Vasectomy

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INTRODUCTION

Vasectomy is the most effective mode of permanent male contraception and the only method that is widely available. The procedure involves interruption or occlusion of each vas deferens and is typically performed in an outpatient setting under local anesthesia.

This topic discusses patient counseling, preoperative preparation, surgical techniques, postoperative care and complications, and reversal of vasectomy. The effect of vasectomy on the patient's overall health (eg, cardiovascular or prostate cancer) is also discussed. Alternative methods of contraception are discussed in another topic. (See "Contraception: Counseling and selection".)

UTILIZATION AND COST

Worldwide, almost 43 million men underwent vasectomy in 2004 [1]. Approximately 527,000 vasectomies were performed in the United States (US) in 2015 [2]. Data collected in the US in 2002 showed that vasectomy was used by 5.7 percent of men ages 15 to 44, making it the fourth most commonly used contraceptive method, after condoms, oral contraceptives, and tubal ligation at that time [3]. Since then, there has been a substantial decrease in the proportion of men in all age groups who use vasectomy in the US. In 2015, men aged 35 to 44 years had the highest rate of vasectomy (1.3 percent) [2].

Approximately 82 percent of vasectomies in the US were performed by urologists, 6.4 percent by family physicians, and 11 percent by other surgeons [2]. Four out of five vasectomies are

performed in the office setting [2]. The cost of the procedure ranges from $350 to $1000, which is below costs associated with long-term pharmacologic contraception or female sterilization procedures [4].

Reported rates of successful infertility after vasectomy exceed 98 percent [5,6], though data are limited by lack of long-term follow-up. Most studies report outcomes only within two years of the procedure and might not account for subsequent failures due to later recanalization.

PATIENT COUNSELING

The primary care provider should discuss the procedure with the patient prior to arranging the referral. This initial discussion should provide information about the nature of the procedure and alternative contraceptive options as well as address patient expectations and questions. The discussion between patient and referring clinician should review [7]:

- Contraception method(s) used and patient understanding of alternatives.
- Patient understanding that the procedure results in permanent sterility.
- Social/family status: whether in stable relationship, number and ages of children (if any), acceptance of procedure by partner, future family intent.
- Patient understanding of the need for interim contraception for a minimum of three months and semen analysis prior to assuming sterility. (See 'Follow-up to confirm sterility' below.)
- Even after vasal occlusion is confirmed, vasectomy is not 100 percent reliable in preventing pregnancy. The risk of pregnancy after vasectomy is approximately 1 in 2000.
- Need for ongoing use of condoms to protect against sexually transmitted infections if not in a committed monogamous relationship. (See "Prevention of sexually transmitted infections".)

A thorough preoperative discussion of the procedure by the clinician performing the vasectomy is equally important, as is true for any surgical procedure, and should review the risks, complications (eg, chronic pain), and long-term effects associated with vasectomy. However, the American Urological Association (AUA) guidelines for vasectomy state that clinicians do **not** need to routinely discuss coronary heart disease, stroke, dementia, hypertension, prostate cancer, or testicular cancer in pre-vasectomy counseling of patients, because vasectomy is not a risk factor for such conditions [7]. (See 'Associated morbidity concerns' below.)

PREOPERATIVE PREPARATION

Prior to vasectomy, medical history should assess for abnormalities in sexual development and history of genital injury and/or surgery. Additionally, the patient should have a complete genital examination to confirm the presence of a single vas deferens and testicle on each side and absence of anatomic abnormalities. Patients with a history of solitary testicle, extensive genital surgery, and/or anatomic abnormalities (such as a nonpalpable vas deferens) should be evaluated by a urologist.

Contraindications to vasectomy include the presence of scrotal hematoma, genitourinary or groin infection, and sperm granuloma, but the procedure can often be performed if these issues can be resolved. Bleeding diathesis or presence of a local anatomic abnormality (eg, varicocele, hydrocele, scrotal mass, cryptorchidism) may challenge office-based vasectomy, and thus urology referral is prudent [8].

Routine preoperative laboratory tests, prophylactic antibiotics [9], and fasting are unnecessary. The patient should not drive immediately after the procedure and therefore should arrange transportation home.

Patients should avoid taking aspirin and nonsteroidal anti-inflammatory medications for seven days prior to the procedure as these may increase the risk of postoperative bleeding. (See "Perioperative medication management", section on 'Medications affecting hemostasis'.)

An anxiolytic (eg, diazepam 10 mg orally) can be given approximately one hour prior to the procedure to help the patient relax. This also helps surgical isolation of the vas deferens by relaxing scrotal and cremasteric muscles. Informed consent must be obtained prior to anxiolytic administration.

Application of a topical anesthetic cream reduces the pain of the anesthetic injection [10]. A commonly used topical anesthetic cream is EMLA (ie, "Eutectic Mixture of Local Anesthetics"), which is a mixture of lidocaine (2.5%) and prilocaine (2.5%) in a cream base. To be effective, EMLA should be applied by the patient to the anterior scrotum approximately one hour prior to the procedure. Covering the area with a plastic wrap or transparent film dressing minimizes evaporation and facilitates absorption of the cream. Dosing is weight dependent, and systemic toxicity (ie, methemoglobinemia) is unlikely if EMLA cream is applied correctly [10,11]. (See "Clinical use of topical anesthetics in children", section on 'Lidocaine-prilocaine'.)

SURGICAL ANATOMY

Knowledge of surgical anatomy will help ensure safe, efficient, effective vasectomy.

- Innervation – The anterior scrotal skin and spermatic cord are innervated by fibers from the ilioinguinal nerve and genital branches of the genitofemoral nerve (figure 1). Local blockade of these nerves provides adequate anesthesia for vasectomy.

- Layers of the scrotum – Just beneath the scrotal skin lie (from outermost to innermost) the dartos fascia and muscle, the external spermatic fascia, and the cremasteric fascia and muscle (figure 2). The internal spermatic fascia is deep to these structures and covers the spermatic cord, which contains the vas deferens and neurovascular supply to the ipsilateral testis.

- Vasculature – The spermatic cord also contains the deferential artery (artery of the vas deferens) and the pampiniform plexus (figure 2). The pampiniform plexus consists of 8 or 10 veins that lie adjacent to the vas deferens and ultimately drain into the testicular vein. These veins are easily injured during aggressive dissection of the spermatic cord. Dilatation of the pampiniform plexus (termed varicocele) is a common abnormality and usually occurs on the left. A varicocele can make isolation of the vas deferens more difficult.

VASECTOMY TECHNIQUES

Vasectomy is a surgical procedure that divides and occludes the vas deferens [8]. The procedure takes approximately 15 minutes and can be performed in an appropriately equipped office or ambulatory surgery center [12]. The two most widely used vasectomy techniques are:

- **Conventional vasectomy** – This traditional vasectomy approach involves bilateral scrotal incisions through which each vas deferens is mobilized and transected. This technique accounts for a small proportion of vasectomies performed in the United States (US) but remains the most common technique in many other areas of the world [13].

- **No-scalpel vasectomy** – The no-scalpel vasectomy technique was developed in China [1]. Instead of incisions, a puncture is made through the scrotal skin overlying the vas deferens and widened only enough to externalize the vas deferens for transection [14]. The remainder of the procedure is performed in a similar fashion to the open incision method. There is no difference in effectiveness compared with the standard approach, but the no-scalpel approach is associated with less bleeding, infection, and pain [15]. No-scalpel vasectomy is the preferred vasectomy technique in the US because of its lower complication rates, but it has yet to be adopted worldwide.

Materials — Equipment needed to perform a vasectomy includes:

- Povidone iodine or chlorhexidine to cleanse the scrotal skin.
- Sterile drapes, sterile gloves, sterile gauze.
- Electrocautery equipment or disposable thermal cautery.
- Sutures (4-0 absorbable [chromic or polyglactin 910], preferably on a noncutting needle).
- 10 mL syringe with a 1.5 inch 25 or 27 gauge needle for administering local anesthetics.
- 1% or 2% lidocaine without epinephrine (maximum dose 4.5 mg/kg [2 mg/pound]).
- Surgical instruments: vas fixation clamp and sharp dissecting forceps, straight scissors, needle holder.

Positioning — The patient is asked to lie supine on the procedure table. It is helpful to position and secure the penis onto the lower abdomen (eg, with surgical drape, adhesive tape, or umbilical tape). Hair is clipped from the anterior scrotum, which is then prepared with an antiseptic solution. Sterile towels are used to drape the area surrounding the scrotum, and sterile technique is employed for the remainder of the procedure.

Anesthesia — The vas deferens is isolated and positioned to lie as superficially as possible beneath the median raphe of the scrotal skin anteriorly, midway between the top of the testes and the base of the penis. This is usually accomplished using the nondominant hand and a "three-finger technique" to manipulate the vas within the scrotum (picture 1).

Local anesthetic without epinephrine (0.5 to 1 mL) is injected into the skin to create a wheal over the vas. A large wheal is avoided because it will interfere with isolating the vas.

Next, a vasal nerve block to anesthetize the deeper tissues can be performed in the following manner [16]. With tension on the vas, the needle is advanced through the anesthetized scrotal skin approximately 2 to 3 cm along the sheath of the vas (but not into the vas) toward the inguinal ring, and 2 to 5 mL of anesthetic (depending on concentration) is injected into the tissue surrounding the vas; there should not be any resistance [16]. Some operators then anesthetize the contralateral vas to allow ample time for the anesthetic to take effect.

An alternate anesthetic method involves a no-needle jet injection technique that uses a high-pressure spray to deliver local anesthetic through the scrotal skin and into the tissue surrounding the vas [17,18]. We have used this technique very successfully for the past several years.

Exposing the vas — The vas is positioned under the skin wheal as close to the skin as possible, and a vas fixation clamp can be used to gently entrap the vas and a minimal amount of overlying tightly stretched skin.

For the conventional technique, a small (<1 cm) incision is made and carried through the skin and subcutaneous tissue to expose the vas (picture 2).

For the no-scalpel technique, a sharp mosquito hemostat is used to puncture through the scrotal skin with care not to go through the vas. An opening approximately twice the width of the vas is made by gently spreading with both tips of the hemostat.

If a vas fixating clamp is in place, it can be left alone or repositioned as needed. If the vas has not been fixed in a clamp, it should now be grasped. The vas is elevated through the incision or opening with an Allis clamp, towel clamp, or dissecting forceps (picture 3). The perivasal tissue is dissected and separated using a dissecting hemostat. Then, approximately 2 centimeters of the vas are brought up as a loop gently and grasped with a second vas fixating clamp, towel clip, or ring forceps (picture 4).

The loop of vas is cleaned of residual tissue with care to avoid trauma to the associated blood vessels. Gauze can be used to achieve blunt dissection. Alternatively, the tip of a hemostat or tips of the dissecting forceps can be inserted into the window of the vas deferens loop and gently spread to completely isolate the vas.

Dividing the vas — The vas is divided, and a segment of vas is removed, although the minimum length of vas that needs be removed to prevent recanalization is controversial [19,20]. Rates of recanalization more likely reflect the technique used to manage the vasal ends than the actual length of the segment removed. We favor excision of a segment 10 to 15 mm in length. (See 'Managing the vasal ends' below.)

If a segment is removed, it can be sent for pathologic confirmation. The author routinely sends the excised segments for pathologic analysis; others do not. Although pathologic analysis of excised vas has little clinical benefit, histologic documentation that full-thickness vas was excised can be helpful in the event of vasectomy failure. (See 'Vasectomy failure' below.)

Irrigation of the prostatic end does not have any documented benefit. Three randomized trials failed to demonstrate any acceleration of sperm clearance by irrigation of the prostatic end during vasectomy [21-23].

Managing the vasal ends — The optimal method of managing the testicular vasal end is debated [24-29]. Several acceptable methods of occluding the vasal ends can be used, but, in general, using ligatures or clips should be avoided. Intraluminal fulguration of the prostatic end of the vas with fascial interposition between the prostatic and testicular vasal ends appears to be the most effective method for managing the vasal ends [13,24,26,30-33]. (See 'Vasectomy failure' below.)

Fulguration using a battery-powered handheld cautery (red-hot wire) appears to scar and occlude the vas lumen more effectively than electrocautery (picture 5 and figure 3) [30]. Fascial interposition creates a tissue barrier between the vasal ends and reduces vasectomy failure [33]. Absorbable suture or a clip is used to tack a layer of the vas sheath between the two cut vasal ends (picture 6 and figure 4) [31,32].

The efficacy of the combined approach (fulguration and fascial interposition) was illustrated in a study of the outcome of 6248 vasectomies performed using fascial interposition in conjunction with thermal cautery of both ends (picture 6 and figure 4) [34]. No failures (ie, pregnancies) occurred, and there was a low rate of complications (congestive epididymitis in 4.8 percent, sperm granuloma in 1.4 percent). Of note, the surgeons did not remove a vas segment or apply ligatures or clips to the open vasal ends.

Ligation alone of the vasal ends should be avoided. A review of six studies that assessed this method (ie, "cut and tie vasectomy") reported failure rates of 1 to 6 percent [35]. Failure may have been due to ischemic sloughing of the vasal ends, which increases the potential for spontaneous recanalization.

Conventional wisdom suggests that both vasal ends should be occluded by fulguration, ligation, or clips; however, some experts advocate leaving the testicular end untreated (open-ended vasectomy) [36-39]. The rationale for leaving one end open is that sperm leakage from the testicular cut end prevents inspissation, increased epididymal pressure, and epididymal rupture and allows a small sperm granuloma to form [36].

The value of this approach is supported by a study of 4330 open-ended and 3867 standard vasectomies (segment excised, cautery of both cut surfaces, ligation of both ends, fascial interposition) that found lower rates of complications with the open-ended approach: congestive epididymitis (1.2 versus 2.7 percent), painful sperm granuloma (1.5 versus 3.2 percent) [37]. There were no significant differences between techniques in the rates of spontaneous recanalization (0.02 versus 0.08 percent).

The open-ended technique can be offered to the patient. However, in our experience, most men choose to have both ends occluded. (See 'Sperm granuloma' below.)

Closure — The perivasal tissues are carefully inspected for bleeding and gently returned to the scrotum. If the incisional approach is used, one to two absorbable sutures are placed in the scrotal skin. In the no-scalpel technique, skin closure is not necessary [14], but skin glue can be applied if desired.

Once the procedure is completed, we dress the wound with antibiotic ointment and a bandage. A fluff dressing is placed and the patient is assisted in putting on tight-fitting underwear or a scrotal support.

POSTOPERATIVE CARE

The dressing and scrotal support are maintained for at least 48 hours after surgery. An ice pack intermittently applied to the scrotum for 24 to 48 hours also helps decrease discomfort and swelling.

Postprocedure pain varies with the technique and surgeon experience and can occur in up to 30 percent of patients but is usually self-limited. Acetaminophen or ibuprofen usually provides sufficient analgesia, although occasionally narcotic analgesics are necessary.

Postoperative instructions should be reviewed with the patient. Mild pain, swelling, and bruising are normal for the first two to three days. The patient should call for increasing pain, bleeding from the incision site, fever, or significant scrotal swelling.

Bed rest or gentle activity is recommended for the first 24 hours following a vasectomy. The patient may return to light work in two to three days but should refrain from heavy work, sports, or lifting for one week.

Sexual activity is avoided for one week. The patient and his partner should be reminded to use an alternate method of contraception until semen analysis has confirmed absence of sperm (azoospermia) in the ejaculate. Since sperm are stored along the entire vas deferens and in the seminal vesicle, interruption of the vas does not result in immediate sterility, and several ejaculations are required to evacuate all of the sperm. (See 'Follow-up to confirm sterility' below.)

FOLLOW-UP TO CONFIRM STERILITY

We suggest obtaining a semen analysis three months postoperatively [7]; the patient should have had at least 20 ejaculates since the time of vasectomy [40,41]. A systematic review including 56 studies reported the time to achieve azoospermia was variable, but more than 80 percent of men were azoospermic after three months and 20 ejaculations [42]. The time to achieve azoospermia declines with increasing number of ejaculations following vasectomy and increases with patient age [43-46]. A coital frequency of at least three times per week seems to be associated with more rapid clearance, regardless of age [45].

Azoospermia in a semen sample is definitive evidence of infertility [42]. An FDA-cleared at-home test is available that allows the patient to check sperm count after vasectomy. However, because the current test is sensitive to sperm count >250,000 sperm/mL (rather than the >100,000 sperm/mL recommended in guidelines), we recommend formal laboratory testing to confirm results prior to assuring sterility [47]. The laboratory performing the analysis should examine a fresh specimen using direct microscopy; a centrifuged specimen is not necessary [7].

If there are motile sperm at the three-month check-up, a follow-up test is performed in another one to two months [48]. Vasectomy is considered a failure if motile sperm are confirmed on the follow-up examination, there have been a sufficient number of ejaculations (>20), and >3 months have elapsed since the procedure. The patient should be advised to use alternative contraception and potentially undergo a repeat procedure. (See 'Vasectomy failure' below.)

Azoospermia is the ideal endpoint of vasectomy. A small proportion of patients, however, do not achieve azoospermia but consistently have nonmotile sperm. Nonmotility is a less definitive sign of infertility than azoospermia since it may reflect death of recently motile sperm due to a prolonged delay between ejaculation and laboratory analysis. The accuracy of determining whether sperm have normal motility is dependent on the timely examination of the semen specimen, ideally less than four hours from the time collected by the patient [40]. When rare, nonmotile sperm are observed, a repeat test in another one to two months may show azoospermia or continued presence of rare, nonmotile sperm.

The continued presence of rare, nonmotile sperm is probably clinically insignificant, and these men can be given cautious assurance of success. Guidelines from the British Andrology Society recommend that patients be given "special clearance" to discontinue other contraception, following appropriate counseling, provided they have a low sperm count (<10,000/mL), all sperm are immotile, seven months have elapsed from vasectomy, and there have been a minimum of 24 ejaculations [40]. The American Urological Association guidelines state that patients may stop using other methods of contraception when examination of one well-mixed, uncentrifuged, fresh post-vasectomy semen specimen shows azoospermia or only rare nonmotile sperm (defined as presence of ≤100,000 nonmotile sperm/mL based on microscopic exam of at least 50 high-powered fields) [7].

COMPLICATIONS

Complications following vasectomy include hematoma, infection, sperm granuloma, and persistent post-vasectomy pain. The most important determinant of postoperative complications is operator experience. In one study, surgeons performing more than 50

vasectomies during the year studied had one-third the complication rate of those performing fewer than 10 procedures [49].

Hematoma — Bleeding and/or hematoma formation is the most common complication associated with vasectomy. In rare cases, bleeding may be severe enough to require reoperation for scrotal exploration, hematoma evacuation, and control of bleeding. The most common site of bleeding is the pampiniform plexus of veins.

Hematoma rates are lower for no-scalpel procedures, where tissue dissection is minimized [31,50]. Hematoma formation occurs in 0.1 to 2.1 percent of men undergoing no-scalpel procedures, compared with 0.3 to 10.7 percent for incisional technique [51].

Infection — Randomized trials comparing no-scalpel and conventional incisional techniques also demonstrate lower wound infection rates for no-scalpel procedures [31,50]. Infection rates reported for the no-scalpel and incisional techniques are 0.2 to 0.9 and 1.3 to 4 percent, respectively [51].

Sperm granuloma — Sperm are highly antigenic and stimulate a significant inflammatory reaction. A sperm granuloma may form when sperm leaks from the testicular side of an open-ended vas following vasectomy. Less commonly, they may form with extravasation from a cauterized or fulgurated vas.

These granulomas are rarely symptomatic and may be protective to the testis and epididymis. The granuloma is rich in epithelial-lined channels that may vent leaking sperm away from the epididymis and protect against increased intraepididymal pressure.

Most granulomas are asymptomatic and over time will ultimately resorb. Granulomas, however, have been implicated in increased rates of post-vasectomy pain and in vas recanalization related to the inflammatory response induced by the antigenic reaction to sperm [52]. Patients with an acute symptomatic granuloma typically present two to three weeks after vasectomy, after they have resumed sexual activities. A tender mass can be palpated near the cut testicular end of the vas. Most patients respond to supportive care including nonsteroidal anti-inflammatory drugs (NSAIDs); surgery is rarely needed.

Epididymitis — Congestive epididymitis can occur at any time after vasectomy. The open-ended technique may in theory reduce that risk. (See 'Managing the vasal ends' above.)

Post-vasectomy pain syndrome — Post-vasectomy pain syndrome is distinct from postprocedure pain; however, there is some controversy regarding its definition and therefore prevalence [53]. Historically, rates for post-vasectomy pain syndrome have been reported as

very low (<1 percent). However, surveys have found that the incidence of "troublesome" post-vasectomy pain is reported by approximately 15 percent of men, with pain severe enough to impact quality of life in 2 percent; survey respondents, however, may not have been representative of all post-vasectomy men [54-57].

The cause of most post-vasectomy pain syndromes is chronic congestive epididymitis [54]. Testicular fluid and sperm production remain constant following vasectomy. The majority of this fluid accumulates in the epididymis, which then swells. While asymptomatic in most men, some will develop a chronic dull ache in the testes, which is made worse by ejaculation. Other causes or contributors to pain syndromes include the formation of sperm granuloma or nerve entrapment at the vasectomy site.

Post-vasectomy pain syndrome should be managed by a urological specialist. First-line therapy for post-vasectomy pain is the administration of nonsteroidal anti-inflammatory medications and warm baths. If unsuccessful, local nerve blocks or steroid injections may be performed by a pain specialist. If the post-vasectomy patient's discomfort is localized to a tender, palpable granuloma, this may be excised, followed by fulguration of the leaking end of the vas [58].

Refractory cases may require surgery, including either vasectomy reversal (vasovasostomy) or complete epididymectomy. Vasovasostomy successfully relieves pain in up to 70 to 82 percent of well-selected patients [59,60]. These patients, however, will almost always require the use of another form of contraception as a result. (See 'Vasectomy reversal' below.)

Complete epididymal resection is reserved for the most severe cases. Injury to the testicular blood supply, a known complication of this procedure, causes testicular atrophy. Thirty to 90 percent of patients undergoing epididymectomy for post-vasectomy orchialgia will have residual scrotal pain [61].

Vasectomy failure — Vasectomy failure can be due to technical errors, recanalization, or unprotected intercourse before azoospermia is documented.

The varying techniques employed in vasectomy to fulgurate, ligate, and manage the vasal ends are associated with different failure rates. Representative failure rates are listed below [62]:

- Cautery (both ends) and fascial interruption: 1.2 percent or less
- Cautery (prostatic end only) and fascial interruption (clip): 0.02 to 2.4 percent
- Cautery of both ends and excision of a segment: 4.8 percent or less
- Ligation and fascial interruption: 16.7 percent or less

- Ligation and excision of segment: 1.5 to 29 percent
- Intraluminal needle cautery (vas not transected, no segment removed; rarely performed in North America): Less than 1 percent [29,63]

Recanalization is rare, occurring in approximately 0.2 percent of patients [52]. It is defined as the presence of any spermatozoa after one or more previously azoospermic samples were properly collected and documented [64]. It can occur at any time following vasectomy.

VASECTOMY REVERSAL

Although vasectomy should be performed only for patients desiring permanent sterility, decisions regarding fertility may change throughout the reproductive years. Vasectomy can be reversed with microsurgical techniques. Vasectomy reversal involves reanastomosis (vasovasostomy) of the vas deferens, ideally at the site of the previous ligation. Successful vasectomy reversal has been reported in 50 to 70 percent of men [65,66]. Rates decline with increasing time between vasectomy and reversal [67].

Multiple studies have examined the relationship between patient characteristics and the likelihood of a future request for vasectomy reversal. The strongest predictive factor for a vasectomy reversal is a change in marital status [65]. Men without children, and men who were older than 30 years at the time of vasectomy, were less likely to request a reversal in the future [68]. There was no correlation between a patient's religion, number of marriages, or occupation and the probability of a future request for reversal.

Key determinants of success and patency of reversal are the method of vasectomy and the duration of obstruction. An effort has been made to prevent irreversible damage at the time of vasectomy. This has led to the development of the open-ended vasectomy. The leaked sperm cause an immune response that may result in a sperm granuloma but reduces the risk of concomitant tubular damage. Sealing the testicular side of the cut end of the vas may result in epididymal damage and decreased vasectomy reversal success.

A large retrospective study found patency rates (sperm present in ejaculate) of >95 percent and a pregnancy rate of approximately 75 percent for men who underwent vasectomy fewer than three years prior to reversal [67]. Both rates decreased in a linear fashion as the duration of obstruction increased. A patency rate of 71 percent and pregnancy rate of 30 percent was reported for men who underwent vasovasostomy 15 years after vasectomy.

ASSOCIATED MORBIDITY CONCERNS

The most common sterilization procedure for women, tubal ligation, requires entering the peritoneal cavity to access the fallopian tubes and is usually performed under general anesthesia. Compared with tubal ligation, vasectomy is safer, is less costly, and has a significantly shorter postprocedure recovery time. Nonetheless, worldwide, tubal ligation is performed five times more often than vasectomy [52]. This finding suggests lower acceptance of vasectomy, which may be attributed to a variety of reasons, including misperceptions of the procedure and its side effects. Concerns have been raised over potential links between vasectomy and a variety of unproven health consequences:

Cardiovascular — A link between vasectomy and atherosclerosis was suggested by a study in monkeys, but this study was later reinterpreted to show no association [69]. Several studies in humans have found **no** increased risk of cardiovascular disease following vasectomy [70-72].

Prostate cancer — Whether a prior vasectomy increases a man's risk of getting prostate cancer is controversial, but the preponderance of the evidence suggests that the risk is low [73-76]. Although observational studies may show an association, these do not prove a causal relationship between vasectomy and prostate cancer and cannot exclude bias [77-86]. As such, we agree with the American Urological Association guidelines that state clinicians do not need to routinely discuss prostate cancer in pre-vasectomy counseling. (See 'Patient counseling' above.)

The risk factors for prostate cancer are further discussed in another topic. (See "Risk factors for prostate cancer", section on 'Vasectomy'.)

Testicular cancer — Large cohort studies have found no increased risk of testicular cancer among vasectomized men [87-89]. Again, any association between the two is likely to be the result of detection bias.

Immune dysfunction — Vasectomy disrupts the blood/testis barrier, resulting in antisperm antibodies in 60 to 80 percent of patients [90]. There is no association between antisperm antibodies and other immune-complex mediated diseases, such as lupus erythematosus, scleroderma, or rheumatoid arthritis [70]. A large observational study of men who underwent vasectomy an average of 13 years previously, compared with nonvasectomized men, found no evidence that vasectomy was associated with increased risk for asthma, diabetes mellitus, thyrotoxicosis, multiple sclerosis, myasthenia gravis, inflammatory bowel disease, testicular atrophy, ankylosing spondylitis, or rheumatoid arthritis [91].

Kidney stones — An association has been found between vasectomy and increased risk for kidney stones [92,93]. A case-control study found a twofold risk for kidney stones in men younger than age 46 (relative risk [RR] 1.9, 95% CI 1.2-3.1) but not for men aged 46 years or older [92]. The physiologic mechanism for this increased risk is unknown.

ALTERNATIVE VASAL OCCLUSION TECHNIQUES

Alternative techniques to vasectomy have been described but are not in general use. These methods are investigational at the present time, and reversal cannot be guaranteed.

Vasal occlusion — Vasal occlusion with a plug (eg, "Shug" or medical-grade silicone rubber) requires microsurgery for implantation and later removal [8]. Either a conventional open or no-scalpel technique may be used to isolate the vas deferens for the implantation of these devices. Surgical vasal occlusion procedures claim to produce reversible azoospermia without affecting spermatogenesis, but there are no human data on success rates.

Vasal injection — Percutaneous methods can be used for injecting chemicals directly into the vas deferens to effect temporary (polymer) or permanent (sclerosing agents) occlusion [8,94-96].

One technique intended for permanent sterilization involves first injecting two dyes into the vas, using a different color for the left and right vas. Then, a sclerosing agent is injected into the vas lumen distal to the previously injected dye. Successful occlusion is determined by having the patient void to see which, if any, dye is excreted in the urine. The chemicals required for this procedure are not available for use in the United States.

Another technique, reversible inhibition of sperm under guidance (RISUG), involves injection of the nonsclerotic polymer styrene maleic anhydride (SMA) [8,97]. It is claimed to offer long-term contraception without adverse side effects [8,95,96]. The purported advantages of this method are that it provides long-term contraception without the side effects associated with male hormonal contraception and, in contrast to the other techniques listed above, is reversible without surgery. Clinical trials are ongoing.

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Vasectomy".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Vasectomy (The Basics)")
- Beyond the Basics topics (see "Patient education: Vasectomy (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- Vasectomy is the most common method for permanent male contraception. Patients should be thoroughly counseled about the permanence of the procedure, potential risks and benefits, failure rates, and alternatives. (See 'Introduction' above and 'Patient counseling' above.)
- Prior to vasectomy, medical history should assess for abnormalities in sexual development and history of genital injury and/or surgery. Additionally, the patient should have a complete genital examination to confirm the presence of a single vas deferens and testicle on each side and absence of anatomic abnormalities. Patients with a history of solitary testicle, extensive genital surgery, and/or anatomic abnormalities (such as a nonpalpable vas deferens) should be evaluated by a urologist. (See 'Preoperative preparation' above.)
- Vasectomy is usually performed as an outpatient procedure under local anesthesia. To perform vasectomy, the vas is isolated and brought up through a scrotal skin incision (conventional) or puncture site (no-scalpel technique). The vas is transected, a segment is removed, and the prostatic end fulgurated. The testicular end is handled variably. Ideally, a

fascial interposition is created to isolate the vasal ends from each other. (See 'Vasectomy techniques' above.)

- We suggest a no-scalpel approach rather than conventional vasectomy (**Grade 2B**). No-scalpel vasectomy has lower bleeding and infection rates. (See 'Vasectomy techniques' above and 'Exposing the vas' above.)

- We suggest intraluminal fulguration of the prostatic end and fascial interposition to manage the vasal ends, rather than another technique (eg, clipping or ligation) (**Grade 2C**). Fulguration and fascial interposition have been associated with lower rates of complications and failures. (See 'Managing the vasal ends' above.)

- Postoperative care includes scrotal support, intermittent ice application, and rest. Sexual activity should be avoided for at least one week, and an alternative method of contraception is advised until azoospermia is confirmed by semen analysis at three months after the procedure. (See 'Postoperative care' above and 'Follow-up to confirm sterility' above.)

- Hematoma is the most common complication of vasectomy. Patients should be seen if they experience significant swelling, bleeding from the vasectomy site, or pain not responding to analgesics. (See 'Complications' above.)

- Vasectomy can be reversed with microsurgical techniques. Vasectomy reversal involves reanastomosis (vasovasostomy) of the reproductive tract, ideally at the site of the previous ligation of the vas deferens. Successful vasectomy reversal has been reported in 50 to 70 percent of men. Key determinants of success and patency of reversal are the method of vasectomy and the duration of obstruction. (See 'Vasectomy reversal' above.)

- There is no conclusive evidence that vasectomy is associated with increased risk of coronary heart disease, stroke, dementia, hypertension, prostate cancer, or testicular cancer. (See 'Associated morbidity concerns' above.)

- Alternative methods of vasal occlusion (microsurgical vasal plug, polymer injection) seek to provide a reversible mode of contraception for men. These methods are still largely investigational at the present time. (See 'Alternative vasal occlusion techniques' above.)

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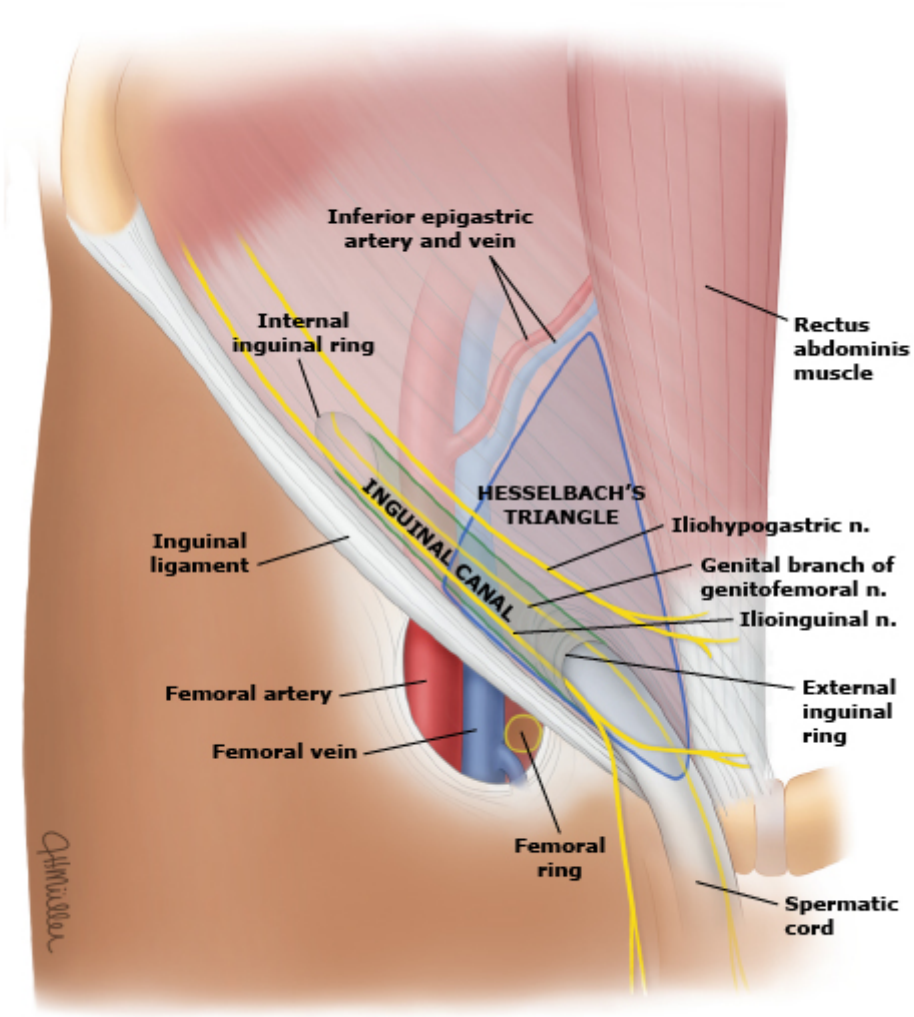
Topic 8094 Version 25.0

GRAPHICS

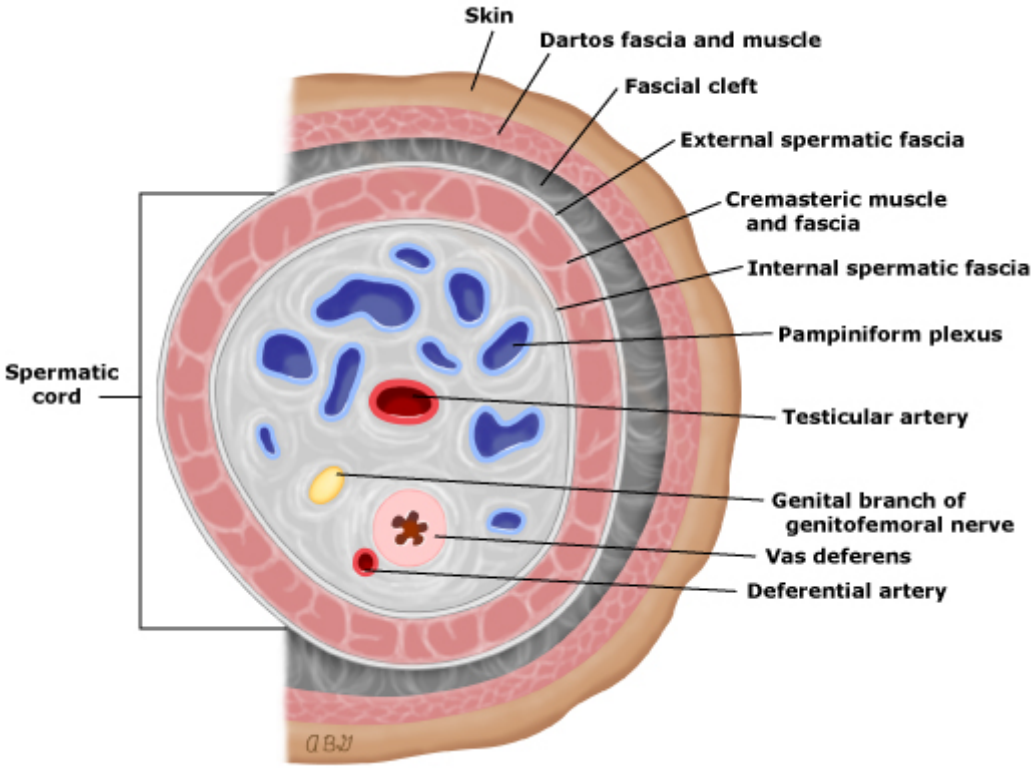
Groin hernia anatomy



Indirect inguinal hernias develop at the internal inguinal ring and are lateral to the inferior epigastric artery. Direct inguinal hernias occur through Hesselbach's triangle (outlined in blue) formed by the inguinal ligament inferiorly, the inferior epigastric vessels laterally, and the rectus abdominis muscle medially. Femoral hernias develop in the empty space at the medial aspect of the femoral canal, inferior to the inguinal ligament.

Graphic 61841 Version 4.0

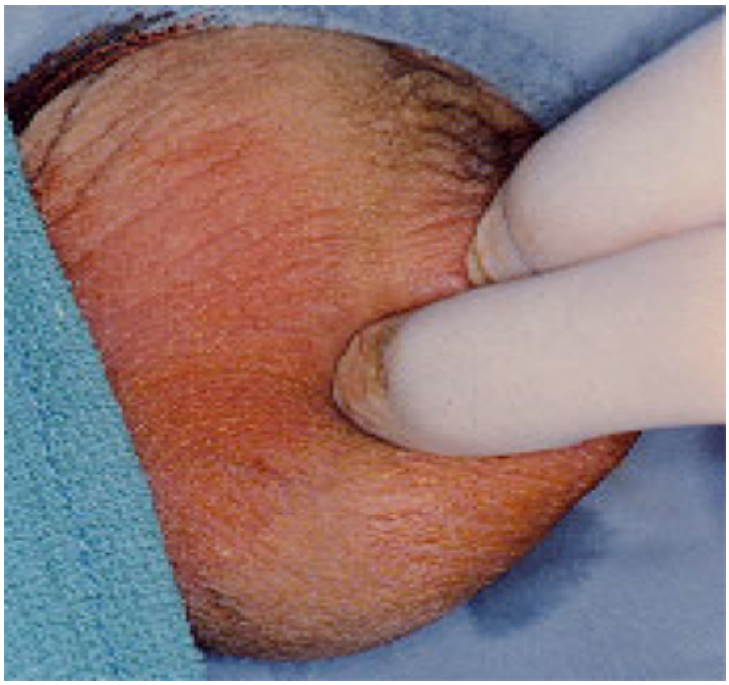
Spermatic cord cross-sectional anatomy



Left spermatic cord.

Graphic 72166 Version 3.0

Isolating and positioning the vas during vasectomy



The vas deferens is positioned to lie as superficially as possible. A "three-finger technique" is used to manipulate the vas within the scrotum using the nondominant hand.

Graphic 78720 Version 3.0

Scrotal incision during vasectomy

Local anesthesia is instilled and a small incision is made overlying the vas.

Graphic 55770 Version 2.0

Grasping the vas during vasectomy

The vas is elevated through the incision.

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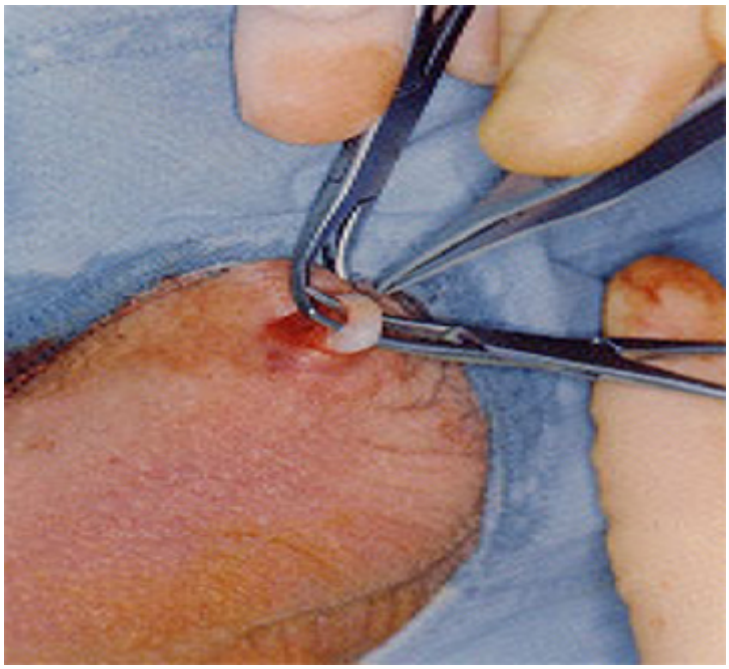
Graphic 53549 Version 2.0

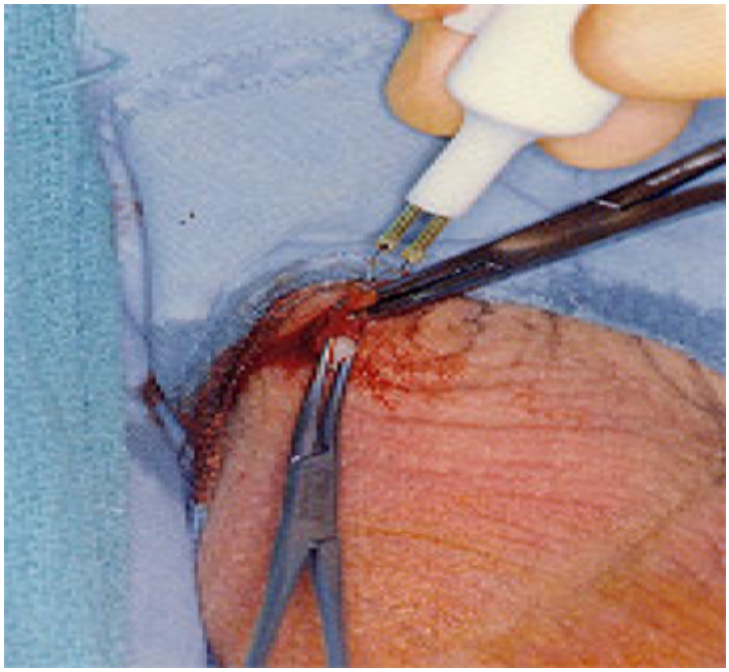
Isolating the vas during vasectomy



A loop of vas deferens is brought up through the wound, divided, and a segment removed.

Graphic 74357 Version 2.0

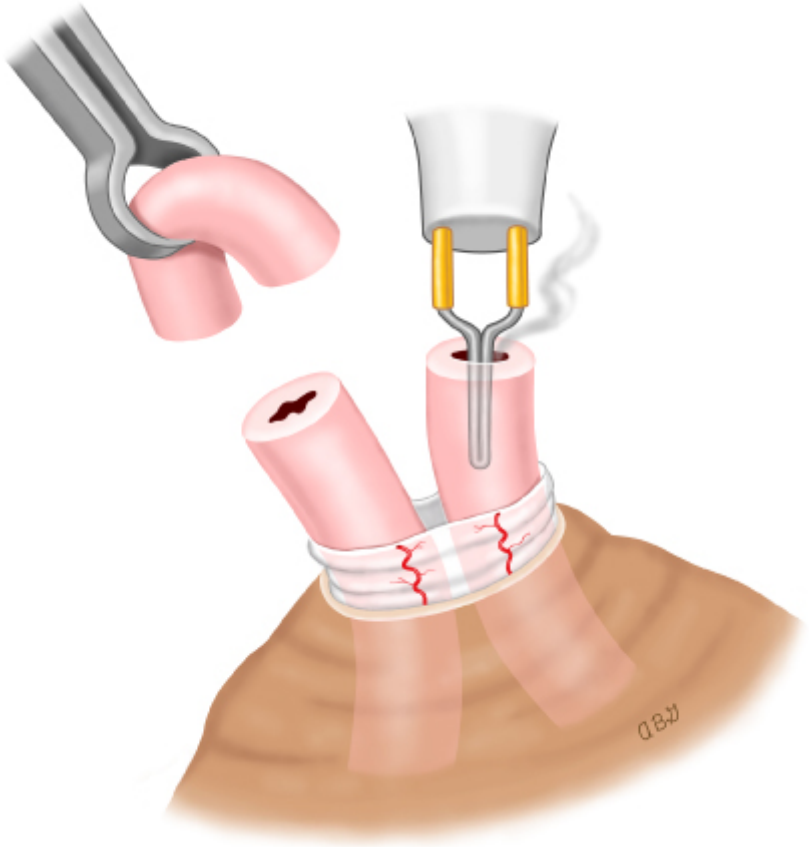
Intraluminal fulgaration of the vas during vasectomy



A disposable cautery is used to fulgarate the lumen of the vas.

Graphic 61651 Version 2.0

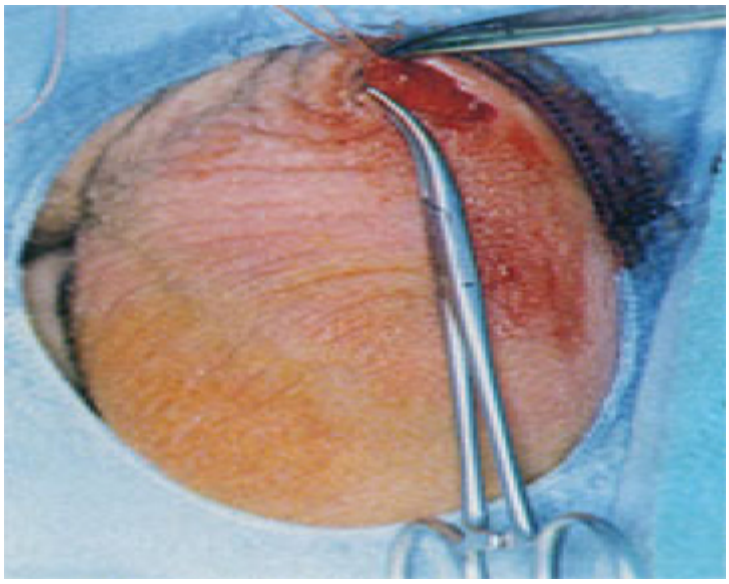
Fulguration of vasal ends during vasectomy illustration



The vas is divided and a segment removed. A handheld cautery can be used to fulgarate the lumen of each vasal end.

Graphic 62120 Version 4.0

Fascial interposition during vasectomy



The vas sheath is sutured over the prostatic vasal end.

Graphic 70870 Version 3.0

Fascial interposition during vasectomy illustration

The vas sheath is sutured over the prostatic vasal end.

Graphic 66760 Version 2.0

Contributor Disclosures

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