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Vasectomy Procedures

Clinical Policy Bulletins | Medical Clinical Policy Bulletins

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Policy History

Last Review
02/18/2025
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Review History

Definitions

Additional Information

Clinical Policy Bulletin Notes

Policy

Scope of Policy

This Clinical Policy Bulletin addresses vasectomy procedures.

I. Medical Necessity

Aetna considers vasectomy reversal medically necessary for the treatment of post-vasectomy pain syndrome if member has failed non-steroidal anti-inflammatory medications and local nerve blocks/steroid injections.

II. Experimental, Investigational, or Unproven

The following procedures are considered experimental, investigational, or unproven because there is inadequate evidence in the peer-reviewed published literature regarding their effectiveness (not an all-inclusive list):

A. Vasectomy Procedures

1. Endoscopic vasectomy
2. Implantable vas deferens ligation clip (Vasclip, VMBC, LLC, Roseville, MN)
3. Pro-Vas occlusion method
4. Vasal injection (e.g., reversible inhibition of sperm under guidance (RISUG)
5. Vasal occlusion (e.g., Intra Vas Plug, and LigaSure);

B. Procedures for Treatment of Post-Vasectomy Pain Syndrome

1. Epididymectomy
2. Micro-denervation of the spermatic cord.

CPT Codes / HCPCS Codes / ICD-10 Codes

CPT codes not covered for indications listed in the CPB:

Code	Code Description
Implantable clip:(Vasclip, VMBC, LLC, Roseville, MN), Vessel Sealing Device (LigaSure) - no specific code:	
Endoscopic vasectomy - no specific code:	
ICD-10 codes not covered for indications listed in the CPB (not all-inclusive):	
N50.811, N50.812, N50.819	Testicular pain

Code	Code Description
Z30.2	Encounter for sterilization
Z98.52	Vasectomy status
Vasectomy reversal procedures:	
CPT codes covered if selection criteria are met:	
54860	Epididymectomy; unilateral
54861	bilateral
55400	Vasovasostomy, vasovasorrhaphy
Other CPT codes related to the CPB:	
52402	Cystourethroscopy with transurethral resection or incision of ejaculatory ducts
55250	Vasectomy, unilateral or bilateral (separate procedure), including postoperative semen examination(s)
89310	Semen analysis; motility and count (not including Huhner test)
ICD-10 codes covered if selection criteria are met:	
G89.28	Other chronic postprocedural pain [post-vasectomy]

Background

According to a guideline on sterilization by the American College of Obstetricians and Gynecologists (ACOG, 2003), approximately 500,000 vasectomies are performed annually in the United States by urologists, general surgeons, and family physicians.

During vasectomy, an incision or puncture (no-scalpel technique) is made in the scrotum and the vas deferens is then cut to disconnect it, thereby interrupting the sperm's route from the testicles to the penis. A piece of the vas is removed (to reduce the chances of the 2 ends of the vas rejoining) and the 2 ends are then clipped, tied, or cauterized. Fascial interposition, in which one end of the vas is covered by either the sheath tissues of the vas itself or with adjacent connective tissue, is also widely used in conjunction with occlusion techniques to reduce the risk of re-

canalization. A controversial and less widespread practice involves leaving the testicular end of the vas unsealed to allow sperm to flow out of the vas in order to minimize pressure on and damage to the epididymis (Errey et al, 1986). Once the vasectomy is performed, the testicles still generate sperm, but their movement is blocked.

The rate of vasectomy failure, defined as lack of azoospermia on follow-up semen analysis (SA) or presence of pregnancy, has generally been reported to be between 0 % to 2 % (Cook et al, 2004; ACOG, 2003). The 3 main causes of vasectomy failure are operative failure, unprotected intercourse before the semen is cleared of sperm, and spontaneous early or late recanalization of the vas (Cook et al, 2004). Failure rates are reportedly lower when traditional vasectomy is performed by more experienced surgeons (Schwingl et al, 2000). Vasectomy is considered a low-risk procedure with fewer than 3 % of cases resulting in complications; complications include: infection, bleeding, hematoma, acute and chronic pain and congestive epididymitis.

Since the late 1960s, attempts have been made to develop an alternative method of vasectomy that would be more easily reversible than a standard vasectomy. Most of these efforts focused on the use of mechanical valves that could be opened and closed. The Vasclip, a locking ligation clip the size of a grain of rice, was cleared for marketing by the Food and Drug Administration (FDA) based on a 510(k) application. Thus, the manufacturer was not required to supply the evidence of effectiveness that would be required to support a pre-market approval application (PMA). The FDA 510(k) summary of substantial equivalence stated the Vasclip is identical in use to the Hem-o-lok, a polymer ligating clip that is used to close off vessels that supply blood to organs.

An unpublished prospective clinical study available through VMBC, LLC, the VASCLIP Company and on their website, reported the results of 124 men who had the Vasclip procedure. Three of the men (2.5 %) did not become infertile due to improper placement of the Vasclip, 0.8 % developed a hematoma and 0.8 % developed a sperm granuloma. Sixty-eight of the patients who returned for a SA all tested as infertile (no live sperm) at an average of 373 days after the Vasclip procedure and all of

the 78 patients who returned for a SA tested as infertile at an average of 853 days after. Reported range of significant pain was 5 %. Statistics on reversal are not yet available.

The potential for enhancing reversal is one main rationale for the use of vas occlusion with clips (Schwingl et al, 2000). In addition, the manufacturer states that the Vasclip results in lower complication rates than conventional male sterilization procedures. However, it is not known whether the Vasclip compresses the vas so tightly that the blood supply to the underlying portion of vas is permanently damaged. There is no adequate evidence in the peer-reviewed published medical literature that the Vasclip has a reduced late failure rate, lower complication rate or improved reversal rate then traditional vasectomy.

There is inconsistent evidence regarding the effectiveness of the Vasclip implant compared to standard vasectomy procedures. Kirby et al (2006) examined if the Vasclip implant procedure would (i) be equivalent to vasectomy in producing azoospermia, (ii) produce greater patient satisfaction post-operatively, and (iii) result in lower complication rates, post-operative pain, hematoma formation, spermatic granuloma, and surgical site infection when compared with historical controls. Successful sterilization, defined by azoospermia at 10 to 14 months, was observed in 116 of 119 subjects. The authors stated that effectiveness seemed to be equivalent to that of vasectomy, although the study did not include an internal control group of subjects receiving vasectomy. The authors observed that the incidence of post-operative pain and hematoma formation was similar to that which had been reported for standard vasectomy. The Vasclip procedure also had similar infection rates. The authors reported that the Vasclip procedure seemed to have lower rates of sperm granuloma formation compared to standard vasectomy. In 3 subjects with persistent presence of sperm, histological examination after traditional vasectomy indicated that misalignment of the device led to partial vas incision with recanalization. The authors reported that 99 % of survey respondents would recommend that other men considering a vasectomy have the Vasclip procedure.

On the other hand, Levine et al (2006) found persistent motile sperm after the Vasclip procedure. The authors assessed the effectiveness and mechanism of failure in a small case series of Vasclip vasectomies. Microscopic semen analysis was done a minimum of 4 weeks post-operatively and after at least 15 ejaculations. The number of sperm and motility were quantified in 15 or more high power fields. Successful vasectomy was defined as 2 consecutive post-operative unspun semen analyses containing no sperm. Patients with failed vasectomy underwent bilateral surgical removal of the vas deferens segments containing the ligation band for gross and histological analysis. Six of 8 patients (75 %) were deemed azoospermic after 2 semen analyses at a mean follow-up of 7 and 11 weeks post-operatively, respectively. Two of 8 patients (25 %) had semen analyses containing multiple motile sperm after vasectomy. In the 2 failed cases 1 side was patent, as demonstrated by vasal cannulation and irrigation with dilute methylene blue despite a well-positioned, intact and secure ligation band. Histological analysis showed extravasation and sperm granuloma on the patent side. The authors concluded that the Vasclip was found to fail at an unexpectedly high rate. Pathological analysis suggests sperm extravasation and fistula tract formation as the mechanism. One failure resulted in an unwanted pregnancy, which demonstrates the need for patient counseling regarding post-operative follow-up.

Cook et al (2004) systematically reviewed the evidence comparing male sterilization techniques. They identified 2 controlled clinical trials (Gupta et al, 1997 [n = 110]; Clausen et al, 1983 [n = 79]) comparing vas occlusion with clips (no transection of the vas) versus a conventional vasectomy technique (transaction of the vas with both ends of the vas ligated and looped back). Neither trial found a significant difference between the 2 groups with regard to the primary outcome of failure to reach azoospermia. However, Cook et al (2004) stated that no firm conclusions can be made about the comparative effectiveness, safety, and acceptability of these vas occlusion techniques due to the poor quality of the studies.

In a Cochrane review on vasectomy occlusion techniques for male sterilization that include excision and ligation, thermal or electrocautery, mechanical/chemical occlusion, as well as vasectomy with vas irrigation or with fascial inter-position (Cook et al, 2007), the authors concluded that

for vas occlusion with clips or vasectomy with vas irrigation, no conclusions can be made as those studies were of low quality and under-powered. Fascial inter-position reduced vasectomy failure. An intra-vas device was less effective in reducing sperm count than was no-scalpel vasectomy. They noted that randomized controlled studies evaluating other vasectomy techniques were not available; more and better quality research is needed to examine vasectomy techniques.

The Pro-Vas occlusion technique utilizes a titanium spring ligation clip that stops the flow of sperm without the need to cut or burn the sperm ducts. Pro-Vas has also been reported to result in less post-procedure pain and quicker return to normal activities compared with traditional vasectomy. Additionally, there were no complications following Pro-Vas occlusions, however, it is acknowledged the number of patients is not sufficient to provide statistically significant results. According to Dr. Swartz, the Pro-Vas occlusion technique has the potential to simplify and standardize the vasectomy technique. It may provide less experienced vasectomy surgeons a means for achieving clinical results similar to those of experienced surgeons. The Pro-Vas technique also spares sacrificing the vasal artery. Dr. Swartz added that there should be a lower re-canalization rate with the Pro-Vas method because the spring ligation clip cannot dislodge or ever lose its constant low-pressure occlusion force. Additionally, the clip is designed not to apply so much pressure that may result in necrosis – a situation that sometimes occurs with other types of ligatures. Should the patient ever change his mind with regard to his vasectomy, reversal of the Pro-Vas procedure should be much easier as the clip is very easy to identify and dissection to find the two occluded ends of the vas will be much simpler. Patient acceptance may be higher with the Pro-Vas occlusion technique than traditional vasectomy because overall quality of the outcomes may be improved. However, these hypotheses need to be confirmed by additional clinical studies.

Michielsen and Beerthuizen (2010) performed a systematic Medline/PubMed and Cochrane Library review of the literature with regard to technique, effectiveness, safety and complications of male sterilization. Vasectomy is an outpatient procedure which can be performed under local anesthesia. The vas deferens is accessed by means of either a conventional incision with a scalpel or by using the "no-scalpel technique". A closed-ended vasectomy (by means of suture

ligature, surgical clips or electro-cautery) or the open-ended alternative is then carried out. Each of these techniques has both advantages and drawbacks. Fascial interposition has been shown to reduce the risk of failure. A promising alternative for occluding the vas consists of placing an intra-vas device. Hematoma and pain are the most common complications. Non-steroidal anti-inflammatory drugs, narcotic analgesics and neuroleptic drugs are effective for treatment of pain. The success of vasectomy reversal ranges from 30 to 60 %. The data on record convincingly demonstrate that vasectomy is a safe and cost-effective intervention for permanent male contraception. The no-scalpel vasectomy under local anesthesia is recommended. Occlusion of the vas is most successful when performed by means of an electrocautery; fascial interposition should complete the procedure.

The American Urological Association's guideline on "Vasectomy" (Sharlip et al, 2012) provided guidance to clinicians who offer vasectomy services. This guideline was peer-reviewed by 55 independent experts during the guideline development process. The guideline stated that vas isolation should be performed using a minimally-invasive vasectomy technique such as the no-scalpel vasectomy technique. Vas occlusion should be performed by any 1 of 4 techniques that are associated with occlusive failure rates consistently below 1 %. These are mucosal cautery of both ends of the divided vas without ligation or clips

(1) with or (2) without fascial interposition; (3) open testicular end of the divided vas with mucosal cautery of abdominal end with fascial interposition and without ligation or clips; and (4) non-divisional extended electrocautery. Patients may stop using other methods of contraception when 1 un-centrifuged fresh semen specimen shows azoospermia or less than or equal to 100,000 non-motile sperm/ml. The authors concluded that vasectomy should be considered for permanent contraception much more frequently than is the current practice in the U.S. and many other nations.

The European Association of Urology's guidelines on "Male infertility" (Jungwirth et al, 2013) stated that fascial interposition and cauterization appears to be the most effective vasectomy technique. Furthermore,

methods of male contraception other than vasectomy are associated with high failure rates or are still experimental (e.g., hormonal approach).

In a Cochrane review, Cook et al (2014) compared the effectiveness, safety, acceptability and costs of vasectomy techniques for male sterilization. In February 2014, these investigators updated the searches of CENTRAL, MEDLINE, POPLINE and LILACS. They looked for recent clinical trials in ClinicalTrials.gov and the International Clinical Trials Registry Platform. Previous searches also included EMBASE. For the initial review, the authors searched the reference lists of relevant articles and book chapters. They included randomized controlled trials (RCTs) comparing vasectomy techniques, which could include suture ligature, surgical clips, thermal or electrocautery, chemical occlusion, vas plugs, vas excision, open-ended vas, fascial interposition, or vas irrigation. These researchers assessed all titles and abstracts located in the literature searches; 2 reviewers independently extracted data from articles identified for inclusion. Outcome measures include contraceptive efficacy, safety, discontinuation, and acceptability. Peto odds ratios (OR) with 95 % confidence intervals (CI) were used for dichotomous outcomes, such as azoospermia. The mean difference (MD) was used for the continuous variable of operating time. A total of 6 studies met the inclusion criteria; 1 trial compared vas occlusion with clips versus a conventional vasectomy technique. No difference was found in failure to reach azoospermia (no sperm detected). Three trials examined vasectomy with vas irrigation; 2 studies looked at irrigation with water versus no irrigation, while 1 examined irrigation with water versus the spermicide euflavine. None found a difference between the groups for time to azoospermia. However, 1 trial reported that the median number of ejaculations to azoospermia was lower in the euflavine group compared to the water irrigation group. One high-quality trial compared vasectomy with fascial interposition versus vasectomy without fascial interposition. The fascial interposition group was less likely to have vasectomy failure. Fascial interposition had more surgical difficulties, but the groups were similar in side effects. Lastly, 1 trial found that an intra-vas was less likely to produce azoospermia than was no-scalpel vasectomy. More men were satisfied with the intra-vas device, however. The authors concluded that for vas occlusion with clips or vasectomy with vas irrigation, no conclusions can be made as those studies were of low quality and under-powered. Fascial interposition reduced vasectomy

failure. An intra-vas device was less effective in reducing sperm count than was no-scalpel vasectomy. Moreover, they stated that RCTs examining other vasectomy techniques were not available. More and better quality research is needed to examine vasectomy techniques.

Tan and Levine (2016) stated that post-vasectomy pain syndrome (PVPS) remains one of the more challenging urological problems to manage. This can be a frustrating process for both the patient and clinician as there is no well-recognized diagnostic regimen or reliable effective treatment. The authors noted that while excision of sperm granuloma, micro-denervation of the spermatic cord (MDSC), epididymectomy, vasectomy reversal or orchiectomy has been used in refractory cases of PVPS, the success rates of these procedures remain unclear due to the availability of only small case series of men undergoing surgical treatment for this condition.

Smith and colleagues (2016) noted that variations in vasectomy techniques have failed to define a means of preventing PVPS. In addition, studies examining the pathophysiology of this condition have failed to elucidate a reproducible cause. Prevailing assumptions are focused upon epididymal congestion and obstruction. Potentially, up-and-coming techniques such as vasal occlusive gels, currently under development, offer novel alternatives to traditional vasectomy. Such an intra-vasal approach could involve the percutaneous puncture of the vasal lumen and instillation of a reversible, semi-permeable polymer gel. This intra-vasal option could theoretically decrease the negative side effects that result from direct scrotal manipulation. However, if the assumption of epididymal congestion holds true, it would stand to reason that any mechanism that retards the flow of sperm from the epididymis has the potential to result in post-vasectomy pain. Thus, potentially the best correction for post-vasectomy pain rests with the generation of a hypothetical male oral conceptive. Such a medication, by avoiding the need to have an occlusive process for vasectomy, could eliminate post-vasectomy pain and its related sequelae.

Vasal Injection and Vasal Occlusion

Kanakis and Goulis (2015) stated that despite the variety of available female contraceptive methods, many pregnancies are still undesired. Many men want to participate equally with their partner in family planning; however, male contraceptive methods (MCMs) account for only 14 % of those used worldwide and no pharmaceutical MCM is available so far. The only 2 MCMs currently available are condoms, which despite protecting against sexually transmitted diseases have high failure rates, and vasectomy, which though very efficient (99 %) is poorly reversible. Among MCMs under investigation, male hormonal contraceptives (MHCs) are those that have come closest to commercialization. The action of MHCs relies on the disruption of spermatogenesis that exogenous androgen administration evokes by suppressing the hypophyseal-gonadal axis. Various regimens of androgens as monotherapy or in combination with progestins have been tested in clinical trials achieving a Pearl Index that is equal to that of the female oral contraceptive pill; however, concerns regarding the variable response rates observed (non-responders: 5 to 20 %), the impracticality of parenteral administration and long-term prostate-associated or cardiovascular morbidity have deflected the interest of the pharmaceutical industry from further research. Non-hormonal contraception methods may be, at least theoretically, more specific by selectively disrupting spermatogenesis and sperm transport or fertilizing ability. The authors noted that only a few have been tested in clinical trials (Intra Vas Plugs ,and reversible inhibition of sperm under guidance [RISUG]); most of them are still in pre-clinical development or have been abandoned due to toxicity (gossypol).

Ansari and colleagues (2016) stated that among the vas-based methods on trial, RISUG, a co-polymer of styrene and maleic anhydride is being projected as an effective alternative to no scalpel vasectomy (NSV). Reversible inhibition of sperm under guidance offers long-term contraception with safety, effectiveness in human trials and can be delivered by no-scalpel injection. Currently, the procedure is under phase-III clinical trial. However, reversal of this vas-based drug-induced contraception needs to be established in animal models prior to clinical trials to ensure its claim as an effective alternative for vasectomy. In the present investigation, the relative suitability of dimethyl sulphoxide

(DMSO) and sodium bicarbonate (NaHCO3) for RISUG induced long-term vas occlusion reversal was carried out in albino rats. Animals were allocated into 4 groups:

(i) sham-operated control (group-I), (ii) vas occlusion with RISUG for 360 days (group-II), (iii) vas occlusion with RISUG for 360 days and reversal with DMSO (group-III) and (iv) vas occlusion with RISUG for 360 days and reversal with NaHCO3 (group-IV); n = 10 for each group. A variable response in fertility was observed in different groups. Absolute sterility in group III at all mating intervals, while, 0 % fertility in groups II and IV following 90 days of occlusion was observed. Following reversal restoration of fertility with DMSO at 45 days, whereas, reversal by NaHCO3 at 30 days was noticed. Ejaculated spermatozoa of RISUG injected and initial intervals of reversed animals exhibited various degrees of abnormalities. The testes exhibited focal degeneration in vas-occluded animals. The occluded lumen of the vas deferens contained an eosinated polymer with exfoliated epithelium. Following vas occlusion reversal, a complete regeneration in the vas epithelium was seen. All other parameters remained unaltered. The authors concluded that the reversal with NaHCO3 resulted in an early resumption of fertility when compared with DMSO and the procedure was found to be successful, feasible and safe up to F1 generation. They state that RISUG provides a hope for reversible male contraceptives.

Ansari and associates (2017) evaluated reversal of short- and long-term vas occlusion with RISUG using DMSO and NaHCO3 in male rabbits; animals were divided into 7 groups (n= 5 for each group). Fortnightly, semen analysis revealed that sperm concentration and output steadily declined after vas occlusion and complete azoospermia was attained at 30 to 60 days post-injection. Spermatozoa re-appeared at 60 to 75 days of reversal and normal zoospermia was noticed between 135 days and 150 days in the reversal groups. All spermatozoa were found non-motile before azoospermia and a gradual recovery in sperm motility was observed between 105 days and 135 days of reversal. A significant decline in viability of sperms was noticed during vas occlusion up to 30 to 60 days, which recovered at 60 to 75 days post-reversal and normalized by 75 to 105 days in the reversal groups. A significant enhancement in the sperm abnormalities was recorded in all vas-occluded animals as well

as those in initial periods of reversal. Other parameters, namely, semen volume, ejaculation time, pH, color, and consistency, remained unaltered during all phases of the study. Fertility test, at the intervals of 15 days, demonstrated that animals exhibited complete sterility during the entire period of vas occlusion. A gradual recovery in fertility was observed with the appearance of spermatozoa following vas occlusion reversal and 100 % fertility was observed following 135 to 150 days of reversal; F1 progeny of reversed animals was found normal. The authors concluded that these findings suggested that reversal with DMSO or NaHCO3 is feasible, with normal progeny, following short- and long-term contraception.

An UpToDate review on "Vasectomy and other vasal occlusion techniques for male contraception" (Viera, 2016) states that "Vasal occlusion with a plug (e.g., "Shug" or medical grade silicone rubber), requires microsurgery for implantation and later removal. 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. One technique intended for permanent sterilization involves first injecting 2 dyes into the vas, using a different color for the left and right vas. Then, a sclerosing agent is then 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 US. Another technique, reversible inhibition of sperm under guidance (RISUG) involves injection the non-sclerotic polymer, styrene maleic anhydride (SMA). It is claimed to offer long-term contraception without adverse side effects. 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".

Endoscopic Vasectomy

Schlager and colleagues (2017) noted that surgical vasectomy remains the gold standard for fertility control in men. Endoluminal occlusion of the seminal ducts, thus avoiding an external incision, may become an appealing alternative to this approach. These researchers had shown that non-traumatic endoscopic inspection of the seminal ducts is feasible in the human cadaver. They examined the feasibility and reliability of occlusion using several commercially available medical sealing agents in the porcine vas deferens (VD). Tests were conducted using 25 porcine spermatic ducts (10 cm in length) ex-vivo. The explanted specimens were fixed and cannulated using the Seldinger technique. These investigators administered 5 different occluding agents:

(i) n-butyle-2-cyanoacrylate, (ii) n-butyle-2-cyanoacrylate in combination with a platinum vascular coil, (iii) Tissucol Duo S, (iv) Gelita Spon, and (v) AFP Plug endoluminally. Tightness was evaluated after 5, 15, 60, 360, 720, and 1,440 minutes for each of the 5 grades, respectively, using a solution of methylene blue and saline injected under controlled pressure of 300 mm Hg followed by histological examination. All agents were administered into the porcine seminal ducts (4 out of 5 via a ureteric catheter). Gelita Spon and Tissucol Duo S did not occlude the lumen sufficiently, whereas n-butyle-2-cyanoacrylate, n-butyle-2-cyanoacrylate in combination with coil, Tissucol Duo and AFP Plug performed satisfactorily. In particular, cyanoacrylate combined with a coil was able to close the seminal duct tightly and for a long time. Histological findings confirmed this sealant's gapless adhesion. AFP Plug application revealed similarly good results. However, its form needs to be optimized to ensure its suitability for endoscopic use. The authors concluded that various developments regarding minimally invasive fertility control methods have been underway for decades. Further miniaturization of endoscopy and novel materials may pave the way for endoscopic fertility control in males in the future. These researchers demonstrated the potential of commercially available medical sealing agents to reliably occlude the porcine VD.

Furthermore, an UpToDate review on "Vasectomy" (Viera, 2017) does not mention endoscopic vasectomy as a vasectomy option.

Vessel Sealing Device (e.g., LigaSure) for Vasectomy

Guzelburc and associates (2019) stated that vasectomy is a popular and effective male surgical contraceptive method. Different techniques have been proposed to reduce failure rates and complications. In this study, these researchers compared vas deferens occlusion rates using both standard occlusion techniques and LigaSure (LSVS) for vasectomy. A total of 9 patients underwent open radical retropubic prostatectomy at the authors' institution. During the procedure, a total of 125 fresh vas deferens samples were obtained and divided into 4 groups as follows: Group 1: ligation (n = 22), Group 2; ligation and electro-cauterization (n = 18), Group 3; 5 mm LSVS (n = 44), and Group 4; 10 mm LSVS (n = 41). All specimens were harvested during surgery and subsequent histopathological assessments were performed to assess the luminal status of the vas deferens. Histopathological evaluation revealed that the majority of vas lumens with LSVS (79.5 % of Group 3 and 89.4 % of Group 4) were totally occluded. With standard techniques, however, the majority of vas lumens (86.4 % and 77.8 % of Groups 1 and 2, respectively) maintained a tiny patency. The authors concluded that on histopathological review, the application of LSVS resulted in better occlusion rates, compared to standard ligation methods. Moreover, they stated that these findings suggested a higher occlusive role for LSVS for vasectomy; further clinical studies are needed to confirm the safety and efficacy of this technique.

Micro-Denervation of the Spermatic Cord for Post-Vasectomy Pain Syndrome

In a retrospective study, Tan and colleagues (2018) evaluated the outcomes of patients who underwent MDSC for PVPS. All patients who underwent MDSC for PVPS by a single surgeon between March 2002 and October 2016 were included in this study. Pain was documented using the numerical rating scale (NRS); spermatic cord block (SCB) was performed on all patients, and success was defined as NRS score of less than or equal to 1 for more than 4 hours. All patients had failed medical therapy prior to MDSC; and all previous procedures for PVPS had been performed elsewhere. Surgical success was defined as a post-operative NRS score of less than or equal to 1. A total of 27 patients with 28 scrotal units underwent MDSC for PVPS. The median (first quartile; third

quartile) follow-up was 10 (2; 16.5) months. The median (range) duration of pain prior to surgery was 57 (8 to 468) months. Pain was bilateral in 14 (52 %), left-sided in 8 (30 %) and right-sided in 5 patients (19 %). Data on SCB were available for 23 patients, with a success rate of 96 %. The median (range) pre-operative pain NRS score was 7 (2 to 10). The median (range) pain score after SCB on the NRS scale was 0 (0 to 5). The median (range) post-operative pain score on the NRS was 0 (0 to 9). Overall success was achieved in 20 of 28 testicular units (71 %). Patients with involvement of multiple structures in the scrotum (i.e., testis, epididymis, spermatic cord) had a success rate of 81 % and were more likely to have a successful surgery ($p < 0.001$); 5 patients had failed a prior epididymectomy and 3 had failed a vaso-vasostomy for PVPS; this had no correlation with the success of MDSC ($p = 0.89$). The authors concluded that MDSC was a reasonably successful, durable and valuable approach for PVPS, especially when pain involves multiple structures in the scrotum (testis, epididymis, spermatic cord). They stated that MDSC was equally effective in patients who had previously failed a procedure for PVPS. No patient had a worsening NRS score after MDSC. This was the largest study to-date evaluating MDSC for the treatment of PVPS.

Furthermore, an UpToDate review on "Vasectomy" (Viera, 2018) does not mention micro-denervation of the spermatic cord as a therapeutic option for post-vasectomy pain syndrome.

Opioids for Post-Vasectomy Pain Control

Barham and colleagues (2019) noted that the American Urological Association (AUA) Position Statement on opioid use recommends using opioids only when necessary. These investigators examined if routine prescribing of opioids is necessary for pain control following vasectomy, and if an association exists with persistent use. They retrospectively reviewed the charts of patients who underwent vasectomy in clinic between April 2017 and March 2018. Patients were stratified into 2 groups, including those initially prescribed opioids and those not receiving opioid prescriptions at the time of vasectomy. The initial pain medication regimen depended on the standard prescription practice of each provider. Encounters with a medical provider for scrotal pain within 30 days, subsequent opioid prescriptions and new persistent opioid prescriptions between 90 and 180 days were compared between the 2

groups using the Fisher exact test. Between April 2017 and March 2018, a total of 228 patients underwent clinic vasectomy as performed by 8 urologists. At the time of vasectomy 102 patients received opioid prescriptions and 126 received no opioid prescriptions. There was no statistically significant difference between the opioid and non-opioid groups in encounters for scrotal pain (12.7 % versus 18.4 %, p = 0.279). The incidence of new persistent opioid use was 7.8 % in the opioid cohort compared to 1.5 % in the nonopioid cohort (p = 0.046). The authors concluded that opioids, which did not appear to be necessary in men who undergo vasectomy, were associated with persistent use in 7.8 % of patients at 3 to 6 months. These researchers stated that in the face of an opioid epidemic urologists should limit over prescription of opioids following vasectomy.

In a retrospective, cohort study, Welk and associates (2020) examined if filling a post-operative opioid prescription following low acuity urologic surgery is associated with new persistent opioid use. This trial was conducted using linked administrative data from Ontario, Canada. Participants were adults who underwent their first vasectomy, transurethral prostatectomy, urethrotomy, circumcision, spermatocelectomy, or hydrocelectomy between 2013 and 2016. These researchers excluded men with prior opioid use, confounding concurrent procedures, prolonged hospitalization, or cancer. They determined whether the patient filled a prescription for an opioid within 5 days of their surgery. The primary outcome was evidence of at least 2 opioid prescriptions filled 9 to 15 months following urologic surgery. The secondary outcome was admission for opioid over-dose. Primary analysis was adjusted logistic regression analysis. These investigators identified 91,083 men, most of whom underwent vasectomy (78 %). A total of 32,174 (35 %) men filled a prescription for an opioid after their procedure. The most common opioid prescribed was codeine (70 %), and urologists were the primary prescribers (81 %). Men who filled a post-procedure opioid prescription did not differ, for most of the 57 medical co-morbidities or markers of healthcare utilization that we measured, from those who did not fill an opioid prescription. There was long-term opioid use in 1,447 (1.6 %); men who had filled a post-operative opioid prescription had a significantly higher risk of long-term opioid use (OR 1.4, 95 % CI: 1.3 to 1.6) and opioid over-dose (OR 3.0, 95 % CI: 1.5 to 5.9). The authors concluded that prescription of opioids

following low acuity urology procedures was significantly associated with increased opioid use at 1 year after surgery. These researchers stated that efforts should be made to reduce post-operative opioids, especially for urologic procedures that do not typically require opioids. Moreover, they noted that a limitation of this study was that they could not determine the indication for long-term opioid prescriptions.

Vasectomy Reversal for Post-Vasectomy Pain Syndrome

Myers et al (1997) noted that the post-vasectomy pain syndrome (PVPS) is a rare but troublesome complication of vasectomy. These investigators reported their experience with 32 patients who underwent vasectomy reversal (VR) for relief of the PVPS. The records of 32 patients undergoing vasovasostomy (VV) or epididymovasostomy (EV) for the PVPV were evaluated for characteristics of symptoms, previous therapy, interval from vasectomy, success of surgery and duration of relief. Of 32 men who underwent VR for the PVPS between 1980 and 1994, 24 (75 %) had relief of symptoms following the initial procedure. Of the 8 men with recurrent pain, 6 underwent a 2nd VR procedure, and 3 of them subsequently had relief of symptoms. Overall, 84.4 % (27 of 32) had resolution of pain. The authors concluded that in their experience, VR had a high rate of success for relief of the PVPS. It did not preclude other forms of surgical therapy and it should be considered in the treatment of the PVPS.

Nangia et al (2000) stated that the cause of the PVPS is unclear. Some postulated etiologies include epididymal congestion, tender sperm granuloma and/or nerve entrapment at the vasectomy site. To the authors' knowledge, nerve proliferation has not been evaluated previously as a cause of pain. VR is reportedly successful for relieving pain in some patients. These investigators reported their experience and correlated histological findings in resected vasal segments with outcome to explain the mechanism of pain in these patients. These researchers retrospectively reviewed the records of 13 men who underwent VR for the PVPS. They compared blinded histological evaluations of the vasal ends excised at VR in these patients with those of pain-free controls who underwent VR to reestablish fertility. Controls were matched to patients for the interval since vasectomy. Histological features were graded according to the degree of severity of vasitis nodosum, chronic

inflammation and nerve proliferation. Mean time to pain onset after vasectomy was 2 years. Presenting symptoms included testicular pain in 9 cases, epididymal pain in 2, pain at ejaculation in 4 and pain during intercourse in 8. Physical examination demonstrated tender epididymides in 6 men, full epididymides in 6, a tender vasectomy site in 4 and a palpable nodule in 4. No patient had testicular tenderness on palpation. Unilateral and bilateral VV was carried out in 3 and 10 of the 13 patients, respectively. Post-operatively 9 of the 13 men (69 %) became completely pain-free. Mean follow-up was 1.5 years. These investigators observed no differences in vasectomy site histological features in patients with PVPS and matched controls, and no difference in histological findings in patients with PVPS who did and did not become pain-free post-operatively. The authors concluded that no histological features aided in identifying a cause of pain or provided prognostic value for subsequent pain relief; and VR appeared to be beneficial for relieving pain in the majority of select patients with PVPS.

Huang et al (2002) carried out a retrospective review of patients who received VR from 1989 to 1998 at Chang Gung Memorial Hospital (CGMH) in Linkou, Taiwan. The patency rate and partner pregnancy rates were also analyzed. A total of 70 patients underwent a VV at CGMH from 1989 to 1998. Post-operative semen analysis and achievement of pregnancy in a partner were examined. Various pre-operative factors were also examined and analyzed. Patients ranged from 30 to 58 (average of 40.8 +/- 6.5) years of age. The most common reason for requesting a VV was divorce (42.3 %). The patency rate was 85.7 % (36/42), and the pregnancy rate was 40.6 % (13/32). However, if patients receiving a VV for reasons other than to achieve pregnancy (i.e., pain, erectile dysfunction [ED], or infertility of the wife) were excluded, the pregnancy rate reached 50.0 % (13/26); 3 patients received a 2nd VV; patency was noted in 2, and pregnancy was achieved in the partner of 1. Of the 5 patients receiving a VV due to PVPS, 3 felt that their condition had improved. The authors concluded that the patency and pregnancy rates of VVs in CGMH were 85.7 % and 50.0 %, respectively. Repeat surgery could be considered an effective means of restoring fertility if an initial VV failed. Moreover, a VV appeared to be an effective means of treating PVPS.

Horovitz et al (2012) stated that PVPS is a rare but serious and debilitating complication of vasectomy. For men with PVPS, VR is a surgical option after medical management has failed; however, there is a paucity of data in the literature defining its therapeutic efficacy. These researchers examined the role and effect of vasectomy reversal in the treatment of men with PVPS. Three urologists in Toronto, Ontario carried out 149 publicly funded VRs between January 2000 and September 2010. The electronic health records were reviewed and 23 of the 149 (15 %) procedures were performed for PVPS. Of these men who underwent 14 VVs, 13 completed a telephone conducted questionnaire (response rate 56 %). Patient demographics, pre-operative and post-operative pain scores, and quality of life (QOL) were retrospectively evaluated. Orchialgia occurred at a mean ± SD of 19 ± 42.5 months following vasectomy and subjects (mean age of 43.8 ± 5.2 years) experienced pain for 50.3 ± 34.9 months before VV. After VV, improvement of pain occurred in 93 % (13 of 14) and 50 % were rendered pain-free with an average improvement in pain intensity scores of 65 % ($p < 0.005$). Of the men 15 % (2 of 13) had a recurrence of pain to baseline; however, 79 % (11 of 14) had a durable positive response. QOL was significantly improved after VV ($p < 0.005$) and 93 % (13 of 14) of the patients said they would undergo the same operation again. The authors concluded that VV was an effective treatment for the treatment of PVPS, and it could achieve robust and durable long-term improvement in pain intensity and QOL.

In a retrospective study, Lee et al (2012) examined outcomes (according to patency) of VR in qualified patients with PVPS. A total of 32 patients with PVPS undergoing VR between January 2000 and May 2010 were examined. Of these, 68.8 % (22/32) completed a study questionnaire, either onsite at the out-patient clinic or via telephone interview. Pre-operative clinical findings, pre-operative and post-operative visual analog scale (VAS) pain scores, patency and pregnancy rate and overall patient satisfaction were analyzed. For the latter, a 4-point rating of cure, improvement, no change or recurrence was used. The mean age was 45.09 ± 4.42 years; and the mean period of follow-up was 3.22 years (0.74 to 7.41). Patency rates were 68.2 % (15/22) and pregnancy rates were 36.4 % (8/22). The mean VAS was 6.64 ± 1.00 pre-operatively and 1.14 ± 0.71 post-operatively ($p < 0.001$). The difference in the mean pre-operative and post-operative VAS was 6.00 ± 1.25 (4 to 8) in the patency

group and 4.43 ± 0.98 (3 to 6) in the no patency group (p = 0.011). A significant difference in procedural satisfaction with surgical outcome was observed between patency and no patency groups (p = 0.014). The authors concluded that in PVPS patients requiring VR, a significant difference was observed between the patency and no patency groups in terms of pain reduction and the degree of patient procedural satisfaction.

In a retrospective study, Lee et al (2014) compared the outcome of epididymectomy and VR in patients with PVPS who required surgical treatment. A total of 50 patients with PVPS who underwent epididymectomy or VR between January 2000 and January 2010 were included. Of these, 36 (72.0 %) patients completed the study questionnaire. These 36 patients completed the questionnaire either during attendance at the out-patient clinic or during a telephone interview; 20 patients (22 cases) underwent epididymectomy, and 16 patients (17 cases) underwent VR. Analyses were carried out for pre-operative clinical findings, pre-operative and post-operative VAS pain scores, patency and pregnancy rate in VR group, and patient satisfaction with surgical treatment. The mean age was 48.28 ± 11.27 years, and the mean period of follow-up was 3.58 years (0.15 to 10.03). The mean VAS pain score was 6.78 ± 0.93 pre-operatively and 1.13 ± 0.72 post-operatively (p < 0.001). The difference in the mean pre-operative and post-operative VAS pain scores was 6.00 ± 1.34 (3 to 8) in the epididymectomy group and 5.50 ± 1.03 (4 to 8) in the VR group. However, this difference was not statistically significant (p = 0.227). No significant difference in satisfaction with surgical outcome was observed between the epididymectomy and the VR groups (p = 0.124). The authors concluded that in PVPS patients requiring surgical treatment, no significant difference was observed between the epididymectomy and VR groups in either the reduction in pain or the degree of patient satisfaction with surgical outcome. Selection of the optimal surgical procedure may be dependent on specific patient characteristics.

Polackwich et al (2015) reviewed their institution's experience and success with VR for the treatment of PVPS over the last 20 years. A single surgeon carried out all the VRs. These investigators identified 123 procedures performed for PVPS treatment and were able to contact 76 patients. They sent surveys or conducted phone interviews inquiring about satisfaction, levels of pain pre-operatively and post-operatively, and

the need for additional procedures for pain. A total of 31 (40.8 %) patients completed phone or written surveys. Furthermore, these researchers compared the location of vasectomy among patients presenting for pain to that of fertile patients. Thirty-one men had VR for post-vasectomy pain, with median age of 38 years (range of 31 to 55 years), of which 26 underwent VV; 7 patients required EV on at least 1 side based on intra-operative findings; 82 % of patients reported improvement in their pain at 3.2 months (± 3.4 months) after VR; 34 % patients had complete resolution of all pain. Mean pain score before procedure was 6.4 (± 2.4), decreasing to a median of 2.7 (± 2.7) afterward. There was a 59 % improvement in pain scores ($p < 0.001$); 2 patients needed additional procedures for continued pain, 1 orchiectomy and 1 epididymectomy; 4 patients required an additional VR, 1 repeat VV at 1 year and 3 EVs at 1, 5, and 9 years, respectively. Follow-up ranged from 1 to 19 years, with a mean follow-up of 8.4 years. These investigators found no relationship between vasectomy location and pain. The authors concluded that VR, via the use of both VV and EV, could provide long-term relief from PVPS.

Smith-Harrison et al (2017) noted that PVPS is a rare, but devastating outcome following vasectomy. Given the widespread use of vasectomy for permanent contraception, with more than 500,000 procedures performed annually in the U.S., it can be a significant challenge for both patients and providers. VR is a surgical option for men with PVPS who fail conservative or medical management. Despite improvements in technique, vasectomy carries some inherent risks making pre-procedure counseling regarding the risks of PVPS paramount. Chronic post-operative pain, or PVPS, occurs in 1 % to 2 % of men undergoing the procedure. These researchers examined the use of VR as a means of addressing PVPS. These researchers stated that men with post-vasectomy pain should be evaluated to rule out other sources of discomfort. Conservative therapy with or without medical management is the appropriate initial treatment for most. How long to continue conservative treatment before proceeding to surgery is unclear. There are currently no guidelines or standardized protocols for which patients should proceed to surgical intervention. In the U.S., VR generally remains an out-of-pocket expense and can carry significant financial burden which may delay or prevent its use entirely. Following failure of more conservative therapies for PVPS, however, VR remains a

reasonable therapeutic option. In the end, choice of surgery should be made after engaging in an in-depth discussion and using a patient-centered approach. Better studies are needed to characterize the incidence of PVPS according to standardized measures beginning shortly after the procedure and continued for long-term follow-up. In a similar fashion, larger studies equipped to evaluate the incidence of chronic pain and its varying severities and those patients reporting impaired QOL, seeking medical help and receiving surgical procedures need to be better captured. Without better data, improvements in the diagnosis and treatment of PVPS will remain elusive.

Auyeung et al (2020) stated that chronic pain following vasectomy is very challenging to diagnose and treat. Being a diagnosis of exclusion, it exposes the patient to a series of investigations and treatment regimens over months. Once a diagnosis is made, the treatment starts with non-invasive behavioral or pharmacotherapies. If these treatments fail, patients might require invasive surgical interventions, such as repeating the vasectomy with wide excision of the severed ends, micro-denervation of the spermatic cord, epididymectomy, VR or orchiectomy. The last resort for patients with debilitating chronic pain is orchiectomy, despite one study by Sweeney et al [2008] stating that 80 % of patients who underwent orchiectomy continued to experience pain".

Furthermore, an UpToDate review on "Vasectomy" (Viera, 2022) states that "Post-vasectomy pain syndrome is distinct from post procedure pain; however, there is some controversy regarding its definition and therefore prevalence. Historically, rates for post-vasectomy pain syndrome have been reported as very low (< 1 %). However, surveys have found that the incidence of "troublesome" post-vasectomy pain is reported by approximately 15 % of men, with pain severe enough to impact quality of life in 2 %; survey respondents, however, may not have been representative of all post-vasectomy men. The cause of most post-vasectomy pain syndromes is chronic congestive epididymitis. 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. 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. Refractory cases may require surgery, including either vasectomy reversal (vasovasostomy) or complete epididymectomy. Vasovasostomy successfully relieves pain in up to 70 to 82 % of well-selected patients. These patients, however, will almost always require the use of another form of contraception as a result".

Vasectomy and Risk of Prostate Cancer

Xu et al (2021) noted that the debate over the association between vasectomy and prostate cancer (PCa) has lasted about 40 years and there is no sign of stopping. In a meta-analysis, these investigators examined if vasectomy is associated with PCa based on the most comprehensive and up-to-date evidence available. PubMed, Cochrane Library, and Embase databases were searched from inception to March 14, 2021 without year or language restriction. Multi-variable adjusted risk ratios (RRs) were used to assess each endpoint. Risk of bias was assessed using the Newcastle-Ottawa scale. A total of 58 studies involving 16,989,237 subjects met inclusion criteria. There was significant association of vasectomy with risk of any PCa (RR, 1.18, 95 % CI: 1.07 to 1.31). Association between vasectomy and advanced PCa (RR, 1.06, 95 % CI: 1.01 to 1.12), low-grade PCa (RR, 1.06, 95 % CI: 1.02 to 1.10), and intermediate-grade PCa (RR, 1.12, 95 % CI: 1.03 to 1.22) were significant. There was no significant association between vasectomy and PCa-specific mortality (RR, 1.01, 95 % CI: 0.93 to 1.10). The authors concluded that this study found that vasectomy was associated with the risk of any PCa and advanced PCa. From the current evidence, patients should be fully informed of the risk of PCa before vasectomy.

The authors stated that this study had several drawbacks. First, some included studies did not report baseline, such as age vasectomy, follow-up duration. The subgroup results might have been different if all individuals were reported. Second, some case-control studies and cross-sectional studies were of poor quality (e.g., used unclear ascertainment of

exposure). Third, this meta-analysis was based on observational studies because RCTs concerning this topic were neither available nor likely to be conducted in the future. Fourth, publication bias between included studies could not be completely eliminated. Subgroup analyses and sensitivity analyses have been carried out to reduce the heterogeneity. Fifth, follow-up duration and age at vasectomy, it was difficult to obtain complete data, which may be confounding factors of the association between vasectomy and PCa.

Baboudjian et al (2022) stated that previous reports have demonstrated an association between vasectomy and PCa. However, there exist significant discrepancies between studies and systematic reviews due to a lack of strong causal association and residual confounding factors such as prostate-specific antigen (PSA) screening. On behalf of the Prostate Cancer Committee of the Association Française d'Urologie (CC-AFU), these researchers examined the association between vasectomy and PCa, in both unadjusted and PSA screen-adjusted studies. They carried out a systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. PubMed, Scopus, and Web of Science databases were searched in January 2022 for studies that examined the association between vasectomy and PCa. A total of 37 studies including 16,931,805 patients met inclusion criteria. A pooled analysis from all studies showed a significant association between vasectomy and any-grade PCa (OR 1.23; 95 % CI: 1.10 to 1.37; $p < 0.001$; $I2 = 96$ %), localized PCa (OR 1.08; 95 % CI: 1.06 to 1.11; $p < 0.00001$; $I2 = 31$ %), or advanced PCa (OR 1.07; 95 % CI: 1.02 to 1.13; $p = 0.006$; $I2 = 0$ %). The association with PCa remained significant when the analyses were restricted to studies with a low risk of bias (OR 1.06; 95 % CI: 1.02 to 1.10; $p = 0.02$; $I2 = 48$ %) or cohort studies (OR 1.09; 95 % CI: 1.04 to 1.13; $p < 0.0001$; $I2 = 64$ %). Among studies adjusted for PSA screening, the association with localized PCa (OR 1.06; 95 % CI: 1.03 to 1.09; $p < 0.001$; $I2 = 0$ %) remained significant. Conversely, vasectomy was no longer associated with localized high-grade ($p = 0.19$), advanced ($p = 0.22$), and lethal ($p = 0.42$) PCa. The authors concluded that this meta-analysis found a significant association between vasectomy and the risk of any, mainly localized, PCa. However, the effect estimates for the association between vasectomy and PCa were increasingly close to null when examining studies of robust design and quality. When these investigators limited the analysis to studies adjusted

for PSA screening, the association remained significant only for localized disease, but not for aggressive and/or advanced PCa. These researchers stated that future studies are needed to prospectively evaluate the possible causality between vasectomy and PCa, with attention to potential residual confounders that were not taken into account in large cohort studies.

The authors stated that the findings of this study need to be interpreted with caution. Translating these findings into clinical practice is likely to dissuade patients from undergoing vasectomy, whereas the absolute risk may be close to zero. Clear, fair, and understandable information should be provided regarding a possible association between vasectomy and PCa, without being able to examine if there is any causality. To definitively address this question, future collaborative, well-designed, international studies are needed to prospectively assess this risk of PCa among vasectomized patients with particular attention to potential confounders such as well-established risk factors for developing PCa.

Robotic-Assisted Microsurgical Vasovasostomy for Reversal of Vasectomy

Seth et al (2024) noted that vasovasostomy is a cost-effective procedure for the reversal of vasectomy. A water-tight adequately blood-supplied mucosal anastomosis is needed for better outcomes. In a systematic review and meta-analysis, these investigators compared the outcome of vasovasostomy carried out by 3 different techniques: macroscopic, pure microsurgical, and robotic-assisted microsurgical techniques. Scopus, Web of Science, PubMed, Embase, and Cochrane library databases were searched for relevant studies from January 1901 to June 2023. These researchers performed quantitative syntheses using the inverse variance method in OpenMeta software. This review involved 95 studies of different designs, with a total sample size of 48,132. The majority of operations were carried out bilaterally, and subjects were monitored for up to 10 years. The pooled patency rate was the highest following robotic-assisted vasovasostomy (94.4 %), followed by pure microsurgical vasovasostomy (87.5 %), and macroscopic vasovasostomy (83.7 %). The pooled pregnancy rate following purely microsurgical vasovasostomy was higher than that of macroscopic vasovasostomy (47.4 % versus 43.7 %). Definitive pregnancy rates in robotic-assisted vasovasostomy are yet

to be determined. The authors concluded that patency outcomes for vasovasostomy were best with robotic-assisted microsurgical technique, followed by pure microsurgical technique, and conventional macroscopic technique. Moreover, these researchers stated that further investigations of robotic-assisted microsurgical vasovasostomy outcomes and RCTs are needed to support this evidence.

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