Laparoscopic *versus* Conventional Open Surgery Approach of Tunica Vaginalis for Palpable Cryptorchidism

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ABSTRACT

Objective: To evaluate the advantages of the laparoscopic approach of tunica vaginalis in the treatment of palpable cryptorchidism.

Study Design: Randomised clinical comparative study.

Place and Duration of Study: Department of Urology Surgery, Baoding Children's Hospital, Baoding, Hebei, China, from July 2019 to June 2020.

Methodology: A total of 80 children admitted with palpable cryptorchidism were selected and randomly divided into two groups *i.e.* the experimental group and the control group, with 40 cases in each group. The experimental group were treated with a laparoscopic approach of tunica vaginalis, and the control group were treated with conventional open surgery. The perioperative indicators, proportion with testicular external fixation, surgical effect, testicular development (6 months postoperative), and incidence of complications were compared.

Results: The postoperative ambulation and discharge time of the experimental group were significantly shorter than the control group ($p<0.001$). The external fixation rate of the control group was higher than the experimental group ($p=0.02$). The effective rate of the experimental group was significantly higher than the control group ($p=0.03$). The re-examination performed, 6 months postoperatively, showed that the testicular volume in the experimental group was significantly higher than in the control group ($p=0.03$). The incidence of the surgical complications in the experimental group was significantly lower than in the control group ($p=0.04$).

Conclusion: Laparoscopic approach of tunica vaginalis is effective in the treatment of palpable cryptorchidism and more conducive to testicular development. It has the advantages of less injury, less complications, quick postoperative recovery, more adequate spermatic cord dissociation, and well-preserved testicular blood supply.

Key Words: *Laparoscopic approach of tunica vaginalis, Palpable cryptorchidism, Treatment.*

How to cite this article: Li LW, Yang B, Liu D, Liu C, Guo SL. Laparoscopic *versus* Conventional Open Surgery Approach of Tunica Vaginalis for Palpable Cryptorchidism. *J Coll Physicians Surg Pak* 2022; **32(09)**:1122-1126.

INTRODUCTION

Cryptorchidism, one of the common congenital malformations of the urogenital system in children, refers to the failure of the testis to descend from the lumbar retroperitoneum to the scrotum following the normal development process, including ectopic testis, undescended testis, or incomplete testicular descent.[1] Approximately 80% of cryptorchidism is located in the inguinal canal.[2] Abnormally located testes, which are often accompanied by the abnormal growth conditions, should be treated immediately as they suffer from an increased risk of malignancy.[3]

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Received: March 20, 2022; Revised: July 05, 2022; Accepted: July 22, 2022
DOI: https://doi.org/10.29271/jcpsp.2022.09.1122

A meta-analysis showed no difference in the efficacy of the drug therapy for cryptorchidism compared with placebo.[4] For this reason, priority should be given to the surgery as a clinical treatment for cryptorchidism. Currently, open trans-inguinal orchiopexy is a standard procedure for it.[5] Nonetheless, this procedure requires a large incision in the skin and an incision in the inguinal canal, resulting in a large surgical injury. Besides, when the procedure is used in the treatment of high inguinal cryptorchidism, some children have unsatisfactory testicular descending position due to the high spermatic cord tension, while others suffer from the postoperative testicular atrophy due to the excessive dissociated inguinal spermatic cord.[6] Therefore, it is of great clinical significance to explore an effective treatment method for cryptorchidism that can ameliorate the cure rate and long-term prognosis of children.

Under the impetus of the development of minimally invasive techniques in recent years, laparoscopy has evolved into a well-proven measure for the detection and treatment of cryptorchidism. It enhances the advantages of having smaller incisions being more minimally invasive than traditional open

surgery. Meanwhile, it is characterised by the magnification of surgical field about 2 times, close observation of the surgical site, and more delicate operation.[7] Laparoscopic approach of tunica vaginalis may be employed in the treatment of palpable cryptorchidism without damaging the inguinal canal, contributing to more dissociated spermatic cord vascular protection and certain clinical effects. The objective of the study was to evaluate the advantages of the laparoscopic approach of fixation of tunica vaginalis compared with the conventional approach.

METHODOLOGY

The study was approved by the Institutional Ethics Committee of the hospital, and written informed consent was obtained from all the participants.

Inclusion criteria were children diagnosed with cryptorchidism;[8] palpable testes by physical examination; aged ≤14 years; without heart, lung and other important organ diseases and no other surgical contraindications; complete clinical data; and whose guardians agreed to participate, signed informed consent, cooperated in completing the study, and had satisfactory treatment compliance. Exclusion criteria were: children with non-palpable cryptorchidism; history of inguinal surgery on the affected side; abnormal functions of the heart, lung and other important organs coagulation disorders or unable to undergo surgery for any reasons; and who could not cooperate to complete the study requirement and compliance.

A total of 80 children with palpable cryptorchidism admitted to Baoding Children's Hospital, Baoding, Hebei, China, between July 2019 to June 2020, were selected and randomly divided into the experimental group and the control group according to the random number table method with 40 cases in each group. Children in the experimental group were treated with orchidopexy *via* the laparoscopic approach of tunica vaginalis, while the control group were treated with orchidopexy *via* conventional open surgery.

In the experimental group, after successful general anaesthesia, abdominal instruments were placed to establish pneumoperitoneum and observed testicular development. Testes were fixed according to the length of the spermatic cord. If the spermatic cord was of sufficient length, internal fixation was performed, and if there was significant tension in the spermatic cord, external fixation was performed.

The children in the control group were given conventional open orchiopexy. The affected side was opened layer-by-layer after oblique inguinal incision to expose the testes and epididymis, processus vaginalis ligated at a high position, and the spermatic cord was fully released. If the spermatic cord could not descend to the bottom of the scrotum without tension, external fixation was performed; otherwise, internal fixation was performed.

The observation indicators were surgery-related indicators, including operative time, intraoperative blood loss, ambulation time, length of hospital stay, and the proportion of children with testicular external fixation were compared and analysed between the two groups. For comparative analysis of the surgical effects, the children in both groups were re-examined 6 months after the surgery to evaluate the surgical effects. The results were markedly effective when testes were located at the bottom of the scrotum, with a volume about 10%-20% smaller than that of the healthy side, normal blood flow, and no testicular retraction. The results were effective, when testes were located above the middle of the scrotum, with a volume of about 20% of the healthy side, normal blood flow, and no testicular retraction. The results were considered invalid, if testes were obviously atrophied, with a volume reduction of >20% compared to the healthy side, and only partial blood flow. The overall total effective rate was the sum of markedly effective and effective rate.[9] The testicular volume was compared before and 6 months after the surgery between the two groups. Testicular volume was taken as the product of thickness, width, and length. The surgical complications including incision infection, testicular retraction, scrotal hematoma, *etc.* were noted.

All the data were analysed with SPSS 20.0 software, and the measurement data were expressed as ($X \pm S$). A two independent sample t-test was used for intergroup comparisons. The categorical data were expressed as a number (n=%) and tested *via* X^2 test. The $p<0.05$ indicates a statistically significant difference.

RESULTS

The comparative analysis of general data of the two groups showed that the experimental group ranged in age from 1 to 9 years, while those in the control group ranged from 1 to 11 years. The data of the two groups were balanced and comparable, without statistically significant differences ($p>0.05$), as shown in Table I.

The comparative analysis of the surgical indicators of the two groups showed that the postoperative ambulation and discharge time of the experimental group were significantly shorter than those of the control group ($p<0.001$). Five cases in the control group underwent external fixation, showing that the external fixation rate in the control group was higher than in the experimental group ($p=0.021$, Table II).

The comparative analysis of the surgical effects of the two groups showed that the effective rate of the experimental group was higher than the control group (n=3% markedly effective, 5 effective and 01 invalid *vs.* 26, 7, and 7, respectively, $p=0.025$).

Comparative analysis of the postoperative testicular development between the two groups manifested that the testicular volume in the re-examination performed 6 months after the surgery was significantly higher in the experimental group than in the control group ($p=0.080$, Table II).

There were only 2 cases (5%) of incision infection in the experimental group, while 4 cases of infection, 03 cases of hematoma, and one case of retraction (overall number 8, 20%) in the control group. The frequency in the experimental group was significantly lower than in the control group ($p=0.043$).

Table I: Comparative analysis of the general data between the two groups (X ±S) n=40.

Group	n	Age (years old)	Site (n)			Testicular position (n)	
			Left	Right	Bilateral	Inguinal	External ring opening
Experimental group	40	4.50±1.54	12	20	8	29	11
Control group	40	4.78±1.94	12	18	9	27	13
t/c^2		-0.703	0.058	0.201	0.075	0.238	
p		0.484*	0.809$^{\Delta}$	0.654$^{\Delta}$	0.785$^{\Delta}$	0.626$^{\Delta}$	

**Two independent samples t-test, p>0.05, $^{\Delta}\chi^2$ test, p>0.05.*

Table II: Comparative analysis of surgical indicators of the two groups (X ±S) n=40.

Groups	Operative time (min)	Intraoperative blood loss (ml)	Ambulation time (d)*	Postoperative length of hospital stay (d)*	External fixation rate (%)*	Testicular volume (ml)	
						Before surgery	After surgery
Experimental group	28.73±4.55	22.05±2.79	2.38±0.87	2.35±0.77	0	0.47±0.05	0.60±0.11
Control group	27.68±4.44	23.05±3.49	5.83±1.63	5.55±1.34	5(12.50%)	0.48±0.04	0.54±0.06
t/c^2	1.045	-1.414	-11.809	-13.106	5.333	-0.980	2.563
p	0.299*	0.161*	<0.001*	<0.001*	0.021$^{\Delta}$	0.330*	0.012*

**Two independent samples t-test, p>0.05, p<0.05, $^{\Delta}\chi^2$ test, p<0.05.*

DISCUSSION

The testes evolve from the gonadal centre in the abdominal cavity during the embryonic period. The gubernaculum testis plays a crucial role in the process of testicular descent. The important pathogenesis of cryptorchidism is that the testicular zone cannot be converted into the testicular muscle due to various reasons, which affect the process of testicular descent.[10] Cryptorchidism in children not only causes genital malformation but also testicular torsion and malignant transformation may occur. Furthermore, bilateral cryptorchidism may affect the reproductive function and hormone secretion of the children. So, the early diagnosis and treatment of cryptorchidism in children should be carried out.[11] The main purpose of treating cryptorchidism is to reset the ectopic testis and promote the normal development of testis.[12] Surgery is currently the preferred treatment for children cryptorchidism.[13] At present, trans-inguinal open surgery is mostly used for inguinal cryptorchidism with palpable testes. However, this surgical method has witnessed some defects, such as postoperative testicular atrophy due to the injury of the testicular artery during spermatic cord dissociation. Neheman *et al*. reported that about 3.7% of the children with inguinal cryptorchidism had testicular atrophy after surgery.[14] Ein *et al*. revealed that among the children undergoing inguinal orchiopexy, testicular atrophy occurred in approximately 5%, and 9% in those who underwent surgery for high cryptorchidism.[15] Open surgery not only destroys the anatomical structure of the inguinal canal but also separates or even disconnects the internal oblique and transverse abdominal muscles for the high inguinal cryptorchidism, resulting in various adverse consequences such as prolonged postoperative wound pain, prone to infection, bleeding, and even testicular retraction. It has been reported in the relevant literature that the wound infection rate of open inguinal surgery is 2.5%,[16] and the incidence of postoperative scrotal hematoma and oedema is about 2%.[17] In this study, 20% of the patients after open surgery had complications such as incision infection, testicular retraction, and scrotal hematoma, which was significantly higher than that in the study group (p=0.04). It shows that open surgery has big trauma and high-incidence of adverse reactions.

With the vigorous development of minimally invasive techniques in recent years, laparoscopic techniques have received more and more attention in the treatment of cryptorchidism.[18] Laparoscopic operation is more delicate, the scope of surgical dissociation is wider, and the retroperitoneal spermatic cord and blood vessels are easier to be loosened and separated, which can minimise the impact on the blood supply of spermatic cord and vas deferens, so as to effectively reduce the occurrence of testicular atrophy and testicular retraction. It has distinct advantages over traditional open surgery, such as fewer postoperative pain-related adverse events.[19]

Abdelhalim *et al.* concluded that excessive spermatic cord separation did not result in apparent testicular atrophy in the early postoperative period,[20] but approximately one-quarter of the testes were expected to experience significant testicular volume loss after 3 months. With laparoscopic technology, spermatic vessels were preserved to the maximum extent, creating an appropriate opportunity for the testicular survival.[21] Braga *et al.* also suggested that additional testicular vascular supply can be preserved with laparoscopic orchiopexy, which may improve the probability of postoperative testicular survival.[22]

During the laparoscopic surgery, the testes can be fixed at the bottom of the scrotum without tension, which can effectively reduce the occurrence of testicular atrophy and testicular retraction. In this study, the effective rate of the study group was significantly higher than the control group (p=0.03). All the children in the study group met the internal fixation standard, and 5 cases in the control group received external fixation. The external fixation rate in the control group was higher than that in the study group (p=0.02). The testicular volume of the study group was significantly larger than that of the control group 6 months after operation (p=0.03).

This procedure preserves the anatomical integrity of the inguinal canal without incising the inguinal canal while avoiding incision of the internal oblique and transverse abdominis muscles at the incision of the internal ring, the patient has little pain and recovers quickly.[23] In this study, laparoscopic sheath sac propulsion in the treatment of palpable cryptorchidism significantly shorten the time of getting out of bed and leaving the hospital after routine open surgery (p=0.00), which is consistent with previous reports.

Cryptorchidism is usually accompanied by patent processus vaginalis on the affected side. Cryptorchidism combined with contralateral patent sheath process is as high as 33%, while only about 20% can be found before operation.[24] Open surgery cannot detect contralateral concealed hernia or patent sheath process. The studies have shown that more than 10% of asymptomatic patent processus vaginalis detected incidentally by laparoscopy will develop into inguinal hernias.[25] The laparoscopic surgery allows simultaneous detection and treatment of contralateral concealed hernia, avoiding the pain and fear of secondary surgery and anaesthesia in children.

Nevertheless, shortcomings can still be seen in this study; small sample size and short follow-up time. In response to this, more cases will be included in future work, and the follow-up time will be extended to further objectively evaluate the long-term effects and clinical significance of the laparoscopic approach for tunica vaginalis.

CONCLUSION

The laparoscopic approach for tunica vaginalis is effective in the treatment of palpable cryptorchidism and more conducive to testicular development, with various advantages such as less injury, low frequency of complications, quick postoperative recovery, more adequate spermatic cord dissociation, and well-preserved testicular blood supply.

SUPPORT:
This study is supported by Baoding Science and Technology Plan Project Task Book (No. 1951ZF075).

ETHICAL APPROVAL:
The study was approved by the Institutional Ethics Committee of Baoding Children's Hospital, and the ethical approvals were obtained prior to initiation of the research work.

PATIENTS' CONSENT:
The authors declared that they had obtained informed consent from the patients and patient' family to publish the data concerning this case.

COMPETING INTEREST:
The authors declared no competing interests.

AUTHORS' CONTRIBUTION:
LL, BY: Research idea and study design.
DL, CL: Data acquisition and analysis.
SLG: Supervision and mentorship.
All the authors have approved the final version of the manuscript to be published.
Each author contributed important intellectual content during manuscript drafting or revision and accepts accountability for the overall work by ensuring that questions pertaining to the accuracy or integrity of any portion of the work are appropriately investigated and resolved.

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