Egyptian Journal of Surgery Vol. (20), No. (1), Jan., 2001

TOWARDS AN OPTIMAL VARICOCELECTOMY:

By
Ahmed Moatamed, M.D.; El-Shahat Farag Ahmed M.D.**; Abdel Azem M.Ali M.D.**
I .E. Dawood, M.D.; M.Y. El-Gindy, M.D.*; M. El-Sadeek, M.D.**
Departments of General Surgery* and Dermatology, Venereology and Andrology**
Faculty of Medicine, Mansoura University.

This study was done to compare microsurgical subinguinal varicocelectomy with laparoscopic and inguinal varicocelectomy as regards the technique and the impact on pregnancy rates. The study comprised 161 patients complaining of infertility with no proven female factor as a cause of infertility. The patients were randomly assigned into 3 treatment groups. Twenty three patients were excluded due to lack of follow up data and the remaining 138 patients were arranged in 3 groups according to the technique used for varicocelectomy. Group I consisted of 48 patients treated by conventional inguinal technique. Group II consisted of 43 patients managed by laparoscopic transperitoneal technique, and group III included 47 patients who underwent microsurgical subinguinal varicocelectomy. Fifteen cases were recurrent after previous surgery, 5 in inguinal group and 10 in microsurgical group. The patients were followed up with clinical and color duplex 6 and 12 months after treatment to exclude possibility of recurrence or hydrocele formation. Semen analysis was carried out before treatment and repeated 6, 9 and 12 months after treatment and follow up for possible pregnancy was extended for two years after surgery. The mean operative time was significantly shorter among patients treated with microsurgical technique compared to group I or group II. For microsurgical group, the hospital stay (<24 hours) and period of convalescence (3±1 days) were nearly similar to laparoscopic group and significantly shorter than inguinal group. The recurrence rate was significantly higher among laparoscopic group (18.6%) compared to inguinal (4.16%) and microsurgical technique (no detected recurrence). The incidence of hydrocoele formation was the highest among inguinal varicocelectomy technique (20.8%) compared to laparoscopic (11.6%) and microsurgical technique (0%). Pregnancy rate was significantly higher among microsurgical varicocelectomy group (59.57%) compared to inguinal varicocelectomy (31.25%) and laparoscopic varicocelectomy (32.55%). Microsurgical subinguinal varicocelectomy was proved to be the most optimal varicocelectomy with no hydrocele or recurrence and with the highest pregnancy rate. So, we recommend microsurgical varicocelectomy as the treatment of choice for varicocele including recurrent cases.

Key words: Varicocelectomy, techniques, pregnancy rate.

INTRODUCTION

Varicoceles are the most frequently encountered surgically correctable cause of male infertility. The incidence in healthy adult males is 15% which climbs to 35% among men presenting with primary infertility and as high as 80% in men with secondary infertility[1]. Varicoceles cause progressive testicular damage with impairment of spermatogenesis. The pathophysiology by which varicocele causes impaired testicular function is probably multifactorial. These factors include abnormally high testicular temperature, hypoxia owing to venous stasis, dilution of intratesticular substances as androgens, and imbalance of hypothalamic-pituitary gonadal axis[2]. Recently, new theories were introduced as excessive generation of free radicals including nitrous oxide[3,4] and dysregulation of apoptosis[5]. Cigarette smoking in the presence of varicoceles has a greater adverse effect than either factor alone[6].

Varicocele ligation improves testicular function and this is reflected by improvement of semen quality. However, this seminal improvement is not usually

associated with parallel increase in pregnancy rate. Marks et al.[7] reviewed the results of 22 varicocelectomy studies (about 3000 patients) and found that the mean value for improved semen parameters was 71%, while the mean value of pregnancy rates was 37% only. It has been suggested that pregnancy rates does not run parallel to seminal improvement due to the use of what is believed to be suboptimal varicocelectomy technique without preservation of testicular arteries and lymphatics, and with incomplete ligation of all venous collaterals which can contribute to reflux[2]. Injury or ligation of testicular arteries may cause poor semen quality even in absence of testicular atrophy[8], and ligation of testicular lymphatics will lead to hydrocele formation which produce discomfort to the patient and, theoretically, may impair spermatogenesis by interference with normal thermoregulation[2].

Our work was done to compare the results of microsurgical varicocelectomy (MSV), with conventional inguinal and laparoscopic techniques and thus we can see if ideal technique will be reflected by optimal results or not.

PATIENTS AND METHODS

A total of 161 patients referred from General Surgery, and Dermatology & Andrology Clinics between January 1997 and December 1999 were admitted in the study. Patients were randomly assigned into 3 treatment groups. Twenty three patients were excluded due to lack of follow up data and the remaining 138 patients were arranged in 3 groups according to the method used for treatment: (I) 48 patients underwent conventional inguinal varicocelectomy, (II) 43 patients underwent laparoscopic varicocelectomy, and (III) 47 patients underwent microsurgical varicocelectomy. Fifteen cases were recurrent, 5 cases in group I (5/48, 10.4%) who were recurrent after high ligation, and 10 cases in MSV group (10/47, 21%) who were recurrent after high ligation (6 cases) and inguinal ligation, (4 cases). Chief complaint was infertility either primary (116 patients, 84%) or secondary (22 patients, 16%). The criteria for entery into the study were the presence of clinical left varicocele (+ right varicocele), no azoospermia, no pregnancy for at least 2 years duration and no proven female factor which could explain infertility of the couple.

A complete history was taken with stress on duration of infertility, sexual habits, infections as mumps, gonadotoxins as chemicals or drugs, heat exposure, radiation, and smoking.

Patients were examined while standing in a warm room. Varicocele size was graded into 3 grades according to the criteria described by Dubin and Amelar, (1970)[9]. Grade I was defined as varicocele palpable only with Valsalva maneuver. In grade II, varicocele was easily palpated without Valsalva maneuver. Grade III was visible through scrotal skin. Grading was reported according to the left side. Color Doppler ultrasound was used to confirm diagnosis in doubtful grade I cases and to exclude subclinical right varicocele. Also, clinical examination and color Doppler ultrasound were repeated at 6 and 12 months postoperatively to exclude persistence or recurrence of varicocele.

Semem Analysis: At least 3 semen samples collected by masturbation after 3 days of sexual abstinence were obtained from each patient. Also 3 semen samples were obtained 6, 9 and 12 months postoperatively. The mean values of all preoperative and postoperative specimens were used as the preoperative and postoperative values for each patient. Minimal standards of normal values were >20 million sperms/ml, >50% motile sperms with forward progression > grade 2, and >60% normal forms[10]. Postoperative improvement of seminal quality was determined by >50% increase in sperm density, >20% increase in active motility and >20% reduction in abnormal forms[7]. Pregnancy was defined as a gestational age of 5 months or more.

Inguinal varicocelectomy: After spinal anaethesia, an oblique incision (3-5 cm) was made along the medial side of the line connecting the anterior superior iliac spine and pubic tubercle. The external oblique aponeurosis was exposed and incised in the direction of the fibres. The spermatic cord was then mobilized at the level of pubic tubercle and a gauze strip was passed beneath the cord elevating it from the canal. The fascial coverings of the cord were opened and all venous channels were isolated and ligated after a representative segment of the veins was excised. Preservation of the testicular artery and ligation of external spermatic vein was done only in some cases. The external oblique fascia was closed followed by the skin[11] (Fig. 1).

Laparoscopic transperitoneal varicocelectomy: After general anaethesia, the veress needle was used to gain access to the peritoneal cavity for insufflation of carbon dioxide for creation of pneumoperitoneum. A curvilinear 5mm incision was made in the inferior crease of the umblicus for the insertion of trocar-sheath unit for telescope. The patient was then put in trendelenberg position to displace the bowel in a cephalad direction. Another two incisions were made midway between anterior superior iliac spine and umblicus on both sides for introduction of two ports to provide access for dissecting instruments. The spermatic vessels at the internal ring were identified and an incision was made in the parietal peritoneum just lateral to and above the vessels that were dissected from the peritoneum and extraperitoneal fat through blunt dissection. The spermatic veins and artery were individually identified, and the veins were clippled and divided with preservation of the artery if possible.

After haemostasis and inspection of visceral integrity, the carbon dioxide was expelled and the ports withdrawn under direct vision followed by closure of the wound[12] (Fig. 2).

Microsurgical subinguinal varicocelectomy: After spinal anaethesia, a 2-3cm incision was made just above the external inguinal ring. Division of the external oblique aponeurosis was unnecessary, thus reducing postoperative discomfort and convalescence. The testis and spermatic cord were delivered through the wound into the operative field and all external spermatic and gubernacular veins were ligated. The testis was then returned to the scrotum and the spermatic cord was dissected under the operating microscope or a magnifying loupe. All testicular and cremasteric arteries encountered in the spermatic cord were identified, isolated and preserved. Doppler probe was used for artery identification. The majority of testicular lymphatics were identified and left intact. All internal spermatic veins are doubly ligated and divided. The only veins left intact were the tiny vessels accompanying the vas deferens. The cord then was returned to its bed and the incision was closed [13] (Fig. 3).

Clinical Outcome: Outcome was judged by operative time, the duration of hospital stay, period of convalescence, incidence of hydrocele, recurrence rates and pregnancy rates.

Statistical Analysis: The data were analysed by computer using SPSS programe (statistical package for social science), 1998. Qualitative data (percentages) were examined by Chi-square test. F test one way annova was used to compare between more than 2 groups. Student "t" test was used to compare between two groups. Significance was considered when P value less than 0.05 and non significance was considered when P value more than 0.05.

RESULTS

The clinical data of our patients are summarized in (Table 1). The total number of patients who started the study was 161 patients. Twenty three patients (14.28%) were excluded due to lack of follow up data and the remaining 138 patients completed the study (up to 2 years follow up). The three groups of patients were homogenous as regards age, laterality and grade of varicocele and indication of treatment with no significant differences when the 3 groups were compared with each other (Table 1).

No major intraoperative complications were encountered in the 3 groups of patients. The testicular artery was preserved in all patients treated by microsurgical technique (group III), while external spermatic vein could be identified and ligated in 31 patients (65.9%) of this group. In group I (conventional inguinal), testicular artery was preserved only in 16 patients (33.3%), while external spermatic vein could be identified and ligated in 14 patients (29.16%). In laparoscopic group (group II), testicular artery was inadvertently divided in 13 patients and preserved in 30 patients (69.76%), while external spermatic veins could not be identified in any case (0%). Other operative data are presented in (Table 2).

Compariosn of preoperative and postoperative spermiograms of each group shows significant increase in count and motility and reduction in abnormal forms in the three groups (Table 3). No significant differences were found when percentage of postoperative improvement in the seminal parameters of the 3 groups were compared with each other (Table 4). However, pregnancy rate was significantly higher in microsurgical group (59.57%) when compared with either group I (31.25%) or group II (32.55%) as seen in (Table 5). Other treatment outcomes are presented also in (Table 5).

Table (1): ***Clinical data***

	Group I n = 48	*Group II n = 43*	*Group III n = 47*	*P value*
Age (years) (X ± SD)	29 ± 6	28 ± 6.1	30 ± 8.2	NS*
Duration of infertility (years) (X±SD)	4 ± 1.1	4.3 ± 1.2	4 ± 1.5	NS **
Onset of varicocele: ***				
* Primary	40 (83.3)	37 (86)	39 (83)	NS **
* Secondary	8 (17.6)	6 (14)	8 (17)	NS **
Laterality of varicocele:***				
* Bilateral	30 (62.5)	28 (65.1)	33 (70.2)	NS **
* Left only	18 (37.5)	15 (34.9)	14 (29.8)	NS **
Grade (left side):***				
* Grade I	12 (25)	8 (18.6)	9 (19.1)	
* Grade II	24 (50)	23 (53.5)	28 (59.6)	NS**
* Grade III	12 (25)	12 (27.9)	10 (21.3)	

Numbers in parentheses are percentages

* NS = Not significant (F test)

** NS = Not significant (Group I vs each of group II and III; Chi-square test).

*** Number of patients.

Table (2): ***Operative data: Comparison between the three groups of varicocelectomy***

Item	*Group I (n = 48)*	*Group II (n = 43)*	*Group III (n = 47)*	** P1 I vs II*	** P2 I vs III*	** P3 II vs III*
Operative time (minutes)						
* Unilateral cases	30 ± 7	28 ± 6	16 ± 5	NS	< 0.001	< 0.001
* Bilateral cases	48 ± 5	64 ± 8	34 ± 8	<0.001	< 0.001	< 0.001
Hospital stay (hours)	48 ± 12	24	24	<0.001	< 0.01	NS
Period of convalescence (days)	8 ± 2	3 ± 1.3	3 ± 1	< 0.001	< 0.001	NS

* t = test

NS = Not significant

Table (3): ***Seminal parameters: Comparison between preoperative and postoperative data of each group***

Group	*Preoperative data*			*Postoperative data*		
	Sperm count (million/ml)	*% of active motility*	*% of abnormal forms*	*Sperm count (million/ml)*	*% of active motility*	*% of abnormal forms*
Group I (n=48)	19.5 ± 4.6	38.1 ± 8	44.6 ± 12.1	34.1 ± 4.5	42.2 ± 11	40.1 ± 9.3
* P value				(P<0.001)	(P<0.05)	(P<0.05)
Group II (n=43)	18.1 ± 5.3	39.4 ± 7.5	44.1 ± 8	31.4 ± 7.4	43.1 ± 8	40.4 ± 8.2
* P value				(P<0.001)	(P<0.05)	(P<0.05)
Group III (n=47)	16.1 ± 4.4	39.1 ± 6.4	48.1 ± 6.1	32.4 ± 6.2	46.4 ± 8.3	39.9 ± 6.2
* P value				(P<0.001)	(P<0.01)	(P<0.05)

* t = test

Table (4): ***Percentages of improvement of seminal parameters after varicocele ligation: Comparison between the three methods of varicocelectomy***

Item	*Group I (n = 48)*	*Group II (n = 43)*	*Group III (n = 47)*	** P1 I vs II*	** P2 I vs III*	** P3 II vs III*
Improvement of sperm count	30 (62.5)	28 (65)	33 (70)	NS	NS	NS
Improvement of sperm motility	26 (54)	24 (56)	30 (69.8)	NS	NS	NS
Reduction of abnormal forms	22 (46)	22 (51)	25 (53)	NS	NS	NS

Numbers in parentheses are percentages
* Chi-square test
NS = Not-significant (P>0.05)

Table (5): ***Treatment outcomes: Comparison between the three groups of varicocelectomy***

Item	*Group I (n=48)*	*Group II (n=43)*	*Group III (n=41)*	** P1 I vs II*	** P2 I vs III*	** P3 II vs III*
Hydrocele formation	10 (20.8)	5 (11.6)	0 (0)	NS	0.003	0.07
Recurrence rate	2 (4.16)	8 (18.6)	0 (0)	NS	NS	0.009
Pregnancy rate	15 (31.25)	14 (32.55)	28 (59.57)	NS	0.014	0.007

* P calculated according to X^2 test (Chi-sauqre test) with continuity correction.
Numbers in parentheses are percentages

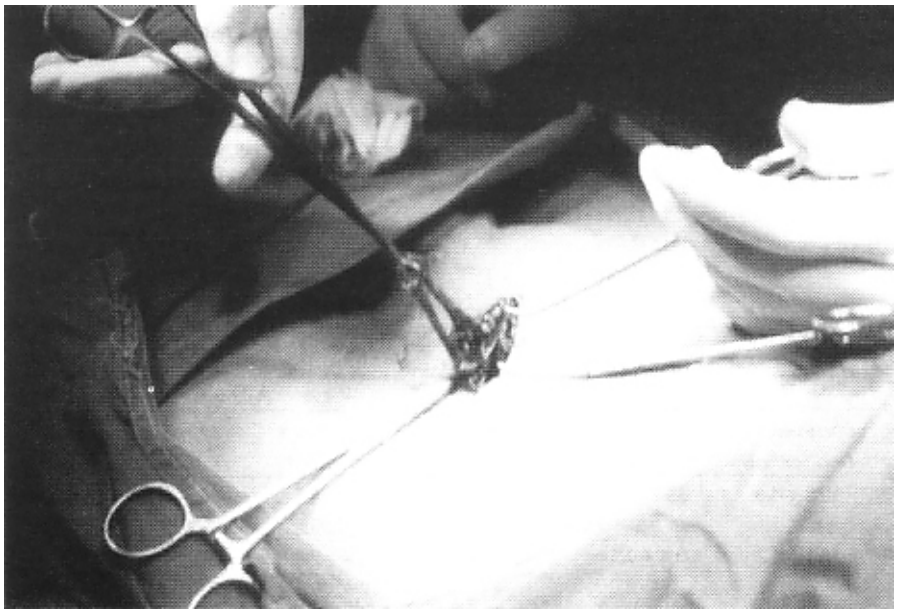

Fig. (1) : Inguinal varicocoelectomy.

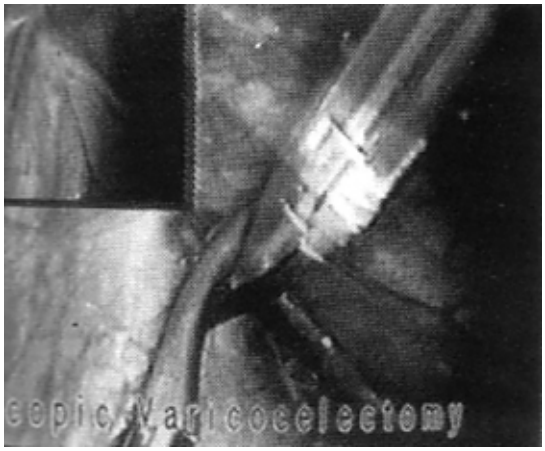

Fig. (2) :Laparascopic trnsperitoneal varicocolectomy

Fig. (3) : Microsurgical subinguinal varicocolectomy

DISCUSSION

Although varicocoele is generally regarded as the most commonly diagnosed cause of male infertility, debates continue about the impact of varicocelectomy on pregnancy rate. Whether the improvement in semen parameters seen in 60-80% of men after varicocele ligation translates into improvement in pregnancy and delivery rates has been a matter of ongoing controversy[2]. In our study, we have compared subinguinal microsurgical varicocelectomy with 2 other methods namely, inguinal and laparoscopic varicocelectomy to see if improvement of surgical technique is reflected by decrease in postoperative morbidity and increase in pregnancy rate or not.

Hydrocele formation is the most common complication reported after nonmicrosurgical varicocelectomy with incidence of about 12%, 3-30%, and 7% in laparoscopic, conventional inguinal, and retroperitoneal techniques respectively[14,2]. In our work, the use of microsurgical technique enabled us to preserve testicular lymphatics in all cases and reduced the incidence of hydrocele to 0% in comparison to the other 2 groups in whom the incidence of hydrocele was 20.8% in inguinal group and 11.6% in laparoscopic group. Our results agreed with other authors who utilized MSV and did not report any hydrocele formation [13,15].

The incidence of varicocele recurrence following surgical repair was summarized by Brandell and Goldstein (1999)[2] as follows: 10-25% for retroperitoneal repair, 15-25% for percutaneous embolization, 5-15% for conventional inguinal, 3-15% for laparoscopic and 1% for MSV. Venographic studies showed that recurrent varicoceles are caused by periarterial, external spermatic (cremasteric), gubernacular (10% of recurrent cases), and trans-scrotal collaterals[16,17]. In our work, the use of MSV enabled us to ligate all possible venous channels which can cause reflux and the incidence of recurrence was reduced to 0% in this group. In inguinal varicocelectomy group, recurrence was reported in 2 patients (4.16%) and this may be explained by presence of missed collaterals as cremasteric and gubernacular veins which could contribute for persistence of reflux. The highest incidence of recurrence (18.6%) was reported among laparoscopic group becasue the only venous channels which was ligated was internal spermatic vein(s) and all other veins which could contribute to reflux were left intact and this may explain this high incidence of recurrence which is significantly higher in compariosn to MSV ($P<0.001$) or inguinal group ($P<0.05$). Our results agreed with figures summarized by Brandell and Goldstein, (1999)[2].

The mean operative time for unilateral and bilateral cases was significantly shorter in microsurgical group when compared with other 2 groups. On the otherhand, when

group I and group II were compared with each other, no significant differences was found in unilateral cases, but bilateral cases took significantly longer time in laparoscopic procedure in comparison to inguinal technique. Our data are consistent with other authors who found that the operative time was significantly shorter in open surgery than in laparoscopic surgery[18,19].

No significant difference was found between microsurgical and laparoscopic approaches as regards hospital stay (<24 hours for both) or the period of convalescence (3+1 and 3+1.3 days respectively). As regards the inguinal approach, the hospital stay (48+12 hours) and period of convalescence (8+2 days) were significantly longer than in group II and group III. These figures are consistent with the results obtained in previous studies [11,18,19].

The postoperative seminal parameters significantly improved compared to the preoperative parameters in all groups with no significant differences were found when the percentage of postoperative seminal improvement in the three groups were compared with each other. However, with the use of subinguinal microsurgical technique, the pregnancy rate showed highly significant increase ($P<0.01$) when it was compared with group I or group II. These results indicated that the percentages of seminal improvement by microsurgical technique (70% increase in count, 63% increase in motility, and 53 reduction in abnormal forms) were associated with nearly parallel increase in pregnancy rate (about 60%). Using the same technique, Fazeli-Matin et al., (1994)[20] reported 69% pregnancy rate after 2 years of postoperative follow-up. The other two groups showed improvement in seminal parameters comparable to microsurgical group, but pregnancy rates were much lower (31.25% for group I and 32.55% for group II) and these figures were consistent with the data reported by Marks et al., (1986)[7]. Rogers et al. (1985)[21] suggested that varicoceles are associated with impaired sperm function in approximately 75 perent of infertile men, and that varix ligation can improve functional quality of sperms in only 25% of them. Among this subgroup with improved sperm functions (sperm penetration assay), 70 percent were able to initiate pregnancy. These observations can be used to explain our results. In subinguinal microsurgical approach, we have used optimized technique which may result in full improvement of sperm function and consequently will increase the fertilizing capacity of sperm, leading to the highest pregnancy rate. The other two approaches did not follow the ideal rules of varicocelectomy with unavoidable injury of testicular arteies and lymphatics is many cases, and with possibility of presence of missed venous callaterals which can cause persistence of reflux.

Inguinal varicocelectomy technique is the most commonly used technique due to its safety, simplicity, and lack of general anaesthesia. However, we found that it has many disadvantages as highest incidence of hydrocele (20.8%), relatively high incidence of recurrence (4.16%), prolonged hospital stay, delayed return to normal activity (8 + 2 days), and low pregnancy rate (31.25%).

Laparoscopic varicocelecotmy has been recently propsoed as an alternative procedure with reported advantages of simplicity, minimal invasiveness, short hospital stay and better convalescence with rapid return to work[22]. In our study, we found no benefit to the laparoscopic approach over the conventional inguinal technique except for minimal invasiveness and rapid return to work. When it was compared with microsurgical varicocelectomy, it has many disadvantages as higher recurrence rate (18.6%), higher incidence of hydrocele (11.6%), need of general anasthesia, and lower pregnancy rate (32.55%). Also, it needs extensive laparoscopic training. Although no serious complications occured in our laparoscopic series, it still carries the potential for serious vascular or visceral damage.

In our work we found that subinguinal microsurgical approach is the most optimal varicocelectomy technique. It was minimally invasive, needed no general anaesthesia and has the least operative time and the highest pregnancy rate. It was done as one day procedure (<24 hours) with early return to work (3 + 1.3 days) and with no detected recurrence or hydrocele formation after 2 years of follow up. The only disadvantage is the need of an operating microsocpe or a magnifying loupe which are not available in all centres and the need of extensive training.

The ultimate beneficial effect of infertility treatment is pregnancy. In our study, the highest pregnancy rate (59.6%) was obtained by a subinguinal microsurgical varicocelectomy technique which is highly significant ($P<0.01$) when it was compared to the other 2 techniques. So, subinguinal microsurgical varicocelectomy is recommended as the primary treatment for varicocele. It also seems to be the procedure of choice in resurrent cases treated by other techniques.

REFERENCES

1. Gorelick, J.I. and Goldstein, M. (1993): Loss of fertility in men with varicocele. Fertil. Steril., 59: 613.
2. Brandell, R.A. and Goldstein, M. (1999): Varicocele and its role in male infertility. Infertil. Reprod. Med. Clin.North. Am., 10: 471-481.

3. Mitropoulos, D.; Deliconstantinos, G. and Zervas, A. (1996): Nitric oxide synthase and xanthine oxidase activities in the spermatic vein of patients with varicocele: A potential role for nitric oxide and peroxnitrite in sperm dysfunction. J. Urol., 156: 1952-1958.

4. Sharma, R.K. and Agarwal, A. (1996): Role of reactive oxygen species in male infertility. Urology, 48: 385.

5. Baccetti, B.; Collodel, G. and Piemboni, P. (1996): Apoptosis in human ejaculated cells (natulae seminologicae 9). J. Submicrosc. Cytol. Pathol., 28: 589. Cited in Brandell and Goldstein, 1999.

6. Peng, B.C.H.; Tomashefsky, P. and Negler, H.M. (1990): The cofactor effect: Varicocele and infertility. Fertil. Steril., 54: 143.

7. Marks, J.L.; McMahon, R. and Lipshultz, L.I. (1986): Predictive parameters of successful varicocele repair. J. Urol.; 136: 609-612.

8. Wright, J. and Goldstein, M. (1994): Ligation of the testicular artery during microsurgical varicocelectomy: Incidence and implications. J. urol., 151: 141A.

9. Dubin, L. and Amelar, R.D. (1970): Varicocele size and results of varicocelectomy in selected subfertile men with varicocele. Fertil. Steril., 21: 601-609.

10. Sigman, M.; Lipshultz, L.I. and Howards, S.S. (1997): Evaluation of the subfertile male. In: Lipshultz, L.I. and Howards, S.S. (eds.): Infertility in the male, ed3. St. Louis, Mosby-year Book, PP; 173-193.

11. Sayfan, J.; Saffer, Y. and Roda, R. (1992): Varicocele treatment: prospective randomized trial of 3 methods. J. Urol., 148: 1447-1449.

12. Tan, S.M.; Ravinthran, T.N. and Lim, P.H. (1995): Laparoscopic varicocelectomy: technique and results. Br. J. Urol., 75: 523-528.

13. Goldstein, M.; Gilbert, B.R. and Dicker, A.P. (1992): Microsurgical inguinal varicocelectomy with delivery of the testis: An artery and lymphatic sparing technique. J. Urol. 148: 1808-1811.

14. Szabo, R. and Kessler, R. (1984): Hydrocele following internal spermatic vein ligation: A retrospective study and review of the literature. J. Urol., 132: 924-925.

15. Marmar, J.L. and Kim, Y. (1994): Subinguinal microsurgical varicocelectomy: A technical critique and statistical analysis of semen and pregnancy data. J. Urol., 152: 1127.

16. Kaufman, S.L.; Kadir, S. and Barth, K.H. (1983): Mechanisms of recurrent varicocele after balloon occlusion or surgical ligation of the internal spermatic vein. Radiology, 147: 435.

17. Sayfan, J.; Adam, Y.G. and Soffer, Y. (1980): A new entity in varicocele subfertility: The cremasteric reflux. Fertil. Steril., 33: 88-90.

18. Hirsch, I.V.; Abdel-Meguid, T.A. and Gomelia, L.G. (1998): Posturgical outcomes assessment following varicocele ligation: laparoscopic versus subinguinal approach. Urology, 51: 810-815.

19. Abdulmaaboud, M.R.; Shokeir, A.A.; Farage, Y.; Abdelrahman, A.; El-Rakhawy, M.M. and Mutabagani, H. (1998): Treatment of varicocele: A comparative study of conventional open surgery, percutaneous retrograde sclerotherapy and laparoscopy. Urology, 52: 294-300.

20. Fazeli-Matin, S.; Morrison, G. and Goldstein, M. (1994): What is the pregnancy rate in vasovasotomy and varicocelectomy patients who are "lost to follow-up". J. Urol., 151: 303A.

21. Rogers, B.J.; Mygatt, G.C. and Soderdahl, D.W. (1985): Monitoring of suspected infertile men with varicocele by the sperm penetration assay. Fertil. Steril., 44: 800-805.

22. Donovan, J.F. and Wintfield, H.N. (1992): Laparoscopic varix ligation. J. Urol., 147: 77-81.