Laparoscopic Fowler-Stephens orchidopexy for intra-abdominal cryptorchid testis: a single institution experience

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Abstract

Fowler-Stephens Laparoscopic Orchiopexy (FSLO) permits the mobilization of Intra-Abdominal Testis (IAT) to the scrotal position after spermatic vessel ligation. We reported our experience of FSLO for IAT. The charts of all boys who underwent a FSLO were retrospectively reviewed. Data were analysed for demographic data, procedure, complications and follow-up results. From January 2008 to June 2016, 160 laparoscopies for Non Palpable Testis (NPT) were performed at a mean age of 3,2 years. 61% of patients had a right NPT, while 6% were bilateral. In 64 cases, an IAT was found: 20 were managed by FSLO with a two-stage procedure in 11 patients. There were no differences in hospitalisations; one patient had a prolonged ileus. Follow-up ranged from 1 to 8 years. Of the 20 patients who underwent FSLO, testicular atrophy developed in three; the remaining testes were in the scrotal position, with normal consistency. FSLO was applied in 31% of IAT. The overall success rate of the technique was 85 %. The percentage of atrophy associated after spermatic vessels interruption appears to provide a good chance of testicular survival.

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Key words: Cryptorchidism; laparoscopy; Fowler Stephens orchidopexy; intrabdominal testis; testicular atrophy.

Contributions: AP: project development, revision of the manuscript and data analysis, data interpretation and manuscript writing; LDR, CN: dossier revision, data collection and revision of the manuscript.

Conflict of Interest: The authors declare no conflict of interest.

Ethics approval and consent to participate: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Given that our study was done retrospectively, formal consent was not required. However, informed consent was obtained from all individual participants included in the study.

Consent for publication: Not applicable.

Availability of data and materials: All data underlying the findings are fully available.

Conference presentation: The paper was presented at the 50° congress of Italian Society of Pediatric Surgery, Oct 22-24, Palermo, Italy.

Received for publication: 15 December 2019.
Accepted for publication: 24 October 2020.

Licensee PAGEPress, Italy
La Pediatria Medica e Chirurgica 2020; 42:224
doi:10.4081/pmc.2020.224

Introduction

Cryptorchidism is the absence of one or both testicles in the scrotum; the incidence is 1% at one year of age, 3% in infants delivered at term and 33% in premature infants.[1,2] The aetiology and pathogenesis appear to be multifactorial with the potential contribution of several mechanisms, including genetic, hormonal and mechanical.[2] Cryptorchidism is considered a risk factor for male infertility and neoplastic transformation. On examination of the groin and scrotum, we distinguish two classes of cryptorchidism: palpable and Non-Palpable Testes (NPT). The advent of minimally invasive techniques has improved the surgical approach to many diseases, even in children, and certainly the application of laparoscopy in the diagnosis and treatment of cryptorchidism, in particular of the NPT, has attained a great consensus.[3-5] Currently, laparoscopy is widely considered the first step in the surgical management of NPT, allowing for accurate diagnosis and leading to management options with the possibility to be operative.[5] Approximately 20% of undescended testes are non-palpable and a quarter of them remains intra-abdominal, emphasising the relevance of a reliable approach. A testis may be non-palpable not only for intra-abdominal placement, but also because of aplasia, intrauterine failure or inguinal location with different grades of abnormal development (atrophy). Although the use of laparoscopy has been principally diagnostic, it has changed the approach to the Intra-Abdominal Testis (IAT) with respect to the traditional procedure that started with an inguinal exploration.[4,5] Robert Fowler and Francis Douglas Stephens first reported a technique that involved the interruption of spermatic vessels, promoting the development of the testicular vascular arcade in the salvage of high undescended testis for orchidopexy.[6] Ransley *et al.* proposed the same procedure in two steps; the ligature of spermatic vessels in a first step was beneficial for the development of anastomotic collateral testicular ves-

sels.[7] Bloom first reported the laparoscopic clipping of spermatic vessels as the first stage of the Fowler-Stephens Laparoscopic Orchidopexy (FSLO).[8] Since then, FSLO has been widely adopted for surgical management of IAT; nevertheless, the criteria for its application and the results of one versus two-step procedure have been long debated and are not yet clarified. Therefore, we report a retrospective review on our experience with FSLO technique for intra-abdominal cryptorchid testes.

Materials and Methods

We performed a retrospective study of all patients submitted to laparoscopy for NPT and from these we selected the cases with an IAT where a FSLO was executed. Since 2008 to June 2016, we have performed laparoscopy in 160 patients with NPT. The potential clinical findings based on laparoscopy were as follows: testicular ectopia, an IAT, agenesia, intra-abdominal blind ending and vas and vessels entering the internal inguinal ring. We reviewed 20 FSLO performed among 64 IATs. Every patient was clinically re-examined under anaesthesia to confirm the NPT. The laparoscopic procedure was accomplished through the insertion of the first 5-mm trocar by an open approach into the umbilicus, and CO_2 pneumoperitoneum was created according to the patient's body weight and age.[9] The internal inguinal ring was then inspected to evaluate the anatomy and the development of spermatic bundle; then, the iliac areas and the pelvis were inspected. If laparoscopy revealed an IAT, it was classified as high or low, depending on the aspect of the internal inguinal ring (open-closed), the distance of the testis (±3cm), the length and the ability to move of the spermatic vessels (Figure 1 and 2). If FSLO was programmed, two 3–5 mm ports were introduced in the left and in the right lower quadrant, just below the transversal umbilical line, lateral to the rectus muscle. In the first stage, a minimal dissection was done close to the spermatic vessel, as high as possible, for double clipping or ligature (Figure 2). In step two, four-six month later, a large dissection was performed in the area close to the spermatic vessel to maintain the peritoneal coverage between the vas and vessel and to leave intact the collateral anastomotic arcade of the testis (Figure 3); this objective is also achieved by minimal use of cauterisation. The FSLO technique does not differ in the bilateral cases, but in the second stage more care is taken not to damage the peritoneal tissue between vas and vessels in order to respect the developed peritoneal anastomotic arcade of the spermatic bundle. When the testis and the peritoneal vascular arcade were completely free (Figure 4), an incision was made at the base of the scrotum to provide a dartos pouch and forceps introduced in the abdominal cavity, to pull down into the scrotum the testis through the medial reflection of the umbilical ligament (Prentiss manoeuvre) or the inguinal canal.[10] In single-step FSLO, the peritoneal pedicle was obtained starting from the lateral aspect of internal inguinal ring and the umbilical ligament and medially over the vas deferens. Once the peritoneal flap was created, the spermatic vessels were divided as high as possible, and then orchidopexy was performed. If the internal inguinal ring was open, it was not closed. The choice of a single versus a two-stage approach was dependent on surgeon's assessment of testis position and level of laxity of the spermatic vessels. Follow-up consisted in physical examination at 6 and 12 months postoperatively for all patients. Atrophy was defined as any reduction in the volume of the testis on clinical examination from the expected intra-operatively size.[11] Procedural success was defined as intra-scrotal placement of normal sized testis.

Results

A total of 160 laparoscopies were performed for NPT: 61% were right NPT, while 6% were bilateral. Cord structures entering the inguinal ring were observed in 75 patients. In 21 patients, a blind-ending vas and vessels were observed. No patients were observed for testicular ectopia and agenesia. We had 64 patients with an IAT; 44 (68.75% of IAT) underwent primary surgical orchidopexy and 20 (31.25% of IAT) were managed by a FSLO (Figure 5). One patient had a bilateral synchronous two stage FSLO procedure. The mean age was 3.2 years (range: 1–7 years). In 11 testes, we performed a two-stage procedure, while 9 had one

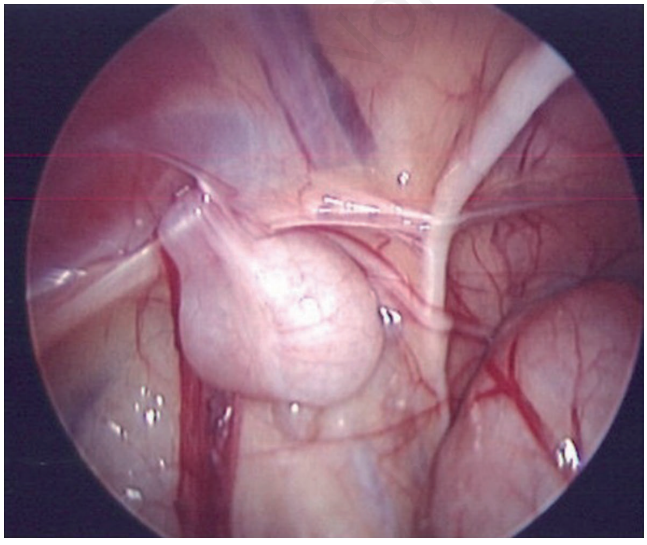

Figure 1. Laparoscopic view: left intra-abdominal testis low position.

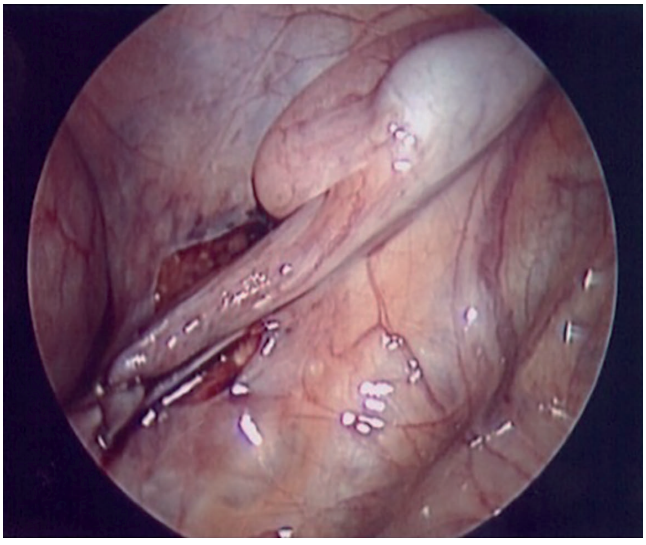

Figure 2. Laparoscopic view of I stage Fowler-Stephens orchidopexy: spermatic vessels high ligature.

stage. There were no differences in hospitalisations, and early post-operative complications were not recorded except for a prolonged ileus in a bilateral patient during the second stage of the FSLO, treated conservatively. For the second stage approach, the intermediate time between stages was 4.5 months. Follow-up ranged from 6 months to 8 years. Of 9 patients who underwent one-stage FSLO, testicular atrophy developed in 2, while in the two-stage group there was one case of testicular atrophy. Thus, the entire rate of atrophy and complications was respectively 15% and 20%. A total of 17 patients, included the bilateral procedure, had a viable testis in the scrotum, with good consistency and volume. The location of the testis and the age of the patient did not appear to be factors in predicting testes that would atrophy. No atrophy resulted after the first stage of a two-stage FS orchidopexy. No reascent of the testis was observed in our series. The overall success rate of the technique was 85%.

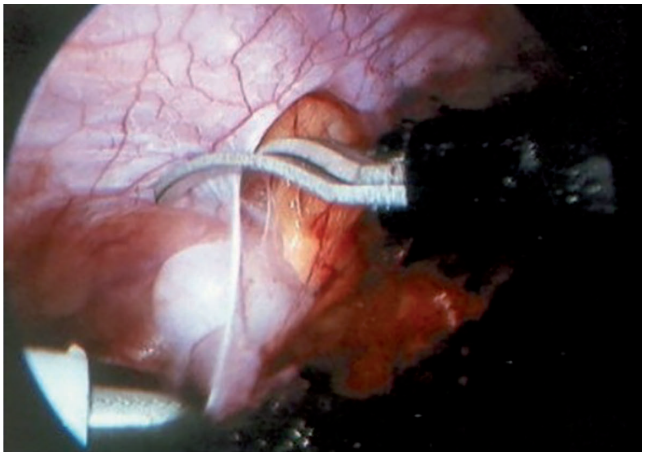

Figure 3. Laparoscopic view of II stage Fowler-Stephens orchidopexy.

Discussion

Laparoscopy is the only procedure that can reliably confirm or exclude an intra-abdominal, inguinal and absent/vanishing testis. This technique offers the incomparable benefit of being diagnostic in all patients through direct assessment of the morphological anatomy of the spermatic cord (spermatic vessels and vas deferens), giving the opportunity to plan the surgical treatment.[5]

If an IAT is present, depending on its location and development, many different surgical strategies can be chosen. If a high IAT is present, we recommend an FSLO. If the testicle emerges from a patent inguinal canal and/or is located at a distance smaller than 3 cm from the ring, with a good degree of development and mobility of the spermatic vessels, we may choose, in these cases, a standard and/or laparoscopic orchidopexy without interruption of the spermatic vessels.[4,5,12] If a remnant or hypoplastic testis is present, it can be removed laparoscopically.[4] Nevertheless, the surgical treatment of IAT is still debated. In 1959, Robert Fowler and Francis Douglas Stephens reported on the role of testicular vascular anatomy in the salvage of high undescended testes.[6] In 1984, Phil Ransley *et al.* proposed the preliminary ligation of the gonadal vessels prior to orchidopexy for the IAT, a staged Fowler-Stephens procedure, to better promote the development of collateral anasto-

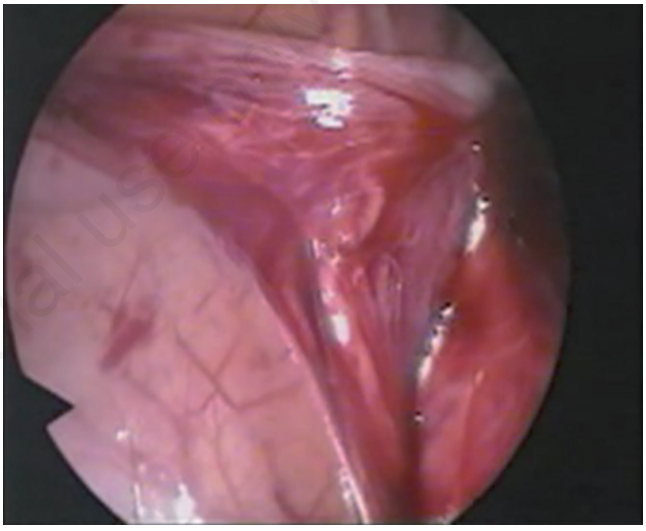

Figure 4. Laparoscopic view of II stage Fowler-Stephens orchidopexy: peritoneal vas deferent anastomotic arcade.

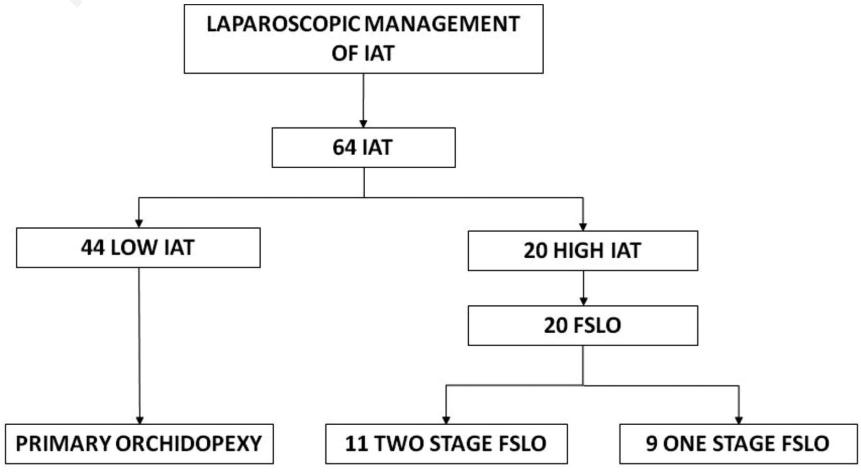

Figure 5. Laparoscopic management of intra-abdominal testis.

motic testicular arcade and the salvage of the testis.[7] In 1991, Bloom proposed the same procedure with the first step of the Fowler-Stephens procedure performed by laparoscopic clipping ligature of spermatic vessels.[8]

Caldamone and Amaral then Jordan and Winslow had very good results with the second stage of the FSLO with a success rate of 100% and a follow-up of 16–18 months.[10,13] The average time of operation was 55–135 minutes with minimal postoperative morbidity. With equal success rate was reported by Franco and Lindgren with one-stage FSLO.[14] In this series, we report 20 patients with high IAT who were managed with an FSLO. In 11 testes, we performed a two-stage operation, while 9 underwent one stage. Early surgical complications and differences in hospitalisations were not registered. We had one patient who had a prolonged ileus after the second stage of the FSLO. Follow-up ranged from 1 to 8 years. Of 20 patients who underwent FS orchidopexy, testicular atrophy developed in 3 (15%); two occurred in the one-step group and one occurred in the two-step group. The remaining patients had the testes in the scrotal position, with normal consistency and volume as revealed by clinical inspection. These results are similar to that reported in the literature. Elyas *et al.*, in their systematic review reported success rates of 80% for single stage Fowler-Stephens orchidopexy (95% CI 75 to 86) and 85% for 2-stage Fowler-Stephens orchidopexy (95% CI 81 to 90).[15] Bagga *et al.* reported a success rate of 68, 6% in the application of two-stage FS orchidopexy and they affirmed that two stages gave a better opportunity to achieve intrascrotal orchidopexy.[16] If we consider the complications of FSLO, the rate of atrophy reported in the large series varied from 4% to 17%. Alagaratnam *et al.* found an incidence of testicular atrophy of 8.8% in 94 patients operated on with FS orchidopexy.[11] Hvistendahl and Poulsen reported atrophy in 14% of 65 testes, while Baker *et al.* reported atrophy in 10% of 58 testes.[17,18] Therefore, the rate of atrophy remains the most important surgical complication reported. No ascent of the testis was observed in our series.

Many factors are important in the choice of FS orchidopexy, including the distance from the internal ring to the testes, the laxity of spermatic vessels, the size of the patients and the surgeon's laparoscopic skill and experience. FS orchidopexy must be planned; it is not a salvage technique. Patients with an IAT have to be carefully considered because in relation to testis position, observed laparoscopically, we can plan the most suitable surgical technique.[3-5] Most of IAT will be placed in the scrotum by a standard orchidopexy. In our experience FSLO was applied in 31, 25% of IAT, those who had a high abdominal testis. By comparing primary to two-stage approaches, Ostlie et al. found that only the 30% of the patients required division of the spermatic vessels.[19] In our opinion, the choice between primary orchidopexy (traditional or laparoscopic) or FSLO is an intraoperative decision where testis position and surgeon's laparoscopic skill and experience are very important for the success of the applied surgical technique. There are some risk factors for FSLO: previous surgery and anomalies of the vascular configuration of the vas augment the rate of atrophy. In the last case the anastomotic arcades to the testis may be not sufficient for the salvage of the testis.[20]

Laparoscopy respects the following primary goals of the surgical management of IAT: to bring the testis out from the abdominal cavity for functional results and to minimise the risk of malignant change.[1,2] Rosito *et al.* studied the volumetric and histological findings in IAT before and after the division of spermatic vessel. They found a significant reduction in the number of spermatogonia and seminiferous tubules 6 months after ligation and division of the spermatic vessels.[21] No changes were observed in terms of testicular volume. They concluded that more studies were necessary to evaluate the consequences of these modifications on future fertility. Certainly, many factors are important for future fertility, and among them appears to be the age at orchidopexy and the relationship between dark spermatogonia, the stem cells of spermatogonia, that appears to reduce with the age of the patients.[2] Nevertheless, many IAT, especially those high in the abdomen, have associated congenital epididymal anomalies an important factor in infertility.

Conclusions

We can conclude that laparoscopic evaluation of abdominal testes provides an accurate diagnosis and information regarding the most appropriate surgical treatment. There are multiple advantages of laparoscopy and FSLO: first the criteria for applying this surgical technique, such as the distance from the internal inguinal ring and the mobility of spermatic vessels, are best clarified. FSLO was applied in 31% of IAT. Through the optical magnification, it is possible to better highlight the testicles and the spermatic vessels to maintain the vas anastomotic arcade necessary for testis perfusion and survival. The overall success rate of the technique was 85%. The percentage of atrophy associated after spermatic vessels interruption appears to provide a good chance of testicular survival. These data provide evidence to proceed with a large multi-institutional study.

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