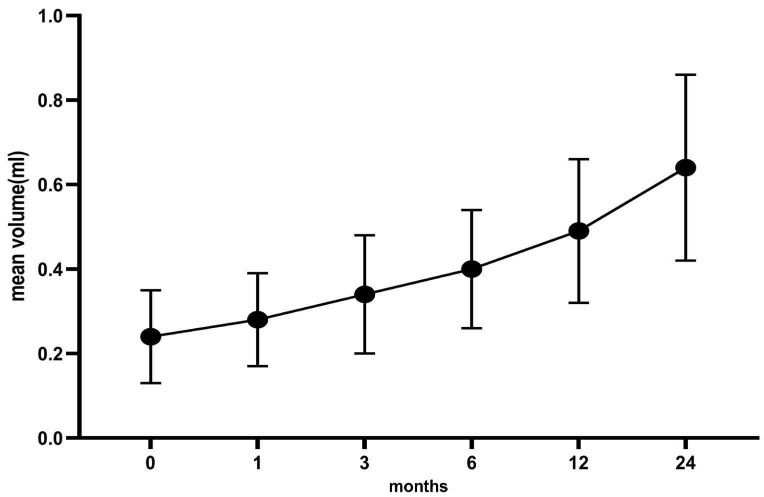

Figure 3. Evolution of the mean UDT volume at each visit in group B. —●— Mean UDT volume ± Standard deviation.

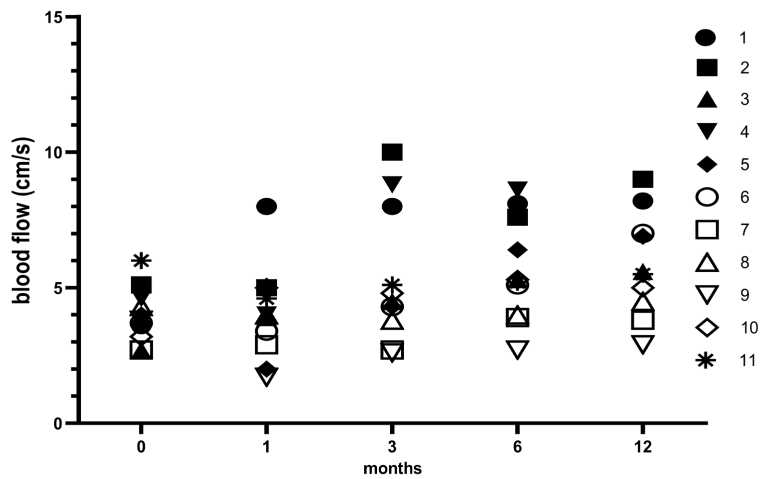

Figure 4. Curves of UDT Blood Flow at each visit in group A. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 represented testes.

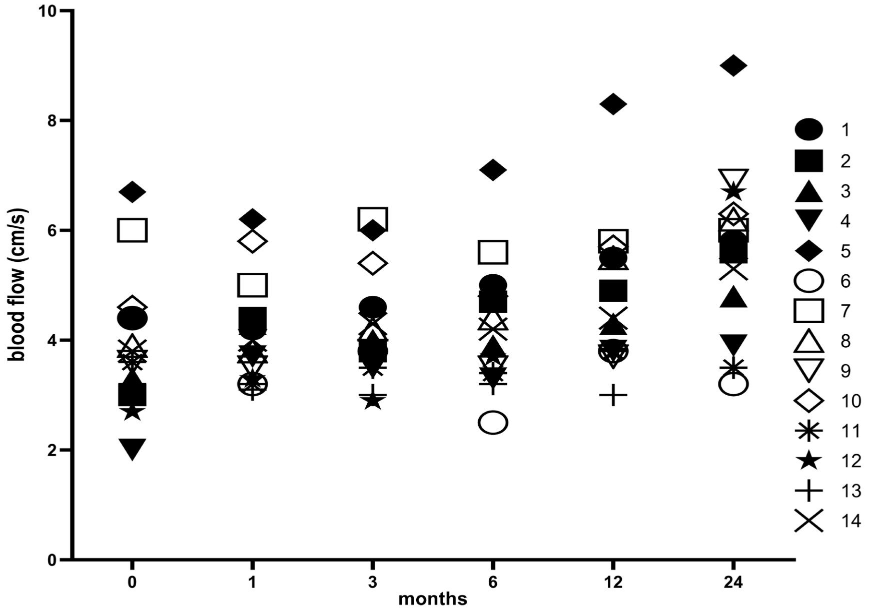

Figure 5. Curves of UDT blood flow in group B. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 represented testes.

4. Discussion

The sample size of 22 patients and 25 testes with a follow-up time ranging between 12 and 24 months is statistically representative and fit to give valuable outcomes of our research compared to other studies in the same domain. In his preliminary report, Shehata got a sample size of 10 patients with 10 testes and followed them for 6 to 12 months [4]. Elsherbeny M *et al.* got a sample size of 20 boys with 22 testes and the follow-up period was 1 year [7]. The age range from 6 months to 14 years was chosen according to the period that the testis achieves its descent after birth (6 months) and the pediatric population age that limits at 14 years old [2]. The mean age of 36.16 ± 18.96 months was higher than the recommended age to perform orchidopexy (6 - 18) months [2] [8]. This may be due to delayed diagnosis of UDT or some parent's hesitancy towards accepting surgery in early childhood [9]. These children are at a high risk of complications and may be followed carefully for early detection of sub fertility and testicular carcinoma [10]. The new technique of orchidopexy has been implemented more than 2 years ago in our department and this cohort of 25 testes could not have the same duration of post operative follow-up. Then, to express our data with more clarity, we divided our sample into 2 groups of 12 and 24 months of follow-up respectively. The difference was made by the number of post operative US done by each patient in each group respectively 4 and 5. It has been also more easily to draw tables and figures with data from testes that had the same duration of post operative follow-up. Current techniques of orchidopexy aim to reduce the rate of testicular atrophy after surgery. To avoid orchidopexy with tension of testicular vessels, Fowler Stephens promoted ligation of collateral vessels during the first stage. This technique led to a high rate of testicular atrophy (more than 20%) due to disruption of blood supply by collateral vessels [11] [12]. Shehata thought to preserve these vessels and proposed traction of the testis for 12 weeks [4]. His method is difficult for high intra-abdominal testes because it uses a single site fixation of the testis at the ASIS (Antero-Superior Iliac Spine). This increases the risk of ischemia due to the predisposition to orchidopexy with tension of vessels. The waiting period of 12 weeks seams too long and increases the risk of testicular damage linked to a long exposure to the intra-abdominal temperature [13]. Our technique aimed to preserve the integrity of blood supply both for the testis and the spermatic cord and reduced the waiting time to 4 weeks. Orchidopexy for high intra-abdominal UDT is convenient with this method; because the testis can be fixed at variable sites to the contra lateral abdominal wall depending on the length of testicular vessels. The most important thing is to stretch vessels and elongation will be completed by intestinal weight and breath movements of the child. We successfully realized 4 orchidopexies of high intra-abdominal UDT. The choice to follow each testis with regular US control after 1, 3, 6, 12, 24 months and after each year has been sustained by many publications [2] [13]. We used the Lambert's Formula $L \times W \times H \times 0.71$ to calculate testicular volume at each visit. Testicular atrophy was investigated with the volume differential index and the total volume lost. This methodology has been used by many authors in previous literature [14] [15]. Some testicular volumes decreased after surgery; this can be explained by the stress due to traction during the first stage and after orchidopexy. We may also consider the variation of operators in the series of US done by the patient. Many studies demonstrated a difference of interpretation and measurement of radiologic images according to operator skills and experience [16] [17]. It could not be a great matter because blood flow was satisfactory at these visits. The presence of blood flow inside the testis has been described as the main indicator of testicular vitality [18]. This blood flow also depends on environmental factors and the emotional state of the child.

5. Conclusion

The efficiency and feasibility of our method needed to be approved by the growth of the testis and the presence of satisfactory blood flow after surgery. This study demonstrated that all testicular volumes increased significantly at the last postoperative visit. Blood flow that was measured from each testis was satisfactory. No testicular atrophy was diagnosed within the cohort of patients that we got. After Fowler Stephens and Shehata, this method gives a new perspective to perform safe orchidopexy both for high and low intra abdominal undescended testes. We invite all pediatric surgeons to emulate this technique and enhance its sustainability with the scientific community.

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To Prof Shehata M, we got experience from you as you were the first surgeon to

care about testicular collateral vessels, and carry out staged-laparoscopic orchidopexy by traction without ligation of vessels.

Author Contributions

Ntsobe Tobie Eric: Concept design and manuscript preparation; Liu Haijin: Data acquisition; Peng Wei: Data analysis; Chen Feng and Nyanit Bob Dorcas: Literature search; Kouna Tsala Irene, Ndikontar Raymond and Liu Qiang: Manuscript editing and review.

Disclosure Statement

Drs Ntsobe Tobie Eric, Liu Haijin, Peng Wei, Cheng Feng, Nyanit Bob Dorcas, Kouna Tsala Irene, Ndikontar Raymond And Liu Qian have no conflict of interest to disclose for this article.

Data Availability

All data generated and analyzed during this study are included in this published article and its supplementary information file. We are owners of all materials and data used in this study and we did not need permission from the third party.

Highlights

The main objective of orchidopexy for intra abdominal testis is to relocate the testis inside the scrotum without tension of testicular vessels. Staged-laparoscopic orchidopexy is currently used to avoid disruption of blood supply due to high tension of vessels. Fowler-Stephen's and Shehata's methods take a long duration between both stages (6 - 12 months for Fowler-Stephen and 12 weeks for Shehata) and are associated to testicular atrophy greater than 10%. Our technique is going to reduce the span between both surgeries to 4 weeks and testicular blood supply is preserved as the first stage is performed with low tension of testicular vessels.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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