

PERCUTANEOUS EMBOLIZATION OF VARICOCELES: OUTCOMES AND CORRELATION OF SEMEN IMPROVEMENT WITH PREGNANCY

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ABSTRACT

Objectives. To assess the technical feasibility and compare the semen quality in men with or without pregnancy after percutaneous embolization of varicoceles in the management of infertility.

Methods. The records of 102 patients who underwent retrograde varicocele embolization between January 1997 and January 2002 were reviewed through the Hospital Information Support System. Infertility was the indication for embolization in 71 cases. The present study consisted of this group of patients. The size of the varicoceles, the size of the testis, the pre-embolization semen analysis parameters, the technical details of embolization procedure, any anomalous vessels seen on venography, and, if unsuccessful, the reason for failure of the procedure were noted. A record of postembolization semen parameters (at least two) was made. Patients were divided into four groups depending on the pre-embolization semen density, and a correlation of this was assessed with improvements in morphology and motility. Follow-up was performed using a questionnaire to evaluate the success rate of the procedure, complications, and any treatment for infertility by the patient or his partner after the procedure. Patients who had a successful pregnancy were compared with those who did not to determine the correlation between the changes in semen quality and pregnancy rate.

Results. Between January 1997 and January 2002, 71 patients underwent retrograde varicocele embolization, using an embolizing coil, for infertility. In 68 (95.7%), it was technically successful. Nineteen patients (26.7%) had various anomalous vessels on venography. A statistically significant improvement ($P = 0.002$) was noted in the motility parameters in patients with a pre-embolization semen density between 10 and 30 million/mL. All patients were followed up by questionnaire. Follow-up was possible in 51 patients (75%). One patient had varicocele recurrence and underwent open inguinal surgical ligation. Of 45 patients, the partners of 18 (40%) had a successful pregnancy. A comparison of the postembolization semen quality between those with and without a successful pregnancy found no correlation between the changes in the semen parameters and the pregnancy rate.

Conclusions. Varicocele embolization is a technically feasible, minimally invasive, outpatient procedure that improves semen quality significantly in patients with a pre-embolization semen density of 10 to 30 million/mL. However, no correlation was found between the improvements in semen quality and the pregnancy rate. UROLOGY 63: 359-363, 2004. © 2004 Elsevier Inc.

Varicocele remains the most common correctable etiologic factor in the management of infertility.¹ The incidence of abnormal seminal pa-

rameters is greater in patients with varicocele and infertility than in comparable controls, highlighting the possible etiologic role of varicocele in the alteration of semen quality.²

Traditionally, varicoceles have been treated by surgical interruption above the pampiniform plexus at varying levels.³⁻⁵ This can be accomplished by open surgical ligation or, more recently, laparoscopically.⁶ The problems of high recurrence rates, inpatient hospital stays, and the morbidity of the procedure in the form of testicular atrophy and hydrocele have been improved with the introduction of improved techniques of microsurgical subinguinal ligation. This is an artery and

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lymphatic sparing approach with a reported recurrence rate of less than 1%. Postoperative recurrence has been attributed to the persistence of collaterals or anomalous veins missed during surgical ligation.⁷ Better anatomic delineation on pre-embolization venography enables the identification of these veins and thus minimizes the possibility of future recurrences.

A radiologic approach is not only a minimally invasive outpatient procedure, but also has the advantages of better anatomic delineation on venography and effective occlusion of venous reflux. The technical effectiveness of the procedure in terms of complete occlusion has also been confirmed by absence of reflux in the same setting. The high rate of technical failure reported in previous series⁸ may reflect a learning curve, which should improve with experience, the availability of better contrast media, and better thrombogenic coils.

Few studies^{9,10} have shown improvement in semen quality after open varicocele surgery in adolescent patients; the issue of varicolectomy in the infertile population remains controversial.^{11,12} The aims of our present study were to determine the technical feasibility of percutaneous embolization in the management of varicoceles with special reference to the presence of anomalous vessels, to determine the effect of embolization of varicoceles on the semen quality of patients; and to determine whether a change in the semen quality has any bearing on the pregnancy rate.

MATERIAL AND METHODS

PATIENT SELECTION

The records of 102 patients who underwent retrograde varicocele embolization between January 1997 and January 2002 were reviewed through the Hospital Information Support System and patient medical records. The local ethical research committee approved this study. The following information was noted: the indication for embolization, the size of the varicocele, the size of the testis, the pre-embolization semen analysis parameters, the technical details of the embolization procedure, any anomalous vessels seen on venography, and the reason for failure of the procedure, if relevant. A group of patients with infertility as an indication for embolization was identified. The partners of these patients were evaluated in an infertility clinic and all evaluations were normal. The mean age of the partners of these patients was 28.6 years (range 18 to 37). All patients underwent physical examination as an outpatient in an upright position with the aid of the Valsalva maneuver. Subsequently, these patients underwent Doppler ultrasonography of scrotum with the Valsalva maneuver, and the varicocele was graded as large (visible, palpable, and audible), moderate (definitely palpable and audible), and small (clinically suspicious and audible on Doppler ultrasonography). The testicular volume was measured using the formula given by Behr *et al.*¹³; a volume of less than 12 cm³ was considered small. All patients had at least two pre-embolization semen analyses, and an average of two for each patient and each parameter was taken for comparison with the postembolization values. The semen analysis was carried out using World Health Organization criteria.¹⁴ At least one of the pa-

rameters of the semen analysis was abnormal before embolization in all patients. The patients were divided into four groups depending on the pre-embolization density: group 1, semen density less than 10 million; group 2, 10 to 30 million; group 3, 30 to 60 million; and group 4, more than 60 million. The effect of the pre-embolization semen density on the improvement in morphology and motility was assessed.

EMBOLIZATION TECHNIQUE

All patients underwent embolization under local anesthesia by a single radiologist. The right common femoral vein was punctured and catheterized with a 5F preformed cobra catheter (Cordis). The left renal vein was selectively catheterized, and, if possible, the origin of the testicular vein was engaged and selective venography performed. If this was not immediately possible, left renal venography was performed during a Valsalva maneuver to locate and demonstrate the origin of the refluxing vein, facilitating subsequent selective catheterization. The Cobra catheter was manipulated as far distally in the testicular vein as possible, ideally to the level of the deep inguinal ring. Additional venography was performed at this level to confirm the position and demonstrate any other collateral veins.

Thrombogenic coil embolization was performed at this level with additional, more proximal, coils deployed to take into account anomalous venous collateral veins, with the aim of isolating the most distal segment of the testicular vein from all potential collateral supply. For embolization of the right testicular vein, the vessel was selectively catheterized using a preformed 5F side wire catheter (Cordis) and was embolized in a similar manner. The catheter was removed and hemostasis achieved.

Postprocedure care included bed rest with routine pulse and blood pressure monitoring and punctures site observation, followed by mobilization after 2 hours. Patients were sent home with nonsteroidal anti-inflammatory analgesics for 3 days.

EVALUATION METHODS

A record of the postembolization semen parameters was made at 3 and 6 months after the procedure. If the semen analysis did not show any improvement, a subsequent semen analysis was obtained at 9 and 12 months. An average of all the semen analyses during the postembolization period for each patient and for each parameter was taken for comparison. The statistical significance of any change in the semen parameters after embolization was tested using the Spearman correlation. Patients were followed up using a detailed questionnaire to discover the success rate of the procedure and any complications.

PREGNANCY DATA

Patients were divided into two groups on the basis of whether they achieved a successful pregnancy on follow-up. The alteration in semen quality of both groups was compared to assess the correlation between semen quality improvement and pregnancy status.

RESULTS

A total of 102 patients underwent retrograde varicocele embolization using thrombogenic coils between January 1997 and January 2002. Infertility was the indication for embolization in 71 cases, and the data of these patients were reviewed in this study. In 68 patients (96%), the procedure was technically successful. The reason for failure in 3

TABLE I. Changes in semen characteristics and semen density

Patients (n)	Semen Density (million/mL)	Motility (%)		Morphology (% of normal)		P Value
		Before	After	Before	After	
13	<10	17 ± 12	20 ± 14	62 ± 36	70 ± 46	0.2
24	10–30	26 ± 14	46 ± 32	55 ± 35	71 ± 36	0.002
16	30–60	30 ± 16	42 ± 18	48 ± 34	70 ± 31	0.11
15	>60	32 ± 12	39 ± 14	55 ± 36	64 ± 37	0.21

Data presented as the mean ± SD, unless otherwise noted.

TABLE II. Patient characteristics stratified by pregnancy after embolization of varicocele

Parameter	With Pregnancy*		Without Pregnancy†	
	Before Embolization	After Embolization	Before Embolization	After Embolization
Volume (cm ³)	2.6	2.7	2.0	2.2
Density (million/mL)	30	44	20	34
Normal motility (%)	26	48	29	44
Normal morphology (%)	56	70	55	73

* Mean patient age 28 yr.

† Mean patient age 26 yr.

cases was venous spasm, the presence of extensive collaterals, and failure to localize the testicular vein on that side. Pre-embolization ultrasonography revealed that 12 patients had a small testis. Large, medium, and small-sized varicoceles were seen on ultrasonography in 17, 30, and 21 patients, respectively. Nineteen patients (26%) had various anomalous vessels on venography. All patients underwent embolization as an outpatient. Patients required analgesia for 1 to 5 days (mean 3). Fifty patients had varicocele on the left side, 15 on the right side, and 6 on both sides.

An improvement in semen parameters in terms of semen density, morphology, and motility occurred, but statistically significant improvement ($P = 0.002$) was only seen in the motility and morphology parameters in patients with a pretreatment semen density between 10 and 30 million/mL (Table I). Fifty-one patients (75%) replied to the questionnaire. One patient had varicocele recurrence and underwent open inguinal surgical ligation and was excluded from the analysis. Five patients who failed to achieve pregnancy chose assisted reproductive techniques and were also excluded from the analysis. Three of those had a successful pregnancy. Of the 45 remaining patients, 18 (40%) had a successful pregnancy at a mean follow-up of 3.6 years (range 1 to 5). None of these patients had tried any other method to reproduce after embolization. The quality of semen in the 18 patients with a successful pregnancy was compared with that of the 27 who failed to achieve pregnancy (Table II). Although improvement in the semen quality occurred in both groups after

embolization, a statistically significant difference in the change in the semen quality was not seen. The presence of anomalous vessels on venography, testicular size, and varicocele size had no statistically significant impact on the outcome of embolization.

COMMENT

Varicocele is an abnormal dilation of the pampiniform plexus of veins, usually caused by reflux of the internal spermatic vein. The incidence of varicocele is greater in the infertile male population, and a correlation between semen quality impairment and varicocele has been reported in previous studies.^{2,15} Debate regarding the role of intervention in the management of varicocele has been considerable. Although some series¹⁵ have reported no or minimal changes in the semen quality or pregnancy rate after surgical ligation, others have reported significant improvement in semen quality and an increased pregnancy rate.¹⁶ The best evidence-based answer would be from a randomized prospective controlled trial; however, this may be difficult to achieve in clinical practice. A strong desire to achieve parenthood, no convincing evidence-based support in published studies, a lack of motivation to recruit controls, and poor compliance are some of the difficulties faced in conducting controlled studies. Mark *et al.*¹⁷ observed that 70% of the patients were lost to follow-up in a large controlled study of 480 patients. In the present study, it was possible to obtain questionnaire-based assessment in only 75% of the pa-

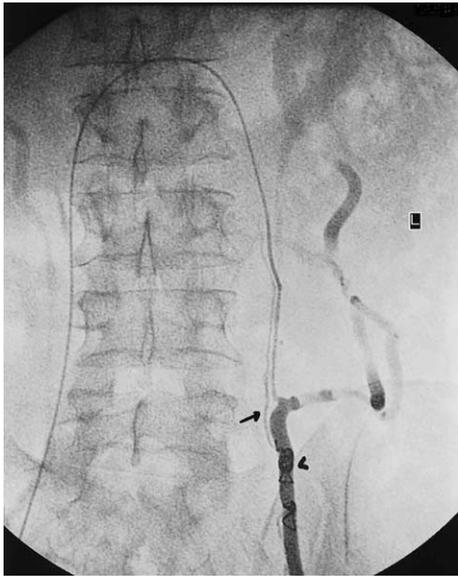


FIGURE 1. Early bifurcation of left testicular vein leading (arrow). Note placement of coil (arrowhead).

tients, despite conducting a one-to-one interview. We attempted to compare the quality of semen after embolization in a retrospective controlled manner by using patients who failed to achieve pregnancy after successful embolization and with no recurrence of varicoceles as the controls. Improvement in semen quality occurred in both groups; however, it did not show any correlation with the pregnancy rate.

The management of varicocele basically involves interruption of reflux in the spermatic vein. This can be achieved by ligation at various levels either by an open or laparoscopic approach. There has been a continuous endeavor to improve the surgical techniques to decrease the morbidity, such as hydrocele, testicular atrophy, and recurrence, since its introduction by Palomo.¹⁸ The recently introduced microsurgical technique^{3,19} carried out in dedicated centers as an outpatient procedure has been reported with the least morbidity and minimal complications. In the present study, retrograde embolization was performed under local anesthesia, with a minimal requirement for analgesics and minimal morbidity. The possible reasons for the minimal morbidity in embolization of varicocele include precise definition of the anatomy on venography, a lack of perivenous dissection or disruption of the lymphatic supply, and a lack of potential danger to the testicular blood supply.²⁰

Recent improvements in angioembolization techniques, the use of better contrast media, the availability of better thrombogenic coils, and the growing expertise in this area have improved the technical success rate. In the present study, it was possible to place coils precisely in 96% of patients (Figs. 1 and 2), demonstrating the high success

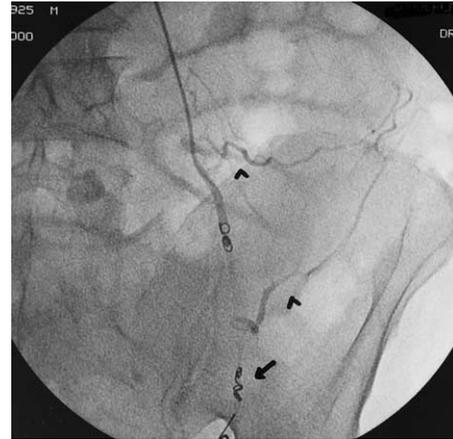


FIGURE 2. Multiple collaterals joining left testicular vein from iliac, ureteral, mesenteric veins (arrowheads). Note precise placement of coil distal to collaterals (arrow).

rate of the procedure. The complications were minimal and easily manageable during the procedure. Some investigators^{21,22} have reported migration or degradation of embolic coils; however, we did not experience any such complication in the present series.

Safayan *et al.*,²³ in a prospective study, demonstrated no improvement in semen density after embolization and suggested that this could be because of potentially missed collaterals. In the present series, we found no statistically significant impact on the presence of anomalous or collateral vessels on the semen parameters. Proper delineation of the anatomy and placement of the coils distal to the collaterals or anomalous vessels ensures interruption of venous reflux in the spermatic vein.

The results of the present study demonstrated improvement in the semen measurements, with highly significant improvement in motility and morphology at a pre-embolization semen density of 10 to 30 million/mL. Our observation is similar to the density-dependent improvement in motility parameters observed in open varicocelectomy studies carried out previously.^{24–26} It is difficult to draw a useful conclusion in absence of a control group. The partners of 18 patients (36%) achieved pregnancy at a mean follow-up of 3.6 years. Despite difficulties in reaching a conclusion, improvement in semen quality could increase the pregnancy rate; however, in our study, no correlation was found between an improvement in the quality of semen and the pregnancy rate. Both groups of patients had improvements in quality after the procedure, but only a few could reproduce successfully.

CONCLUSIONS

Retrograde embolization of varicocele improves semen parameters, especially in patients with a pre-

embolization semen density of 10 to 30 million/mL. It is a technically feasible, minimally invasive procedure for the management of infertility due to varicocele. No correlation was found between an improvement in semen quality and the pregnancy rate.

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