

## Seminal Improvement Following Microsurgical Subinguinal Varicocelectomy: Preoperative Sonographic Parameters of Success

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### ABSTRACT

**INTRODUCTION:** The aims of the study were to: (1) evaluate the use of color Doppler ultrasound to diagnose and grade varicocele, and (2) identify the ultrasonographic patient selection criteria for microsurgical subinguinal varicocelectomy that would result in the best seminal improvement.

**METHODS:** Participants were 94 infertile patients undergoing microsurgical subinguinal varicocelectomy. All patients were evaluated with a case history, physical examination, semen analysis, hormonal assay, and color Doppler scrotal ultrasound. Postoperative improvement indexes in sperm concentration, sperm motility and normal sperm morphology were calculated. Improvement index  $> 0.5$  was considered a good outcome. Statistical analysis was done to show the relationship between microsurgical varicocelectomy outcome and testicular vein diameter at the lower testicular pole and the degree of reflux measured by color Doppler ultrasound.

**RESULTS:** Seminal improvement indexes  $> 0.5$  were found for sperm concentration, motility, and morphology in 61.3%, 29.9% and 19.3% of cases, respectively. Patients with testicular vein diameter  $\geq 2.5$  mm at the lower pole of the testis had a significantly higher seminal improvement index in sperm concentration, motility, and morphology than those with a testicular vein diameter  $< 2.5$  mm ( $P = .001, .001, .003$ , respectively). Patients with reflux detected by color Doppler ultrasound at the lower pole of the testis had a significantly higher seminal improvement index in sperm concentration, motility, and morphology than patients with reflux only in the suprastesticular venous channels ( $P = .02, .013, .042$ , respectively).

**CONCLUSIONS:** Color Doppler ultrasound is an important method for accurate diagnosis and grading of varicocele and for prediction of the outcome of varicocelectomy. Microsurgical subinguinal varicocelectomy is recommended for patients with testicular vein diameter  $\geq 2.5$  mm, regardless of the grade of reflux at the inferior pole of the testis.

**KEYWORDS:** Color Doppler ultrasound; Varicocele; Microsurgical varicocelectomy; Seminal improvement

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## INTRODUCTION

*Varicocele* is an abnormal dilatation of the pampiniform venous plexus. It is present in approximately 15% to 20% of the general population, 40% of men with primary infertility, and 45% to 81% of men with secondary infertility [1]. Varicoceles are associated with small ipsilateral testes in both adolescents and adults. In addition, ipsilateral testicular growth is often impaired in adolescents with varicoceles [2,3].

Microsurgical subinguinal varicocelectomy is an adequate approach for the treatment of varicocele, but improvement in semen parameters is not achieved in all cases [4-7]. Lack of improvement may be due to overdiagnosis and undertreatment of the varicocele.

The use of color Doppler ultrasound for the diagnosis of varicocele has been evaluated in several studies [8,9]. However, because the outcome following varicocelectomy is still uncertain, improvement in preoperative selection of patients is needed. Many parameters must be taken into consideration preoperatively. These parameters may be related to the patient's age and clinical condition, semen characteristics, or condition of the testis and varicocele [10].

The purpose of the present study was to evaluate the use of color Doppler ultrasound to diagnose varicocele and to predict the outcome of microsurgical varicocelectomy.

## METHODS

### *Participants*

Ninety-four male infertile patients with clinical varicocele were evaluated at an infertility clinic. The mean age of the patients was 33 (SD = 11; range, 20-48 years). Patient characteristics were assessed through a complete case history, physical examination, multiple semen analyses, and hormonal assay.

### *Procedure*

**Ultrasound Evaluation.** Scrotal ultrasound and color Doppler examination were done to all patients using Toshiba Ecocee Nemio XG SSA-580A (Toshiba Medical Systems, Tokyo, Japan) with a linear 7.5 MHz transducer. Data were collected with the patient in the supine and standing positions and with and without Valsalva maneuver. The spermatic vein and the pampiniform plexus of veins were evaluated in the supine position to detect the average caliber of the dilated veins. Then, the degree of reflux was assessed with color Doppler ultrasound.

The presence of reflux in the testicular veins by color Doppler

ultrasound confirmed the diagnosis of varicocele. The author used the Sarteschi et al [11] classification of varicocele to assess the degree of reflux. The classification is divided into 5 grades according to reflux characteristics, including the location and amount of time the reflux is present, as well as changes observed during the Valsalva maneuver. Grade 1 is characterized by the detection of prolonged reflux of vessels in the inguinal channel only during the Valsalva maneuver. Grade 2 is characterized by the presence of venous reflux in the suprastesticular region only during the Valsalva maneuver. Grade 3 is characterized by reflux at the inferior pole of the testis only during the Valsalva maneuver and only when the patient is evaluated in a standing position; no reflux is detected if the examination is performed in a supine position. Grade 4 is characterized by venous reflux even if the patient is studied in a supine position. Enhancement of venous reflux after the Valsalva maneuver is the criterion that distinguishes this grade from the previous and the next one. Grade 5 is characterized by the presence of an important basal venous reflux that does not increase after Valsalva maneuver. The reader is referred to Figure 1, Figure 2, Figure 3, and Figure 4 for examples of the Sarteschi et al classifications.

**Varicocele Surgery.** Microsurgical subinguinal varicocelectomy was done by the same surgeon for all patients. The surgery was completed with meticulous vein ligation, while preserving the testicular arteries and lymphatic vessels. The Ziess microscope with 8x magnification was used. The surgeon performed varicocelectomy on the left side in 49 patients and on both sides in 45 patients.

Postoperative follow-up was done monthly. It included a physical examination, semen analysis (starting at 3 months), and color Doppler ultrasound (at 3-6 months).

### *Data Analysis*

Pre- and postoperative *improvement indexes* were calculated for sperm concentration, percent of forward progressive motility, and normal morphology. For example, improvement in sperm concentration was calculated by dividing the difference between the postoperative and preoperative sperm concentration by the preoperative sperm concentration. An improvement index of more than 0.5 was considered a good outcome [12].

All continuous variables were expressed as means and standard deviations. Parameters of semen analysis were compared to the normal values established by the World Health Organization (WHO). All of the examined variables were correlated to testicular vein diameter and the degree of reflux. Pearson

Figure 1. Grayscale Ultrasonography of the Testicular vein (3.2 mm) at the Inferior Pole of the Left Testis.

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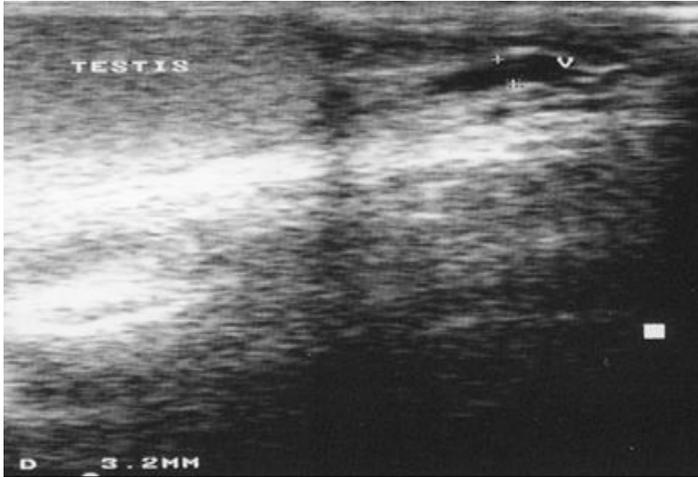
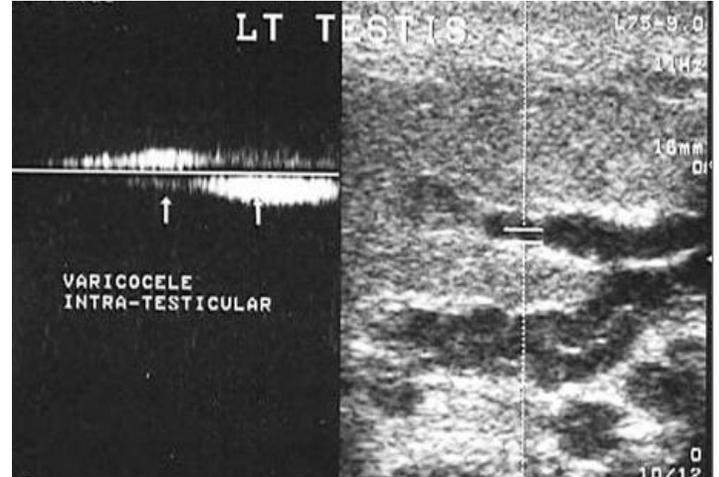


Figure 2. Doppler Ultrasonography Showing Reversed Venous Reflux After Valsalva Maneuver.

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correlation coefficient and *t* tests were used for comparison of continuous variables, with  $P > .05$  considered statistically significant. Chi square was used for comparison of categorical variables.

## RESULTS

### Testicular Vein Diameter and Reflux

None of the patients demonstrated any complications such as testicular atrophy or hydrocele. The mean diameter of testicular veins measured by color Doppler ultrasound was 2.5 mm (SD = 0.5; range, 1.7 - 3.8 mm) on the right side and 2.9 mm (SD = 0.9;

range, 1.8 - 5.6 mm) on the left side. There was a significant difference between testicular vein diameter and the incidence of reflux detected in veins at the lower pole of the testis ( $P = .023$ ). Forty-five percent of patients with vein diameter < 2.5 mm had reflux in veins at the inferior pole of the testis; 83% of patients with vein diameter  $\geq$  2.5 mm had reflux at the inferior pole of the testis.

Table 1 contains the means and standard deviations of semen analyses before and after surgery. According to WHO standardization, 31% of the patients had normal semen parameters after surgery. Improvement in sperm

Figure 3. Doppler Ultrasonography Showing Grade 2 Reflux: Venous Reflux in the Suprategesticular Region Only During the Valsalva Maneuver.

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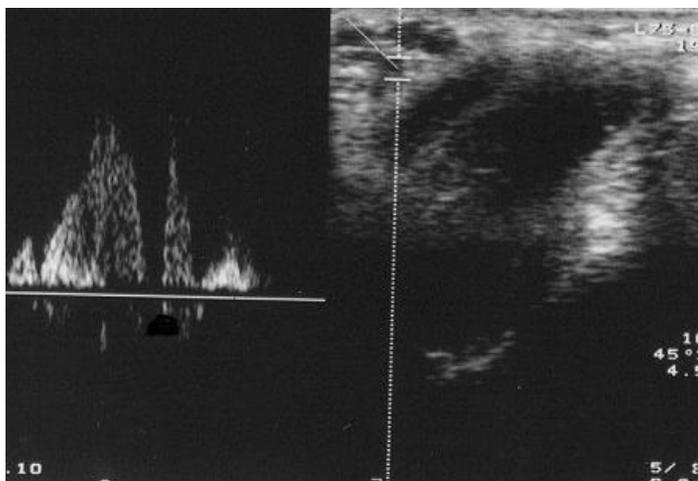


Figure 4. Doppler Ultrasonography Showing Grade 4 Reflux: Venous Reflux While the Patient is in a Supine Position with Enhancement After Valsalva Maneuver.

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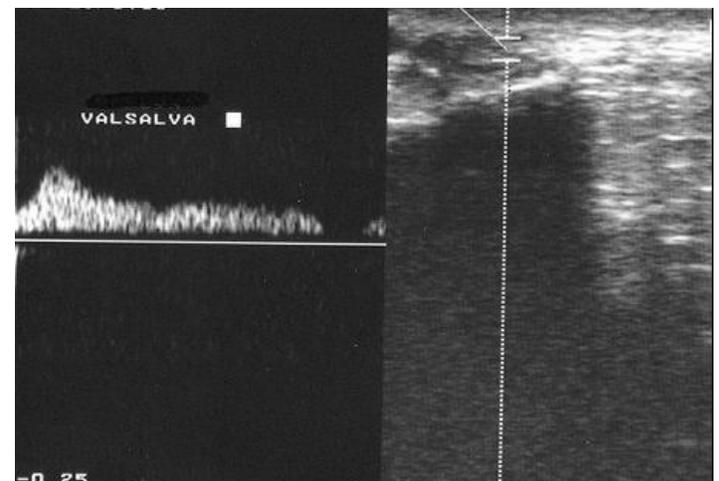


Table 1. Semen Analysis Variables and Probability of Significant Differences Before and After Surgery.

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| Variable                                | Mean | SD   | P    |
|---|------|------|------|
| <b>Sperm concentration (million/mL)</b> |      |      |      |
| Preoperative                            | 11   | 15.6 | .001 |
| Postoperative                           | 16.2 | 13   |      |
| <b>Sperm motility (%)</b>               |      |      |      |
| Preoperative                            | 22   | 12.5 | .001 |
| Postoperative                           | 27.6 | 17.2 |      |
| <b>Normal sperm morphology (%)</b>      |      |      |      |
| Preoperative                            | 41.7 | 24.4 | .003 |
| Postoperative                           | 56.8 | 23.8 |      |

concentration, forward motility, and normal morphology was > 0.5 (good outcome) in 61.3%, 29.9%, and 19.3% of the patients, respectively.

Table 1 also contains the probability of significant differences between preoperative and postoperative paired comparisons for semen variables. There was a significant correlation between the vein diameter and the improvement index in sperm concentration (Pearson  $r = 0.55$ ;  $P = .001$ ), motility (Pearson  $r = 0.45$ ;  $P = .001$ ) and percentage of normal forms (Pearson  $r = 0.83$ ;  $P = .003$ ).

The author chose a cutoff of 2.5 mm for venous diameter. Table 2 contains the number of patients with testicular vein diameter  $\geq 2.5$  mm and  $< 2.5$  mm for each of the semen variables. Patients with a testicular vein diameter  $\geq 2.5$  mm ( $n = 51$ ) had significantly higher sperm concentration, motility, and morphology postoperatively than patients with a testicular vein diameter  $< 2.5$  mm ( $n = 43$ ) ( $P = .004$ ,  $.014$ ,  $.033$ , respectively). Table 2 also shows the number of patients with good outcome (improvement index > 0.5) in patients with testicular vein diameter  $\geq 2.5$  mm and  $< 2.5$  mm.

Table 3 shows the semen analysis variables and probability of significant differences relative to the degree of reflux. There was a significant difference between improvement in sperm concentration, motility and morphology and the degree of reflux detected by color Doppler ultrasound ( $P = .001$ ,  $.02$ ,  $.041$ , respectively). Patients with a higher degree of reflux had a significantly higher improvement index. Additionally, patients with reflux detected only at the inguinal and suprastesticular veins (Grades 1 and 2) had significantly lower improvement in sperm concentration, motility and morphology when compared with patients with reflux at the inferior pole of the testis (Grades 3, 4, 5) ( $P = .02$ ,  $.013$ ,  $.042$ , respectively).

Table 2. Number of Patients with Testicular Vein Diameter  $\geq 2.5$  mm and  $< 2.5$  mm and Probability of Significant Differences in Semen Variables Between These Groups (N = 94). doi: 10.3834/uij.1944-5784.2009.08.04t2

| Variable                  | Testicular Vein Diameter |      |            |      | P    |
|---------------------------|--------------------------|------|------------|------|------|
|                           | $\geq 2.5$ mm            |      | $< 2.5$ mm |      |      |
|                           | n                        | % n  | n          | % n  |      |
| <b>Count outcome</b>      |                          |      |            |      | .004 |
| Good                      | 36                       | 70.6 | 19         | 44.2 |      |
| Poor                      | 15                       | 29.4 | 24         | 55.8 |      |
| <b>Motility outcome</b>   |                          |      |            |      | .014 |
| Good                      | 26                       | 51   | 0          | 0    |      |
| Poor                      | 25                       | 49   | 43         | 100  |      |
| <b>Morphology outcome</b> |                          |      |            |      | .033 |
| Good                      | 16                       | 31.4 | 3          | 7    |      |
| Poor                      | 35                       | 68.6 | 40         | 93   |      |

## DISCUSSION

Varicoceles are the most common curable cause of male infertility [13]. Microsurgical subinguinal varicocelectomy is one of the methods for management of varicocele-induced male infertility, leading to improvement in semen parameters and increasing the chance of pregnancy [5,7]. In the present study, all semen parameters improved significantly after microsurgical subinguinal varicocelectomy, showing results similar to those of previous studies [5,7].

The author of the present study used improvement indexes to assess the outcome of varicocele repair. *Good outcome* (improvement index > 0.5) was found in sperm concentration for 61.3% of the patients. This was a greater improvement than was found for sperm motility and sperm morphology (29.9% and 19.3% of the patients, respectively). These results have a similar pattern to those of Kumar and Gupta [14], who found improvement in sperm concentration, motility, and morphology in 71%, 60% and 49% of cases, respectively.

Varicocelectomy improves pregnancy rates in couples undergoing intrauterine insemination. It can also result in sperm in the ejaculate of men with nonobstructive azoospermia [15,16].

A comparison of subclinical and clinical varicoceles is difficult because the clinical varicocele is based on palpation, which is less objective and more prone to errors than identification through ultrasonography. The accuracy of detection of varicoceles by physical examination has been shown to be correlated with the experience of the physician [17]. Shiraishi et al [18] used color Doppler ultrasound, among different noninvasive methods, to diagnose varicocele. They found that

Table 3. Semen Analysis Variables and Probability of Significant Differences Relative to the Degree of Reflux .  
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| Improvement Index       | Mean | SD   | P    |
|-------------------------|------|------|------|
| <b>Sperm count</b>      |      |      |      |
| Reflux Grade 1          | 0.21 | 0.8  | .001 |
| Reflux Grade 2          | 0.43 | 0.12 |      |
| Reflux Grade 3          | 0.99 | 0.31 |      |
| Reflux Grade 4          | 1.86 | 0.63 |      |
| Reflux Grade 5          | 2.15 | 0.98 |      |
| <b>Sperm motility</b>   |      |      |      |
| Reflux Grade 1          | 0.09 | 0.25 | .020 |
| Reflux Grade 2          | 0.32 | 0.12 |      |
| Reflux Grade 3          | 0.69 | 0.42 |      |
| Reflux Grade 4          | 0.88 | 0.63 |      |
| Reflux Grade 5          | 1.33 | 0.72 |      |
| <b>Sperm morphology</b> |      |      |      |
| Reflux Grade 1          | 0.28 | 0.31 | .041 |
| Reflux Grade 2          | 0.39 | 0.39 |      |
| Reflux Grade 3          | 0.42 | 0.53 |      |
| Reflux Grade 4          | 0.71 | 0.62 |      |
| Reflux Grade 5          | 0.76 | 0.43 |      |

color Doppler ultrasound can be used to predict the outcome of varicocelectomy. One study found no correlation between the varicocele size and improvement in sperm quality [19]. In the present study, the author found a significant difference between testicular vein diameter at the lower testicular pole using color Doppler ultrasound and improvement in all semen parameters. These results are similar to findings by Steckel et al [20], who reported that infertile men with a large varicocele have poorer preoperative semen quality than men with small or medium varicoceles, but men with a large varicocele have the greatest improvement after varicocelectomy.

Repair of the varicocele detected by color Doppler ultrasound results in an increase in sperm concentration and motility [21]. The presence of bilateral varicoceles, even if subclinical on one side, increases the overall volume of the varicocele and requires bilateral varicocelectomy [22]. In the present study, the large percentage of bilateral varicocelectomy may be attributed to the routine use of color Doppler ultrasound in the diagnosis of varicocele. This procedure detects contralateral subclinical varicoceles, and the rate of detection is similar to that found previously [23].

Many studies have reported different criteria for the diagnosis of varicocele detected by ultrasonography. Some authors reported that positive outcome after subclinical varicocelectomy was found for a venous diameter > 3 mm. These authors found

that patients with larger varicocele had greater postoperative seminal improvement than those with small varicocele [23]. However, Gonda et al [24] reported that ultrasound has 95% sensitivity for the diagnosis of subclinical varicoceles using a 2 mm cutoff for venous diameter. Finally, another study reported that there is no threshold for the diagnosis of subclinical varicocele; that is, the venous diameter detected by ultrasound may be < 2 mm with retrograde flow [25]. Cocuzza et al [26] showed that concomitant use of intraoperative vascular Doppler during microsurgical varicocelectomy allows more arterial branches to be preserved and more internal spermatic veins are likely to be ligated. These procedures improve surgical outcomes and safety.

In summary, the author of the present study found a significant difference between testicular vein diameter and the incidence of venous reflux detected at the inferior pole of the testis. The author's ultrasonographic venous cutoff was 2.5 mm; patients with a testicular vein diameter ≥ 2.5 mm have a significantly higher improvement index in all semen parameters than those with a testicular vein diameter < 2.5mm. There was no significant improvement in semen parameters after varicocelectomy in patients with testicular veins < 2.5 mm detected at the lower testicular pole. Reflux in the testicular veins detected by color Doppler ultrasound is the most important factor for the diagnosis of varicocele, because there is a high percentage of false-positives and false-negatives for cases diagnosed by venous diameter only [25]. In the present study, there was a significant correlation between degree of reflux and seminal improvement; patients with a higher degree of reflux on color Doppler ultrasound had a significantly higher improvement index in all semen parameters after microsurgical subinguinal varicocelectomy. Finally, the results showed that varicocelectomy in patients with reflux only at the inguinal and suprastesticular level results in valueless improvement in semen parameters.

## CONCLUSIONS

Proper candidate selection for surgery is necessary in order to improve the outcome of varicocelectomy. Color Doppler ultrasound is an important method for accurate diagnosis and grading of the varicocele. The author recommends routine use of color Doppler ultrasound in patients with clinical varicocele for diagnosis of a possible contralateral subclinical varicocele. Measurement of testicular vein diameter and the degree of reflux can be used to predict the outcome of varicocelectomy. The results of color Doppler ultrasound in the present study indicate that microsurgical subinguinal varicocelectomy should be used for patients with testicular vein diameter ≥ 2.5 mm, regardless of the grade of reflux at inferior pole of the testis.

**Conflict of Interest:** None declared

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