Microsurgical Management of the Infertile Male

a report by
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Male infertility is the end result of a variety of conditions. The most important step in treating male infertility is to evaluate every male partner of an infertile couple with at least a semen analysis, history, physical, and basic hormonal profile. This will help to generate the proper treatment strategy. In 2007, there are many medical and surgical options that can help most couples overcome male factor infertility. Male infertility can most easily be broken down into problems of sperm production (testicular dysfunction) or problems of sperm transport (obstruction). When applicable, medical therapies are utilized as an initial strategy to improve sperm production, or as a preliminary therapy to transiently boost production in anticipation of a surgical sperm retrieval attempt. In all cases of male factor infertility secondary to obstruction and in many instances of male factor infertility secondary to testicular dysfunction, surgery is required to either restore sperm to the ejaculate or to retrieve sperm for use with advanced reproductive techniques. This article covers a range of surgical options to correct the various causes of male infertility—testicular dysfunction secondary to varicoceles or idiopathic causes or obstruction.

Surgical Management of Male Infertility

The surgical management of male infertility provides many options to the couple with male factor infertility. Problems amenable to surgery include varicoceles, obstruction, or testicular dysfunction resulting in azoospermia on a semen analysis. Surgical techniques include varicocele repair, microsurgical reconstruction of the obstructed system, or microsurgical sperm retrieval for *in vitro* fertilization (IVF) with intra-cytoplasmic sperm extraction.

Testicular Dysfunction

Varicoceles are found in upwards of one-third of men with primary and nearly 80% of men with secondary infertility, but only 15% of the general population.[1,2] The association with infertility has been recognized for more than five decades.[3] Varicocele causes a progressive decline in semen parameters and testosterone production.[4,5] Venous dilation is thought to impair the counter-current heat exchange mechanism in the scrotum.[6] Venous blood pools in the dilated veins and increases intra-testicular temperature and causes the progressive, duration-dependent decline in testis function observed in patients with a varicocele.[7,8] Repair of a varicocele prevents further testicular damage, improves sperm production and improve testosterones production.[4,9-10] Several investigators have sought to determine pre-operative characteristics of a varicocele that would predict response to varicocelectomy.[11-12]

The authors utilize the microsurgical, subinguinal approach to repair varicoceles.[13] This approach, with optical magnification, minimizes complications and produces the best results by ligating all of the internal spermatic and cremasteric veins that contribute to the formation of varicoceles. The testicular artery is identified and preserved. Any cremasteric arteries and lymphatic channels can also be preserved to prevent the formation of hydroceles.[14] Use of the operating microscope results in a hydrocele rate of approximately 1% compared with up to a 30% rate of hydrocele formation six months post-operatively after conventional inguinal and laparoscopic approaches.[15,16] Recurrences are not uncommon and are seen in up to 15–25% of men using non-microsurgical approaches, but in <1% of men using microsurgical approaches.[16] Loupes under 2.5x do not provide enough power to reliably identify the testicular artery or lymphatics. Other approaches to varicocele surgery include the conventional inguinal, the retroperitoneal, and the laparoscopic approaches.

Patients with larger varicoceles were found to have greater improvements in semen analysis parameters after the procedure than men with smaller varicoceles.[17] Semen analysis parameters improved in men with clinically non-palpable varicoceles detected by ultrasound, and a cutoff of a venous diameter of three millimeters or reversal of flow have been suggested as operating criteria.[18-21] Several studies have demonstrated improvements in semen parameters, testosterone production and pregnancy outcomes. Semen parameters improve in 60–80% of men after repair.[22,23] Bilateral repair in men with a large

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unilateral and small contralateral varicocele, and repair in younger men may have an even greater beneficial effect on sperm parameters and androgen production than repair in older men.[24-26]

While varicoceles cause testicular dysfunction that is associated with infertility, most obstructive causes of male infertility are either iatrogenic or intentionally caused. Vasectomy is performed on more than 500,000 men per year in the US to affect 'permanent' contraception.[27] However, 3–8% of vasectomized men request reversal, most commonly due to divorce and remarriage.[28,29] Injury to the vas is also a common cause of obstruction, most often the result of childhood hernia repair, orchiopexy or hydrocelectomy.[30] The application of microsurgical techniques has vastly improved the success rate of surgery to repair vasal or epididymal obstruction. Reversal of vasal obstruction can usually be accomplished by a vasovasostomy. In cases of either congential anomalies or secondary epididymal obstruction, a vas to epididymis anastomosis is required. Vasovasostomy is successful in up to 99% of cases, while vasoepididymostomy has a success rate of up to 90%.[16,31-35]

Vasovasostomy

Microsurgical vasovasostomy, initially described by Owen and Silber in 1975, resulted in significantly improved outcomes compared with older techniques.[34,36] A modified microsurgical single-layered anastomosis is statistically equivalent to a two-layer technique.[31] Patency and pregnancy rates vary directly with the obstructive interval. While overall patency rate was 86% and pregnancy rate was 51.6%, the results for men with obstruction less than three years were 97% patency with a 76% pregnancy rate.[31] Others have reported similarly good results with a microsurgical approach to vasectomy reversal.[32,37] The gold standard for vasovasostomy is still the microsurgical multi-layer sutured technique, which had a success rate of up to 99.5% in a large series.[32]

The identification of prognostic features of the vasal fluid helps to guide the surgeon in choosing the type of reconstruction to perform. The best results are achieved when sperm are found in the testicular end of the vas, but high rates of return of sperm to the ejaculate are achieved with clear watery fluid present or if many sperm heads are found in the fluid.[16]

The layers of the anastomosis include a mucosa-to-mucosa layer of six 10–0 nylon sutures, a muscular layer of six 9–0 nylon sutures at the region of the gaps, six additional 9–0 nylon sutures in the serosa between each muscular layer suture, and finally approximation of the vasal sheath with six 7–0 nylon sutures.[32] This achieves a watertight anastomosis and prevents the formation of sperm granulomas. The importance of placing these sutures is magnified by the realization that there is no constituent of vasal fluid that will promote the sealing of the anastomotic site internally.

Vasoepididymostomy

Vasovasostomy is not always a feasible option to restore vasal patency. If epididymal obstruction is present, whether primary or secondary to chronic vasal obstruction, a vasoepididymostomy is required. This remains one of the most technically challenging procedures in all of microsurgery. In cases of epididymal obstruction, the decision to perform a vasovasotomy or vasoepididymostomy is made intra-operatively and is based on the microscopic examination of the proximal vas fluid and the time of obstruction.[38,39]

The authors recently reported results comparing the four main techniques of vasoepididymostomy.[33] Success and pregnancy rates were not significantly different between groups. All conceptions in the intussusception groups were through intercourse; none required assisted reproductive techniques. Among men with return of sperm to the ejaculate, the intussusception groups had lower rates of disappearance of sperm from the ejaculate after 12 months ($p<0.04$).

The newer intussusception techniques offer comparable outcomes in terms of return of sperm to the ejaculate and pregnancy rates compared with the older techniques. Importantly, the late shutdown rates of sperm in the ejaculate are lower. Fewer sutures are also used with these techniques which eases the performance of this challenging anastomosis.

Sperm Retrieval Techniques

Many cases of testicular dysfunction are not correctable by medical or surgical means. Reconstruction of the vasal and epididymal systems is also not always possible. In such situations, sperm retrieval for IVF is undertaken. Sperm retrieval with assisted reproduction is an also an appropriate option for men with poor sperm production, in selected cases of obstruction with female factors or when only one pregnancy is desired.

A variety of genetic and acquired disorders may cause a man with obstructive azoospermia to be unreconstructable. For example, in congenital bilateral absence of the vas deferens (CBAVD), patients have mutations in the cystic fibrosis transmembrane conductance regulator gene. This results in defects in the sperm transport system anywhere from the mid-

epididymis to the seminal vesicles, and most of these men are not candidates for reconstruction.[40,41]

Non-obstructive azoospermia describes men in whom either genetic or environmental factors cause severe depression in spermatogenesis to the point that no sperm are present in the ejaculate. Even in these severely affected men, successful sperm retrieval is possible in the majority of cases.[42] Spermatogenesis in many of these patients is a sporadic process throughout the testis. A technique that exposes and explores the entire testis is critical to optimize success rates for sperm retrieval in these challenging patients.

One subgroup of men with non-obstructive azoospermia is those with Klinefelter's syndrome, with an abnormal karyotype of 47 XXY. Prior to the advent of intra-cytoplasmic sperm injection (ICSI), men with this technique were considered sterile. Today, a technique of microsurgical sperm retrieval with ICSI is the preferred treatment modality in those desiring paternity, as sperm can be retrieved in over 70% of cases.[43,44]

Testicular Biopsy

The success of different biopsy methods varies directly with the cause of infertility. In cases of vasal or epididymal obstruction, various percutaneous techniques are highly successful in terms of retrieving sperm. However, in cases of primary testicular dysfunction with low sperm production, open biopsies are certainly the preferred techniques. Of 14 patients with primary testicular failure as proven by histopathology, only in one case (7.1%) were spermatozoa recovered by multiple aspirations, while in nine cases (64.3%) spermatozoa were recovered by open biopsy.[45]

Percutaneous aspiration successfully retrieves sperm in cases of unreconstructable obstruction[45] and is substantially less painful than open biopsy techniques with faster recovery times. However, it has a far lower success rate in men with non-obstructive azoospermia, where open biopsy yields much better results.[46,47] Still, some groups have reported higher success rates of sperm retrieval using a percutaneous technique in men with non-obstructive azoospermia. A recent large series from Jordan found a 53.6% success rate in 84 men.[48] In an even larger series of 291 men, 63 men had successful percutaneous retrievals using a 21 gauge butterfly needle.[49] The remaining 228 men required an open biopsy in this series.

Open biopsy in cases of non-obstructive azoospermia is certainly the preferred means of attempting sperm retrieval. Reports with a multiple biopsy approach reveal successful sperm retrieval in 40–50% of cases among men with non-obstructive azoospermia.[47]

Microsurgical Sperm Retrieval Techniques

The technique of microsurgical epididymal sperm aspiration is used to obtain sperm in men with an intact epididymis. This technique is most commonly employed in men with CBAVD or after a long obstructive interval after vasectomy with the desire for only one additional pregnancy. Using this technique, sperm can be aspirated that are suitable for use with ICSI.[50,51] Owing to chronic obstruction, the sperm retrieved from these men is often of poor quality and does not fertilize ovum readily, making ICSI a must.

In men with non-obstructive azoospermia, the microdissection testicular sperm extraction technique provides the highest yield in terms of sperm retrieval while preserving as much testicular parenchyma as possible.[52] The histology of the testis can often predict the likelihood of successful sperm retrieval; however, even in the worst cases, sperm may be found over 40% of the time.[53] Post-chemotherapy, sperm were found in 9/20 retrieval attempts in men with azoospermia.[54]

Microsurgical testicular sperm extraction is the most successful technique to retrieve sperm in men with non-obstructive azoospermia and it results in the least damage to the testis. Post-operative scarring is substantially lower with this technique compared with open biopsy.[55] The disadvantages of any microsurgical technique are the need for experience and the acquisition of microsurgical skills.[56] These techniques require general anesthesia. However, in cases of non-obstructive azoospermia, the microsurgical testicular sperm extraction is the procedure of choice for sperm retrieval offering the highest success rates with relatively low complications.

Conclusions

Infertility is a couples' problem, and both partners must be properly evaluated so that the most appropriate therapy can be tailored to the man and the woman. In the vast majority of cases, male infertility is treatable. Whether by medical therapy or surgical means, the male partner can be treated to affect either a natural pregnancy or a pregnancy via assisted reproductive techniques. The specific goals and desires of the individual couple always are of paramount importance when deciding on specific therapies. Surgical therapy for the infertile male is tailored to the specific problem and to the couples' goals. ■

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1. *Gorelick JI, Goldstein M,* Fertil Steril *(1993); 59(3): pp. 613–616.*
2. *Kim ED, et al.,* J Urol *(1999); 162(3 Pt 1): pp. 737–740.*
3. *Russell JK,* Lancet *(1957); 273 (6988): pp. 222.*
4. *Chehval MJ, Purcell MH,* Fertil Steril *(1992); 57(1): pp. 174–177.*
5. *Su LM, Goldstein M, Schlegel PN,* J Urol *(1995); 154(5): pp. 1752–1755.*
6. *Dubin L, Amelar RD,* Fertil Steril *(1971); 22(8): pp. 469–474.*
7. *Goldstein M, Eid JF,* J Urol *(1989); 142(3): pp. 743–745.*
8. *Zorgniotti AW, Macleod J,* Fertil Steril *(1973); 24(11): pp. 854–863.*
9. *Younes AK,* Arch Androl *(2003); 49(3): pp. 219–228.*
10. *Shah JB,* J Urol *(2005); 173: p. 449.*
11. *Eskew LA, et al.,* Fertil Steril *(1993); 60(4): pp. 693–697.*
12. *Takahara M, et al.,* Int J Urol *(1996); 3(4): pp. 282–285.*
13. *Goldstein M, et al.,* J Urol *(1992); 148(6): pp. 1808–1811.*
14. *Marmar JL, Kim Y,* J Urol *(1994); 152(4): pp. 1127–1132.*
15. *Hassan JM, et al.,* J Urol *(2006); 175(3 Pt 1): pp. 1076–079.*
16. *Goldstein M, Campbell's Urology. 8th ed.,* WB Saunders, *(2002): pp. 1532–1588.*
17. *Steckel J, Dicker AP, Goldstein M,* J Urol *(1993); 149(4): pp. 769–771.*
18. *Jarow JP, Ogle SR, Eskew LA,* J Urol; *(1996) 155(4): pp. 1287–290.*
19. *McClure RD, Hricak H,*J Urol *(1986); 135(4): pp. 711–715.*
20. *Pierik FH, et al.,* Int J Androl *(1998); 21(5): pp. 256–260.*
21. *Schiff JD, Li PS, Goldstein M,* Fertil Steril *(2006); 86(1): pp. 250–252.*
22. *Madgar I, et al.,* Fertil Steril *(1995); 63(1): pp. 120–124.*
23. *Hadziselimovic F, et al.,* J Urol *(1989); 142(2 Pt 2): pp. 583–585; discussion 603–605.*
24. *Kass EJ, Belman AB,* J Urol *(1987); 137(3): pp. 475–476.*
25. *Lemack GE, et al.,* J Urol *(1998); 160(1): pp. 179–181.*
26. *Scherr D, Goldstein M,* J Urol *(1999); 162(1): pp. 85-88.*
27. *Montie JE, Stewart BH,* J Urol *(1974); 112(1): pp. 111–113.*
28. *Cos LR, et al.,* Urology *(1983); 22(6): pp. 567–575.*
29. *Lee HY,* J Urol *(1986); 136(2): pp. 413–415.*
30. *Sheynkin YR, et al.,* J Urol *(1998); 159(1): pp. 139–141.*
31. *Belker AM, et al.,* J Urol *(1991); 145(3): pp. 505–511.*
32. *Goldstein M, Li PS, Matthews GJ,* J Urol *(1998); 159(1): pp. 188–190.*
33. *Schiff J, et al.,* J Urol *(2005); 174(2): pp. 651-655; quiz 801.*
34. *Silber SJ,*Fertil Steril *(1977); 28(11): pp. 1191–202.*
35. *Silber SJ,* Fertil Steril *(1978); 30(5): pp. 565–571.*
36. *Owen ER,* Aust NZ J Surg *(1977); 47(3): pp. 305–309.*
37. *Silber SJ,* Hum Reprod *(1989); 4(3): pp. 318–322.*
38. *Chawla A, et al.,* J Urol *(2004); 172(3): pp. 1048–050.*
39. *Thomas AJ, (2004) Infertility, Lippincott Williams & Wilkins, pp. 829–830.*
40. *Daudin M, et al.,* Fertil Steril *(2000); 74(6): pp. 1164–1174.*
41. *Stuhrmann M, Dork T,* Andrologia *(2000); 32(2): pp. 71–83.*
42. *Chan PT, Schlegel PN,* Curr Opin Urol *(2000); 10(6): pp. 617–624.*
43. *Palermo GD, et al,* Hum Reprod *(1999); 14(3): pp. 741–748.*
44. *Schiff JD, et al.,* J Clin Endocrinol Metab *(2005); 90(11): pp. 6263–6267.*
45. *Tournaye H,* Hum Reprod *(1999); 14 Suppl 1: pp. 71–81.*
46. *Ezeh UI, Moore HD, Cooke ID,* Hum Reprod *(1998); 13(11): pp. 3075–080.*
47. *Friedler S, et al.,* Hum Reprod *(1997); 12(7): pp. 1488–1493.*
48. *Khadra AA, et al.,* J Urol *(2003); 169(2): pp. 603–605.*
49. *Mercan R, et al.,* Hum Reprod *(2000); 15(7): pp. 1548–1551.*
50. *Temple-Smith PD, et al.,* J In Vitro Fert Embryo Transf *(1985); 2(3): pp. 119–122.*
51. *Silber SJ, et al.,* Hum Reprod *(1994); 9: pp. 1705–1709.*
52. *Schlegel PN,* Hum Reprod *(1999); 14(1): pp. 131–135.*
53. *Su LM, et al.,* J Urol *(1999); Jan; 161(1): pp. 112–116*
54. *Chan PT, et al.,* Cancer *(2001); 92(6): pp. 1632–1637.*
55. *Ramasamy R, Yagan N, Schlegel PN,* Urology *(2005); 65(6): pp. 1190–1194.*
56. *Goldstein M, Tanrikut C,* Nat Clin Pract Urol *(2006);3(7): pp. 381–391.*

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