The Role of Testicular Volume in Adolescents With Varicocele: The Better Way and Time of Surgical Treatment

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Purpose: We report varicocele prevalence in adolescents. Surgical treatment has been proposed in adolescents with relevant testicular disproportion to avoid fertility problems in adulthood. We prospectively analyzed the testicular volume variation in adolescents with varicocele and hypoplastic testis.

Materials and Methods: In a 2-year period we selected 54 consecutive pediatric patients with a median age of 14.5 years (range 13 to 16) who had left varicocele using certain criteria, including testicular volume discrepancy greater than 20%, no previous inguinal-testicular surgery and no symptoms. Adolescents were divided into 2 groups, including 27 who underwent surgical correction with lymphatic sparing microsurgical varicocelectomy (intervention) and 27 who were only observed (control). After surgery or at first observation patients were evaluated clinically and by ultrasound at 3, 6 and 12 months. Testicular volume was estimated by the prolate ellipsoid formula.

Results: We noted significant improvement in testicular volume with less than 20% disparity between the 2 gonads in 23 patients (85.2%) in the intervention group and in 8 controls (29.6%). Two recurrences (7.4%) were reported in the intervention group, each in an adolescent with increased testicular volume.

Conclusions: Our study confirms significantly increased testicular volume in many surgically treated boys and shows that physiological catch-up growth occurs in adolescents with varicocele without treatment. Considering critically results in each group, in select cases clinical and ultrasound followup is indicated before intervention due to a possible spontaneous decrease in testicular asymmetry. Further histopathological studies are needed to identify the relationship between testicular hypoplasia, irreversible damage and future fertility problems to determine which adolescents should be treated.

Key Words: testis, spermatic cord, varicocele, adolescent, organ size

VARICOCELE, defined as abnormal dilatation of the pampiniformplexus and testicular veins, is a common disease that mostly affects the left side. The prevalence tends to increase significantly after adolescence to become the most common andrological disorder in this period of life.1-3 Male infertility due to varicocele may be caused by several mechanisms, including increased intrascrotal temperature, reflux of toxic adrenal and renal metabolites through the renal vein, and testicular hypoxia and ischemia.4 Its prevalence may be as high as 40% in men who present for infertility evaluation and in 80% of those with secondary infertility.1,2

Fertility is the main issue when considering appropriate varicocele treat-
ment. The American Urological Association and American Society of Reproductive Medicine stated, “Varicocelectomy may be considered the primary treatment option when a man with a varicocele has sub-optimal semen quality and a normal female partner.”

Many groups have reported that varicocele correction improves testicular function and semen parameters, although fertility is restored in only 35% to 46% of treated men.

In adolescent boys the usefulness of semen analysis is unclear so that testicular size has been used as a more effective parameter to determine spermatogenic potential in adolescents with varicocele. Treating all adolescents with varicocele and hypoplastic testis is costly and may lead to significant overtreatment. Considering that varicocele alone may not be the first cause of infertility and such dilatation can be found in almost a fifth of adolescents, routine correction is not recommended.

Many adolescent boys with varicocele and a greater than 15% or 20% volume differential show catch-up growth on followup examination.

The challenge is to identify adolescents with varicocele who are likely to benefit most from varicocelectomy in terms of potential future fertility. As a first step, we prospectively examined testicular volume variation in adolescents with varicocele and an ipsilateral hypoplastic testis.

**MATERIALS AND METHODS**

From January 2006 to March 2008 we observed 97 boys with left varicocele at our institutions. Of these patients 54 were included in the study based on certain criteria, including 1) varicocele with objective evidence of greater than 20% decreased testicular size ipsilateral to the lesion, 2) no previous testicular or inguinal surgery and 3) absent symptoms such as scrotal discomfort and orchialgia. The other 43 boys were excluded from study due to no data on testicular size discrepancy.

Each boy was followed 1 year. All varicocele diagnoses were made by clinical and instrumental examination, including color Doppler US of the spermatic cord and US of the testes using a 7.5 MHz probe. All US was done by the same operator blinded to treatment by a patch on the patient inguinal region. Testicular volume was estimated by the prolate ellipsoid formula, volume in cm$^3$ = length \times width \times height \times 0.523. The percent difference in testicular volume between the right and the left testes was calculated using the formula, (right testicular volume – left testicular volume) \times 100/right testicular volume. Venous reflux while supine and upright on color Doppler US spontaneously and during the Valsalva maneuver was an essential criterion to diagnose varicocele and identify recurrence.

Adolescents were divided into 2 homogeneous groups by age and Tanner stage. In 27 cases we treated varicocele with lymphatic sparing microsurgical varicocelectomy just after diagnosis (IG). The other 27 patients were observed for 12 months (CG). After receiving local institutional review board approval informed consent was obtained from all parents or patients before the study.

At lymphatic sparing microsurgical varicocelectomy we identified and exposed the spermatic cord through a small subinguinal incision using loupe magnification. The testis was delivered through the incision to ensure visual access to all possible routes of venous return, including the external spermatic, cremasteric and gubernacular veins. All veins were isolated and closed. Microsurgical approach allowed identification and preservation of the testicular artery or arteries and of many lymphatic channels.

After initial examination patients were reassessed clinically, and on US at 3, 6 and 12 months. Collected data were examined using chi-square analysis with statistical significance considered at $p <0.05$ and $<0.01$.

**RESULTS**

Median age in the study group was 14.5 years (range 7 to 16). Tanner stage was 1 or 2 in 22 boys (40.7%) and 3 to 5 in 36 (59.3%). At the 3-month observation 4 IG (14.8%) and 2 CG (7.4%) patients showed left testis catch-up growth so that the volumetric difference was less than 20%. This was also noted in 17 IG (62.9%) and 6 CG (22.2%) patients at 6 months. At 12 months of observation 23 IG (85.2%) and 8 CG (29.6%) patients showed left testis catch-up growth so that the volumetric difference became less than 20% (see table).

At 12 months 2 IG patients (7.5%) had persistent grade III reflux with less than a 20% difference between the testes. By study end 19 CG patients had no spontaneous catch-up growth and, thus, they underwent surgical treatment.

At study end we noted no complications, such as hematoma, wound infection, hydrocele or persistent inguinal-scrotal pain. No patient had a left gonad larger than the right gonad.

<p>| Testicular volume difference on US at 3, 6 and 12-month followup in 27 patients |</p>
<table>
<thead>
<tr>
<th>% Vol Change</th>
<th>No. IG (%)</th>
<th>No. CG (%)</th>
<th>p Value</th>
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<tr>
<td>Less than 20</td>
<td>4 (14.8)</td>
<td>2 (7.4)</td>
<td>Not significant</td>
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<tr>
<td>Greater than 20</td>
<td>23 (95.2)</td>
<td>25 (92.6)</td>
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<td>6 Mos:</td>
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<td>Less than 20</td>
<td>17 (62.9)</td>
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<td>Greater than 20</td>
<td>10 (37.1)</td>
<td>21 (77.2)</td>
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<td>Greater than 20</td>
<td>4 (14.9)</td>
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DISCUSSION

Treatment for adolescent varicocele remains an open problem for urological and pediatric surgeons.12 Historically identifying adolescents who needed varicocele correction depended on varicocele grade, gonadotropin-releasing hormone stimulation studies, testicular disproportion, semen analysis and peak retrograde flow on color Doppler US of the spermatic cord.13 However, the most widely accepted objective criterion for surgery is testicular asymmetry since about 70% of male adolescents with varicocele present with ipsilateral testicular hypotrophy associated with varicocele.4,10,11 Kass and Belman noted that the testis on the unaffected right side was often smaller than the expected volume of a right testis in a healthy patient but not nearly as small as the contralateral affected left testis.14

Several studies describe the use of testicular size as an indirect indicator of developing spermatogenic potential in adolescents with varicocele.4,10,11 Men with testicular hypotrophy associated with varicocele often present with semen analysis anomalies.14,15 To our knowledge the normal range for semen analysis in the younger population has not yet been established. Thus, testicular biopsy is a better way to investigate whether varicocele in adolescence is associated with gonadal histological or cytological anomalies. Since percutaneous needle biopsy and fine needle cytology are considered invasive and potentially dangerous, they are rarely used, although real risks have not been reported in childhood.16–18 In cases of histological anomalies gonadotropin-releasing hormone therapy could be useful to improve testicular tropism and potential future fertility.19,20

Thus, the difference in testicular volume is the best criterion available as a gauge of testicular health and the main indication for surgical correction for asymptomatic adolescence varicocele, although the real relationship between this disease and testicular volume is not well understood.21 Thomas and Elder arbitrarily assigned 15%, 20% and 2 cc size differentials22 while the American Society for Reproductive Medicine guideline affirms that surgical management should be done when the volume disparity persists or increases in a short time.5

Testicular volume is considered an imperfect measure of testicular function and fertility potential, and testis volume measurement can be subjective, especially at a single examination.23,24 Corporal asymmetry is often a physiological parameter in adults and adolescents. Gonadal asymmetry could be considered a parameter completely independent of varicocele, possible histological anomalies and possible future infertility. Just as female breast development occurs asynchronously, the testes may also grow asynchronously. During adolescence even normal boys experience a testicular volume discrepancy, probably because the testes grow asynchronously through puberty.25 This discrepancy may be temporary but sometimes it persists. Our study underlines the possible normalization of testicular asymmetry associated with varicocele in adolescence, including possible normalization of the testicular discrepancy with time, to avoid surgical intervention.

Testicular catch-up growth is still possible in adolescence independent of surgical treatment. For this reason Kolon et al evaluated whether after an observation period a window of opportunity would be lost to achieve improved testicular volume.26 They followed 28 patients with an initial 15% or greater volume differential by 3 US studies done at least 6 months apart. At the end of followup 27 of 38 patients (71%) showed testicular volume differentials in the normal range of less than 15% independent of age range, Tanner stage, varicocele grade and bilateralism. Thus, they were spared surgical intervention.

According to our experience and a recent study27 patients with greater than 15% testicular asymmetry at presentation have a higher incidence of catch-up growth at higher Tanner stages. Also, Tanner 1 cases were more likely to have worsening asymmetry (greater than 25%) than those of any other Tanner stage. Even when patients presented with symmetrical testicular size, a high percent showed asymmetry in the future. In our experience testicular catch-up growth was statistically significant for Tanner stage 2 or greater.

Relatively little is known about the relationship between Tanner stage at surgery and postoperative catch-up growth. Cayan et al studied 39 males 11 to 19 years old with left unilateral or bilateral varicocele associated with testicular asymmetry who underwent varicocelectomy.28 By a mean 2-year followup 53% of patients had significant testicular growth after varicocelectomy but it was limited almost exclusively to those younger than 14 years at surgery. They concluded that this finding may be due to the fact that testicular growth is almost complete at this age and even after removing the varicocele no further growth is likely to occur. A critique of this study is that, although patients had preoperative testicular asymmetry, the definition of catch-up growth was based on absolute increases in testicular size and not on whether there was a decrease in the size differential between the left and right testes.10

We observed CG boys for 1 year. About 30% of patients experienced spontaneous growth great
enough to decrease the size difference to less than surgical criteria between the affected and the unaf-
fected testis. In contrast, after varicocelectomy 85.2% of IG patients achieved testicular volume normal-
ization, confirming that surgical management im-
proved testicular volume. Observation longer than
1 year to allow spontaneous catch-up growth in
more than about 30% of adolescents with varicocele
should be possible. However, the impossibility of
performing testicular biopsy or obtaining data on
cytological aspects make it unsafe for future patient
fertility.

US measurements of testicular parameters can
also lead to statistically different results. Thus, a
conservative approach should be possible in patients
with less than 20% testicular discrepancy.29

According to our study and the literature27,30
initial therapy in an adolescent with asymptomatic
varicocele and a greater than 20% testicular
discrepancy should be an almost 1-year surveil-
ance by serial US. Surgical treatment should be
done only when there is persistent or worsening
testicular asymmetry. However, in select cases
clinical and US followup is not indicated and so
surgery must be the first therapeutic approach.

These cases included those of symptomatic varico-
cele,26 greater than 30% to 40% testicular volume
discrepancy, which tends to persist with time,30
Tanner stage 1, which is associated with worsen-
ing gonadal discrepancy,27 retrograde flow 38 cc
per second10 and high Tanner stage (4 or 5) in
adolescence.13

CONCLUSIONS
There is still open debate on treatment for varico-
cele in adolescence. Surgical intervention is com-
mon for testicular hypotrophy and orchialgia but
which patients really benefit from this is not yet
understood. According to our study surgical treat-
ment should not be considered as the first line
therapy in adolescents with asymptomatic varico-
cele and about 20% testicular hypotrophy. They
should undergo clinical and US followup for al-
most 1 year since normalization of testicular vol-
ume is possible. If surgery is not needed for other
reasons, this would avoid surgical intervention in
about 30% of cases. If biopsy were possible, obser-
vation time could be longer. Our study also shows
that surgery allowed normalization of testicular
volume in 85.1% of patients.

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