# VARICOCELE IN MALE INFERTILITY: CURRENT STATUS OF SURGERY TECHNIQUES

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## ABSTRACT

Varicocele is the most common cause of male infertility and is generally correctable, or at least improvable, through various surgical techniques. Although several different techniques for varicocele repair have been described in the literature, microsurgical subinguinal varicocelectomy is recognised as the gold-standard approach for varicocelectomy due to high success rates with minimal complications. This article reviews the current status of the effects of varicocelectomy techniques on male infertility and the recurrence and complication rates associated with these techniques.

Keywords: Varicocele, varicocelectomy, microsurgical varicocelectomy, laparoscopic varicocelectomy, open varicocelectomy.

## INTRODUCTION

Varicocele is the abnormal dilatation of the pampiniform plexus due to the inversion of venous blood flow within spermatic veins.[1] Although the cause of varicocele is multifactorial, the most popular mechanism today is increased abdominal pressure during childhood and early adolescence.[2] Pathological dilatation of the veins that drain the testicles leads to increased temperature in the seminiferous tubules and decreased sperm quality.[3] The most common clinical symptom of varicocele is male infertility, and less commonly testicular pain or palpable mass.[4]

Varicocele is the most frequent cause of male infertility. This condition can be detected in 19-41% of patients with primary infertility and 45-81% of those with secondary infertility.[5] Some researchers have hypothesised that impaired venous drainage causes an increase in venous stasis and a decrease in arterial blood flow, thus inducing hypoxia and deficiency in testicular microcirculation. Also, it is thought that this hypoxia could be responsible for defective energy metabolism at the mitochondrial level, which causes dysfunction of both Leydig and germinal cells.[6,7] Other researchers have suggested that varicocele is associated with increased sperm DNA damage, and that this sperm pathology may be secondary to varicocele-mediated oxidative stress. Varicocelectomy can reverse this sperm DNA damage. However, the exact pathophysiology of varicocele remains unknown.[8,9]

Accepted indications for the treatment of varicocele are men with infertility and scrotal pain or men with discomfort.[10] Scrotal pain is generally treated with conservative methods such as scrotal support, limited physical activity, and anti-inflammatory drugs, but this has been met with poor resolution rates and a surgical approach is rarely performed. Varicocelectomy is frequently performed for infertility due to varicocele.[11] Guidelines relating to varicoceles and infertility have been put forth by the American Urological Association,[12] and more recently by the American Society for Reproductive Medicine.[13] Both reports recommend varicocele repair in cases of clinically palpable varicocele with documented infertility, one or more abnormal semen parameter, and in the setting of normal or potentially correctable female fertility. The duration of infertility also seems to be important. In a recent study it was shown that couples with infertility of >2 years duration had a significantly higher pregnancy rate after varicocelectomy compared with couples with an

untreated varicocele. In couples with a shorter duration of infertility, such a difference was not observed.[14] In men with subclinical varicocele or normal semen analysis, the treatment of varicocele has not been recommended because its effectiveness has not been shown.[12] The aim of this review is to present the current status of the effects of varicocelectomy techniques on male infertility, as well as their recurrence and complication rates.

## TREATMENT OPTIONS FOR VARICOCELE

The basis of varicocele treatment is the blockade of the internal spermatic venous drainage of the testicle while preserving the internal spermatic artery, the vasal and deferential vessels, and the spermatic cord lymphatics.[10] Various techniques have been introduced and practised for varicocele repair. These techniques can largely be classified into two categories: surgical and radiological approaches. Radiological treatment has been used as an alternative to surgical repair with the aim of less invasiveness and better opportunity to control the small collaterals that may not be detected during surgery. The modalities of the radiological approach are retrograde embolisation or sclerotherapy and antegrade sclerotherapy.[11]

## VARICOCELECTOMY TECHNIQUES

A number of different techniques have been described to treat varicocele. The type of intervention chosen depends mainly on the experience of the surgeon.[15] Complications of varicocele repair include hydrocele formation, recurrence of the varicocele, and, rarely, testicular atrophy. The rates of recurrence, complications, and pregnancy that are associated with open, microsurgical, and laparoscopic varicocelectomy techniques are summarised in Table 1[16-22] and Table 2.[23]

### Open Retroperitoneal, Inguinal, or Scrotal Varicocelectomy

The aim of open surgical techniques is the ligation of the internal spermatic vein superior to the internal ring. A number of different localisations have been described for open varicocelectomy. These include:[1] retroperitoneal (high) ligation of the testicular artery and vein above the internal inguinal ring (Palomo technique);[2,24] high ligation of the vein while sparing the artery (Bernardi technique);[3,25] and ligation of the cremasteric and internal spermatic veins as they travel within the inguinal canal as structures of the spermaticcord (Ivanissevich technique).[26]

**Table 1: The rates of recurrence of varicocele, formation of hydrocele, and pregnancy in comparative studies of varicocelectomy (open, laparoscopic, and microsurgical techniques).**

| Study | Surgical technique (n) | Recurrence, % | Hydrocele, % | Pregnancy, % |
|---|---|---|---|---|
| Cayan et al.[16] | Palomo (232)<br>Microsurgical high inguinal (236) | 15.51<br>2.11 | 9.09<br>0.69 | 33.7<br>42.8 |
| Bebars et al.[17] | Palomo (65)<br>Laparoscopic (128) | 10.8<br>3.9 | 4.6<br>2.3 | 43<br>51 |
| Ghanem et al.[18] | Palomo (109)<br>Microsurgical subinguinal (304) | 7<br>0 | 6.4<br>1.6 | N/A<br>N/A |
| Watanabe et al.[19] | Palomo (50)<br>Microsurgical subinguinal (61)<br>Laparoscopic (33) | 12<br>0<br>6.1 | 10<br>0<br>3.03 | 35.8<br>50.9<br>40.4 |
| Al-Kandari et al.[20] | Open inguinal (40)<br>Microsurgical subinguinal (40)<br>Laparoscopic (40) | 17.5<br>2.5<br>22.5 | 17.5<br>0<br>25 | 28<br>40<br>30 |
| Al-Said et al.[21] | Open inguinal (92)<br>Microsurgical subinguinal (112)<br>Laparoscopic (94) | 17.4<br>3.6<br>26.6 | 4.3<br>0<br>8.5 | 31<br>38<br>33 |
| Abdel-Maguid, Othman[22] | Open subinguinal (80)<br>Microsurgical subinguinal (82) | 11.3<br>0 | 8.7<br>1.2 | 21.2<br>37.8 |

N/A: not available.

**Table 2: Rates of pregnancy, recurrence of varicocele, and formation of hydrocele associated with different surgical techniques, arranged according to descending order of pregnancy rate.[23]**

| Surgical technique | No. of studies analysed | Pregnancy rate (range), % | Recurrence of varicocele (range), % | Formation of hydrocele (range), % |
|---|---|---|---|---|
| Microsurgical subinguinal | 13 | 44.75 (33.8-51.5) | 2.07 (1.4-14.8) | 0.72 (0.3-1.6) |
| Microsurgical inguinal | 6 | 41.78 (40.8-42.8) | 9.47 (0.7-15.2) | 0.29 (0.0-0.7) |
| Palomo | 4 | 34.21 (33.5-36.0) | 12.5 (7.3-15.5) | 7.58 (4.6-9.0) |
| Inguinal | 6 | 30.06 (20.0-31.5) | 15.65 (3.57-17.5) | 7.47 (4.3-17.5) |
| Laparoscopic | 9 | 27.53 (13.1-40.0) | 11.11 (4.0-26.5) | 7.57 (1.7-12.7) |

**Table 3: The rates of recurrence of varicocele, formation of hydrocele, and pregnancy in studies comparing microsurgical inguinal and subinguinal varicocelectomy.**

| Study | Microsurgical technique (n) | Recurrence, % | Hydrocele, % | Pregnancy, % |
|---|---|---|---|---|
| Gontero et al.[31] | Inguinal (50)<br>Subinguinal (45) | 8.0<br>4.9 | 0<br>0 | 48.9<br>50.0 |
| Orhan et al.[32] | Inguinal (147)<br>Subinguinal (65) | 0.68<br>3 | 0<br>0 | 41<br>33 |

Several studies have shown that, although the recurrence and complication rates of open varicocelectomy techniques were higher than those of the microsurgical techniques, the pregnancy rates of the open techniques were lower (Table 1). Cayan et al.[16] compared the Palomo technique (n=232) with microsurgical high inguinal varicocelectomy (n=236) in patients with primary infertility and abnormal semen analysis. They noticed that the recurrence rates of the Palomo and microsurgical techniques were 15.5% and 2.1%, respectively. Hydrocele formation rates of the Palomo and microsurgical techniques were found to be 9.0% and 0.6%, respectively. Although the complication and recurrence rates of the Palomo technique were higher than those of microsurgical techniques, the pregnancy rate of the Palomo technique was lower than that of the microsurgical (33.7% and 42.8%, respectively). Abdel-Maguid and Othman[22] compared open subinguinal (n=80) and microsurgical subinguinal (n=82) techniques. They reported that the rates of varicocele recurrence and formation of hydrocele with open varicocelectomy were found to be higher than with the microsurgical technique (11.3%, 8.7% and 0%, 1.2%, respectively). None of the patients who underwent microsurgical subinguinal varicocelectomy had a recurrence of varicocele. The rates of pregnancy in the open and microsurgical group were found to be 21.2% and 37.8%, respectively. They also noticed that postoperative mean sperm count and motility improved significantly in both groups: 42.7% and 67.1% of the microsurgical subinguinal varicocelectomy group and 23.7% and 33.8% of the open subinguinal varicocelectomy group showed a ≥50% improvement in sperm count and motility, respectively, after 1 year. The results of these two studies were similar to other studies that compared open and microsurgical varicocelectomy.[18-22]

## Microsurgical Inguinal or Subinguinal Varicocelectomy

The microsurgical approach to varicocelectomy has become a popular treatment because it identifies small spermatic veins, the testicular artery, and lymphatics more effectively, thus substantially decreasing recurrence and complication rates.[6] In three randomised controlled studies comparing open, laparoscopic, and microsurgical techniques, the lowest rates of recurrence and hydrocele formation were found in the patients who underwent a microsurgical technique. Although two[19,21] of these studies included only patients with infertility and abnormal semen analysis, the other study[20] also included patients with pain and normal semen analysis. Watanabe et al.[19] noted that the recurrence rates associated with the Palomo (n=50), laparoscopic (n=33), and microsurgical (n=61) approaches were 12%, 6.1%,

and 0%, respectively; the rates of hydrocele formation were: 10%, 3%, and 0%, respectively. The authors found that the pregnancy rates associated with the Palomo, laparoscopic, and microsurgical techniques were 35.8%, 40.4%, and 50.9%, respectively. Al-Kandari et al.[20] found that the recurrence rates in the open (n=40), laparoscopic (n=40), and microsurgical (n=40) varicocelectomy groups were 17.5%, 22.5%, and 2.5%, respectively; the rates of hydrocele formation were: 17.5%, 25%, and 0%, respectively. The authors also reported that the pregnancy rates of open, laparoscopic, and microsurgical techniques were 28%, 30%, and 40%, respectively. Al-Said et al.[21] reported that the recurrence rates of open (n=92), laparoscopic (n=94), and microsurgical (n=112) approaches were 17.4%, 26.6%, and 3.6%, and that the rates of hydrocele formation were 4.3%, 8.5%, and 0%, respectively. The pregnancy rates after open, laparoscopic, and microsurgical techniques were found to be 31%, 33%, and 38%, respectively.

The most current microsurgical approaches are subinguinal[27] and inguinal varicocelectomy.[28] Microsurgical subinguinal varicocelectomy was introduced by Marmar et al.[29] in 1985, and was then modified by Goldstein et al.[30] in 1992. Since then it has become the gold-standard technique in adults.[2] In studies comparing subinguinal and inguinal techniques, although the rates of pregnancy were similar, the rates of recurrence were discordant (Table 3).[31,32] Gontero et al.[31] noted that the rates of recurrence after inguinal (n=50) and subinguinal (n=45) microsurgical varicocelectomy were 8.0% and 4.9%, respectively. The pregnancy rates of the inguinal and subinguinal group were found to be 48.9% and 50.0%, respectively. Conversely, Orhan et al.[32] found that the rate of recurrence in the inguinal (n=147) microsurgical group was lower than in the subinguinal (n=65) group (0.6% and 3.0%, respectively). The pregnancy rates of the inguinal and subinguinal group in this study were 41% and 33%, respectively.

### Laparoscopic Varicocelectomy

The laparoscopic transperitoneal Palomo varicocelectomy was introduced in the early 1990s.[33] Since then it has gained wide acceptance as a safe, simple, and minimally invasive procedure in both adults and children.[34] Earlier studies reported that, although the rates of hydrocele formation and recurrence of varicocele in the laparoscopic approach were lower than in open varicocelectomy, the rate of pregnancy in laparoscopic varicocelectomy was higher than in open varicocelectomy.[17,19] However, the results of ensuing studies were incompatible with the results of these two studies. Al-Kandari et al.[20] noticed that the rates of recurrence and hydrocele in laparoscopic varicocelectomy were 22.5% and 25.0%, respectively. These rates in open varicocelectomy were only 17.5% and 17.5%, respectively. Al-Said et al.[21] reported that the rates of recurrence and hydrocele in the laparoscopic approach were higher than in the open approach. In these two studies, the rates of pregnancy in laparoscopic and open varicocelectomy were found to be similar.

## VARICOCELECTOMY IN ADOLESCENTS

Varicocele is not common in children: in adolescents the prevalence ranges from 13.7-16.2%.[35] However, it is believed that the population of boys with varicoceles represents the same population of adults with varicoceles. Varicocele progressively affects the testis, resulting in atrophy and abnormal semen.[36] The recommended indications for varicocele repair in children and adolescents are:[1,37] varicocele associated with a significantly small ipsilateral testis;[2] additional testicular conditions affecting fertility;[3] bilateral palpable varicoceles;[4] pathological sperm quality (in older adolescents);[5] varicocele associated with a supranormal hormone response to the gonadotropin-releasing hormone stimulation test;[6] symptomatic varicocele (i.e. causing physical discomfort).

Microsurgical subinguinal varicocelectomy was undertaken in adolescents by Lemack et al.[2] in 1998, and is now increasingly applied in children and adolescents. Many studies have described significant improvement in semen quality after varicocelectomy in both adults and adolescents.[36,38,39] However, it must be considered that 50-80% of male patients with a varicocele never have problems with fertility.[40] Therefore, further studies comparing observation with surgical intervention are needed to refine the current indications for varicocele repair in the adolescent male.

## CONCLUSION

Varicocele is the most common identifiable and treatable cause of male infertility. Varicocelectomy should be considered in the case of a clinical

varicocele, oligospermia, infertility duration of >2 years, and otherwise unexplained infertility in the couple. Several varicocelectomy approaches that differ according to surgical technique (such as open, laparoscopic, and microsurgical) and localisation (such as high inguinal, inguinal, and subinguinal) are available for treatment of varicocele. Current evidence indicates that microsurgical varicocelectomy is the most effective and least morbid method among the varicocelectomy techniques. Many studies have shown that the optimal surgery technique for the treatment of varicocele is the microsurgical approach. The complication and recurrence rates of microsurgical varicocelectomy are lower than those of both laparoscopic and open varicocelectomy and the pregnancy rate is higher than that following the other techniques. Although laparoscopic varicocelectomy is feasible, it must be justified in terms of cost-effectiveness.

## REFERENCES


1. Ficarra V et al. Varicocele repair for infertility: what is the evidence? Curr Opin Urol. 2012;22(6):489-94.

2. Mirilas P, Mentessidou A. Microsurgical subinguinal varicocelectomy in children, adolescents, and adults: surgical anatomy and anatomically justified technique. J Androl. 2012;33(3):338-49.

3. Hopps CV, Goldstein M. Varicocele: unified theory of pathophysiology and treatment. AUA Update Series. 2004;23:90-5.

4. Ribe N et al. Clinical follow-up after subinguinal varicocele ligation to treat pain. Arch Ital Urol Androl. 2002;74(3): 51-3.

5. Agarwal A et al. Efficacy of varicocelectomy in improving semen parameters: new meta-analytical approach. Urology. 2007;70(3):532-8.

6. Tarhan S et al. Long-term effect of microsurgical inguinal varicocelectomy on testicular blood flow. J Androl. 2011;32(1):33-9.

7. Balci A et al. Long-term effect of varicocele repair on intratesticular arterial resistance index. J Clin Ultrasound. 2008;36(3):148-52.

8. Zini A, Dohle G. Are varicoceles associated with increased deoxyribonucleic acid fragmentation? Fertil Steril. 2011;96(6):1283-7.

9. García-Peiró A et al. Multiple determinations of sperm DNA fragmentation show that varicocelectomy is not indicated for infertile patients with subclinical varicocele. Biomed Res Int. 2014;2014:181396.

10. Masson P, Brannigan RE. The varicocele. Urol Clin North Am. 2014;41(1):129-44.

11. Cho KS, Seo JT. Effect of varicocelectomy on male infertility. Korean J Urol. 2014;55(11):703-9.

12. American Urological Association, Inc. Report on varicocele and infertility: an AUA Best Practice Policy and ASRM Practice Committee Report. 2001. Available at: http://www.auanet.org/common/pdf/education/clinical-guidance/Varicocele-Archive.pdf. Last accessed: 7 July 2015.

13. Practice Committee of American Society for Reproductive Medicine. Report on varicocele and infertility. Fertil Steril. 2008;90(5 Suppl):S247-9.

14. Giagulli VA, Carbone MD. Varicocele correction for infertility: which patients to treat? Int J Androl. 2011;34(3):236-41.

15. Ding H et al. Open non-microsurgical, laparoscopic or open microsurgical varicocelectomy for male infertility: a meta-analysis of randomized controlled trials. BJU Int. 2012;110(10):1536-42.

16. Cayan S et al. Comparison of results and complications of high ligation surgery and microsurgical high inguinal varicocelectomy in the treatment of varicocele. Urology. 2000;55(5):750-4.

17. Bebars GA et al. Laparoscopic versus open high ligation of the testicular veins for the treatment of varicocele. JSLS. 2000;4(3):209-13.

18. Ghanem H et al. Subinguinal microvaricocelectomy versus retroperitoneal varicocelectomy: comparative study of complications and surgical outcome. Urology. 2004;64(5):1005-9.

19. Watanabe M et al. Minimal invasiveness and effectivity of subinguinal microscopic varicocelectomy: a comparative study with retroperitoneal high and laparoscopic approaches. Int J Urol. 2005;12(10):892-8.

20. Al-Kandari AM et al. Comparison of outcomes of different varicocelectomy techniques: open inguinal, laparoscopic, and subinguinal microscopic varicocelectomy: a randomized clinical trial. Urology. 2007;69(3):417-20.

21. Al-Said S et al. Varicocelectomy for male infertility: a comparative study of open, laparoscopic, and microsurgical approaches. J Urol. 2008;180(1):266-70.

22. Abdel-Maguid AF, Othman I. Microsurgical and nonmagnified subinguinal varicocelectomy for infertile men: a comparative study. Fertil Steril. 2010;94(7):2600-3.

23. Diegidio P et al. Review of current varicocelectomy techniques and their outcomes. BJU Int. 2011;108(7):1157-72.

24. Palomo A. Radical cure of varicocele by a new technique; preliminary report. J Urol. 1949;61(3):604-7.

25. Bernardi R. Varicocele: results obtained with a personal technic in 500 cases. Rev Asoc Med Argent. 1958;72(2):57-64.

26. Ivanissevich O, Gregorini H. Una nueva operaciûn para curar el varicocele. Semana Med. 1918;25:575.

27. Kumar R, Gupta NP. Subinguinal microsurgical varicocelectomy: evaluation of the results. Urol Int. 2003;71(4):368-72.

28. Binsaleh S, Lo KC. Varicocelectomy: microsurgical inguinal varicocelectomy is the treatment of choice. Can Urol Assoc J. 2007;1(3):277-8.

29. Marmar JL et al. The management of varicoceles by microdissection of the spermatic cord at the external inguinal ring. Fertil Steril. 1985;43:583-8.

30. Goldstein M et al. Microsurgical inguinal varicocelectomy with delivery of the testis: an artery and lymphatic sparing technique. J Urol. 1992;148:1808-11.

31. Gontero P et al. Inguinal versus subinguinal varicocele vein ligation using magnifying loupe under local anesthesia: which technique is preferable in clinical practice? Urology. 2005;66(5):1075-9.

32. Orhan I et al. Comparison of two different microsurgical methods in the treatment of varicocele. Arch Androl. 2005;51(3):213-20.

33. Aaberg RA et al. Laparoscopic varicocele ligation: a new technique. Fertil Steril. 1991;56(4):776-7.

34. Kachrilas S et al. Laparoscopic varicocelectomy in the management of chronic scrotal pain. JSLS. 2014;18(3);doi:10.4293/JSLS.2014.00302.

35. Niedzielshi J et al. Assessment of adolescent varicocele. Pediatr Surg Int. 1997;12:410-3.

36. Serefoglu EC et al. Adolescent varicocoele management controversies. Andrology. 2013;1(1):109-15.

37. Kogan SJ (ed.), The Pediatric Varicocele (2011), Philadelphia, PA: WB Saunders.

38. Chehval MJ, Purcell MH. Deterioration of semen parameters over time in men with untreated varicocele: evidence of progressive testicular damage. Fertil Steril. 1992;57:174-7.

39. Paduch DA, Niedzielski J. Repair versus observation in adolescent varicocele: a prospective study. J Urol. 1997;158: 1128-32.

40. Pryor JL, Howards SS. Varicocele. Urol Clin North Am. 1978;14:499-513.