Microsurgical inguinal varicocelectomy in adolescents: delivered versus not delivered testis procedure

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Introduction: *The aim of our study is to compare two different surgical procedures, lymphatic vessels and arterioles sparing microsurgical inguinal varicocelectomy (LASMIV) without delivery of the testis and LASMIV with delivery of the testis and ligature of collateral and gubernacular veins.*
Materials and methods: *Seventy adolescents suffering from varicocele and reduction of the ipsilateral testicular volume greater than 20% were prospectively assigned to two homogenous groups according to age and Tanner stage. The patients, operated from 2008 to 2013, were randomized to undergo either LASMIV without delivery of the testis or LASMIV with delivery and ligature of collateral and gubernacular veins. All patients were evaluated clinically and sonographically 6 months and 12 months after surgery, to measure testicular volume and to rule out any complications or recurrences.*
Results: *The catch up growth of testicular volume is significantly higher at 6 (p value = 0.008) and 12 months (p value = 0.004) in patients treated with LASMIV with delivery. The rate of varicocele recurrence in patients who underwent the delivered maneuver is 0%, whereas is 2.8% without delivery; however this findings is not statistically significant (p value > 0.01). None of the patients of both groups presented secondary hydrocele.*
Conclusions: *LASMIV with delivery of the testis and ligature of all collateral and gubernaculuar veins results in significantly higher left testicular catch up growth.*

Key Words: gubernacular vein, surgical technique, testicular delivery, testicular volume, varicocele

Introduction

Varicocele is an anomalous dilatation of the pampiniform venous plexus in the spermatic cord and of the venous drainage system of the testis. The disease is rare in children, while it occurs in 15%-20% of adolescent boys.[1] It is a progressive disease and the rate of testicular atrophy increase with the puberty.[2]

Persistent testicular pain and discrepancy in testicular volume greater than 20% after a 1 year follow up with scrotal color doppler ultrasonography (CD US) represent the correct indication for the treatment of varicocele in children.[3-6] Clinical and instrumental surveillance of the testicular volumes, for at least 1 year, is necessary since there may be a spontaneous catch up growth without any treatment.[5,7]

The management of varicocele in adolescents is debated:[3] the varicocele grade does not seem to be related

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with the potential state of infertility and is not therefore suitable for the selection of therapeutic candidates.[8]

Surgical varicocelectomy in adolescents is still without a gold standard method, despite the existence of several (open or laparoscopic) techniques.[9-10] Varicelectomy may be performed either as an high retroperitoneal ligation of the spermatic vessels described by Palomo[11] or as a low inguinal ligation described by Ivanissevich.[12] In children and adolescents the sub inguinal microsurgical varicocelectomy described by Lemack et al[13] is commonly used; this is an open technique that permits to identify dilated veins and to preserve the arterioles and the lymphatics, reducing the risk of complications.

Some authors[3,14-19] suggest including in varicocelectomy the "delivered" maneuver to obtain a better access to all the possible channels of testicular venous drainage, including gubernacular veins. On the other hand, most authors[20-22] supported a surgical approach without delivery and without ligation of the gubernacular veins.

Our intent is to try to clarify between the possible therapeutic alternatives found in literature for the treatment of varicocele in adolescent patients, identifying which surgical approach allows the better growth recovery of the affected testis and limits the possible recurrence of disease. It is essential to understand if there is a real advantage in term of results in performing the maneuver of delivery and legating the gubernacular veins, or if this is unnecessary.

We compare two different surgical procedures, lymphatic vessels and arterioles sparing microsurgical inguinal varicocelectomy (LASMIV) without delivery of the testis and LASMIV with delivery of the testis and ligature of collateral veins (internal spermatic vein, cremasteric or external spermatic vein) and gubernacular veins as well, and analyze the differences regarding post-surgical testicular volume, recurrences and secondary hydrocele.

To our knowledge, the following is the first study that statistically compares two homogeneous groups of pediatric patients affected by varicocele with discrepancy in testicular volume greater than 20%, operated with or without gubernacular veins ligation.

Materials and methods

This study, a prospective randomized trial, include 70 adolescents affected by unilateral varicocele, operated in our department from 2008 to 2013. Patients were classified according to the Tanner stage.

Inclusion criteria of the study were: age (range 7-17 years old), unilateral varicocele with testicular volume discrepancy > 20%, no previous groin surgery, no multi-system anomalies, no endocrine disorders that can alter testicular volume.

The asymmetry of testicular volume was assessed by ultrasound examinations performed with Toshiba drives with 7.5 and 10 MHz linear array transducers, using the equation "volume right testicle – volume left testicle / volume right testicle". The testicular volume has been calculated utilizing the formula for determining the volume of an ellipsoid directly from the scrotal ultrasound measurements: TV (mL) = $\pi/6$ x (length x width x height).[5,23]

Eligible population included 95 patients; 25 of them were excluded because they did not meet the inclusion criteria. Seventy patients were prospectively randomized into two homogenous groups. They were initially created by a simple randomization; then, a block randomization algorithm[24] was used to reach a close uniformity on age and Tanner stage. Data gathering has been considered concluded when uniformity on the two confounding parameters was reached.

Group A (35 patients) received LASMIV without delivery of the testis; Group B (35 patients) was treated with LASMIV with delivery, Table 1.

All patients in both groups were evaluated clinically and by CD US 6 months and 12 months after surgery, to measure testicular volume and to rule out any complications (e.g., secondary hydrocele) or varicocele recurrences.

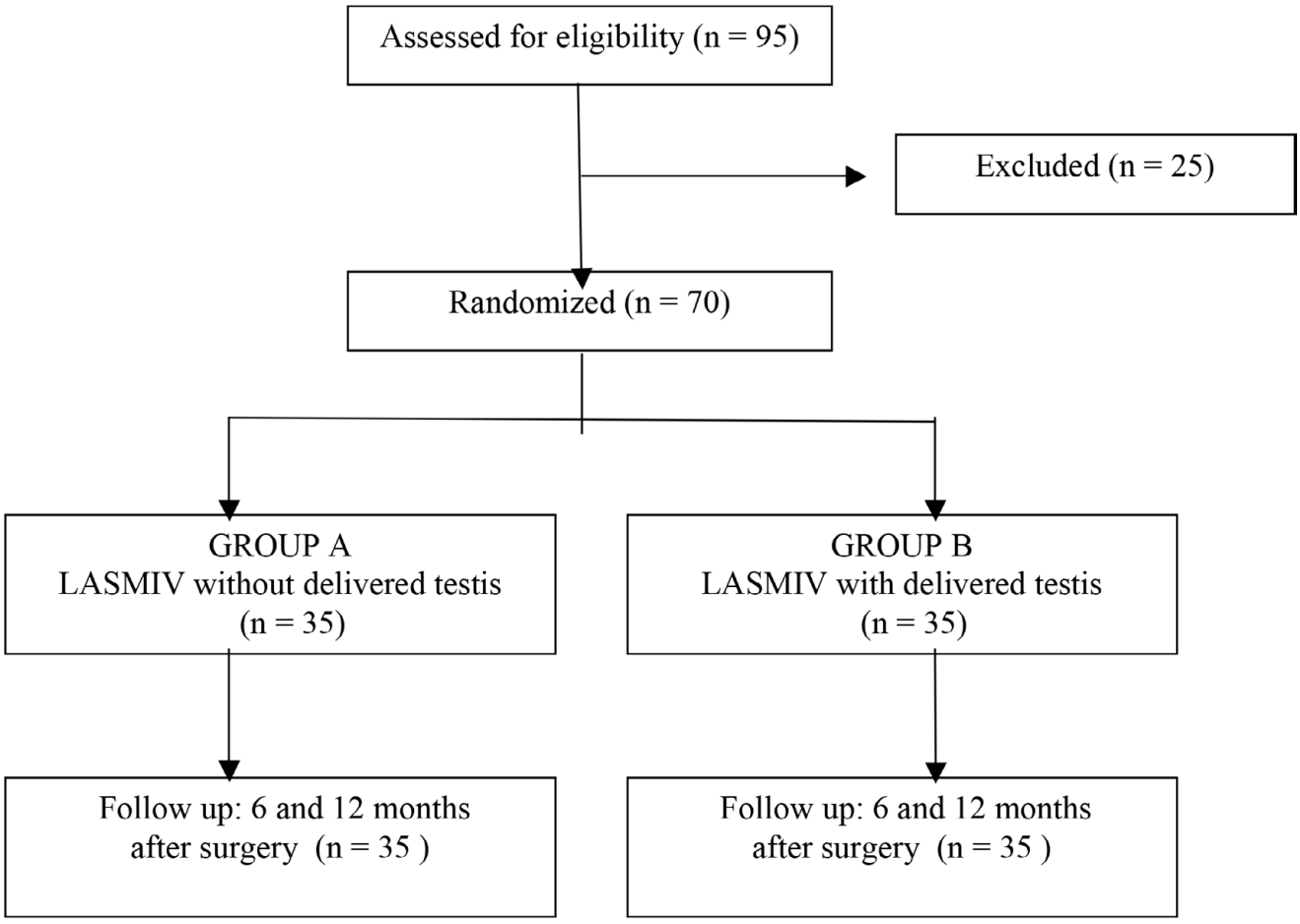
Statistical analysis were performed using the Student t test and one-tailed Fisher's exact test, with statistical significance considered at p value < 0.01.

Parental consent was obtained for surgical treatment and inclusion in the follow up for all patients. This study was conducted in accordance with the Declaration of Helsinki and with the approval of our Institutional Ethics Committee.

Surgical technique

It is fundamental to have a clear picture of the vascular anatomy of the testis to understand the surgical procedure that will be explained afterwards. This anatomical region presents a four-axis vein system: three deep vertical venous systems (internal spermatic veins; veins of the deferent duct; cremasteric veins or external spermatic veins) and one superficial venous system (anterior and posterior scrotal veins).[21] All of the three deep venous systems converge at the "venous junction" at the caudal pole of the testis. At this level, deep and superficial veins make an anastomosis through the gubernacular veins, which are anastomotic vessels found in 71% to 79% of cases.[25] The drainage system of veins is organized

TABLE 1. **Flow chart of the study**



as follows: internal spermatic veins run through the spermatic cord and, proximal to the internal inguinal ring, their number decreases and they converge to a terminal trunk in the retroperitoneal space that drains into the left renal vein. Veins of deferens, which run adhered to the vas deferens, join the internal iliac vein. Cremasteric veins, generally with one or two branches, drain into the inferior epigastric vein. Scrotal veins, finally, follow the scrotal arteries and anterior scrotal veins drain into the external pudendal vein and then into the great saphenous vein, whereas posterior scrotal veins follow superficial perineal veins and empties into the internal pudendal vein; furthermore, anterior and posterior scrotal veins make anastomosis between themselves and contralateral veins, Figure 1.

The same surgeon, experienced in microsurgery, performed all operations under general anesthesia. The procedure was an inguinal microsurgical (x6 magnification) varicocelectomy with sparing of lymphatic vessels and arterioles performed through a 2 cm incision. The patient has been placed in the reverse Trendelenburg position to increase the venous ectasia. After the section of the external oblique muscle aponeurosis - avoiding the injury of the ileoinguinal nerve - and the longitudinal incision of the cremaster muscle fibers, the spermatic cord has been isolated and clasped on a vessel loop. After incision of the internal spermatic fascia, internal spermatic veins have been identified. Each of them has been selectively isolated and tagged with a vessel loop. Small arteries and lymphatic vessels adhering to the veins are gently removed and saved. Afterwards deferential and cremasteric veins are identified and selectively prepared as well.

From here, the procedure is different in the two groups. In Group A (LASMIV without delivery) the patient is placed in the Trendelenburg position to facilitate the venous outflow and all the veins previously identified are tied and cut with removal

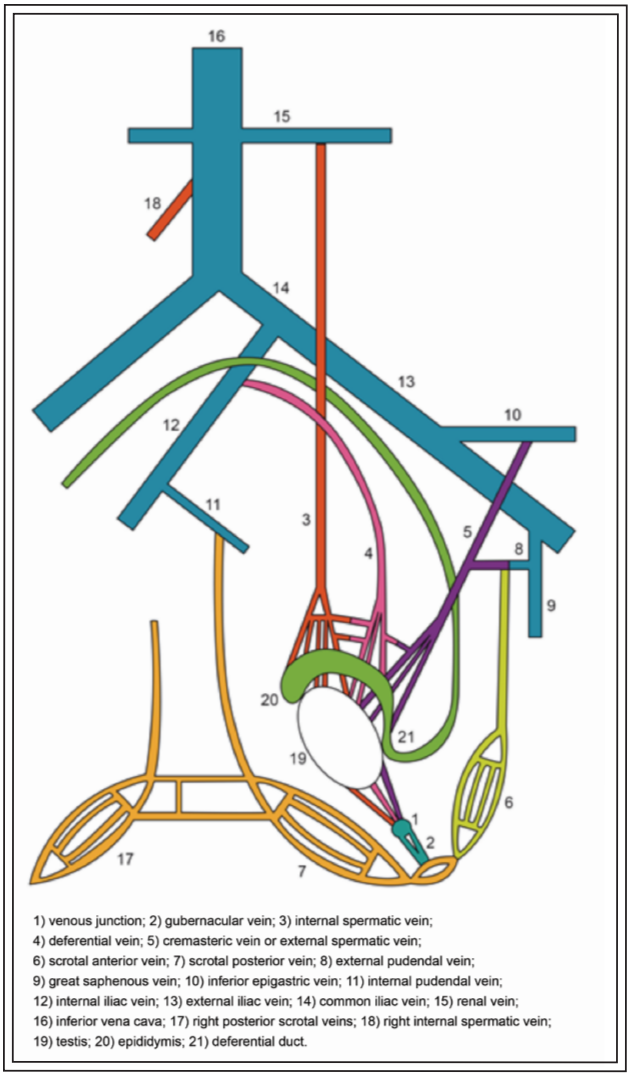


Figure 1. Venous system of the left testicle.

of a venous segment of 1 cm at least. In Group B (LASMIV with delivery) the testis is everted through the incision in the groin and all external spermatic veins and gubernacular veins located at the caudal pole are macroscopically examined; a slight pull on the testis and spermatic cord allows to have a clear view of all the venous return, thus any extrafunicolar veins previously missed out can be identified, Figure 2. The patient is now placed in the Trendelenburg position and the preparated veins are tied and cut as well; then, the testis and the spermatic cord are positioned in their normal anatomical site. In both groups the procedure ends with the suture of the cremaster muscle, external oblique muscle aponeurosis and subcutaneous tissue. Finally, intradermal suture is used for the skin.

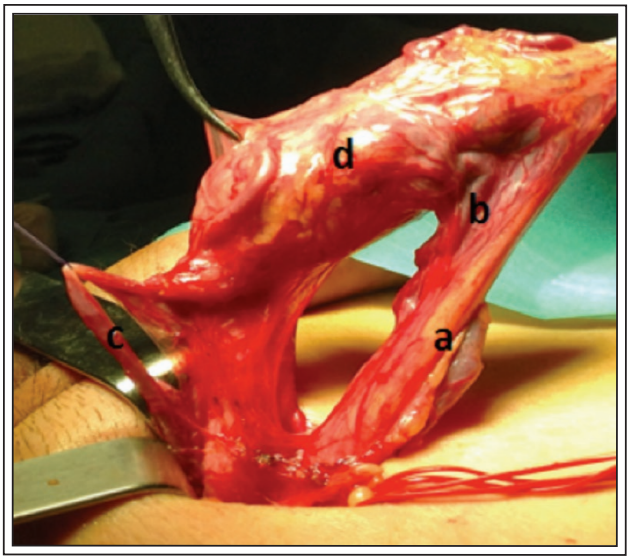


Figure 2. Intraoperative image: isolation of ectasic gubernacular veins. **a)** Internal spermatic vein; **b)** cremasteric vein; **c)** gubernacular veins; **d)** testis.

Results

Median age in the study group was 14.5 years (ranging from 7 to 17). The average age was 14.4 years in Group A and 14.6 years in Group B, Figure 3.

In Group A, preoperative Tanner stage was 1 or 2 in 15 patients (42.9%) and 3 to 5 in 20 patients (57.1%); in Group B, preoperative Tanner stage was 1 or 2 in 13 patients (37.1%) and 3 to 5 in 22 patients (62.9%). The difference in Tanner stage between the two groups is not statistically significant (p value = 0.625).

Our study shows how in Group B (LASMIV with delivery of the testis) the catch up growth of testicular volume is significantly higher at 6 (p value = 0.008)

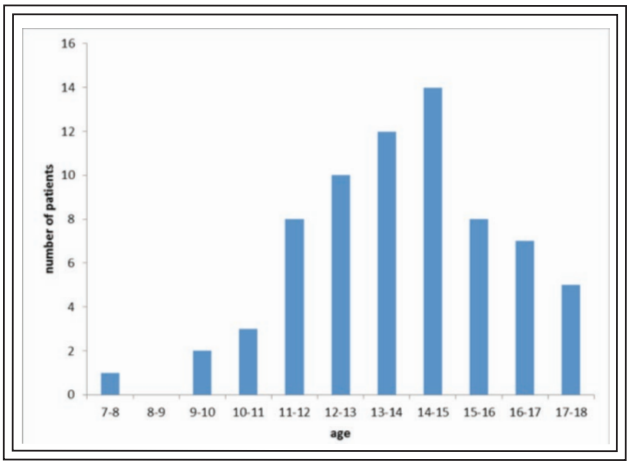


Figure 3. Age distribution of patients.

TABLE 2. **Data after a 6 month and 12 month follow up**

	Group A (35 pts)	Group B (35 pts)	p value
6 month			
Δ TV < 20%	14 (40 %)	25 (71.4 %)	< 0.01
Δ TV > 20%	21 (60 %)	10 (28.6 %)	< 0.01
Recurrences	1 (2.8 %)	0 (0 %)	N.S. (> 0.01)
Ipsilateral hydrocele	0 (0 %)	0 (0 %)	N.S. (> 0.01)
12 month			
Δ TV < 20%	19 (54.3 %)	30 (85.7 %)	< 0.01
Δ TV > 20%	16 (45.7 %)	5 (14.3 %)	< 0.01
Recurrences	3 (8.5 %)	0 (0 %)	N.S. (> 0.01)
Ipsilateral hydrocele	0 (0 %)	0 (0 %)	N.S. (> 0.01)

TV= testicular volume

and 12 months (p value = 0.004), compared to Group A (patients treated with LASMIV without delivery). The rate of varicocele recurrence after 12 months in Group B is 0%, whereas is 8.5% in Group A; however, this finding is not statistically significant (p value > 0.01). The rate of secondary hydrocele is 0% after 6 months and 0% after 12 months, Table 2.

Discussion

Varicocele is an anomalous dilatation of the pampiniform venous plexus caused by an increased pressure in the renal-spermatic system (intrafunicular reflux into the internal spermatic vein) or in ileal-spermatic system (extrafunicular reflux into the cremasteric veins, deferens veins and gubernacular veins) or both systems.[26,27] Based on venographyc study, Coolsaet[28] concluded that varicocele is caused by a venous reflux into the intrafunicular veins in 67% of cases, into the extrafunicular veins in 20% of cases, or both veins in 14% of cases.

Surgical repair of varicocele should be aimed to restore testicular function and improve potential fertility. It is important to perform the ligature of all dilated veins draining the testis associated to the saving of the arterioles and lymphatics, in order to obtain a low rate of relapse or therapeutic failure and to avoid post-surgical complications, such as hydrocele and testicular atrophy; postoperatively, the increase in testicular volume may well be as result of testicular function recovery.[29]

A possible limitation of our study is represented by the fact that the comparison between the growth of the testis following the two different types of surgical technique is performed on a large sample of the population in developmental age, hence exposed to a physiological growth. This is supported by the fact that the Tanner stage himself, in the sample, has a high standard deviation from the mean value.

The advent of microsurgery reduced drastically the rate of secondary hydrocele, which is probably due to lymphatic obstruction.[19] Nevertheless, this complication still occurs in some studies with greater than 10% rate.[2,30] The lymphatic sparing technique is useful to prevent hydrocele; furthermore, it optimizes testicular function and increases the catch up growth.[31,32]

The significance of testicular artery sparing when performing a varicocelectomy is still debated: Chan et al[33] concluded that this care allows an adequate blood supply that prevents testicular atrophy and preserves fertility. On the other hand, Fast et al[31] reported that the artery sparing does not offer any benefit in terms of catch up growth and is associated to a higher incidence of recurrences (12.2% versus 4%).

Based on post-surgical venography, recurrences are mostly due to the persistence of dilated cremasteric veins and gubernacular veins.[26,27] Abdebaky et al[34] concluded that is important that all internal and external spermatic veins be ligated to improve the testicular function and to prevent varicocele relapse.

The rate of recurrences in literature varies from 0% to 35%, depending on the surgical technique performed.[20] Varicocele relapse, in fact, occurs most commonly with a retroperitoneal approach that does not allow the ligature of cremasteric veins, as well as with an inguinal or sub-inguinal approach which doesn't permit to tie gubernacular veins and distal collateral veins.[20,30] Microsurgical inguinal varicocelectomy with delivered of the testis, instead, provides direct visual access to all avenues of testicular venous drainage and is reported to result in a significant decrease in the incidence of varicocele recurrence.[14,15,20]

Therefore, inguinal approach offers the advantages both to identifying and legate/cut internal spermatic veins and cremasteric veins, and allows preserving, due to the microscope magnification, small arteries and lymphatics. Moreover, the caliber of the veins at this level is bigger and the number smaller than at sub-inguinal level, where there is often a dense weave of small veins and arteries strictly adhered each other, such to make the resection challenging with an high risk of vessels injury.[14,25] Further, the delivered maneuver through inguinal incision permits a direct visual access and the ligature/cut of all the draining veins of the testis, in particular of the gubernacular veins. Thus, it is possible to repair varicocele due to renal-spermatic reflux or ileal-spermatic reflux, and either due to both of them.[26] Finally, the delivery of the testis facilitates the execution of testicular biopsy useful in selected cases.

Conclusions

In adolescents affected by varicocele with reduction of the ipsilateral testicular volume greater than 20%, LASMIV with delivery of the testis has been shown to support the recovery of testicular growth. Our study demonstrates that this growth is statistically significant compared to that obtained after LASMIV without delivery. □

References

1. Cayan S, Shavakhabov S, Kadioğlu A. Treatment of palpable varicocele in infertile men: a meta-analysis to define the best technique. *J Androl* 2009;30(1):33-40.
2. Akabay E, Cayan S, Doruk E, Duce MN, Bozlu M. The prevalence of varicocele and varicocele-related testicular atrophy in Turkish children and adolescents. *BJU Int* 2000;86(4):490-493.
3. Schiff J, Kelly C, Goldstein M, Schlegel P, Poppas D. Managing varicoceles in children: results with microsurgical varicocelectomy. *BJU Int* 2005;96(4):710.
4. Diamond DA, Zurakowski D, Atala A et al. Is adolescent varicocele a progressive disease process? *J Urol* 2004;172(4 Pt 2): 1746-1748.
5. Spinelli C, Di Giacomo M, Lo Piccolo R, Martin A, Messineo A. The role of testicular volume in adolescents with varicocele: the better way and time of surgical treatment. *J Urol* 2010;184 (4 Suppl):1722-1726.
6. Coutinho K, McLeod D, Stensland K, Stock JA. Variations in the management of asymptomatic adolescent grade 2 or 3 left varicoceles: a survey of practitioners. *J Pediatr Urol* 2014;10(3): 430-434.
7. Clement MR, Cartwright L, Carr MC, Canning DA, Snyder HM 3rd. Transient asynchronous testicular growth in adolescent males with a varicocele. *J Urol* 2008;180(3):1111-1114.
8. Bertolla RP, Fraietta R, Ortiz V, Cedenho AP. Does varicocele grade determine extent of alteration to spermatogenesis in adolescents? *Fertil Steril* 2008;90(5):1769-1773.
9. Ishibashi H, Mori H, Yada K, Shimada M, Sogami T, Nii A. Indigo carmine dye-assisted lymphatic-sparing laparoscopic Palomo varicocelectomy in children. *J Med Invest* 2014;61(1-2):151-155.
10. Zampieri N, Zampieri G, Antonello L, Camoglio FS. Trans-scrotal varicocelectomy in adolescents: clinical and surgical outcomes. *J Pediatr Surg* 2014;49(4):583-585.
11. Palomo A. Radical cure of varicocele by a new technique; preliminary report. *J Urol* 1949;61(3):604-607.
12. Ivanissevich O. Left varicocele due to reflux; experience with 4,470 operative cases in forty-two years. *J Int Coll Surg* 1960;34:742-755.
13. Lemack GE, Uzzo RG, Schlegel PN, Goldstein M. Microsurgical repair of the adolescent varicocele. *J Urol* 1998;160(1):179-181.
14. Schlegel PN, Goldstein M. Intraoperative varicocele anatomy: a macroscopic and microscopic study. *J Urol* 1992;148(4):1190-1194.
15. Goldstein M, Gilbert BR, Dicker AP, Dwosh J, Gnecco C. Microsurgical inguinal varicocelectomy with delivery of the testis: an artery and lymphatic sparing technique. *J Urol* 1992;148(6):1808-1801.
16. Zini A, Fischer A, Bellack D et al. Technical modification of microsurgical varicocelectomy can reduce operating time. *Urology* 2006,67(4):803-806.
17. Can C, Sarica K. Extended vein ligation: a new aspect of the surgical treatment of varicocele. *Urol Int* 1993;51(4):220-224.
18. Nourparvar P, Herrel L, Hsiao W. Microsurgical subinguinal varicocelectomy with testicular delivery. *Fertil Steril* 2013;100(6):e42.
19. Swain J, Fode M, Sonksen J, Christman GM, Ohl D. The great debate: varicocele treatment and impact on fertility. *Fertil Steril* 2011;1;95(3):841-852.
20. Shiraishi K, Oka S, Ito H, Matsuyama H. Comparison of the results and complications of retroperitoneal, microsurgical subinguinal, and high inguinal approaches in the treatment of varicoceles. *J Androl* 2012;33(6):1387-1393.
21. Mirilas P, Mentessidou A. Microsurgical subinguinal varicocelectomy in children, adolescents, and adults: surgical anatomy and anatomically justified technique. *J Androl* 2012;33:338-349.
22. Glassberg KI, Badalato GM, Poon SA, Mercado MA, Raimondi PM, Gasalberti A. Evaluation and management of the persistent/recurrent varicocele. *Urology* 2011;77(5):1194-1198.
23. Spinelli C, Strambi S, Busetto M, Pucci V, Bianco F. Effects on normalized testicular atrophy index (TAIn) in cryptorchid infants treated with GnRHa pre and post-operative vs surgery alone: a prospective randomized trial and long-term follow-up on 62 cases. *Ped Surg Int* 2014;30(10):1061-1067.
24. Efird J. Blocked randomization with randomly selected block sizes. *Int J Environ Res Public Health* 2011;8(1):15-20.
25. Hopps CV, Lemer ML, Schlegel PN, Goldstein M. Intraoperative varicocele anatomy: a microscopic study of the inguinal versus subinguinal approach. *J Urol* 2003;170(6 Pt 1):2366-2370.
26. Gendel V, Haddadin I, Nosher JL. Antegrade pampiniform plexus venography in recurrent varicocele: Case report and anatomy review. *World J Radiol* 2011;28;3(7):194-198.
27. He Y, Wu Z, Chen S et al. Nutcracker syndrome--how well do we know it? *Urology* 2014;83(1):12-17.
28. Coolsaet BL. The varicocele syndrome: venography determining the optimal level for surgical management. *J Urol* 1980;124(6):833-839.
29. Raheem OA. Surgical management of adolescent varicocele: Systematic review of the world literature. *Urol Ann* 2013;5(3): 133-139.
30. Nees SN, Glassberg KI. Observations on hydroceles following adolescent varicocelectomy. *J Urol* 2011;186(6):2402-2407.
31. Fast AM, Deibert CM, Van Batavia JP, Nees SN, Glassberg KI. Adolescent varicocelectomy: does artery sparing influence recurrence rate and/or catch-up growth? *Andrology* 2014;2(2):159-164.
32. Cayan S, Akbay E, Bozlu M et al. The effect of varicocele repair on testicular volume in children and adolescents with varicocele. *J Urol* 2002;168(2):731-734.
33. Chan PT, Wright EJ, Goldstein M. Incidence and postoperative outcome of accidental ligation of the testicular artery during microsurgical varicocelectomy. *J Urol* 2005;173:482-484.
34. Abdelbaky T. Ligation of the dilated external spermatic veins improves the outcome of microscopic subinguinal varicocelectomy. *Urology* 2011;78(3):229.