

# Vasectomy and vasectomy reversal: An update

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## ABSTRACT

Vasectomy is an elective surgical sterilization procedure for men that is intended to obstruct or remove a portion of both vas deferens, thereby preventing sperm from moving from the testes to the ejaculatory ducts. Although intended for permanent sterilization, vasectomy can be reversed in most men seeking to restore their fertility due to a change in marital status or reproductive goals. The purpose of this document is to provide a synopsis of the latest techniques used in vasectomy and reversal.

**Key words:** Contraception, infertility, microsurgery vas deferens

## EPIDEMIOLOGY

Worldwide, approximately 6% of married women using contraception rely on vasectomy.<sup>[1]</sup> Bhutan has approximately 40% of contraceptive couples relying on vasectomy, the highest proportion, followed by New Zealand with approximately 25%, then Canada, the United Kingdom, and the United States at approximately 20% each.<sup>[2]</sup> In 2002, an estimated 526,501 vasectomies were performed in the United States, which converts to a rate of about 10 vasectomies for every 1000 men aged 25–49 years.<sup>[3]</sup> Overall, 7%–10% of married American couples select vasectomy for contraception, making it the most common urologic procedure in North America.<sup>[4]</sup> Today, in India, vasectomy prevalence varies greatly from one state to another, ranging from a high of 6.3% in Himachal Pradesh to a low of less than 0.05% in Mizoram and Nagaland. Due to recent incentives provided by the government, the state of Gujarat experienced a 20-fold increase in the annual number of vasectomies performed.<sup>[2]</sup>

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<b>Quick Response Code:</b> 	<b>Website:</b> <a href="http://www.indianjurol.com">www.indianjurol.com</a>
	<b>DOI:</b> 10.4103/0970-1591.78440

## SURGICAL TECHNIQUE

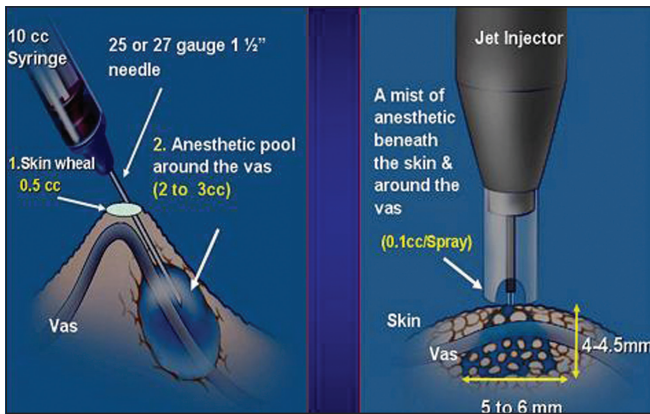
Several vasectomy techniques are performed today, including those using the standard anesthetic cord blocks. Many of these methods yield good results but we favor a no-scalpel, no-needle approach modified from the Chinese technique initially developed by Li *et al.* in 1974.<sup>[5]</sup>

## PREPARATION AND ANTIMICROBIAL PROPHYLAXIS

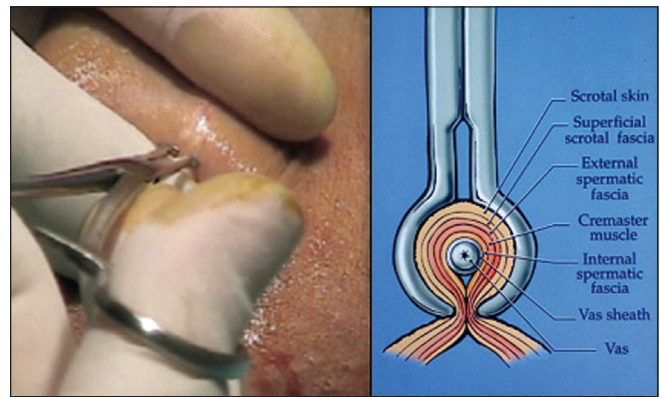
Perioperative anti-inflammatory treatment with celecoxib (200 mg po bid), started the night before the procedure may help to prevent postoperative pain. The incidence of surgical site infection after conventional or no-scalpel vasectomy is low, ranging from 1.5% to 9%.<sup>[6]</sup> For this reason, prophylactic antimicrobials are typically not used when performing vasectomy, especially in the clinic setting.<sup>[7]</sup> Recently, an advisory council has recommended the use of prophylactic antibiotics in select patients who have total joint replacements. These patients include those who are immunocompromised, who have HIV, diabetes, malignancy, or prior joint replacement infections.<sup>[8]</sup>

## ANESTHESIA

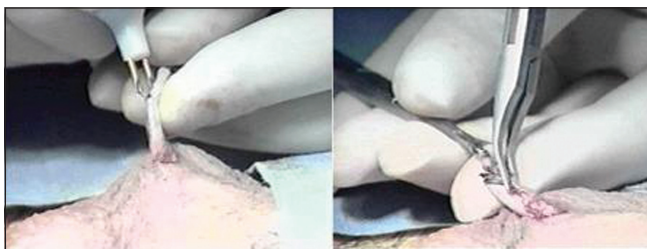
The median raphe is identified, and the nondominant hand is used to palpate the vas deferens. The index finger and thumb form a C configuration and the vas deferens is pressed between this C and the middle finger [Figure 1]. Each vas is brought up against the skin to the same spot at the median raphe, about 2 cm below the base of the penis. The MadaJet XL Medical, Urology (Mada, Inc., Carlstadt, NJ) is used to deliver the anesthetic cocktail (about 3 sprays are delivered to each vas deferens), which is a 1:1 mix of 2% plain lidocaine and 0.5% plain bupivacaine [Figure 1]. Each



**Figure 1:** Atraumatic vasectomy technique demonstrating vas isolation and lidocaine injection. Courtesy of the Brady Urology Foundation



**Figure 2:** Use of ring clamp to facilitate vasal fixation. Courtesy of the Brady Urology Foundation



**Figure 3:** Vasal occlusion with thermal cautery and clips. Courtesy of the Brady Urology Foundation

high pressure spray delivers about 0.1 cc of the anesthetic solution.<sup>[9]</sup> Alternatively, local infiltration of 1% xylocaine to the skin may be used, with a 1.5", 25-gauge or longer needle advanced along the vas deferens to provide a cord block.

### VASAL ACCESS

Once the vas deferens is brought up to the skin of the median raphe using the 3 finger grasp, a ring-tipped clamp is used to secure the vas through the skin [Figure 2]. The ring-tipped clamp is reapplied for better purchase around the vas deferens. Tissue adherent to the vasal sheath is cleared away with the mosquito hemostat using the same spreading motion of its blades, and the vasal sheath is further cleared of adventitia. It is important to achieve a segment of vasal sheath completely free from adherent tissue.

### VASAL OCCLUSION

A reusable Hi Temp Cautery device (Advanced Meditech International, Inc., Flushing, New York) is used for the occlusion [Figure 3]. The vas deferens is hemi-transected with the cautery, exposing the lumen. The tip of the device is inserted into each end of the vas deferens and both openings are cauterized. Care should be taken to avoid full-thickness cautery of the vas to prevent necrosis. Cautery is done just to obliterate the luminal lining. A small segment of vas deferens is excised for pathologic evaluation. The distal cut end of the vas deferens (toward

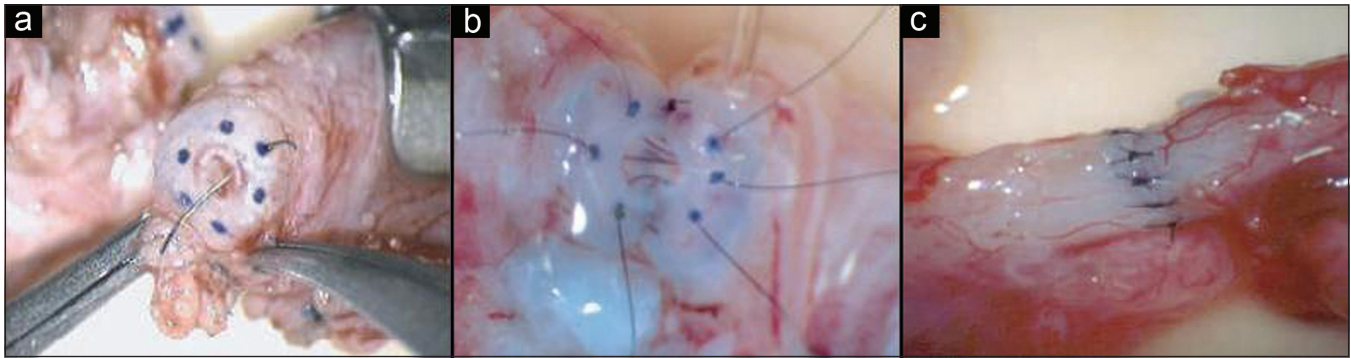
the testis) is closed with a small surgical clip [Figure 3]. The proximal end is pushed (telescoped) down into the vasal sheath and a small surgical clip can be placed on the sheath overlying the vasal end. This move separates the 2 ends of the vas deferens into different planes or compartments, reducing the risk of recanalization. Care must be taken to avoid including any spermatic cord nerves in the clip during this process of "fascial interposition," a potential cause of postvasectomy pain. For this reason, some surgeons avoid fascial interposition, despite its benefits in marginally improving the effectiveness of vasectomy. After careful inspection for hemostasis, the vas deferens is returned to its native position in the scrotum. The same process is repeated for the contralateral vas deferens through the same opening. Once the procedure is completed, the opening is pinched for a few minutes for hemostasis, while the betadine is wiped away from the skin. A scrotal supporter with fluff-type dressing is applied along with an ice pack. No antibiotics are required, and acetaminophen or celecoxib is sufficient for postoperative pain management.

### COMPLICATIONS

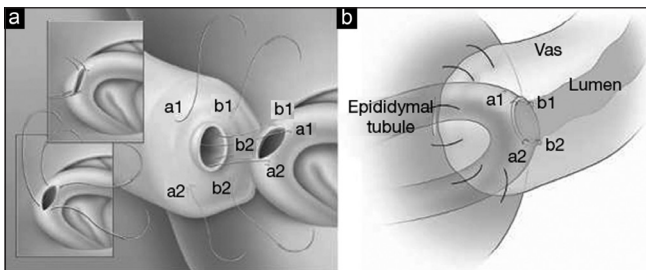
Early complications of vasectomy include hematoma and infection, with an average incidence in published reports of about 2% and 3.4%, respectively.<sup>[10]</sup> Chronic testicular pain or the postvasectomy pain syndrome is one of the most vexing postoperative complications of vasectomy. Patients can present with orchalgia, pain with intercourse and/or ejaculation, pain with physical exertion, and tender or full epididymis.<sup>[11]</sup> Sperm granulomas form in 4%–60% of closed-ended vasectomies.<sup>[12]</sup>

### POSTVASECTOMY FOLLOW-UP

The British Andrology Society guidelines put forth the following recommendations for the assessment of postvasectomy semen analysis (PVSA): "Initial assessment should take place at 16 weeks postvasectomy and after the



**Figure 4:** Microsurgical vasovasostomy with multilayer microdot method (×25). (a) Placement of 10-0 nylon suture inside the vasal lumen and through the microdot target. (b) The first 3 (of 6) sutures of the anastomosis have been placed and tied down. The final 3 sutures have been placed and are ready to be tied. (c) Completed anastomosis. Reproduced with permission from Goldstein M. Surgical management of male infertility and other scrotal disorders. In: Walsh PC, editors. Campbell's Urology, 8th ed. Philadelphia: WB Saunders; 2002. p 1533–87. © (2002) Elsevier Inc



**Figure 5:** Microsurgical end-to-side 2-suture intussusception vasoepididymostomy. (a) Two parallel sutures are placed in the epididymal tubule, then the tubule is incised between the 2 needles (top inset). Once the tubule is incised, the sutures are pulled through (bottom inset). The double-arm needles are placed in-to-out through the vasal lumen. The suture points are labeled to indicate where they run (a1 to a1, etc.). (b) Completed anastomosis. The suture points at the completed anastomosis are indicated by a1, a2, b1, and b2. Reproduced with permission from Kolettis PN, Burns JR, Nangia AK, Sandlow JI. Outcomes for vasovasostomy performed when only sperm parts are present in the vasal fluid. J Androl 2006;27:565-7. © (2003) Elsevier Inc.

patient has produced at least 24 ejaculates; if no sperm are seen on direct microscopy of freshly produced specimen, a centrifuged specimen examination for the presence of motile and nonmotile spermatozoa should follow; clearance should be given after 2 sperm-free ejaculates; and in cases of persistent identification of nonmotile spermatozoa, the patient should be advised regarding the cessation of other contraceptive precautions.<sup>13</sup> The finding of motile sperm on the first PVSA is not uncommon and should be followed with additional PVSA before considering a repeat vasectomy. Persistence or reappearance of nonmotile sperm after vasectomy is a management dilemma familiar to many urologists. Fresh semen samples should be examined to ensure that the sperm are truly nonmotile, as the presence of even 1 motile sperm more than 3–6 months after the procedure is an indication for repeat vasectomy. Furthermore, as a procedure vulnerable to litigation, the authors stress the importance of sound surgical technique, clear communication with the patient, and documentation of all aspects of the procedure and encounters, including counseling and consent. Laboratory results should be communicated directly to the patient by the surgeon.

## OUTCOMES

Level I evidence indicates that the no-scalpel method is generally preferred over the conventional technique for fewer complications but it appears more difficult for physicians to learn. In a Cochrane database review, Cook *et al.* evaluated 2 randomized controlled trials comparing the scalpel and no-scalpel incisions for vasectomy.<sup>6</sup> Although no difference in effectiveness was found between the 2 techniques, the authors noted that the no-scalpel approach resulted in less bleeding, hematoma, infection, and pain, as well as shorter operative times. Fascial interposition was noted to reduce surgical failure.<sup>14</sup> The US Collaborative Review of Sterilization prospective cohort study reported a 9.4 (95% CI 1.2–17.5) cumulative probability of failure per 1000 procedures 1 year after vasectomy and a 11.3 (95% CI 2.3–20.3) cumulative probability at years 2, 3, and 5.<sup>15</sup>

## VASECTOMY REVERSAL

### Patient evaluation

A thorough history of the male and the female partner needs to be taken. The duration of time after vasectomy is the most important prognostic factor for reversal success.<sup>16</sup> In addition, if the female partner is nulliparous and over 35 years of age, the chance of a successful pregnancy is low despite a successful reversal. On physical exam, the presence of sperm granuloma and the length of the testicular vasal segment can be prognostic factors for success.

### Preoperative factors predicting success

The prognosis for success after microsurgical vasectomy reversal declines progressively as the interval between vasectomy and its reversal increases [Table 1]. The Vasovasostomy Study Group<sup>17</sup> observed that both patency and pregnancy rates after vasovasostomy decrease as the time since vasectomy increases. Pregnancy rates drop to lower than 50% after 9 years as secondary obstruction of the epididymis becomes increasingly more common. Another recent study has, however, observed significantly



**Table 1: Factors affecting the success of vasectomy reversal**

Time interval since vasectomy
Sperm granuloma
Quality of vasal fluid
Microsurgical technique
Age of female partner

lower pregnancy rates, only after 15 years or more after vasectomy.<sup>[18]</sup> The age of female partner has important predictive value<sup>[19]</sup> and so does having a baby with the same partner as opposed to men having a different partner.<sup>[20]</sup>

### Techniques and intraoperative considerations

The modern techniques for vasovasostomy are modifications of the microsurgical approaches described in the mid-1970s by Drs Owens and Silber.<sup>[21]</sup> The technique for vasectomy reversal (vasovasostomy vs Vasoepididymostomy [VE]) depends on the intravasal findings at the time of surgical exploration. Vasal fluid having a thick, creamy consistency should be diluted with normal saline to allow evaluation of sperm otherwise easily overlooked in viscous fluid containing a large amount of cellular debris. The examiner must be alert to the presence of sperm heads having no attached tails. After careful microscopic examination of the testicular vasal fluid, sperm quality generally is categorized<sup>[17,21]</sup> as follows:

- Grade 1—mainly normal motile sperm
- Grade 2—mainly normal non-motile sperm
- Grade 3—mainly sperm heads
- Grade 4—only sperm heads
- Grade 5—no sperm

Optimal results with vasovasostomy (or VE) are achieved when these principles are followed: (1) Accurate mucosa-to-mucosa anastomosis to allow a leak-proof anastomosis, (2) Tension-free anastomosis, with or without the use of a specialized clamp designed to facilitate approximation (3) Adequate blood supply to the ends of the vas with healthy mucosa and muscularis, and (4) Atraumatic technique. Adherence to these principles is far more important than how many layers are performed or the exact suture material used. For obstructive azoospermia that is not due to vasectomy or absence of the vas deferens, VE is indicated when the testis biopsy reveals complete spermatogenesis, and the scrotal exploration reveals the absence of sperm in the vasal lumen.

### Vasovasostomy

High vertical scrotal incisions are performed bilaterally over the testis, directed toward the external inguinal ring. The testis is delivered; the site of vasectomy is isolated and dissected free. The testicular side of the vas is isolated and cleanly divided at a 90° angle with the aid of a slotted nerve clamp. Once the scarred ends of the vas are excised, patency of the abdominal end of the vas can be evaluated by demonstrating free flow of sterile irrigation fluid introduced through a 24-gauge blunt-

tipped needle directly into the lumen. Vasal fluid is carefully evaluated and graded as discussed above. If no sperms are present, the vasal fluid should be sequentially sampled during evaluation of the contralateral vasectomy site. The abdominal side of the vas is similarly divided with the slotted nerve clamp and saline vasography performed. Formal vasography is only necessary if saline vasography is not possible or is abnormal. The two ends of the vas are carefully examined under the operating microscope to confirm that the cut ends of the vasa are healthy. The vasa are stabilized in a vasal approximator and the anastomosis performed over a Penrose-covered tongue blade at 25× power magnification. We use a 3-layer technique of vasovasostomy that facilitates precision suture placement. The technique involves mapping of the planned suture exit points with “microdots” placed on the cut ends of the vas deferens with a microtip marking pen. Microdots are placed at 12, 3, 6, and 9 o'clock position. Four additional dots are placed between each of the previous 4 dots. Exactly 8 mucosal sutures (double armed 10-0 monofilament sutures) are used for each anastomosis [Figure 4].<sup>[37]</sup> The anastomosis is completed with 8 muscularis sutures (9-0 monofilament) and 6–8 sutures (6-0 monofilament) approximating the vasal sheath.

VE is the microsurgical procedure for treatment of epididymal obstruction. It is the most difficult microsurgical procedures for the treatment of male infertility and requires excellent microsurgical skills. The technique of VE has changed over time. Original procedures were performed in an end-to-end fashion. Later the end-to-side anastomosis became popular,<sup>[22]</sup> which was refined further to the current 2 or 3 suture intussusception techniques.<sup>[23]</sup> The choice of technique is dependent on operator experience and vasal length. An end-side anastomosis is easiest to perform when a clear level of obstruction is easily seen on visual inspection of the epididymis, allowing set up of the anastomosis prior to performing an incision in the epididymal tunics. Where tubular dilation is not as clear, an end-end technique is preferred. Serial sectioning of the epididymis is performed until a gush of cloudy fluid is obtained from a single dominant epididymal tubule.

### End-side approach

At Cornell University, a longitudinal 2-suture intussusception VE approach [Figure 5a] was developed in order to further improve the procedure.<sup>[24]</sup> With this method, four microdots are marked on the cut surface of the vas deferens and two parallel double-arm sutures are placed in the distended epididymal tubule; however, the needles are not pulled through. After the epididymal fluid is tested for sperm and aspirated into micropipettes for cryopreservation, the 2 needles within the epididymal tubule are pulled through, and all 4 needles are placed through the vas lumen at the marked locations. Tying down the sutures allows the epididymal tubule to be intussuscepted into the vasal lumen, completing the

anastomosis [Figure 5b]. The vasal adventitia is then approximated to the epididymal tunic with 9-0 nylon.

### Effectiveness

Before the refinement of microsurgical techniques, results of vasectomy reversal were relatively poor, with pregnancy rates varying from 5% to 30%. Microsurgical techniques of reversal now result in return of sperm to the ejaculate in 85%–90% of men.<sup>[17]</sup> However, only about 60% of couples actually achieve a pregnancy after vasovasostomy.<sup>[25]</sup> Antisperm antibodies, female infertility, secondary obstruction in the epididymis or recurrent obstruction at the anastomotic site may all contribute to the inability of men to contribute to pregnancies in nearly half of all men with patency after vasovasostomy.

The success rates based on fluid grade were outlined by the Vasovasostomy Study Group in 1991 [Table 2]. The pregnancy rate and the likelihood that sperm will be present in the ejaculate are higher when the vasal fluid appeared watery (colorless, transparent, or clear). If the fluid is thick and creamy, the rates decrease.<sup>[16]</sup> The overall success rate of vasovasostomy is good for fluid with grades 1–4 and VE is performed if grade 4 or 5 fluid is found.<sup>[26]</sup>

### Prevention of vasal injury during pediatric hernia repair

Injury to the vas deferens and testicular atrophy are potential risks during pediatric inguinal hernia repair. The estimated incidence of injury to the vas deferens after pediatric inguinal hernia repair ranges from 0.8% to 2%.<sup>[27]</sup> Grasping the spermatic cord with surgical instruments, such as Adson forceps or mosquito hemostat, during inguinal herniotomy is one of the suggested mechanisms implicated in injury to the vas deferens. Damage to the vas deferens caused by stretching of the spermatic cord, is probably related to vascular compromise or damage to the muscular layer of the vas. Accidental division is a potentially devastating but very rare vasal injury. As long as the spermatic cord is manipulated with a moist surgical sponge, digital compression, and/or blunt dissection is performed, the vas should be protected. Gentle manipulation and avoidance of excessive stretching of the spermatic cord should help prevent subsequent morbidity.<sup>[28]</sup>

### Postoperative monitoring and management of operative failures

After either vasovasostomy or VE, semen analyses should be obtained approximately every 2–3 months until sperm concentration and motility return to normal or until a pregnancy occurs. The incidence of postoperative reobstruction ranges between 3% and 12% after vasovasostomy and is approximately 21% after VE.<sup>[25]</sup> When sperms do not return to the semen by 6 months after vasovasostomy or by 18 months after VE, the procedure has failed.<sup>[29]</sup>

Microsurgical vasectomy reversal is one of the most

**Table 2: Return of sperm to the semen and pregnancy rates after vasovasostomy in relation to the quality of sperm observed in the vasal fluid**

Quality of sperm	Return of sperm to the semen (%)	Pregnancy rate (%)
Grade 1	94	63
Grade 2	91	54
Grade 3	96	50
Grade 4	75	44
Grade 5	60	31

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**Table 3: Factors contributing to the failure of vasectomy reversal**

- Technically poor repair
- Inadequate blood supply to the vas
- Failure to recognize and repair epididymal obstruction
- Extremely high epididymal obstruction

challenging operations in all of surgery, because of the extremely small size and delicacy of the structures being reconstructed. This is particularly true with VE, where the wall of the epididymal tubule is only about 1/4 the diameter of a human hair. Highly experienced reversal surgeons will, as expected, have the lowest failure rates—but it is important to determine the nature of even a good surgeon’s skills—in particular, their experience and success with epididymal and vasal reconstruction, which is far more challenging than uncomplicated microsurgery. Some of the factors for operation failure are listed in Table 3.

Although a repeat operation may be offered to men who remain azoospermic after vasectomy reversal, most men decline to undergo further surgery. Repeat procedures may be more difficult technically because of shorter viable segments of the vas and scar tissue formed after the first operation. Among the 222 repeat vasectomy reversal procedures reported by the Vasovasostomy Study Group,<sup>[17]</sup> sperm returned to the semen after surgery in 75% of men, and 43% of their partners subsequently conceived. Several groups<sup>[30-32]</sup> have since reported comparable patency and pregnancy rates after repeat vasectomy reversal.

### SPERM CRYOPRESERVATION

The recent popularity of various assisted reproduction technologies, particularly *in vitro* fertilization and intracytoplasmic sperm injection (ICSI), provides alternative and complementary treatment options for infertile couples. Cryopreservation of sperm obtained during VE is important since 35% of men remain azoospermic after surgery.<sup>[18]</sup> However, the significant costs and specific health risks (ovarian stimulation and multiple gestations) associated

with assisted reproduction technologies should be taken into consideration when counseling infertile couples. Although harvesting sperm during vasectomy reversal is recommended by some,<sup>[33]</sup> others believe that it is neither useful nor cost-effective.<sup>[34]</sup> Recent cost-effectiveness analyses<sup>[35,36]</sup> have shown that microsurgical reconstruction, in cases that are feasible, is a more cost-effective initial approach and typically yields better pregnancy rates than sperm retrieval combined with ICSI. The technical aspects of vasectomy reversal should take priority over cryopreservation of sperm. Therefore, clinicians specialized in treating male infertility should therefore be familiar with the 2 common microsurgical reconstructive procedures vasovasostomy and VE.

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**How to cite this article:** Ramasamy R, Schlegel PN. Vasectomy and vasectomy reversal: An update. *Indian J Urol* 2011;27:92-7.

**Source of Support:** Nil, **Conflict of Interest:** None declared.