Advanced Techniques of Vasoepididymostomy

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Key Points

- Good anastomoses rely on healthy tissue and an accurate watertight mucosa-to-mucosa opposition in a tension-free anastomosis; setup is key.
- Anastomotic techniques include end-to-end, end-to-side, and end-to-side intussusception.
- Vasal length can be increased on the epididymal end or the vasal end or both. If these two maneuvers prove insufficient, orchiopexy should be considered as well as a crossed septal vasoepididymostomy in cases of unilateral testicular atrophy or absence.
- Our preferred anastomosis is the two-suture longitudinal, end-to-side intussuscepted technique.
- We have developed a single-arm version of vasoepididymostomy, which is useful when double-arm sutures are difficult to obtain.
- Vasoepididymostomy is the most challenging of all microsurgery and should only be performed by surgeons with sufficient training and adequate volume of microsurgery.

14.1 Introduction

The first vasoepididymostomy (VE) was reported in 1902 by Dr. Edward Martin at the University of Pennsylvania. His technique involved slashing across multiple epididymal tubules and anastomosis of the vas to the epididymal tunic in a side-to-side manner with four fine silver wires [1, 2]. Patency depended on the formation of a fistula. In 1909, Martin reported in a series of 11 patients with epididymal obstruction a patency rate of 64% and a pregnancy rate of 27% [3]. He proved that vasoepididymostomy was technically feasible and his approach is the foundation on which subsequent work was based.

With advances in surgical technique and the development of microsurgical techniques, modern vasoepididymostomy allows us to accurately approximate the mucosa of a single epididymal tubule to the mucosa of the vasal lumen [4]. With this increased precision, we have been able to achieve even higher patency and pregnancy rates [5, 6]. Microsurgical vasoepididymostomy, however, remains the most technically demanding procedure in all of microsurgery. In virtually no other operation are results so dependent upon technical perfection. Thus, microsurgical vasoepididymostomy should only be attempted by an experienced microsurgeon who performs a sufficient volume of microsurgery.

14.2 Vasoepididymostomy

Vasoepididymostomy is indicated in patients with obstructive azoospermia, and the decision to perform a vasoepididymostomy rather than a vasovasostomy is made intraoperatively. During vasectomy reversal, the testicular end of the vas is cut until a patent lumen is seen and the intravasal fluid is evaluated both grossly and with the aid of a 400× bench microscope. The presence of thick toothpaste-like fluid devoid of sperm, scant fluid in a patient without a sperm granuloma, or scant fluid with no spermatozoa seen on barbotage constitutes indications for vasoepididymostomy. For non-vasectomy-related obstruction, vasoepididymostomy is indicated when a testis biopsy reveals complete spermatogenesis and transection of the testicular end of the vas reveals no sperm even with barbotage.

The evolution of modern single tubule vasoepididymostomy techniques has progressed from the original end-to-end anastomoses described by Silber, end-to-side anastomoses

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described by Wagenknecht and Fogdestam, and end-to-side intussusception anastomoses first described by Berger. In all of these, the initial exposure and setup are similar. A high vertical scrotal incision is made about 3–4 cm in length aimed toward the external ring of the inguinal canal. In cases with inadequate length of the vas, the incision can be extended to the external ring if necessary and the external oblique aponeurosis can be incised and an inguinal dissection of the vas performed. After incision through the skin and dartos fascia, the testicle is delivered with the tunica vaginalis intact. Using a Babcock clamp, the vas is isolated and surrounded with a Penrose drain. The operating microscope is brought into the field. The junction of the straight and convoluted vas is identified and isolated. The vas is then dissected free of its investing sheath and blood vessels under the operating microscope to expose a clean segment of bare vas. The bare segment of vas is hemitransected with a 15° ultrasharp knife until the lumen is visualized. The vasal fluid is then sampled, placed on a slide mixed with media, covered with a coverslip, and examined using a bench microscope at 400× magnification. If no spermatozoa are seen, then an additional 0.1–0.2 ml of fluid is injected into the testicular end and that fluid is expressed back out by squeezing the testis and epididymis and the fluid examined under the bench microscope. Absence of vasal sperm on microscopic exam in a man with either a normal testis biopsy or a positive antisperm antibody assay [7] confirms the diagnosis of epididymal obstruction.

At this point, the abdominal end of the vas is checked for patency by cannulating the abdominal end of the vas with a 24-gauge angiocatheter and injecting 1 ml of lactated ringers. Smooth injection without resistance or backflow confirms patency of the abdominal end of the vas. If further confirmation is desired, then a Foley catheter can be inserted after injecting indigo carmine and the color of the urine inspected. Green or blue urine confirms the patency of the abdominal vas as well as the ejaculatory ducts.

Once epididymal obstruction is confirmed and the need for a vasoepididymostomy verified, the abdominal end of the vas is prepared for anastomosis by completing the transection using an ultrasharp knife drawn through a slotted 2, 2.5, or 3 mm nerve-holding clamp. The vas is cut until healthy vasal tissue is seen. The cut surface of the testicular end of the vas deferens is inspected using 15–25 power magnification and should look like a bullseye with the three vasal layers distinctly visible. A healthy white mucosal ring should be seen which springs back immediately after gentle dilation. This layer is surrounded by muscularis which should appear smooth and homogeneous. A gritty-looking muscularis layer may indicate the presence of scar/fibrosis. Healthy bleeding should be noted from both the cut edge of the mucosa and the surface of the muscularis. If the blood supply is poor or the muscularis is gritty, the vas is recut until healthy tissue is found. The vasal artery and vein are ligated with 6-0 Vicryl. Small bleeders are controlled with a microbipolar forceps set at low power. At this point, the tunica vaginalis is opened and the epididymis is inspected.

In patients with previous vasectomy, there are some minor variations, but the overall approach is similar. In these patients, the testicular and abdominal ends of the vas are identified and dissected free. The abdominal end is transected and checked for patency. After confirmation of abdominal end patency, the testicular end is then inspected and sectioned and intravasal fluid microscopically inspected. If examination of the fluid reveals no spermatozoa, even with barbotage, the need for vasoepididymostomy is confirmed. The tunica vaginalis is opened and the epididymis is inspected under the operating microscope. At this point, it is time to determine the site of anastomosis.

14.3 End-to-End Anastomosis

This is the original microsurgical technique introduced by Silber and it is the first technique to allow the anastomosis of a specific epididymal tubule to the vas. At its introduction, it was far superior to any method previously described. In this technique, the epididymis is dissected down to its junction with the convoluted vas. The epididymis is then serially sectioned until a large rush of fluid is noted (Fig. 14.1), indicating that the area of obstruction has been bypassed. The single tubule with gushing fluid is identified and anastomosed to

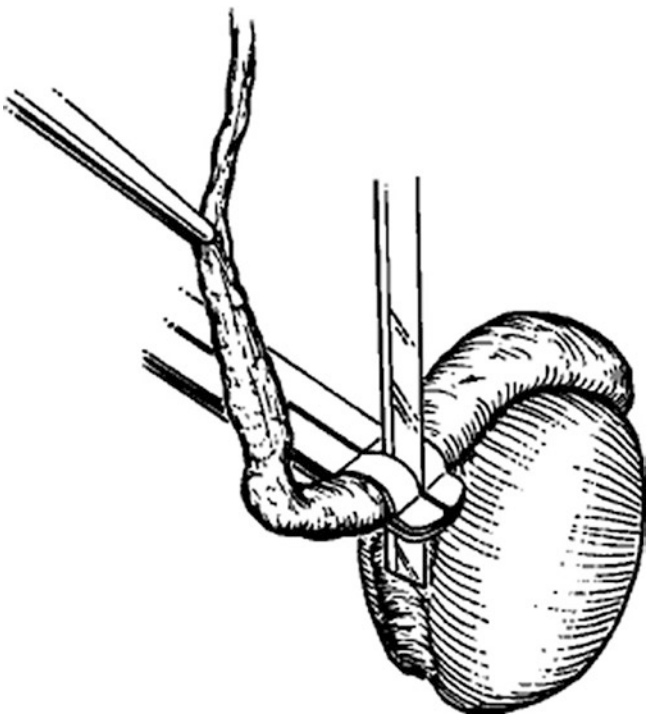

Fig. 14.1 Sectioning method employed in the end-to-end technique. (Reprinted from Goldstein [25], with permission of Elsevier)

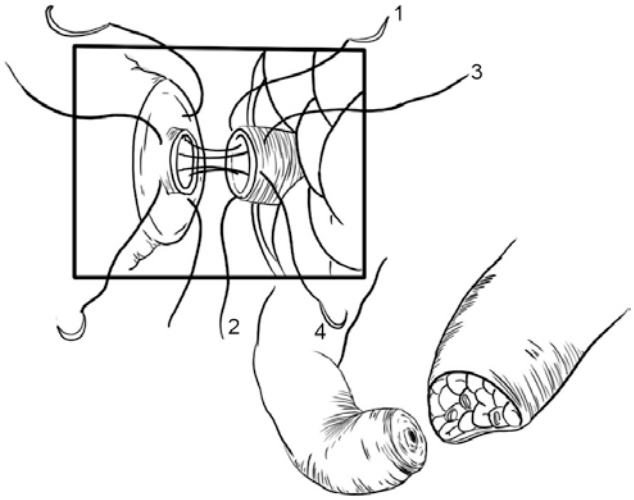

Fig. 14.2 End-to-end anastomosis showing anastomosis of a single epididymal tubule to the vasal lumen. Note that the outer vasal layers are then anastomosed to the tunica of the epididymis. (Reprinted from Goldstein [26]. With permission from Elsevier)

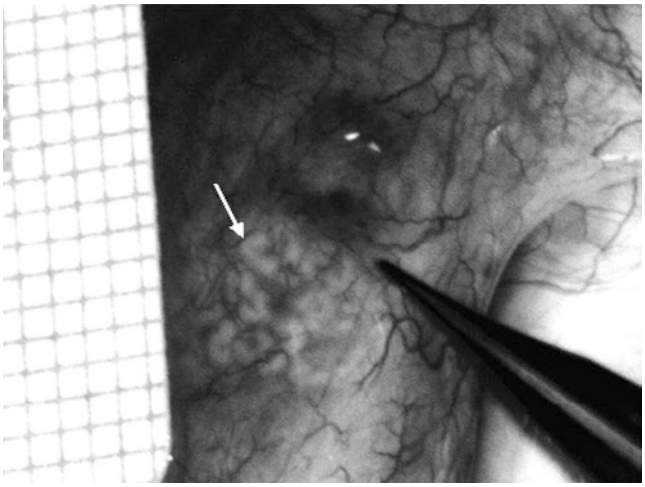

Fig. 14.3 Example of dilated epididymal tubules seen under the operating microscope

the vas with 3–5 interrupted 10-0 nylon sutures. The outer layer of the vas is anastomosed to the tunica of the epididymis with 9-0 nylon sutures (Fig. 14.2).

The advantages of this technique include the ability to dissect off the epididymis and rotate it to gain additional length if there are issues with short vasal length. A major disadvantage of this technique is that the outer diameter of the epididymal tunica is far larger than the outer diameter of the vas deferens, making a watertight closure exceedingly difficult. Also, the epididymal blood supply is invariably affected during transection. It also is more difficult to obtain clean, blood-free sperm for cryopreservation than it is with the end-to-side technique.

14.4 End-to-Side Techniques

End-to-side techniques of vasoepididymostomy improved on the end-to-end technique and have the advantage of being relatively bloodless and less traumatic to the delicate epididymis [8–11]. It requires minimal dissection of the tubule and allows the surgeon to easily tailor the size of the opening in the epididymal tubule. Also, this method allows for the preservation of all the epididymal branches of the testicular artery. Thereby, if another vasovasostomy is required, the blood supply to the intervening segment of vas can be preserved. In cases where the integrity of the testicular artery is in doubt (previous orchiopexy, previous non-microscopic varicocelectomy, or hernia repair), preservation of the deferential artery may be required for the maintenance of testicular blood supply.

The selection of an anastomotic site is a bit more involved with the end-to-side technique when compared with the end-to-end technique. After the vas has been prepared, the tunica vaginalis is opened and the testis delivered. Inspection of the epididymis under the operating microscope may reveal a clearly delineated demarcation above which epididymal tubules are markedly dilated and below which the tubules are collapsed. Often, a discrete yellow sperm granuloma is noted, above which the epididymis is indurated and the tubules dilated and below which the epididymis is soft and the tubules collapsed (Fig. 14.3). If the level of obstruction is not clearly delineated, a 70-μm tapered needle from the 10-0 nylon microsuture is used to puncture the epididymal tubule beginning as distal as possible and fluid sampled from the puncture site until sperm are found. At that level, the puncture is sealed with microbipolar forceps and the anastomosis is performed proximal to the puncture site.

An anastomotic site is selected where the epididymal tubules are clearly dilated. An avascular area is grasped with jeweler's forceps and the epididymal tunica tented upward. A 3–4-mm buttonhole is made in the tunica with microscissors to match the outer diameter of the vas. The epididymal tubules are then gently dissected until dilated loops of tubules are clearly exposed.

At this point an opening is made in the tunica vaginalis and the vas deferens end is brought through and secured to the tunic with two to three interrupted 6-0 prolene sutures to ensure that the vasal lumen reaches the opening in the epididymal tunica without tension and with some length to spare. The posterior edge of the epididymal tunica is then approximated to the posterior edge of the vas muscularis and adventitia with two to three interrupted sutures of double-armed 9-0 nylon. At the end of this step, the vasal lumen should be in close approximation to the epididymal tubule selected as the site for anastomosis. Proper positioning of the vasal segment and

proper setup are critical to the creation of a long-lasting tension-free anastomosis.

14.5 Anastomotic Technique

Once setup for the anastomosis is complete, the surgeon has a choice of anastomotic techniques which vary by the number of sutures placed, the order of suture placement, and intussusception of the tubule. We will discuss the classic end-to-side anastomosis as well as the various intussusception techniques.

14.6 Original End-to-Side

The classic end-to-side approach involves creation of a longitudinal incision along the selected epididymal tubule. This is done under 25–32× magnification. The intratubular fluid is microscopically inspected with the bench microscope. If no sperm are seen on microscopic exam, then the tubule is closed with a 10-0 suture and the overlying tunica closed with 9-0 nylon. A more proximal location is then identified and the setup for anastomosis is repeated. If sperm are found on microscopic inspection, it is safe to continue with the procedure. The extruded epididymal fluid is aspirated into glass capillary tubes and flushed into media for cryopreservation [12]. Diluted indigo carmine is applied to the field to highlight the edges of the epididymal tubule as well as the mucosal edges of the vas segment. Of note, we have previously shown that methylene blue and radiographic contrast are toxic to spermatozoa, while diluted indigo carmine is not [13]. Thus, it is our preference to use indigo carmine diluted 50% with lactate ringers for all vasograms and for emphasis of the mucosal edges.

Constant irrigation with saline or lactated ringers is required to keep the delicate epididymal tubule open and to visualize the edges. The posterior mucosal edge of the cut epididymal tubule is approximated to the posterior edge of the vasal mucosa with two interrupted sutures of 10-0 nylon double-arm sutures with 70-μm diameter tapered needles. After these mucosal sutures are tied, the anterior mucosal anastomosis is completed with two to four additional 10-0 interrupted sutures. The outer muscularis and adventitia of the vas are then approximated to the cut edge of the epididymal tunica with six to ten additional interrupted sutures of 9-0 nylon double armed with 100-μm diameter needles. The vasal sheath is secured to the epididymal tunica with three to five sutures of 9-0 nylon allowing for a straight course without kinks. The tunica vaginalis is then closed with 5-0 Vicryl and the dartos reapproximated with absorbable suture. The skin is closed in a subcuticular fashion.

14.7 End-to-Side Intussusception Technique

The next advance in vasoepididymostomy techniques came with the development of intussusception techniques. This method was first introduced by Berger in 1998 [14]. The setup is identical to that for the classic procedure. After the vas is fixed to the opening in the epididymal tunica, six microdots are placed on the cut surface of the vas to mark the sites of needle exit. The microdot technique ensures precise suture placement by exact mapping of each planned suture. The microdot method separates the planning from the placement of sutures [15]. Much as a civil engineer is consulted before workmen commence construction on a bridge, the microdot method allows the surgeon to completely focus on each individual task at hand. This results in substantially improved accuracy in suture placement as well as better suture spacing. Next, the epididymal tubule selected for anastomosis is dissected until it is free of surrounding tissue and displays prominently. Indigo carmine is applied to highlight the tubule. Using double-arm 10-0 nylon sutures with 70-μm tapered needles, three sutures are placed in the epididymal tubule in a triangular configuration. The needles are left in situ, creating a triangle of needles (Fig. 14.4). It must be remembered that the needle of the 10-0 suture is 70 μm in diameter while the suture material itself is only 17 μm. Thus, if the needles are pulled through prematurely, epididymal fluid and sperm would immediately leak through the suture hole causing the tubules to collapse, making placement of subsequent sutures and opening the tubules more difficult. Leaving the needles in situ also prevents accidentally cutting sutures when making the opening in the epididymal tubule.

After all three needles are properly placed, Berger originally described using a 9-0 cutting needle to lift the tubule and tear an opening in it. We prefer a 15° microknife to make an opening in the epididymal tubule in the center of the triangle. The three needles are then pulled through. The six needles are now

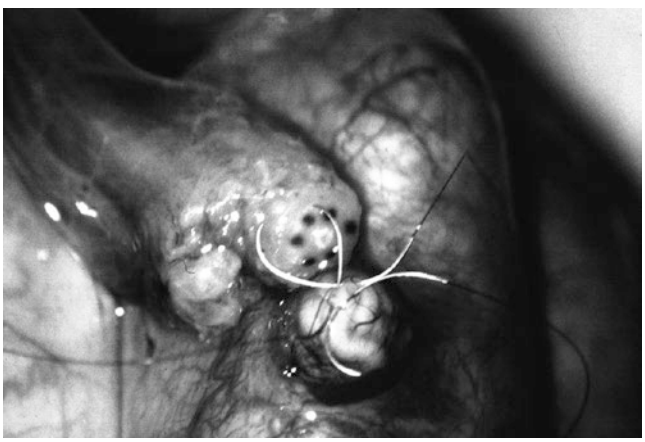

Fig. 14.4 Triangle of needles formed during the triangulation end-to-side intussusception technique introduced by Berger

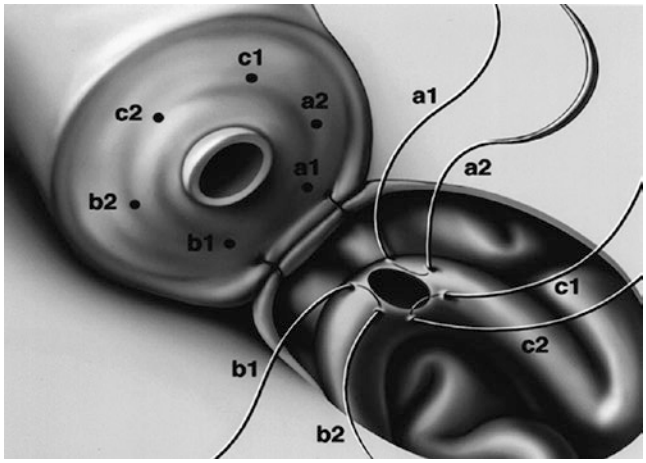

Fig. 14.5 End-to-side triangulation intussusception technique introduced by Berger. (Reprinted from Goldstein [25], with permission of Elsevier)

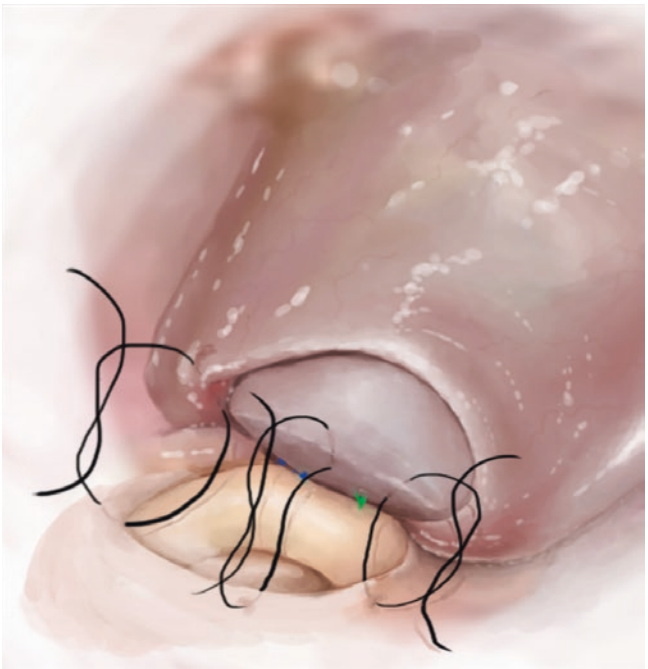

Fig. 14.6 Closure of the epididymal tunica should be done with 9-0 nylon sutures with particular attention paid to avoid incorporating any underlying tubules into the closure. (Reprinted from Goldstein [26]. With permission from Elsevier)

laid out to avoid tangling. The extruded fluid is inspected under the microscope for sperm. If sperm are seen, then the six needles are passed inside out the vas deferens exiting through the six previously placed microdots (Fig. 14.5). The sutures are then tied, intussuscepting the epididymal tubule into the vas lumen and thereby creating a watertight closure. Intussusception also allows the flow of fluid from the epididymal tubule into the vas to push the edges of the epididymal tubule against the vasal mucosa, further reinforcing the watertight nature of this anastomosis. The edges of the vas are then closed with interrupted 9-0 nylon sutures (Fig. 14.6). Limitations of the triangulation technique include the need for a relatively large tubule for the three needles to fit. Thus, this technique is not suitable for anastomosis to the efferent ductules or the proximal caput epididymis where the tubule is smaller.

14.8 Two-Stitch Longitudinal Vasoepididymostomy (LIVE Technique)

This is our currently preferred method of VE which allows for a two-stitch intussuscepted anastomosis. In this technique, four microdots are made on the vasal end. Two needles from two separate 10-0 double-arm sutures are then placed longitudinally in the tubule with care not to pull the needles completely through. The opening in the epididymal tubule is then made with a 15° microknife between the needles. After microscopic confirmation of the presence of spermatozoa, the needles are passed. The four needles are then passed through the vasal lumen and exiting the microdots (inside to outside). A 9-0 suture is placed to pull the anterior vas and adventitia toward the opening in the epididymal tubule bringing the vas mucosa into close approximation to the opening in the epididymal tubule. The lumen is irrigated with heparinized saline just prior to tying the mucosal sutures. Finally, the mucosal sutures are tied down (Fig. 14.7), allowing for the intussusception of the epididymal tubule. The outer layer is closed with interrupted 9-0 nylon sutures careful to not inadvertently incorporate any epididymal tubules when placing these sutures (Fig. 14.8). Again, by not pulling the needles completely through the tubule until the tubule has been incised, the tubule remains distended, which makes suture placement and incision of the tubule more accurate and reliable. Variations in this technique include

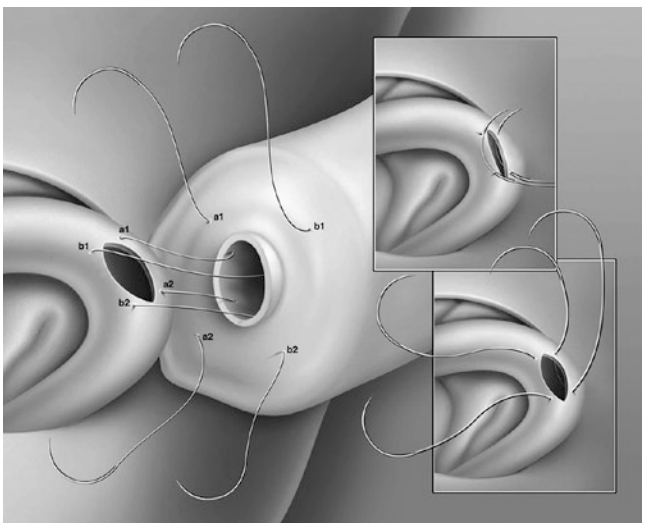

Fig. 14.7 Longitudinal intussuscepted vasoepididymostomy technique. Mucosal suture placement. (Reprinted from Goldstein [26]. With permission from Elsevier)

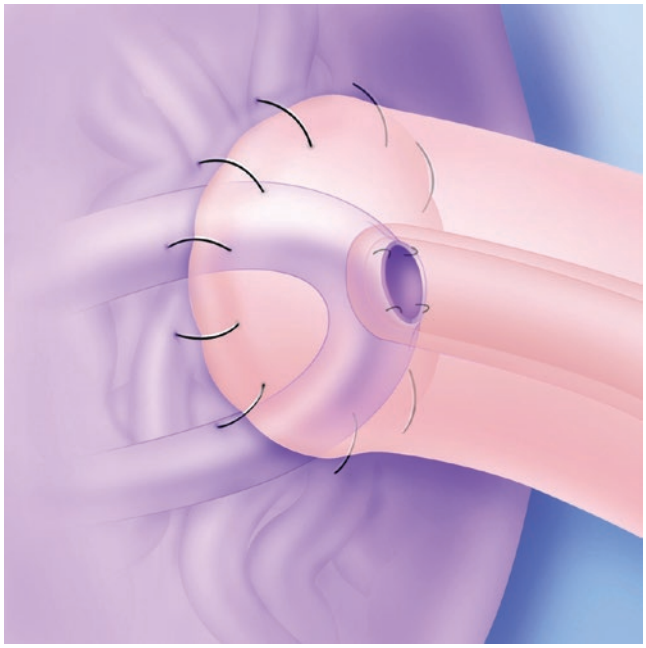

Fig. 14.8 Completed anastomosis for longitudinal intussuscepted technique. (Reprinted from Goldstein [26]. With permission from Elsevier)

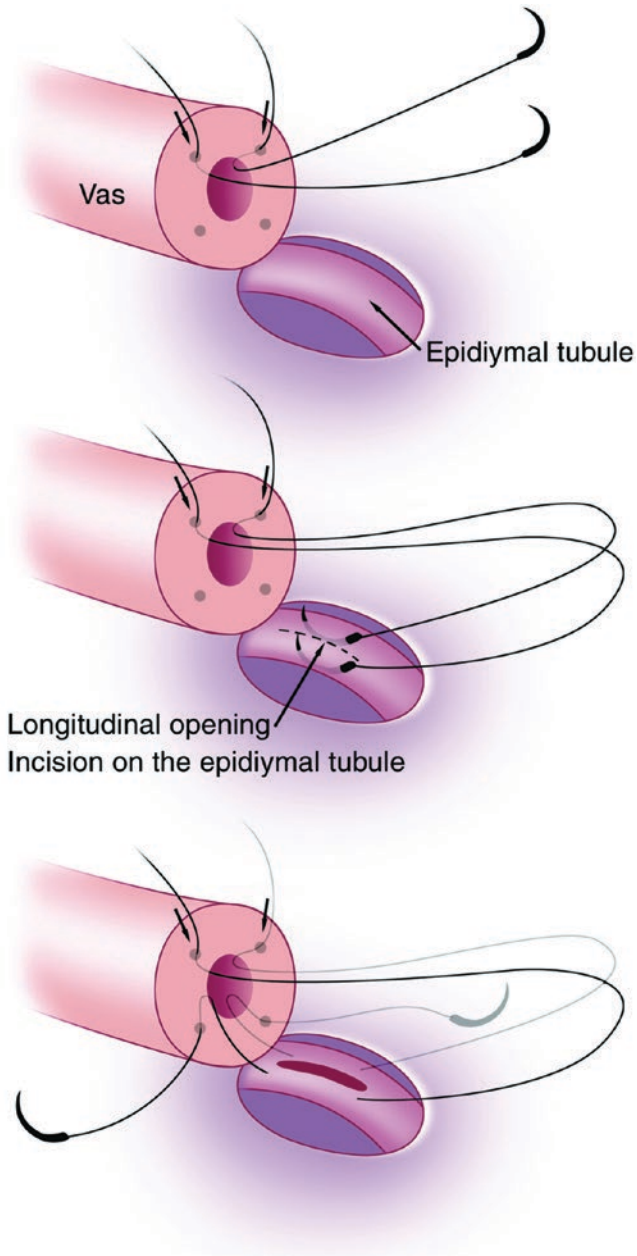

Fig. 14.9 Technique of single-arm vasoepididymostomy technique. Needles are passed outside in on the vas deferens. The needles are then passed longitudinally in the selected epididymal tubule and the cut made in the epididymal tubule. The needles are then passed and then placed inside out in the vas deferens. (Reprinted from Goldstein [26]. With permission from Elsevier)

mounting two needles in a single needle holder and placing them simultaneously transversely in the tubule as suggested by Marmar.

Of note, the cost of double-arm sutures can be high. In response to this, we have developed a single-arm technique of VE which we have found to be almost as effective as its double-arm counterpart [16]. It begins with the standard setup for VE. We then place four microdots in the vasal end. Two 10-0 single-arm nylon sutures are then passed through the microdots and exiting the vasal lumen (outside to inside). After this, the same two sutures are placed longitudinally in the selected tubule and the needles are not completely passed. After opening the tubule and confirming the presence of spermatozoa, the needles are pulled through and the needles passed through the vasal lumen and exiting the microdot (inside to outside) (Fig. 14.9). The sutures are then tied allowing the intussusception of the epididymal tubule. The outer sheath of the vas deferens is then approximated to the tunic of the epididymis with two to four interrupted 9-0 nylon sutures, removing all tension from the anastomosis.

14.9 Techniques When Vasal Length Is Severely Compromised

One of the most common problems that arise during vasoepididymostomy is inadequate vasal length, often due to a very destructive vasectomy. When there is inadequate length of the vas deferens to reach the dilated epididymal tubule without tension, a number of surgical techniques may be employed involving any of the following: freeing up the epididymis, increasing vasal length, fixation of the testis higher in the scrotum, or use of the contralateral vas deferens.

To gain length on the epididymis, the cauda and corpus epididymis can be dissected down to the vasoepidid-

ymal junction and then dissected off the testes as in the end-to-end operation. The epididymis is encircled with a small Penrose drain at the level of obstruction and dissected off of the testis up to the level of obstruction, yielding sufficient length to perform the anastomosis. Usually an avascular plane can be found between the tunica albuginea of the testis and the epididymis, and injury to the epididymal blood supply can be avoided. The inferior and, if necessary, middle epididymal branches of the testicular artery are ligated and divided to free up an adequate length of epididymis. The superior-epididymal branches entering the epididymis at the caput are always preserved, and this is adequate blood supply for the entire epididymis.

If the epididymis is indurated and dilated throughout its length, the epididymis is dissected all the way past the vasoepididymal junction. This dissection is often facilitated by first dissecting the convoluted vas to the vasoepididymal junction from below, and then, after encircling the epididymis with a Penrose drain, dissecting the epididymis to the vasoepididymal junction from above. In this way, the entire vasoepididymal junction can be freed up. This will allow preservation of maximal epididymal length in cases of obstruction near the vasoepididymal junction. After the epididymis is dissected off of the testis and flipped-up, a two-stitch longitudinal end-to-side intussusception anastomosis can be performed as described previously (Fig. 14.10).

Increasing vasal length can be done with extensive blunt dissection of the vas deferens off the spermatic cord toward the inguinal ring. If necessary, the external oblique aponeurosis is incised toward the internal inguinal ring and dissected with a finger sweeping motion. In extreme situations, the vas deferens can be rerouted medial to the vessels similar to the Prentiss maneuver employed during difficult orchiopexies [17]. An opening in the floor of the inguinal canal is made and the vas rerouted medially under the floor of the canal and right over the pubis.

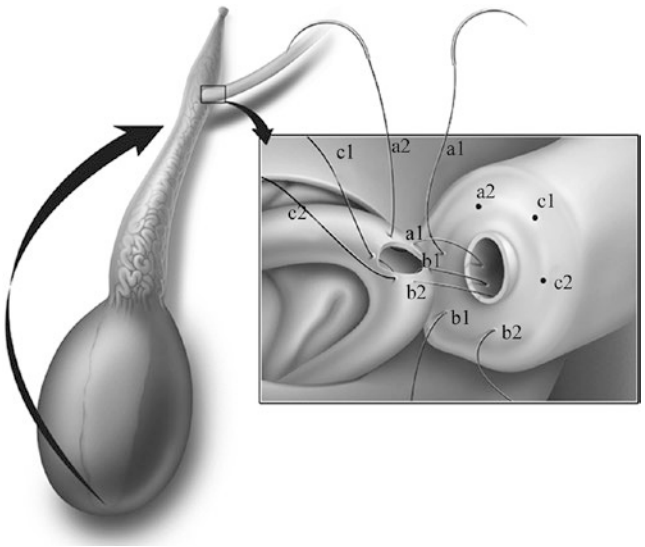

Fig. 14.10 Technique of dissecting the corpus and cauda epididymis to gain further length in cases of short vasal length. This is most helpful when the entire epididymis is dilated. (Reprinted from Goldstein [26]. With permission from Elsevier)

It is also possible to perform an orchiopexy positioning the testicle in a horizontal or even upside-down configuration to decrease the length needed. One must be careful to make sure the cord has no kinks in it and that the stitches do not damage the blood supply to the testis.

In cases where there is a unilateral atrophic testis or the contralateral testis is missing, it is possible to perform a crossed transseptal vasoepididymostomy. This is even more attractive if there is an ipsilateral hernia repair or where there is a second obstruction in the inguinal or abdominal vas. In this procedure, the contralateral vas is harvested as close to the vasoepididymal junction as possible. If vasal length is still inadequate, then the testicle can be pexed in the contralateral scrotal compartment to facilitate a tension-free anastomosis.

14.10 Long-Term Follow-Up Evaluation and Results

Microsurgical vasoepididymostomy in the hands of experienced skilled microsurgeon will result in the appearance of sperm in the ejaculate in 50–85% of men. Classic end-to-side or older end-to-end methods result in patency rates about 70% with a 43% pregnancy rate with a follow-up of 2 years [5, 18]. With intussusception techniques, patency rates are 70–90% with pregnancy rates of 40–45% [6, 14, 19–22]. Regardless of technique, pregnancy rates are higher the more distal the anastomosis is performed [23]. Therefore, one should always strive to make the anastomosis as distal as possible on the epididymis. The advantages and disadvantages of the main techniques we discussed are summarized (Table 14.1).

Another vexing problem is that of late anastomotic failure. With the older end-to-end or end-to-side methods, at 14 months after surgery, 25% of initially patent anastomoses have shut down [12]. With intussusception techniques, the late shutdown rates appear to be less than 10%, but long-term follow-up with these techniques has not yet been reported. Nevertheless, we recommend banking sperm both intraoperatively [24] and as soon as motile sperm appear in the ejaculate postoperatively after vasoepididymostomy, regardless of technique employed. In men with very low counts or poor sperm quality postoperatively and men who remain azoospermic, the sperm intraoperatively cryopreserved can

Table 14.1 Advantages and disadvantages of three main vasoepididymostomy techniques

Techniques	Advantages	Disadvantages
Intussusception (longitudinal intussusception vasoepididymostomy)	Virtually bloodless anastomosis Easier technique with dilated epididymal tubule	Unable to assess for sperm presence before anastomotic setup
End-to-side vasoepididymostomy	Able to assess for sperm presence prior to anastomotic setup No disruption of epididymal blood supply	Difficult to suture to collapsed epididymal tubule
End-to-end vasoepididymostomy	Technically easier inner layer anastomosis Able to assess for sperm presence prior to anastomotic setup Able to assess for sperm presence prior to anastomotic setup Able to mobility the epididymis off the testis for large gaps	Disruption of epididymal blood supply from inferior epididymal artery Difficult outer layer closure Can be difficult to identify proper tubule for anastomosis

be used for IVF with intracytoplasmic sperm injection. Persistently azoospermic men without cryopreserved sperm can opt for either a redo-vasoepididymostomy or microscopic epididymal sperm aspiration combined with IVF and intracytoplasmic sperm injection.

14.11 Conclusion

The modern evolution of vasoepididymostomy has been a remarkable journey. Since Martin's first attempts over 100 years ago, we have continued to make significant strides in the refinement of this surgical technique. Most recently, adoption of microsurgical techniques and intussusception methods of vasoepididymostomy have made this surgery progressively more effective. With the introduction of the two-stitch longitudinal intussusception method, anastomoses have become simpler and easier to teach with a decreasing risk of technical error.

Modern IVF–ICSI has opened up reproductive options for those couples desiring fertility. This has caused some to question the need for advanced reconstructive reproductive tract surgery. However, in the hands of experienced microsurgeons, vasoepididymostomy is a safe, effective method of reconstruction for patients, especially for those who do not want to undergo IVF or desire multiple children. In addition, vasoepididymostomy skills are crucial to have because of the possibility of finding secondary epididymal obstruction at the time of vasectomy reversal. It is of our opinion that any reproductive surgeon who performs vasal reconstruction must be capable of performing a vasoepididymostomy.

While vasoepididymostomy is already associated with good outcomes, we look forward to the future. Further technical refinements will most likely focus on the simplification of the vasoepididymostomy procedure, decreasing operative times and making the procedure more accessible to more surgeons. These developments will come from microsurgical models and animal models. Additionally, collaborative multi-institutional datasets may allow us to find better intraoperative or perioperative predictors of anastomotic patency and pregnancy. Intraoperative factor to evaluate and consider further research into would be factors at the anastomotic site: analysis of the gross fluid quality of epididymal fluid, the effect of microscopic motility, and sperm viability testing during reconstruction.

14.12 Review Criteria

An extensive search of studies examining the vasoepididymostomy outcomes in humans was performed using PubMed in December 2018. The overall strategy for study identification and data extraction was based on the following keywords: "vasoepididymostomy," "epididymovasostomy," and "infertility." Articles published in English were considered. Data that were solely published in conference or meeting proceedings, websites, or books were not included.

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