Evaluation of testicular catch-up growth in adolescent microsurgical varicocelelectomy

Fevzi Bedir¹, Ercüment Keskin², Mehmet Karabakan³, İbrahim Karabulut¹, Fatih Kürşat Yılmazel¹, Ertuğrul Gazi Özbey⁴, Yılmaz Aksoy⁵, İsa Özbey⁵

ABSTRACT

Objective: The incidence of varicocele is approximately 15% in adolescent men. Early treatment with varicocele is aimed to resolve testicular hypotrophy and ensure catch-up growth. The aim of this study was to evaluate ipsilateral catch-up growth rates relative to contralateral testicular growth in adolescents with varicocele undergoing microsurgical subinguinal varicocelelectomy.

Material and methods: Fifty adolescents with unilateral grade 2-3 varicoceles were included in the study. All patients underwent microsurgical subinguinal left varicocelelectomies performed by the same experienced surgeon. All patients were evaluated clinically and using orchidometric measurements to define the grade of varicocele and testicular volume at presentation and follow-up. The number of internal and external spermatic veins, testicular arteries and lymphatic vessels preserved during the subinguinal microsurgical varicocelelectomy were recorded. The mean follow-up period was 26 months (range 6-48 months).

Results: At presentation, mean patient age was 12.9±2.1 years. Mean testicular preoperative volumes were 7.1±4.3 mL for the right and 5.4±3.4 mL for the left testis. There were significant differences between mean volumes of the right and left testis ($p=0.002$). At the final postoperative follow-up visit, mean testicular volumes were 10.8±5.1 mL (range 3-25) for the right and 9.9±4.3 mL (range 2-20) for the left, and the difference between the right and left testicular volumes was insignificant ($p=0.47$). In our series, catch-up growth was observed in 70% (35/50) of our patients.

Conclusion: Adolescent varicocelelectomy is associated with a higher percentage of patients showing testicular catch-up growth. In our study, similarly to the available literature the catch-up growth rate was found as 70% and observed to have positive effects of adolescent varicocelelectomy on testicular growth.

Keywords: Adolescence; catch up growth of the testis; subinguinal microscopic varicocelelectomy; varicocele.

¹Clinic of Urology, Erzurum Training and Research Hospital, Erzurum, Turkey

²Clinic of Urology, Erzincan University Mengücek Gazi Training and Research Hospital, Erzincan, Turkey

³Clinic of Urology, Mersin Toros State Hospital, Mersin, Turkey

⁴Clinic of Urology, Taşköprü State Hospital, Kastamonu, Turkey

⁵Department of Urology, Atatürk University School of Medicine, Erzurum, Turkey

Submitted:
09.05.2016

Accepted:
31.10.2016

Available Online Date:
03.05.2017

Correspondence:
Mehmet Karabakan
E-mail:
karabakanm@hotmail.com

©Copyright 2017 by Turkish Association of Urology

Available online at
www.turkishjournalofurology.com

Introduction

Although varicocele is detected in 35% of primary infertile men, nearly 80% of adults with varicocele are asymptomatic, and fertile.^[1-3] Varicocele is one of the prevalent urological abnormalities of adolescent men which can be corrected surgically.^[4] Various studies have shown adverse effects of adolescent varicocele on testicular volume, and presence of a correlation between varicocele, and regression of testicular development has been demonstrated.^[5-7] Although severe testicular damage is found in 20% of adolescents with

varicocele, the presence of milder testicular abnormalities have been demonstrated in 46% of them. Testicular hypertrophy is more prevalent in patients with high-grade varicoceles, and in 70% of the affected patients grade 2-3 varicoceles have been reported.^[8] As an accepted strategy in adolescent varicocele treatment should be instituted in case of ipsilateral testicular hypotrophy.^[7,9] In these patients, indications for surgical intervention are debatable, more than 20% difference in testicular size relative to the intact testis, abnormalities in sperm parameters, and painful varicoceles have been asserted as indications for surgical

intervention.^[3] In infertile men, subinguinal microsurgery has become an gold standard approach for spermatic vein ligation in infertile men with lower complication, and recurrence rates relative to other techniques, however the place of this approach in adolescent population is still debatable.^[2] It has been documented that in 60-90% of the patients affected testes caught up normal growth rate after surgical repair, and in many studies recovery of testicular hypertrophy has been reported after varicocelectomy.^[10-12]

One of the most important problems in the treatment of adolescent varicocele, is to determine the varicocelectomy method, and optimal age of surgery which will achieve highest catch-up growth rate.^[3] However, in many studies it has been shown that surgical technique does not effect catch-up growth rate.^[13] Studies investigating whether preserving lymphatics during varicocelectomy effect testicular volume have yielded controversial results.^[10,14]

The aim of this study is to evaluate development of ipsilateral testis after adolescent varicocelectomy by monitoring testicular volume.

Material and methods

Patients with diagnosis of only unilateral left varicocele left established during routine physical examination among a total of 57 patients aged 5-17 years who applied to the outpatient clinic of urology between January 2009, and August 2013 with complaints of scrotal swelling, and dysmorphism were included in the study. Two cases who were followed up for less than 6 months, and patients who had undergone orchiopexy (n=3) or herniotomy (n=2) were excluded from the study because of potential testicular atrophy which might develop due to these pathologies, and surgical interventions, and the study was completed with 50 cases.

The parents of the patients were informed in detail about the procedure, and their written informed consent forms, and approval of Ethics Committee of Ataturk University Faculty of Medicine for the study were obtained (decision #: 5-7/1-2). Scrotal examinations were performed with the patients standing erect, and lying supine before, and after Valsalva manoeuvres. Severity of varicoceles were graded based on the classification of Dubin and Amelar^[15] (Grade 1: Palpable only during Valsalva maneuver, Grade 2: Varicose veins can be palpated without resorting to Valsalva maneuver, and Grade 3: Dilated veins can be easily seen through scrotal skin). All of our patients underwent abdominal ultrasonographic (USG) examination. Testicular volumes were measured before, and after the surgery by the same physician using Prader's orchidometer, and recorded separately for both testes.

Symptomatic patients with varicocele whose testicular volume decreased 20% or more than 2 mL, cases with testicular softening, and pain were deemed to have indication for surgery. To reveal left testicular hypotrophy previously described formula [(Volume of the intact testis- volume of the affected testis)/Volume of the intact testis x 100] was used, and the result was expressed in mL.^[16] The patients were followed up for a mean period of 26.04±2.8 months (range, 6 months-4 years). During follow-up period, patients whose symptoms like pain did not resolve, and testicular volumes did not catch-up growth and/or testicular softening persisted were accepted as treatment-refractory cases.

Statistical analysis

In this study IBM SPSS 20 (IBM Statistical Package for the Social Sciences; Armonk, NY, USA) Windows package program was used for statistical analysis. In the study continuous variables, number of vessels ligated or preserved were expressed as continuous variables, standard deviation, minimum, and maximum. Pre-, and postoperative testicular volumes, and differences between right, and left testicular volumes, their fitness to normal distribution were analyzed using Kolmogorov-Smirnov test, and for non-normally distributed parameters unpaired *t*-test was used. The transition between groups which demonstrated testicular catch-up growth was analyzed using Marginal Homogeneity test. P<0.05 was accepted as the level of statistical significance.

Results

Mean age of our patients was 12.96±2.09 (5-17) years. Admission complaints of the patients were pain (n=3; 6%), scrotal deformity (n=34; 68%), and varicocele incidentally detected during physical examination of 13 (26%) cases. Postoperative controls were performed at 6-month intervals, and mean follow-up period was 26.04±2.8 months (6-48 months) On physical examination grading system described by Dubin, and Amelar^[15] was used. Accordingly, Grade 2 (n=16; 32%), Grade 3 (n=34; 68%) varicoceles were detected in respective number of our patients. All patients underwent surgery for their left-sided varicoceles. The surgeries were performed by the same experienced surgeon under Carl Zeiss Set Navigation S 88 1343-989 (Oberkochen, Germany) model microscope. Any intra-, and peri-operative complication was not observed. In the long term hydrocele, and recurrent varicocele were not observed.

Mean values for right and left testicular volumes before the operation, and after postoperative follow-up of at least 6 months are shown in Table 1. In Figure 1, differences in testicular volumes as calculated before, and after the operation are shown as a column chart. Preoperatively mean value for the right testicular volume was 7.14±4.31 mL which was found to be significantly higher when compared with the mean value for left testicular

volume (5.38 ± 3.42 mL) ($p=0.002$). After at least 6 months of follow-up, mean values for right, and left testes were 10.78 ± 5.06 mL, and 9.88 ± 4.35 mL respectively, without any statistically significant intergroup difference ($p=0.47$).

In only 8 (16%) cases any difference between preoperative right, and left testicular volumes was not found, and in 35 (70%) cases postoperative testicular volumes did not differ. Based on a new concept, surgery is indicated, if we consider the presence of a $\geq 20\%$ difference between both testicular volumes. Accordingly, in 38 (76%) cases an insignificant difference was found between right, and left testicular volumes during postoperative follow-up period. Only in a case with more than 35% decrease in the left testicular volume preoperatively, surgery could not achieve any testicular growth, and difference between left, and right testicular volumes remained the same (Table 2). Transition between groups which achieved testicular catch-up was calculated using Marginal Homogeneity test. Difference between right, and left testicular volumes statistically significantly disappeared as detected at the final postoperative follow-up visit ($p<0.0001$). Pre-, and post-varicocelectomy differences in testicular volumes were evaluated, preoperatively mean difference between right, and

left testicular volumes as calculated by subtracting right testicular volumes from the left testicular volumes was -1.68 ± 1.42 mL, while during postoperative follow-up the corresponding value was -0.84 ± 1.65 mL, with a significant difference between these two values ($p=0.001$) (Figure 2). Number of intraoperatively ligated internal (4.68 ± 1.95), and external spermatic veins (0.84 ± 0.58) of the study participants, and the number of preserved spermatic arteries, and lymphatic vessels were evaluated individually for each case (Table 3). A significant correlation could not be found between number of ligated vessels, and postoperatively determined testicular volumes ($p=0.8$). In 76.8% of our cases external spermatic vein could be detected. In all cases in whom testicular softening was detected preoperatively, normal testicular consistency was achieved after varicocelectomy. Preoperative semen analysis was not performed in any study patient. Only 4 patients underwent semen analysis during postoperative follow-up period. Since preoperative semen analyses were not performed, the results of semen analyses could not be statistically evaluated. The results of these four cases were evaluated as normospermia.

Table 1. Pre-, and post-operative right, and left testicular volumes

	Preoperative	Postoperative
Right testicular volume (mL)	7.14 ± 4.31 (2-25)	10.78 ± 5.06 (3-25)
Left testicular volume (mL)	5.38 ± 3.42^a (1-20)	9.88 ± 4.35^b (2-20)

^a: when compared with preoperative right testicular volume, $p=0.002$

^b: when compared with post-operative right testicular volume, $p=0.47$

The results are shown as mean $\pm$ standard deviation ((minimum-maximum)).

Figure 1. Pre-, and post-operative left, and right testicular volumes of the patients

Table 2. A crosstab demonstrating pre-, and postoperatively classified differences in testicular volumes, and catch-up growth rates

			Differences in postoperative testicular volumes				Total
			10-19.9	20-34.9	+35	No difference	
Differences in preoperative testicular volumes	10-19.9 mL	n	0	1	0	5	6
		(%)	0	16.7	0	83.3	100
	20-34.9 mL	n	2	6	0	15	23
		(%)	8.7	26.1	0	65.2	100
	≥ 35	n	1	3	1	8	13
		(%)	7.7	23.1	7.7	61.5	100
	No difference	n	0	1	0	7	8
		(%)	0	12.5	0	87.5	100
Total	n	3	11	1	35	50	
	(%)	6	22	2	70	100

Figure 2. Differences between pre-, and post-operative testicular volumes as determined by subtracting left from the right testicular volumes

Table 3. Microanatomic details of our cases estimated during microscopic varicocelectomy

Vessels	Mean $\pm$ standard deviation (minimum-maximum)
Internal spermatic vein	4.68 $\pm$ 1.95 (1-9)
External spermatic vein	0.84 $\pm$ 0.58 (0-3)
Total number of ligated veins	5.52 $\pm$ 2.08 (2-10)
Artery	1.14 $\pm$ 0.6 (0-2)
Lymphatics	1.72 $\pm$ 0.8 (1-4)

Discussion

In our study, preoperatively a significant difference was found between right, and left testicular volumes, but postoperative measurements were not significantly different. Median follow-up period in our study was 26 months, and our catch-up growth rate was 70 percent. Incidence of adolescent varicocele in general population was 15%, however since they are generally asymptomatic, their incidence may be higher than already known.^[17-19] Since for postoperative evaluation in pediatric age, semen analysis cannot be performed, testicular catch-up volume is the most important parameter in evaluating the outcome of varicocelectomy.^[9] Some investigators have reported recovery of testicular development, and sperm dysfunction after varicocelectomy.^[10,20,21] Sinanoğlu et al.^[10] followed up 39 adolescents with varicocele at 3 month-intervals after varicocelectomy just by calculating testicular volumes. As a result of an average follow-up of 39 months, they reported catch-up growth in 90% of the cases with ipsilateral testicular atrophy. They determined that catch-up growth started nearly 9 months after varicocelectomy,

and indicated that testicular volume is the most important parameter in the evaluation of testicular function. In various novel series catch-up growth rates have varied between 73, and 90 percent.^[20-22]

In studies performed on the impact of surgical method on catch-up growth rate, any effect of surgical method on testicular catch-up rate could not be detected.^[13,23] Recently, Shiraishi et al.^[23], performed subinguinal, and high-ligation microsurgical varicocelectomy, and indicated 70, and 78% catch-up growth rates during 24 months of the follow-up period, respectively. However, they couldn't detect a statistically significant difference between both methods. Atassi et al.^[13] compared 36 patients who had undergone artery-preserving varicocelectomies (n=36) with those undergone Palomo procedure during a follow-up period of 22 months, and when compared with preoperative values in patients undergoing artery-preserving surgery, left testicular volume increased from 73% up to 91%, while in patients who had undergone Palomo procedure average increase from 73% to 91% was detected in testicular volumes relative to preoperative values without any statistically significant intergroup difference.

In some studies, decrease in postoperative complications as hydrocele has been detected with varicocelectomies performed using lymphatic vessel preserving surgery.^[24,25] In our study the same method was used without development of hydrocele in any patient. Some studies have indicated favourable impact of lymphatic congestion secondary to varicocelectomy on catch-up growth rate in surgeries performed with non-lymphatic preserving approach,^[14,22,26] while others could not detect any effect of lymphatic vessel-preserving varicocelectomy on catch-up growth rate.^[10,24] Fast et al.^[24] detected that ligation of lymphatic vessels significantly prolonged duration of catch-up growth.

In a study by Sadoy et al.^[27] post-pubertal testicular volumes of the patients who had undergone surgery with the diagnosis of cryptorchidism, and those of the patients whose testicular descent occurred spontaneously, and healthy control group were compared and significant intergroup differences in testicular volumes were detected. Post-pubertal small testes were associated with decreased number of Sertoli cells. In this study, testicular volumes were calculated based on Lambert's formula with the aid of US measurements, and Prader orchimetry. Difference in testicular volumes between these two measurement instruments was attributed to deficiency in understanding Lambert's formula.^[27]

In a study by Sinanoğlu et al.^[10] the authors determined that post-varicocelectomy catch-up growth started from 9. month and persisted up to 36. month postoperatively. Still in a study performed in 15-19 year-old men with grade 2-3 varicoceles, testicular catch-up growth started within 12 months after varico-

celectomy.^[28] In various current series 73-90% catch-up growth rates have been detected.^[20-22] In our study 70% catch-up growth rate was detected. However, Cayan et al.^[29] observed improvement in previously low sperm counts of 15-19-year-old men after varicocelelectomy, while testicular catch-up growth was not observed in these patients.

Our relatively small patient group, inability to perform semen analysis of the patients, lack of a control group, inability to analyze testicular volumes according to age groups, use of only Tanner scale scoring, and Prader's orchimeter for the measurement of testicular volumes are evaluated as limitations of our study.

In conclusion, as has been demonstrated in our study, and in many other studies, in adolescent varicocelelectomy catch-up growth rate is an important therapeutic evaluation parameter. It is appropriate to evaluate postoperative outcomes in larger series with longer follow-up.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Atatürk University School of Medicine.

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – İ.Ö., F.B.; Design – Y.A., F.B., İ.Ö.; Supervision – İ.Ö., Y.A.; Resources – E.K., F.B.; Materials – E.G.Ö., F.K.Y.; Data Collection and/or Processing – İ.K., E.G.Ö., F.K.Y.; Analysis and/or Interpretation – İ.Ö., F.B.; Literature Search – M.K., E.K.; Writing Manuscript – F.B., M.K.; Critical Review – İ.Ö., Y.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Jarow JP. Effects of varicocele on male fertility. *Hum Reprod Update* 2001;7:59-64. [\[CrossRef\]](#)
2. Mehta A, Goldstein M. Microsurgical varicocelelectomy: a review. *Asian J Androl* 2013;15:56-60 [\[CrossRef\]](#)
3. Diamond DA, Gargollo PC, Caldamone AA. Current management principles for adolescent varicocele. *Fertil Steril* 2011;96:1294-8. [\[CrossRef\]](#)
4. Diamond DA. Adolescent varicocele. *Curr Opin Urol* 2007;17:263-7. [\[CrossRef\]](#)
5. Paduch DA, Niedzielski J. Repair versus observation in adolescent varicocele: A prospective study. *J Urol* 1997;158:1128-32. [\[CrossRef\]](#)
6. Laven JS, Haans LC, Mali WP, te Velde ER, Wensing CJ, Eimers JM. Effects of varicocele treatment in adolescents: a randomized study. *Fertil Steril* 1992;58:756-62. [\[CrossRef\]](#)
7. Cayan S, Akbay E, Bozlu M, Doruk E, Erdem E, Acar D, et al. The effect of varicocele repair on testicular volume in children and adolescents with varicocele. *J Urol* 2002;168:731-4. [\[CrossRef\]](#)
8. Tekgul S, Dogan HS, Erdem E, Hoebeke P, Kocvara R, Nijman JM, et al. EAU Guidelines on Paediatric Urology 2015: European Association of Urology and European Society of Paediatric Urology. Available from: http://www.uroweb.org/guideline/Paediatric_urology/.
9. Zampieri N, Cervellione RM. Varicocele in adolescents: A 6-year longitudinal and followup observational study. *J Urol* 2008;180:1653-6. [\[CrossRef\]](#)
10. Sinanoğlu O, Eyyüpoğlu SE, Ekici S. Ipsilateral Testicular catch-Up growth rate following microsurgical inguinal adolescent varicocelelectomy. *ScientificWorldJournal* 2012;356-74.
11. Sakamoto H, Ogawa Y, Yoshida H. Relationship between testicular volume and varicocele in patients with infertility. *Urology* 2008;71:104-9. [\[CrossRef\]](#)
12. Sakamoto H, Yajima T, Nagata M, Okumura T, Suzuki K, Ogawa Y. Relationship between testicular size by ultrasonography and testicular function: measurement of testicular length, width, and depth in patients with infertility. *Int J Urol* 2008;15:529-33. [\[CrossRef\]](#)
13. Atassi O, Kass EJ, Steinert BW. Testicular growth after successful varicocele correction in adolescents: comparison of artery sparing techniques with the Palomo procedure. *J Urol* 1995;153:482-3. [\[CrossRef\]](#)
14. Kocvara R, Dolezal J, Hampl R, Povýsil C, Dvůráček J, Hill M, et al. Division of lymphatic vessels at varicocelelectomy leads to testicular oedema and decline in testicular function according to the LH-RH analogue stimulation test. *Eur Urol* 2003;43:430-5. [\[CrossRef\]](#)
15. Dubin L, Amelar RD. Varicocele size and results of varicocelelectomy in selected subfertile men with varicocele. *Fertil Steril* 1970;21:606-9. [\[CrossRef\]](#)
16. Kocakoc E, Kiris A, Orhan I, Bozgeyik Z, Kanbay M, Ogur E. Incidence and importance of reflux in testicular veins of healthy men evaluated with color duplex sonography. *J Clin Ultrasound* 2002;30:282-7. [\[CrossRef\]](#)
17. Richardson I, Grotas AB, Nagler HM. Outcomes of varicocelelectomy treatment: An updated critical analysis. *Urol Clin North Am* 2008;35:191-209. [\[CrossRef\]](#)
18. Aksoy Y, Ziypak T, Adanur Ş. Adölesan Varikosel. *Türkiye Klinikleri* 2012;5:61-6.
19. Kass EJ. Adolescent varicocele. *Pediatr Clin North Am* 2001;48:1559-69. [\[CrossRef\]](#)
20. Moursy EE, El Dahshoury MZ, Hussein MM, Badawy AA. Dilemma of adolescent varicocele: Long term outcome in patients managed surgically and in patients managed expectantly. *J Pediatr Urol* 2013;9:1018-22. [\[CrossRef\]](#)
21. Li F, Chiba K, Yamaguchi K, Okada K, Matsushita K, Ando M, et al. Effect of varicocelelectomy on testicular volume in children and adolescents: A meta-analysis. *Urology* 2012;79:1340-5. [\[CrossRef\]](#)

22. Zampieri N, Mantovani A, Ottolenghi A, Camoglio FS Testicular catch-up growth after varicocelectomy: does surgical technique make difference? *Urology* 2009;73:289-92.
23. Shiraishi K, Oka S, Matsuyama H. Surgical comparison of subinguinal and high inguinal microsurgical varicocelectomy for adolescent varicocele. *Int J Urol* 2016;23:338-42. [\[CrossRef\]](#)
24. 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;2:159-64.
25. Riccabona M, Oswald J, Koen M, Lusuardi L, Radmayr C, Bartsch G. Optimizing the operative treatment of boys with varicocele: sequential comparison of 4 techniques. *J Urol* 2003;169:666-8. [\[CrossRef\]](#)
26. Poon SA, Kozakowski KA, Decastro GJ, Gjerston CK, Glassberg KI. Adolescent varicocelectomy: postoperative catch-up growth is not secondary to lymphatic ligation. *J Pediatr Urol* 2009;5:37-41. [\[CrossRef\]](#)
27. Sadov S, Koskeniemi JJ, Virtanen HE, Perheentupa A, Petersen JH, Skakkebaek NE, et al. Testicular Growth During Puberty in Boys With and Without a History of Congenital Cryptorchidism. *J Clin Endocrinol Metab* 2016;101:2570-7. [\[CrossRef\]](#)
28. Paduch DA, Niedzielski J. Semen analysis in young men with varicocele: Preliminary study. *J Urol* 1996;156:788. [\[CrossRef\]](#)
29. Cayan S, Shavakhabov S, Kadioglu A. Treatment of palpable varicocele in infertile men: A meta-analysis to define the best technique. *J Androl* 2009;30:33. [\[CrossRef\]](#)