

Testicular Catch-up Growth After Varicocelectomy: Does Surgical Technique Make a Difference?

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OBJECTIVES	Catch-up growth of the affected testis in adolescents after varicocele repair has been well documented. Many investigators have found evidence that testicular hypotrophy related to varicocele can be reversed by early intervention. The aim of this study was to analyze the testicular catch-up growth rate in pediatric patients, correlating it with patient age at surgery, varicocele size, procedures used, and semen quality.
METHODS	Between March 1990 and September 2006, a total of 465 varicocelectomies were performed at our department. We evaluated the mean testicular volume before and after varicocelectomy in patients aged 9-14 years. Two procedures were used: laparoscopic artery-preserving varicocelectomy (group 1) and open inguinal microscopic artery-preserving varicocelectomy with a venous-venous bypass (group 2). The testicular volume was measured before and after surgery using ultrasonography, and the mean testicular catch-up growth was recorded.
RESULTS	Although the overall catch-up growth rate for both groups was 80%, after 18 months, only 45% of patients in group 1 and 34% of patients in group 2 had equal bilateral testicular volume. None of these procedures showed a statistically significant correlation with age at surgery, varicocele size, or catch-up rate. The semen analysis results did not show statistically significant differences between the 2 groups.
CONCLUSIONS	Although 80% of patients demonstrated testicular catch-up, with a different distribution depending on the procedure type used but without statistically significant differences, only 32% of patients had complete and real testicular volume catch-up. UROLOGY 73: 289-292, 2009. © 2009 Published by Elsevier Inc.

Idiopathic varicocele is the most commonly diagnosed peripubertal andrologic disease and the most commonly treatable cause of male-related impaired fertility potential.¹

It is now accepted that the treatment of varicocele during childhood should be concomitant with the onset of ipsilateral testicular hypotrophy (or testicular growth arrest) and when varicocele is accompanied by pain. Obviously, changes in semen quality are not considered as a parameter for surgery in pediatric patients, although they remain the first indication for surgery in adult patients, or as soon as patients are old enough to provide a sample for semen analysis.²

Catch-up growth of the affected testis in adolescents after varicocele repair has been well documented, and many investigators have found evidence that testicular

hypotrophy related to varicocele can be reversed by early intervention.³⁻⁵

Recently, different studies have reported a catch-up growth rate of 60%-89% in treated patients, suggesting a correlation between semen analysis and fertility improvement.³⁻⁷

Through a retrospective analysis, the aim of this study was to analyze the testicular catch-up growth rate in pediatric patients and to correlate it with patient age at surgery, varicocele size, procedures used, and semen quality after surgery.

MATERIAL AND METHODS

From March 1990 to September 2006, a total of 465 varicocelectomies were performed at our department.

All patients aged 9-14 years underwent surgery for ipsilateral testicular hypotrophy. The varicocele was classified as follows: grade 1, palpable varicocele only with a Valsalva maneuver; grade 2, palpable varicocele without a Valsalva maneuver; grade 3, visible varicocele. Testicular hypotrophy was defined as a testicular volume loss of >20% compared with the contralateral testis, assessed using the Siemens Sonoline Elegra Ultrasound

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Imaging System (Siemens AG, Munich, Germany) with a 7.5-MHz probe. Measurements of the testicular length, width, and height were obtained using electronic calipers. The testicular volume was estimated with the formula for a prolate ellipsoid (volume in $\text{cm}^3 = 523 \times \text{length} \times \text{width} \times \text{height}$).

The inclusion criteria for this study were patient age of 9-14 years, left varicocele, testicular hypotrophy at ultrasound, no previous infections of the urinary system, no previous testicular trauma or previous inguinal and scrotal surgery, no neurologic or metabolic diseases, and complete follow-up data (3, 6, and 18 months after surgery). Recurrence and persistence of varicocele, testicular atrophy after surgery, and hydrocele were the exclusion criteria.

The long-term results were recorded for the patients who underwent semen analysis (at 18 years of age) to determine the semen quality and long-term testicular catch-up growth rate. Statistical analysis was performed to compare the testicular volume before and after surgery. The results were compared with the seminal data. The semen was collected by masturbation after 3-4 days of abstinence and processed within 1 hour from ejaculation. A minimum of 2 specimens were collected from each patient, separated by a 4-week interval. The analysis focused specifically on sperm motility and form.²

Because of the variety of procedures used at our institution to treat varicocele, we focused our analysis only on those techniques that preserve the testicular artery. This criterion was also used because a recent study by Zampieri et al.² suggested treating varicocele with testicular hypotrophy to preserve the spermatic artery.

In the present study, 2 techniques were compared: laparoscopic artery-preserving varicocelectomy and open inguinal microscopic artery-preserving varicocelectomy with a venous-venous bypass.

All medical charts were reviewed. The following parameters were considered: the mean testicular volume before and after surgery for both sides, the catch-up growth rate for both techniques, and the correlation between the catch-up growth rate and patient age at surgery and varicocele size.

All testicular measurements were performed on ultrasound scans using the Siemens Sonoline Elegra Ultrasound Imaging System (Siemens) with a 7.5-MHz probe.

Statistical analysis was performed using the Student *t* test, the χ^2 test, and Fischer's exact tests. Significance value was set at $p < 0.05$. The analysis was conducted with the Statistical Package for Social Sciences, version 15 for Windows (SPSS, Chicago, IL).

RESULTS

After a review of the medical charts, and in compliance with the inclusion and exclusion criteria, 225 patients with a left varicocele were considered for the present study. Of these 225 patients, 97 underwent laparoscopic artery-preserving varicocelectomy (group 1), and 124 underwent microsurgical varicocelectomy (group 2).

None of the patients had grade 1 varicocele; 60 had grade 2 and 165 had grade 3 varicocele. Testicular hypotrophy correlated strictly with the varicocele grade (grades 2 and 3 vs 1) but not specifically with grade 2 vs 3 ($P > .05$).

Surgical complications, which were exclusion criteria, occurred as follows: 4 cases of hydrocele and 1 recurrence

in the laparoscopic group (group 1) and 8 cases of hydrocele, 3 recurrences, and 2 cases of testicular atrophy in the microsurgical group (group 2). No case of persistence was recorded after either technique.

In group 1, the mean preoperative left testicular volume was $6 \pm 2 \text{ cm}^3$ and the mean right testicular volume was $8 \pm 1.2 \text{ cm}^3$. At 18 months after surgery, the mean left testicular volume was $7 \pm 1.5 \text{ cm}^3$ and the mean right testicular volume was $9.5 \pm 2 \text{ cm}^3$. Of the 97 patients in group 1, 84 (85%) had statistically significant catch-up growth ($P < .05$) and 13 (15%) did not. At 18 months after surgery, only 38 (45%) of the 84 patients with catch-up growth had equal bilateral testicular volumes.

In group 2, the mean preoperative left testicular volume was $7 \pm 1.7 \text{ cm}^3$ and the mean right testicular volume was $8 \pm 2 \text{ cm}^3$. At 18 months after surgery, the mean left testicular volume was $8 \pm 0.7 \text{ cm}^3$ and the mean right testicular volume was $10.5 \pm 2.1 \text{ cm}^3$. Of the 124 patients in group 2, 99 (75%) had statistically significant catch-up growth ($P < .05$) and 25 (25%) did not. At 18 months after surgery, 34 (34%) of the 99 patients with catch-up growth had equal bilateral testicular volumes.

The overall catch-up growth rate for both groups was 80%. This result is in line with previously reported data, although neither of the 2 procedures seemed to correlate with a greater catch-up rate ($P = .18$). None of the study patients had testicular hypertrophy after varicocelectomy. A review of the medical charts, especially for those patients who underwent semen analysis (56 patients), showed that the data for the testicular catch-up growth rate were also confirmed after a mean of 40 months after surgery.

None of the procedures used showed a statistically significant correlation between patient age at surgery, varicocele size, and catch-up rate ($P > .05$).

As described in a previous study,⁸ for patients treated with a microsurgical technique, it was possible to demonstrate the long-term patency of microsurgical anastomoses between the internal spermatic vein and the inferior epigastric vein using color flow Doppler ultrasonography at 18 months after surgery.

A total of 56 patients underwent semen analysis. Of these patients, 32 had undergone laparoscopic varicocelectomy and 24 microsurgical varicocelectomy. In group 1, 13 patients had normalization of the testicular volume compared with the contralateral, and 19 patients did not. In group 2, 14 patients had normalization of the testicular volume and 10 did not. No statistical correlation was found between patient age at surgery, testicular volume, and the seminal parameters after surgery between the 2 groups (laparoscopic vs microsurgical technique). No statistically significant difference was found in semen quality between patients showing normalization of testicular volume compared with their contralateral testis and patients with "partial" testicular catch-up growth. As previously described in our other studies, we also found in the present study that the semen

quality for patients with varicocele does not correlate with either testicular hypotrophy or varicocele grade. Neither varicocele grade nor testicular volume at surgery was predictive of low sperm motility or a high or low percentage of anomalous spermatozoa.

COMMENT

Many investigators have reported a correlation between ipsilateral testicular hypotrophy and varicocele in adolescent and adult patients.⁸⁻¹²

Testicular hypotrophy related to varicocele is the objective indication to correct a varicocele at any age; however, the relationship between testicular hypotrophy (or testicular growth arrest) and the fertility status of the patient has not yet been established.

Many recent studies have shown an association between abnormal semen parameters, especially total motile sperm counts and form, and testicular hypotrophy in infertile men. However, the difference between the right and left testicular volume did not differ between fertile and infertile men with varicocele.¹³⁻¹⁵

Regarding the outcomes of varicocelectomy, testicular volume catch-up is one of the most important endpoints. In the pediatric age group, when it is not possible to perform preoperative semen analysis, no clinical criteria are available to properly define the postoperative outcomes. Therefore, and because the role of varicocelectomy is to stop vein reflux, the improvement in the testicular volume is considered the main outcome measure.

According to the data collected during the present study, although progressive testicular catch-up growth occurred, only 45% of group 1 patients and 34% of group 2 patients had equal bilateral testicular volume at 18 months postoperatively.

Thus, although 80% of patients had testicular catch-up growth, with a different distribution depending on the procedure type used but without statistically significant differences, only 32% (72 patients) had complete and real testicular volume catch-up growth. Also, comparing the pre- and postvaricocelectomy testicular volume in the remaining patients, the testicular catch-up growth proved to be only partial. This cannot be considered an optimal outcome.

Consequently, although it was not possible to determine a statistically significant difference between the values before and after surgery, it is clear that this situation can be interpreted differently. For instance, the arrested testis continued to grow but more slowly than the contralateral testis not affected by varicocele, and this is the reason varicocelectomy did not result in a good outcome. Conversely, complete testicular catch-up growth (with equal right and left testicular volumes) resulted because of hindrance to blood flow or blood stasis within the gonad rather than an actual increase in testicular parenchyma. According to some investigators, this intraparenchymal stasis could also explain the increase in testicular volume as well as

the onset of postvaricocelectomy hypertrophy. Other investigators have also reported that testicular catch-up does not correlate with improved semen quality in all patients.^{14,16,17}

If testicular catch-up can be strictly related to intraparenchymal blood stasis, this could also explain the different catch-up rates depending on which surgical procedure is used. Laparoscopic ligation, performed higher than the inguinal approach, revealed better relative catch-up rates. Therefore, upper ligation apparently improves blood stasis even if the failed testicular catch-up growth might be caused by the surgical procedure itself. Although impossible to demonstrate, unlike testicular atrophy, which could be a secondary event related to surgery, this is an important finding to be kept in consideration.

The data collected also show some of the limits of this study. The present study compared 2 surgical artery-preserving techniques. The data might be different if patients undergoing varicocelectomy with complete artery ligation could be observed and compared. Also, not all patients completed follow-up. This might have affected the study results, but the data were not different in the subjects completing follow-up and undergoing a follow-up visit once they were 18 years old.

Although published studies have reported postvaricocelectomy testicular catch-up in most patients, this finding might not represent actual testicular trophism. An important, although preliminary, finding of the present study is that testicular catch-up growth and semen quality are independent variables. As many other studies have shown, testicular hypotrophy does not always correlate with alterations in semen quality^{14,18}; thus, despite the semen data collected in the present study, it seems logical to suppose that testicular catch-up growth also does not correlate with semen quality. Additional (multicenter) studies comparing different surgical techniques and including complete semen analysis are necessary before it is possible to discuss actual testicular catch-up growth.

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