



ORIGINAL ARTICLE

Preoperative sonographic and Doppler parameters predictors of semen analysis improvement after unilateral varicocelectomy



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Abstract Objective: To assess the sonographic and Doppler parameters predicting varicocelectomy outcome.

Methods: This study included 86 infertile patients with abnormal semen analysis. All patients had preoperative ultrasound and color Doppler to calculate testicular volume, pampiniform vein caliber and duration of reflux in the dilated veins during sustained valsalva maneuver. The patients underwent unilateral varicocelectomy and had semen analysis 6 months after operation, improvement index of the semen analysis was calculated.

Results: The patients were classified into 2 groups: Group 1: 58 patients with normal-sized testes, and group 2 included 28 patients with subnormal testes (8–12 cm³), in the first group, the patients with improvement index >0.5 were 26 (44.8%), the group with subnormal testicular volume showed improvement in 5 patients (17.8%), the difference between the two groups was statistically significant <0.05. There was a significant positive correlation between the degree of reflux preoperatively and the improvement index ($P < 0.001$), also there was a positive correlation between the vein diameter and the improvement index ($P = 0.03$).

Conclusions: The best preoperative sonographic parameters of success of unilateral varicocele repair are the presence of normal-sized testes, high grade reflux, and to lesser degree large vein diameter.

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1. Introduction

Varicocele is a dilatation of the pampiniform venous plexus and the internal spermatic vein. It is detected in approximately 15–20% of the general male population, with the prevalence increasing to 40% in infertile men (1,2). The presence of a varicocele has been associated with impaired testicular function,

often causing abnormalities in semen parameters, including sperm count, motility and morphology, testis size and histology, blood hormone levels and pregnancy rates (3,4). The most likely mechanism is an elevation of testicular temperature due to an impaired countercurrent heat exchange mechanism. In addition, varicocele inhibits Sertoli cell function and decreases androgen secretion by Leydig cells, causing premature, age-related hypoandrogenism (5).

Color Doppler ultrasound (CDU) is the preferred method for diagnosing varicoceles. CDU defines the anatomic and physiologic aspects of varicoceles by measuring the size of the pampiniform plexus and blood flow parameters of the spermatic veins (6,7).

Several authors have reported significant improvement of semen parameters after surgical varicocelectomy in infertile men (8,9). On the other hand several studies have demonstrated that improvement of semen parameters is not always achieved by varicocelectomy (10).

Because the outcome and prognosis after varicocelectomy are still controversial, and there are many preoperative parameters that determine the probability of success of the operation, there is a great need for research to improve preoperative selection of patients. Some of these parameters are general, related to the patient's age and clinical condition; some of them are related to semen analysis; and others are local parameters related to the testes and the varicocele itself. This study was done to assess the sonographic findings that could predict the outcome of varicocele repair in the treatment of male infertility/subfertility related to varicocele.

2. Materials and methods

From October 2011 to March 2013, 86 men with unilateral varicocele were included in the study. Patient's age ranged from 22 to 39 years, with a mean age of 27.4 years. Inclusion criteria were infertile men with abnormal semen analysis. Patients with infection, history of genitourinary trauma, chromosomal disorders and bilateral varicocele were excluded

from the study. Written consents were taken from all patients after thorough explanation and understanding the study.

All patients underwent preoperative semen analysis twice, their preoperative semen analysis showed oligospermia, asthenospermia, or oligoasthenospermia. All patients underwent varicocele repair by a low ligation technique using the subinguinal approach performed by a senior urologic surgery consultant under general or spinal anesthesia according to the anesthetist's preference after routine preoperative assessment and written patient consent. Semen analysis was repeated after 6 months, and improvement index was calculated for all patients. Improvement index in sperm count, for example, was calculated by dividing the difference between postoperative and preoperative sperm concentration by preoperative sperm concentration. Good outcome was defined as improvement index of more than 0.5, and poor outcome was defined as improvement index of <0.5.

CDS examination was performed using GE E8 color Doppler ultrasound with the patients in supine position. Examination was performed at the level of the inguinal canal and just over the superior-lateral edge of the testis or posterior-lateral edge in large varicoceles. The maximum venous diameters in the testicular veins were measured both during rest and Valsalva's maneuver (maximal abdominal strain against a closed epiglottis just after a deep inspiration) using a 7.5 MHz linear array transducer. Veins that were larger than 2 mm in diameter at rest were considered to be a varicocele. If reflux was present, the duration of Valsalva's maneuver was measured in spectral analysis.

The degree of venous reflux was quantified by measuring the duration of venous reflux as follows: brief reflux lasted less than 1 s; intermediate reflux lasted from 1 to 2 s; and permanent reflux lasted longer than 2 s (11).

The Pearson correlation coefficient test, spearman's rho test and independent *t* test were used for the comparison of continuous variables. Chi square test and Mann Whitney *U* test were used to compare categorical variables. *P* < .05 was considered to indicate a statistically significant difference.

Table 1 Relationship between testicular volume and post operative improvement in the study.

	No	No of improved patients post varicocelectomy	%	<i>P</i> Value
Normal testicular volume (> 12 cc)	58	26	44.8	<0.05
Subnormal testicular size (8–12 cc)	28	5	17.8	

Chi square test.

Table 2 Relationship between the vein diameter, degree of reflux and post varicocelectomy improvement in semen quality in patients with normal testicular volume.

	No	No	No of improved patients post operative	%	
Vein size 2–3 mm	16	Reflux > 2 s	7	3	42.8
		Reflux 1–2 s	5	1	20
		Reflux < 1 s	4	1	25
3–4 mm	24	Reflux > 2 s	14	8	57.1
		Reflux 1–2 s	7	3	42.8
		Reflux < 1 s	3	1	33.3
> 4 mm	18	Reflux > 2 s	13	7	53.8
		Reflux 1–2 s	4	2	50
		Reflux < 1 s	1	–	0

Table 3 Relationship between the vein diameter, degree of reflux and post varicocelectomy improvement in semen quality in patients with sub-normal testicular volume.

	No		No	Improved patients	%
Vein size 2–3 mm	6	Reflux > 2 s	2	0	0
		Reflux 1–2 s	3	1	33.3
		Reflux < 1 s	1	0	0
3–4 mm	9	Reflux > 2 s	4	1	25
		Reflux 1–2 s	3	1	33.3
		Reflux < 1 s	2	0	0
> 4 mm	13	Reflux > 2 s	8	2	25
		Reflux 1–2 s	2	0	0
		Reflux < 1 s	3	0	0

3. Results

The relationship of testicular volume and improvement in semen analysis is summarized in [Table 1](#): this study included 86 patients, 58 of them with testicular volume > 12 cc, whereas the other 28 with sub-normal testicular size (8–12 cc). There was a significant difference between the improvement index in the group with normal testicular volume and the group with subnormal testicular $P < 0.05$ ([Table 1](#)).

Table 4 Relationship between degree reflux and semen improvement (improvement index) in patients with normal sized testes independent of the vein size.

Patients with normal sized testes	No	No of improved patients post operative	<i>P</i> Value
Reflux > 2 s	34	18	0.001
Reflux 1–2 s	16	6	
Reflux < 1 s	8	2	

Table 5 Relationship between degree reflux and semen improvement (improvement index) in patients with subnormal testicular volume independent of the vein size.

Patients with normal sized testes	No	No of improved patients post operative	<i>P</i> Value
Reflux > 2 s	14	3	0.163
Reflux 1–2 s	8	2	
Reflux < 1 s	6	0	

Table 6 Relationship between vein diameter and semen improvement (improvement index) in patients with normal sized testes independent of the reflux.

Patients with normal sized testes	No	No of improved patients post operative	<i>P</i> Value
2–3 mm	16	5	0.03
3–4 mm	24	12	
> 4 mm	18	9	

Table 7 Relationship between vein size and semen improvement (improvement index) in patients with subnormal testicular volume independent of the reflux.

Patients with subnormal sized testes	No	No of improved patients post operative	<i>P</i> Value
2–3 mm	6	1	0.263
3–4 mm	9	2	
> 4 mm	13	2	

The patients in each group were studied for the vein diameter and degree of reflux ([Tables 2 and 3](#)).

Twenty-four patients had normal testicular volume, vein diameter was 3–4 mm, the reflux was > 2 s in 14 patients (58.3%), reflux was 1–2 s duration in 7 patients, and < 1 s in three patients. The improvement index > 0.5 was 57.1%, 42.8% and 33.3%, respectively. Eighteen patients had vein diameter > 4 mm, of them 13 had reflux duration > 2 s, 4 had reflux 1–2 s, and only one had reflux < 1 s. The improvement index > 0.5 was achieved in 53.8%, 50% and 0%, respectively.

In the group of normal testicular volume, there was a significant positive correlation between the degree of reflux preoperatively and the improvement index ($P < 0.001$), also there was a positive correlation between the vein diameter and the improvement index, but less significant than the duration of reflux ($P = 0.03$) ([Tables 4 and 6](#)).

In the group of subnormal testicular volume, there was no significant positive correlation between the degree of reflux preoperatively and the improvement index ($P < 0.163$), also there was no positive correlation between the vein diameter and the improvement index ([Tables 5 and 7](#)).

4. Discussion

Varicocele often causes disturbance in the spermatogenic process. The effect of varicocele on sperm production in infertile men manifests with abnormal semen quality, including a low sperm count, decreased sperm motility and a high percent of abnormal sperm forms ([12,13](#)).

After varicocelectomy, there is no agreement with the nature of the improvement in sperm quality. Most reports showed that approximately two-thirds of the patients with varicocele show improvement in sperm quality after spermatic vein ligation ([14,15](#)), whereas others claimed that the sperm does not show any quantitative or qualitative improvement ([16,17](#)). In this study, we studied the sonographic and Doppler parameters

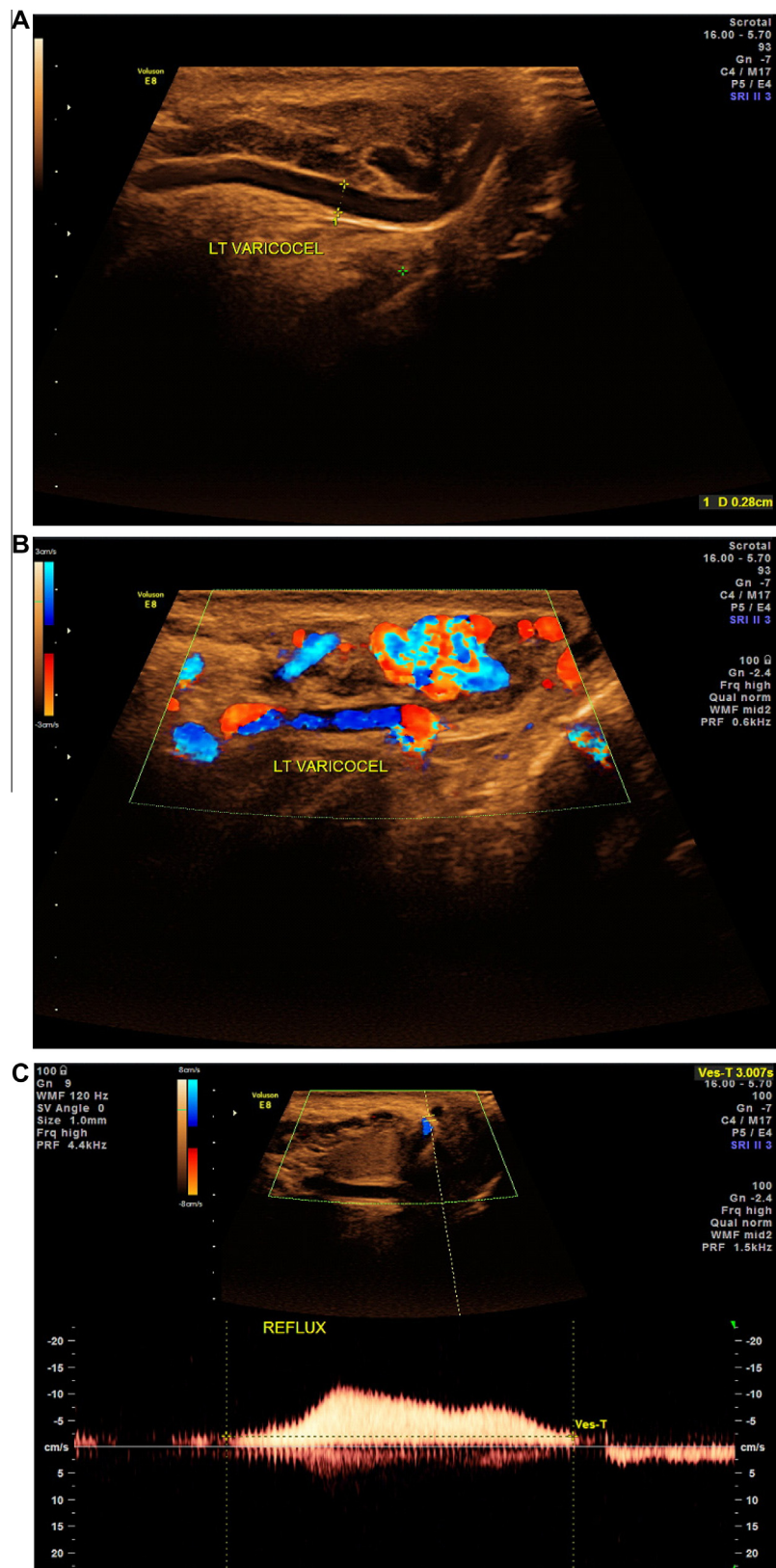


Fig. 1 (A) B mode sonogram shows dilated veins of the pampiniform plexus, diameter 2.8 mm. (B and C) Color and spectral Doppler sonography reveal marked reflux, duration > 3 s.

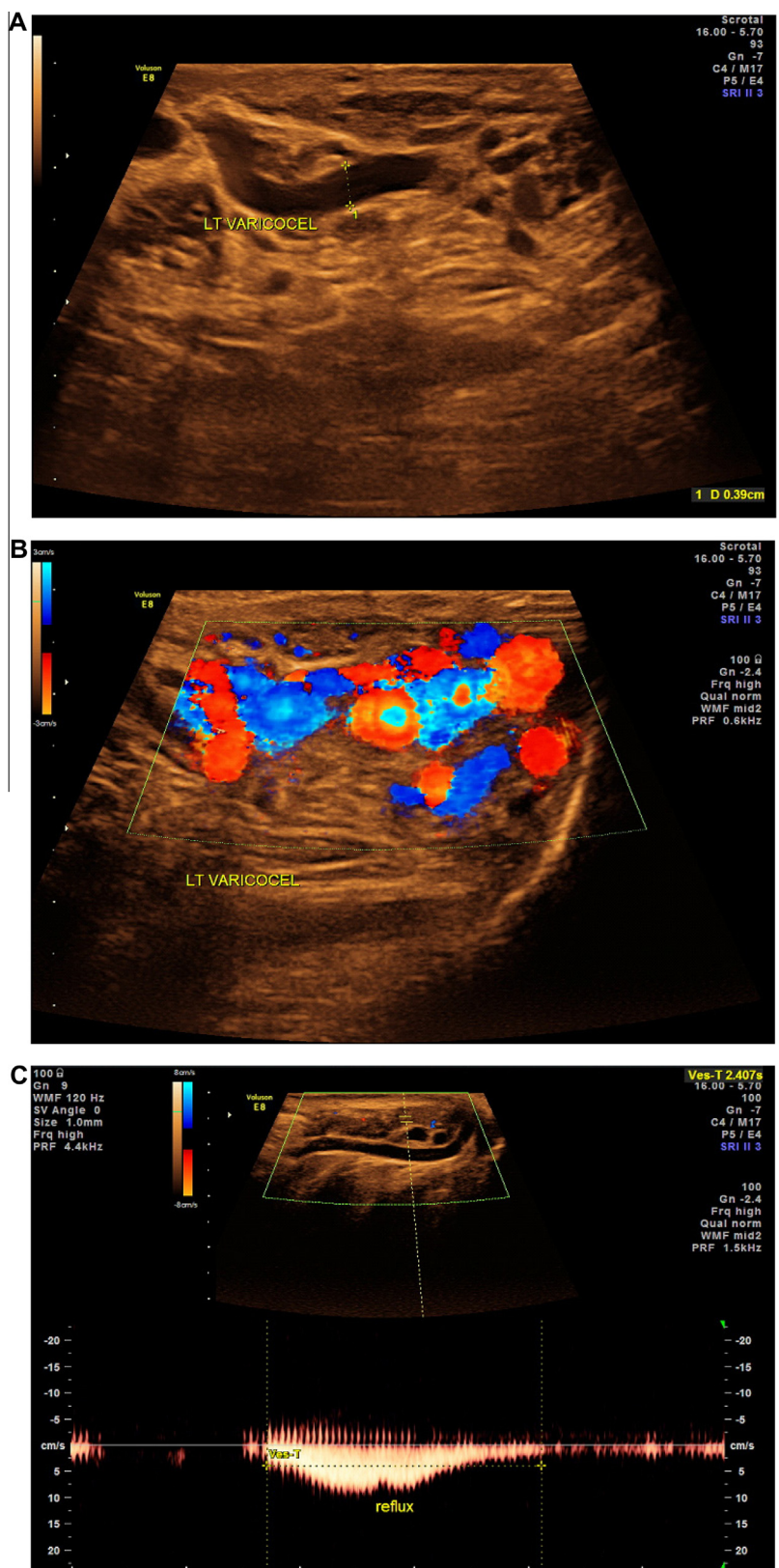


Fig. 2 (A) B mode sonogram shows dilated veins of the pampiniform plexus, diameter 3.9 mm. (B and C) Color and spectral Doppler sonography reveal reflux duration 2.4 s.

which can predict which patients with varicocele would get benefit from varicolectomy (See Figs. 1–4).

Color Doppler ultrasound is a reliable and noninvasive method that is useful not only for diagnosis but also for post-varicocele repair follow-up (18).

We used improvement index to assess the outcome of varicolectomy. Improvement index >0.5 in sperm count, motility, or morphology was found in 44.5% of patients with normal testicular volume, and in 17.8% patients with subnormal testicular volume. Our results are in agreement with those of Merharban et al. (19) who found 40.7% and 57.5% improvement index in sperm count and motility, respectively. The improvement index was significantly higher in patients with normal testicular volume than in patients with subnormal testicular volume ($P < 0.05$). Pierik et al. (20) found that the increase in sperm count was related positively to testicular volume before surgery.

For many clinicians, the presence of reversal of flow with Valsalva on Doppler ultrasound is also deemed essential to the diagnosis of a varicocele (21), however, the mere presence of venous reflux on color Doppler sonography is not always significant.

In the current study, in the normal sized testes group, there was a strong positive correlation between the degree of reflux pre-operatively and the semen improvement index post-operatively ($P < 0.001$), there was a positive, but less strong correlation between the degree of venous diameter pre-operatively and the semen improvement index post-operatively, while, in the subnormal volume group, there was no significant correlation between the degree of reflux or the venous diameter and the semen improvement index post operatively, standstill, five patients showed improvement in this group, two of them had venous diameter >4 mm with permanent reflux. The other three had significant reflux.

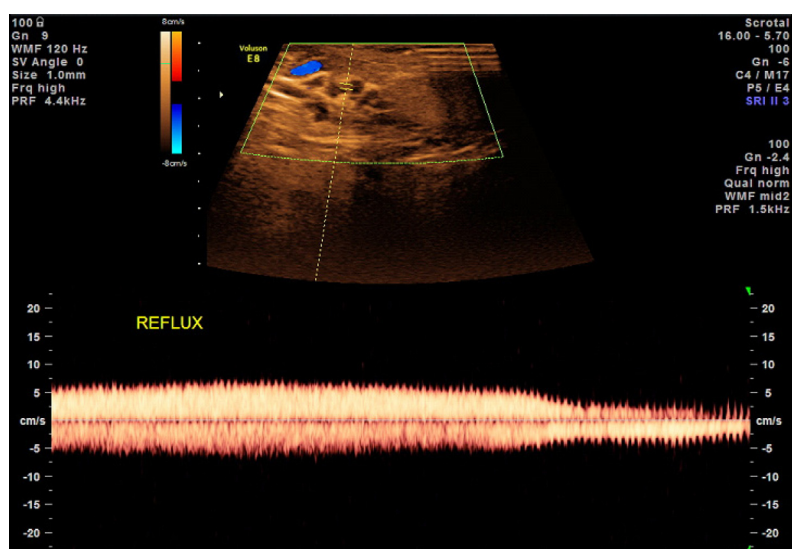


Fig. 3 Color and spectral Doppler sonography reveal marked (permanant) reflux in the dilated pampiniform plexus, duration of reflux >4 s.

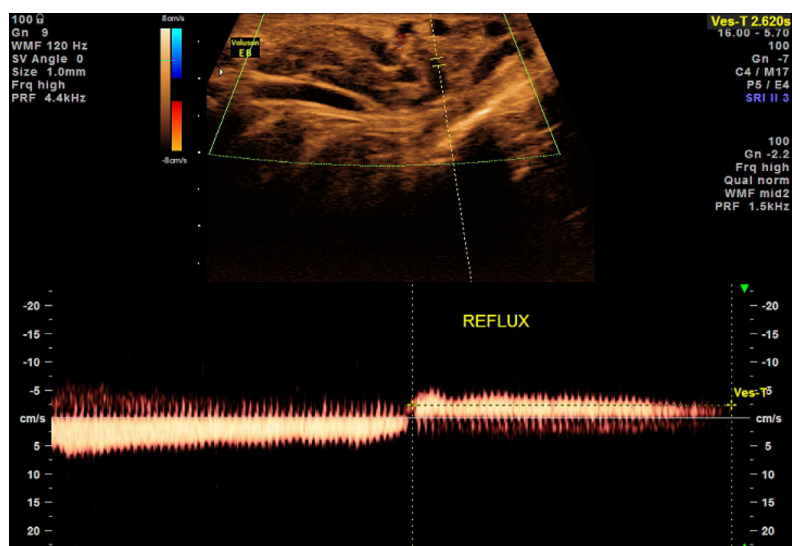


Fig. 4 Dilated pampiniform with reflux 2.6 mm on spectral Doppler ultrasound.

Many studies have suggested that the response to varicocele surgery is related to the average caliber of the dilated veins, with greater improvement in semen parameters resulting from repair of large-caliber versus small-caliber varicocele. Schiff et al., (22) in a study included 68 patients found a positive correlation between ultrasound-measured venous diameter and reversal of flow and successful outcome. Also, Hussein's study (23), included 104 patients found that patients with a testicular vein of more than 2.5 mm have a significantly higher improvement index in sperm concentration, motility and morphology than patients with a testicular vein diameter less than 2.5 mm.

In our study, there was weak positive correlation between the venous diameter and the improvement index post operatively, and in the group with normal testicular volume, 50% of the group with vein diameter markedly dilated (> 4 mm in caliber) and moderately dilated (3–4 mm in caliber) showed improvement index 0.5 or more. This result agrees with the conclusion of Marks et al., (24) and Donkol and Salem (25).

This means that more significant varicocele may not be associated with markedly dilated veins. The explanation for this is that the degree of venous reflux may be compensated by enhanced drainage through the differential cremasteric veins, preventing substantial venous dilatation (25).

In conclusion, to improve the postoperative paternity rate after varicocele repair, proper candidate selection for surgery is necessary. The best preoperative sonographic parameters of success are the presence of normal-sized testes with a permanent grade of venous reflux and to a lesser degree the vein diameter.

Conflict of interest

None declared.

References

- (1) Gorelick JJ, Goldstein M. Loss of fertility in men with a varicocele. *Fertil Steril* 1993;59:613–6.
- (2) Witt MA, Lipshultz LI. Varicocele is a progressive or static lesion? *Urology* 1993;42:541–3.
- (3) World Health Organization. The influence of varicocele on parameters of fertility in a large group of men presenting to infertility clinics. *Fertil Steril* 1992;57:1289–93.
- (4) Vazquez-Levin MH, Friedmann P, Goldberg SI, Medley NE, Nagler HM. Response of routine semen analysis and critical assessment of sperm morphology by Kruger classification to therapeutic varicolectomy. *J Urol* 1997;158:1804–7.
- (5) Goldstein M, Eid JF. Elevation of intratesticular and scrotal skin surface temperature in men with a varicocele. *J Urol* 1989;142:743–5.
- (6) Kocakoc E, Serhatlioglu S, Kiris A, Bozgeyik Z, Ozdemir H, Bodakci MN. Color Doppler sonographic evaluation of interrelations between diameter, reflux and flow volume of testicular veins in varicocele. *Eur J Radiol* 2003;47:251–6.
- (7) Liguori G, Trombetta C, Garaffa G, Bucci S, Gattuccio I, Salamè L, et al. Color Doppler ultrasound investigation of varicocele. *World J Urol* 2004;22:378–81.
- (8) Agarwall A, Deepinder F, Coczza M, et al. Efficacy of varicolectomy in improving semen parameters: new meta-analysis approach. *Urology* 2007;70(3):532–8.
- (9) Madgar I, Weissenberg R, Lunenfeld B, et al. Controlled trial of high spermatic vein ligation for varicocele in infertile men. *Fertil Steril* 1995;63:120–4.
- (10) Okeke L, Ikuero O, Chiekwe I, et al. Is varicolectomy indicated in subfertile men with clinical varicoceles who have asthenospermia or teratospermia and normal sperm density? *Int J Urol* 2007;14:729–32.
- (11) Cornud F, Belin X, Amar E, Delafontaine D, Hele Moreau JF. Varicocele: strategies in diagnosis and treatment. *Eur Radiol* 1999;9:536–45.
- (12) Kass EJ, Reitelman C. Adolescent varicocele. *Urol Clin North Am* 1995;22(1):151–9.
- (13) Nagler HM, Luntz RK, Martinis FG. Varicocele. In: Lipshultz LI, Howards SS, editors. *Infertility in the male*. St. Louis: Mosby; 1997. p. 336–68.
- (14) Madgar I, Weissenberg R, Lunenfeld B, Karasik A, Goldwasser B. Controlled trial of high spermatic vein ligation for varicocele in infertile men. *Fertil Steril* 1995;63:120–4.
- (15) Li F, Yamaguchi K, Okada K, Matsushita K, Ando M, Chiba K, et al. Significant improvement of sperm DNA quality after microsurgical repair of varicocele. *Syst Biol Reprod Med* 2012;58(5):274–7.
- (16) Jarow JP, Ogle SR, Eskew LA. Seminal improvement following repair of ultrasound detected subclinical varicoceles. *J Urol* 1996;155:1287–90.
- (17) Seftel AD, Rutchik SD, Chen H, Stovsky M, Goldfarb J, Desai N. Effects of subinguinal varicocele ligation on sperm concentration, motility and Kruger morphology. *J Urol* 1997;158:1800–3.
- (18) El-Haggag S, Nassef S, Gadalla A, Latif A, Mostafa M. Ultrasonographic parameters of the spermatic veins at the inguinal and scrotal levels in varicocele diagnosis and post-operative repair. *Andrologia* 2012;44(3):210–3.
- (19) Merharban D, Taghdiri M, Nategh S, et al. Ultrasonic predictors of improved seminal parameters after bilateral laparoscopic varicolectomy. *Int Urol Nephrol* 2012;44:1121–5.
- (20) Pierik FH, Vreeburg JT, Stijnen T, et al. Improvement in sperm count and motility after ligation of varicoceles detected with color Doppler ultrasonography. *Int J Urol* 1998;21(5):256–60.
- (21) Lee J, Binsaleh S, Lo K, Jarvi K. Varicocele: the diagnostic dilemma. *J Androl* 2008;29:143–6.
- (22) Schiff JD, Li PS, Goldstein M. Correlation of ultrasound-measured venous size and reversal of flow with Valsalva with improvement in semen-analysis parameters after varicolectomy. *Fertil Steril* 2006;86(1):250–2.
- (23) Hussein AF. The role of color Doppler ultrasound in prediction of the outcome of microsurgical subinguinal varicolectomy. *J Urol* 2006;176(5):2141–5.
- (24) Marks JL, McMahon R, Lipshultz LI. Predictive parameters of successful varicocele repair. *J Urol* 1986;136:609–12.
- (25) Donkol RH, Salem T. Paternity after varicolectomy. Preoperative sonographic parameters of success. *J Ultrasound Med* 2007;26:593–9.