Section A -Research paper

Management of Intra-abdominal Testicle: Review Article

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Abstract:

Fowler–Stephens orchidopexy is the most widely used technique for the surgical management of intra-abdominal testes with laparoscopy being the preferred approach.

Keywords: Intra-abdominal Testicle, undescended, Fowler–Stephens orchidopexy.

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Introduction:

The prevalence of cryptorchidism has been estimated between 2 and 8% with wide geographical variation **(1).** A study performed in the north of England between 1993 and 2000 using Hospital Episode Statistics reported a prevalence of cryptorchidism of 7.6 per 1,000 male live births **(2).**

About 20% of undescended testes are reported to be impalpable **(3, 4)**, with half of these being intra- abdominal **(5).** Cryptorchidism is associated with impairment of germ cell maturation and subsequent infertility, which is thought to be minimized by performing early orchidopexy **(3).**

While palpable undescended testes can be managed surgically by a groin approach, the impalpable testes represent a diagnostic and management challenge. This was first addressed by Fowler and Stephens in 1959 **(6).** They reported that conventional orchidopexy techniques used on high undescended testes gave very poor results and described a novel technique of dividing the testicular vessels to facilitate mobilization of the testis into the scrotum. Subsequently in 1984, **Ransley et al. (7)** modified this technique to a staged approach, which began

with a preliminary ligation of the testicular vessels at the first operation, followed by a second operation to mobilize the testis into the scrotum, performed following an interval of varying length.

In 1982, **Scott (8)** described the technique of using laparoscopy to accurately visualize and document the position of intra-abdominal testes and it remains the most valuable diagnostic technique. Further to this, **Bloom et al. (9)** described using laparoscopic technique to perform a staged Fowler Stephens orchidopexy. Others simultaneously described the single-stage laparoscopic orchidopexy techniques **(10).** Since then laparoscopic orchidopexy procedures have become increasingly popular. Laparoscopy is now widely used as the first choice tool for confirming the diagnosis of impalpable testis and verifying the location of the testis if present.

Increasingly, the subsequent management if the testis is found to be intra-abdominal is performed laparoscopically. Debate continues in the literature, however, with regard to whether the operation should be performed in one or two stages. Within our institution, all patients with intra-abdominal testes are offered laparoscopic two-stage Fowler–Stephens orchidopexy.

Hormonal Treatment:

The hormonal treatment of UDT is based on the hypothesis of deficiency of the hypothalamic-pituitary-testicular axis at the end of gestation or shortly after birth, and hence the lack of the 'mini-puberty'. Hormonal therapy is usually carried out using HCG, gonadotropin releasing hormone (GnRH, luteinizing hormone releasing hormone – LHRH) or a combination of both. It can be administered as a neoadjuvant therapy prior to the orchiopexy or as a supplementary treatment after early surgery for UDT ***(11).***

The first method of hormonal therapy was HCG administration, advocated in boys with UDT in the 1950s, with some of the treatment series dated as early as the 1930s the HCG is produced by the syncytiotrophoblast and stimulates testicular Leydig cells to produce testosterone. As androgen takes part in the process of testicular descent it seems justified to stimulate its production. Evidence for the beneficial role of the hormonal therapy to improve testis position has been reported ***(12).***

Treatment with HCG is still used; however, in the 1990s and 2000s critical studies and meta-analyses of UDT treatment with HCG and its adverse effect on future reproductive function in adults appeared ***(13)***

Gonadotropin releasing hormone therapy was first administered in boys with UDT in the 1970s. GnRH is produced by the hypothalamus and stimulates the anterior pituitary gland to secrete LH and follicle-stimulating hormone (FSH). FSH stimulates the proliferation and differentiation of spermatogonia. GnRH therapy may improve germ cell number, maturation and later semen parameters in boys with UDT. The combined administration of GnRH and HCG in boys younger than 1 year can be beneficial for spermatogonial transformation and proliferation, with a success rate of about 20% ***(14).***

Buserelin, a synthetic LHRH super analogue, is administered in very small doses, such as 10 μg every other day for 6 months. It induces testicular descent in 17% of cryptorchid boys, which is similar to the results achieved with either LHRH or HCG. Buserelin may also improve germ cell histology and spermiograms obtained after

spontaneous descent or orcheopexy. It is available in Europe but it is not approved for use in the United States. Another GnRH analogue, Naferelin, has demonstrated preliminary results similar to those of Buserelin. ***(15).***

The dose of hormonal therapy is usually as follows:

– **GnRH** 3 × 400 μg/day (i.e. 3 × daily one puff of 200 μg into each nostril) over 4 weeks as nasal spray,

– **HCG** 50 IU/kg body weight in intramuscular injection twice a week for 3–5 weeks (total dosage of 6,000–9,000 IU ***(16).***

Hormonal therapy is associated with some temporary harms of treatment. The HCG may cause scrotal hyperemia, swelling of the genitals, frequent erections (as a result of the increase in testosterone circulating levels), and restlessness which usually subside a few weeks after discontinuation of therapy. The GnRH usually has a virilizing side effect and it is rarely responsible for restlessness ***(16).***

The success rate of hormonal therapy (scrotal position of testis) varies from 8% to 60%, less if retractile testes are excluded. The meta-analyses revealed an overall efficacy of around 20%, which decreases with time to about 15% after re-ascent of some testes. This should be compared with about 95% efficacy of primary orchiopexy ***(13).***

Hormone administration is contraindicated in newborns, in patients who are unlikely to respond (e.g., those with postoperative undescended testes or ectopic testes), in patients who cannot anatomically respond (e.g., boys with prune-belly syndrome), and in patients beyond puberty who are endocrinologically normal ***(17).***

Penile enlargement, frequent erections, scrotal rogation and pigmentation, increased appetite and weight gain, and aggressive behavior are all seen to some degree with hormonal administration. A potential serious complication of excessive hormonal therapy is premature closure of the epiphyseal plate, limiting long bone growth. Possible imprinting due to high androgen levels in the central nervous system has not been proven to occur but remains a remote possibility ***(15).***

Timing of surgery:

Recent guidelines such as recommendations of the American Urological Association (AUA) and The European Association of Urology (EAU) advocate orchiopexy between 6 and 18 months of age to maximize fertility potential and to decrease the risk of malignant changes **(18).**

Surgical options:

When the testis is non-palpable, diagnostic laparoscopy will determine which surgical approach should be taken. If the laparoscopy reveals an intra-abdominal testis, several options are available depending on the exact location of the testicle, low or high intra-abdominal and the length of the vas deferens. **(19).**

Three main laparoscopic findings are possible:

- Intra-abdominal testis, observed in 40% of patients.

- Intra-abdominal blind-ending cord structures, observed in 15%.
- The cord enters the internal inguinal ring in 45% of patients **(19).**

The laparoscopic orchidopexy is an appealing option, which can be either a single or a two-stage procedure depending on the location of the testis and the length of the testicular vessels. There are two criteria for evaluation of testicular location: the testis, <2 cm from the ipsilateral inner ring, indicates low IAT of the abdominal cavity; on the contrary, the testis, >2 cm from the ipsilateral inner ring, indicates high IAT of the abdominal cavity **(20).**

The success of orchidopexy depends on the ability to mobilize the testis into its normal position in the scrotum, without damaging its blood supply. **(21).**

Several techniques have been described for laparoscopic orchidopexy. Fowler-Stephens laparoscopic orchidopexy (FSLO) can be performed in one or two stages. In FSLO, the testicular vessels are divided to allow adequate mobilization of the testis into the scrotum. However, in the testicular traction technique, the testicular vessels are left intact, which is an advantage of this technique **(21).**

Two Stage Fowler Stephens laparoscopic orchiopexy

Use of this technique was introduced by Robert Prentiss in 1959 in order to further shorten the distance required for the test is to travel to reach the scrotum**.** The work of Fowler Stephens led to the development of the current preferred operation for managing intra-abdominal testes, by identifying that the blood supply to the testes comes not only from the spermatic arteries, but also has contributions from the inferior epigastric, cremasteric and vas deferens arteries. Ligation of the spermatic artery can therefore be carried out to provide a longer vascular pedicle. Development of collateral blood supply from the remaining vessels maintains testicular vascularization. **(22)**

Based on this theory, Fowler Stephens orchidopexy for the treatment of intra-abdominal testis and achieved good clinical efficacy. **(23).**

The first stage involves vessel ligation, then a period of around 6 months is allowed for collateral blood supply to develop before a return to theatre where testicular mobilization and then fixation within a dartos pouch is performed **(22)**

Indications of Fowler-Stephens laparoscopic orchidopexy (FSLO):

1. The position of the testicle, which is usually 2-2.5 cm or more away from the internal inguinal ring, makes it too difficult to achieve a satisfactory testicular descent by loosening the spermatic vessels.
2. The spermatic vessels are slender and connected to the testicles with the shape of an “I” and not a “J”; thus, it is difficult to obtain the desired length by loosening the spermatic vessels.
3. The gubernaculum and fascia around the vas deferens have a certain vascular network that should be appropriately protected. **(23).**

Complications of two stage Fowler Stephens orchiopexy:

1. The mobilization of the testis through the deep ring carried a greater risk of testicular ascent than when mobilized through the conjoint tendon.
2. Dissection around testes artery and post-surgery inflammation might cause ischemic injury or testes atrophy.
3. Other complications include the testicular retraction, infection or bleeding **(22)**

Staged Laparoscopic Traction orchiopexy

The idea of applying traction on the testicular vessels to elongate them was presented in the early 1900s, by fixing the testis to the fascia of the thigh. After a period of 3–6 months, the testis was released, after achieving elongation, to be put in the scrotum. In 1955, Snyder and Chaffin tried elongation of the testicular vessels by fixing, the testis medial to the epigastric vessels as caudally as possible, preferably lateral to the pubic tubercle. In 2008, the concept of traction was revisited by Shehata (Shehata technique). The testis is fixed to the anterior abdominal wall 1 cm above and medial to the contralateral anterior superior iliac spine and is hung 1 cm away from the anterior abdominal wall **(24).**

This gradual traction is thought to be achieved by the weight of the intestine on the stretched testicular vessels. Also, movement of the abdominal wall muscles during respiration may add to this traction and elongation **(24).**

It's recommended that the traction period (12 weeks) is sufficient to achieve adequate elongation of the testicular vessels without any signs of inflammation or other drawbacks **(18).**

Complications of Staged Laparoscopic Traction Orchiopexy

1. Internal Herniation, Intestinal Obstruction. There is a theoretical chance for internal herniation and/or strangulation of intestines through testicular vessels passing across abdominal cavity.
2. Fixation Suture insufficiency. Slippage of the stitch which fixes the testis to the abdominal wall during the traction period was the significant complication following the traction technique causing insufficient elongation of testicular vessels as well as inappropriate scrotal positioning. Therefore, redo traction is sometimes necessary before the second stage.
3. Adhesions of the spermatic cords while a bilateral fixation at the same time. Cross adhesion of spermatic cords and subsequent division of them affords the possibility of testicular vessel and/or spermatic duct injury with consequent testicular atrophy and impaired fertility.
4. Testicular Atrophy is the most serious complication of orchiopexy affecting testicular function and fertility. Atrophy defined as undetectable testicular tissue or lack of blood flow on Doppler US.
5. Minor Complications, e.g. wound healing disorders and hydrocele. **(18)**

References:

1. Virtanen HE, Bjerknes R, Cortes D, et al. Cryptorchidism: classification, prevalence and long-term consequences. Acta Paediatr 2007616–611:(5)96;
2. Abdullah NA, Pearce MS, Parker L, Wilkinson JR, Jaffray B, McNally RJ. Birth prevalence of cryptorchidism and hypospadias in northern England, 1993-2000. Arch Dis Child 2007;92(7):576–579
3. Chung E, Brock GB. Cryptorchidism and its impact on male fertility: a state of art review of current literature. Can Urol Assoc J 2011;5(3):210–214
4. Moursy EE, Gamal W, Hussein MM. Laparoscopic orchiopexy for non-palpable testes: outcome of two techniques. J Pediatr Urol 2011;7(2):178–181
5. Burjonrappa SC, Al Hazmi H, Barrieras D, Houle AM, Franc-Guimond J. Laparoscopic orchidopexy: the easy way to go. J Pediatr Surg 2009;44(11):2168–2172
6. Fowler R, Stephens FD. The role of testicular vascular anatomy in the salvage of high undescended testes. Aust N Z J Surg 1959; 29:92106–
7. Ransley PG, Vordermark JS, Caldamone AA, Bellinger MF. Preliminary ligation of the gonadal vessels prior to orchidopexy for the intra-abdominal testicle. World J Urol 1984;2:266–268
8. Scott JE. Laparoscopy as an aid in diagnosis and management of the impalpable testis. J Pediatr Surg 1982;17(1):14–16
9. Bloom DAD, Ayers JWJ, McGuire EJE. The role of laparoscopy in management of nonpalpable testes. J Urol (Paris) 1988;94:(10-9) 465470–
10. Guar DD, Agarwal DK, Purohit KC, Darshane AS. Laparoscopic orchiopexy for the intra-abdominal testis. J Urol 1995;153:(2) 479–481
11. Hadziselimovic F& Herzog B. (2001): The importance of both an early orchidopexy and germ cell maturation for fertility. Lancet; 358: 1156-7.
12. Kucharski P & Niedzielski J. (2013): Neoadjuvant human Chorionic Gonadotropin (hCG) therapy may improve the position of undescended testis: a preliminary report. Cent Eur J Urol; 66: 224-8.
13. Ong C, Hasthorpe S and Hutson JM. (2005): Germ cell development in the descended and cryptorchid testis and the effects of hormonal manipulation. Pediatr Surg Int; 21: 240-54
14. Kula K, Walczak-Jedrzejowska R, Slowikowska-Hilczer J, et al., (2002): Estradiol enhances the stimulatory effect of FSH on testicular maturation and contributes to precocious initiation of spermatogenesis. Mol Cell Endocrinol; 178: 89-97.

15. Esposito C, Caldamone AA, Settimi A, et al., (2008): Management of boys with nonpalpable undescended testis. Nat Clin Pract Urol 5:252–260.
16. Tekgül S, Dogan HS, Hoebeke P, et al., (2014): Pediatric Urology. European Society for Paediatric Urology, European Association of Urology. Guidelines on Paediatric Urology. Chap3 P11-13
17. Bertelloni S, Baroncelli GI, Ghirri P et al (2001): Hormonal treatment for unilateral inguinal testis: comparison of four different treatments. Horm Res; 55:236.
18. Varga, A., Kardos, D., Radványi, Á., Vajda, P., Szabó, L., & Kovács, T. (2023b). Medium-Term results of staged laparoscopic traction orchiopexy for intra-abdominal testes: a multicenter analysis. Journal of Pediatric Surgery, 58(10), 2020–2026.
19. Hsu, H. (2012c). Management of boys with nonpalpable undescended testes. Urological Science, 23(4), 103–106.
20. Liu, J., Tang, R., Wang, X., Sui, B., Jin, Z., Xu, X., Zhu, Q., Jin, C., Ma, H., & Duan, G. (2021c). Comparison of two types of staged laparoscopic orchiopexy for High Intra-Abdominal testes in children: a retrospective study from a single center. Frontiers in Pediatrics, 9.
21. Bawazir, O. A., & Maghrabi, A. M. (2021). A comparative study between two techniques of laparoscopic orchiopexy for intra-abdominal testis. Indian Journal of Urology, 37(3), 261.
22. Roy, C., Cullis, P., Clark, C., & Munro, F. D. (2020). Retrospective analysis of testicular outcomes following laparoscopic two-stage Fowler Stephens orchidopexy. Journal of Pediatric Surgery, 55(2), 300–303.
23. Wang, C. Y., Wang, Y., Chen, X. H., Wei, X. Y., Chen, F., & Zhong, M. (2017). Efficacy of single-stage and two-stage Fowler–Stephens laparoscopic orchidopexy in the treatment of intraabdominal high testis. Asian journal of surgery, 40(6), 490-494.
24. Elsherbeny, M., Abdallah, A., AbouZeid, A. A., Ghanem, W., & Zaki, A. (2018). Staged laparoscopic traction orchiopexy for intra-abdominal testis: Is it always feasible? Journal of Pediatric Urology, 14(3), 267.e1-267.e4.