Chapter 5
Vasectomy Reversal: The First Steps

Performing a correctly performed microsurgical vasectomy reversal is so much more than throwing a few microsutures. There are a number of preparations the surgeon should take as well as key concepts before and during the reversal to ensure that the patient receives the very best care and surgical outcomes. This chapter highlights some of the critical steps and how we work through challenges in our program before and during the pre-anastomosis portion of a vasovasostomy or vasoepididymostomy. Confirming that the OR has all that you will need before you start the reversal ensures that there will be no surprises. It is important to understand crucial principals about preserving the tissues, locating the vasal defect, confirming abdominal patency, and transecting the vas. Analysis of the vasal fluid, both gross and microscopic, guides the intraoperative decision-making as to whether to perform a vasovasostomy or vasoepididymostomy. Challenges often occur with indeterminate vasal fluid with concerns about cross contamination. Sperm banking during the reversal is an option to be discussed preoperatively with the patient.

Confirm Before You Start

Before each and every case, especially at surgery centers and hospitals, it is important to confirm with your OR circulator that they have available and ready all of the critical microinstruments, enough specific microsutures and whatever else may be necessary for you to perform the reversal that day. It is smart before you start to also confirm backup light bulbs are available for the surgical microscope and lab scope. If you have performed reversals long enough at a variety of centers, you will most likely have been halfway through a reversal when the circulating nurse announces that they have run out of the specific microsuture that you just asked for and that you routinely use, offering you instead something similar that they think should be fine (and rarely is). If intraoperative sperm banking is an option, you should have the special prep ready, such as a vial of HTF (human tubule fluid/sperm washing

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medium, Irvine Scientific, Catalog ID 9983), and confirm that the andrologist is there on-site and ready to accept the specimens. Finally, verify that the OR has your vasoepididymostomy microinstrument tray and microsutures ready, if needed, even if the patient has a short obstructive interval from vasectomy and you anticipate a VV.

Prophylactic Antibiotics

We routinely give all patients perioperative prophylactic broad-spectrum antibiotics – cephalexin (Kefzol) 1 gram IV – to prevent infection. Though the risks for infection are rare in a "clean-contaminated" wound and many experts do not use prophylactic antibiotics unless the patients are considered high risk [1–3], any intrascrotal infection can be devastating to the patient, disastrous for the success of the reversal, and make any future surgery or a redo reversal attempt especially difficult.

Vasovasostomy: Pre-anastomosis

As you begin the reversal, there are a number of key steps before the surgery begins and then to retrieve and prepare the vas before the anastomosis. Taking the time to address these points will allow for easier surgery with fewer problems and better results.

Pre-reversal Exam

Once the patient is adequately sedated or asleep under general anesthesia, it is smart to perform a scrotal exam, before or after the prep and drape, to better assess the patient's specific anatomy and any post-vasectomy findings. You will get much more information with a better exam when the patient is sedated or asleep than you can preoperatively. This allows you to evaluate the vasal gaps for their location in the spermatic cord, the length of the gaps, possible clips or ties, the presence of a sperm granuloma, and, if present, the size, as well as other pathology. This can include thickening of the cord with induration from a prior bleed, infection, or failed prior reversal attempt, epididymal cysts, and the presence of a hydrocele or a testicular or spermatic cord mass. This is when you will get the most information from an examination of the testicle for any pathology, peri-testicular scarring from prior surgery, any atrophic changes, masses, or evidence of prior trauma. This added information will allow you to more precisely plan the surgical approach and the

incisions and anticipate and address any anatomic or surgical issues or concerns that may impact on the reversal.

Local Anesthesia

We infiltrate about 10 cc of local anesthetic solution into the scrotal skin along the planned incision site and underlying subcutaneous tissues before we start, even if the patient is under general anesthesia. We have found we achieve the best results with a 1:1 solution of 2% plain lidocaine and 0.5% plain bupivacaine. Once we have made the incision, we instill more local anesthetic high in the proximal spermatic cord and peri-vasal tissues. It is important to take care not to inject the local into the vas itself. If the incision must be extended, then infiltrate additional local along the anticipated incision path. Providing a cord block before addressing the vas and performing the reversal ensures that patient remains comfortable and pain-free during and after the procedure.

Incision Options

Most reversals are performed using a single midline vertical scrotal incision or two lateral vertical scrotal incisions (Fig. 5.1). Though there are advantages to both, we have found that most often the technique preferred by each surgeon is the approach learned in their residency or fellowship training.

When considering the length of the incision, in general it is best to use the smallest incision or incisions possible that will allow for adequate access and visualization of the damaged vas. Most often a 3–4 cm incision is fine. Wherever the incision(s), you should allow for possible extension as warranted by the intra-op findings and possible need for delivery of the testicle for a vasoepididymostomy or extended abdominal peri-vasal dissection. In my practice, I have found that a single midline incision provides plenty of access almost all the time whether for a VE or for more proximal exploration. If, at the time of the pre-reversal exam, I have concerns about a high abdominal vas or lengthy gaps, then I will use lateral vertical scrotal incisions. Dr. Peter Burrows here at our center prefers the two lateral vertical incisions.

Some experts prefer to use the mini-incision technique as proposed by Dr. Keith Jarvi, which for selected cases may be a viable option [4–6]. Each side must be assessed for anatomy and post-vasectomy changes to determine the size and location of incision(s) and if a mini-incision is appropriate. If the mini-incision approach is found to be inadequate, then the incision can be extended as needed. The concern with the mini-incision approach is that it is important to be careful not to make incision too small, which could limit direct visualization of the vas and peri-vasal

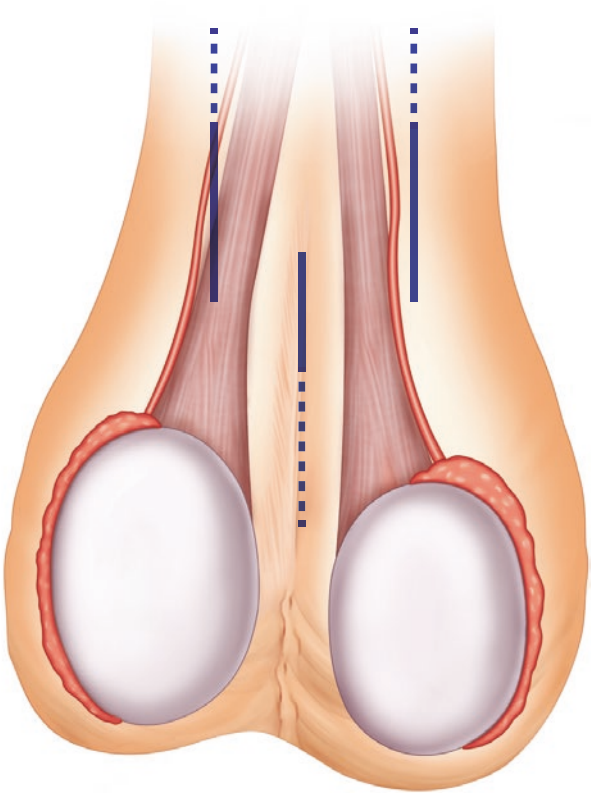

Fig. 5.1 Most experts use either a single vertical midline scrotal incision or two lateral vertical scrotal incisions

tissues, and so theoretically increase the risk for missing a bleeding vessel. Though a small incision is very appealing to patients, I have only had one patient in more than 3 decades, and many thousands of reversals complain that the 3 cm scrotal incision that we used was too long.

Finding the Vasectomy Site

Palpate the entire length of the vas superiorly to inferiorly, between the thumb and forefinger, gently feeling for a gap, metal clips, ties, or subtle thinning or thickening to identify and localize the damaged portion of the vasectomy site or adherent scar or fat. Usually this is easy to find. Often the only sign is dense or vascular changes in the peri-vasal tissues overlying the vasectomy location.

If You Are Unable to Identify the Vasectomy Site

On rare occasions the vasal defect or scar from the vasectomy might not be identified. If no palpable irregularity or deformity is easily identified, then visually look at the length of the vas through the surgical microscope for any remnants of any vasectomy sutures that may be present. Sometimes pinpoint black or blue dots are a clue that may represent residual sutures. Other times you can see an amber dot or nodule of an absorbable suture. Another trick is to look for the localization of any fat or adventitia that may be adherent to the vas. If this fat is gently teased off the vas, often you can see remnants of ties or of the damaged vas that was otherwise felt to be intact. Sometimes we have been surprised to find the vasectomy site much further down in the very deep convoluted vas or even a small wedge of the tail of the epididymis excised. What makes this even more challenging is that the vasectomy on the contralateral side may have been performed where most vasectomies are usually located up in the mid straight vas.

If the vasectomy site is still not localized, we have found that if you deliver the testicle, if not already done, this may allow you to find the vasectomy site if very low deep in the convoluted vas or distal epididymis. You may need to open the tunica vaginalis for examination of the distal epididymis. Other times, we have found the vasectomy site very high up in the scrotum, just below the inguinal canal (Fig. 5.2). It may a good idea at this point to move over to the contralateral side and see if the vasectomy site can be identified there. If so, then repair that side and return to the initial side, knowing what to look for.

If you are still unable to localize the vasectomy site, and the patient has a known history of hernia repair, orchiopexy, torsion, or any inguinal or pelvic surgery, then we presume that the vasectomy was performed in the groin or pelvis concomitantly with the other inguinal or pelvic/abdominal surgery [7–10]. It is important to realize this concern is not just with pelvic surgeries, as we have had a patient that had an intra-abdominal laparoscopic vasectomy at the time of elective cholecystectomy. Another patient had a laparoscopic vasectomy on one side when his hernia was repaired and a transscrotal vasectomy through a midline incision on the other, so the patient, not understanding, thought the vasectomy was performed transscrotally on both sides. At this point we rereview the medical records and also closely reexamine the patient for an inguinal incision to see if the vasectomy may have been performed inguinally. With so many inguinal hernias repaired laparoscopically, alone or concomitantly with other pelvic or abdominal surgery, there are instances when there is no identifiable vasectomy site, no inguinal scar and no history of hernia repair. This is when we or the nurse would talk to the partner, if available, to see if she might be aware of any abdominal or inguinal surgery that they forgot to mention.

Very rarely, you may not be able to find the vasectomy site. If you are unable to identify the vasectomy site on one or both sides, then you have several options. You may perform the reversal only on the contralateral side where you are able to

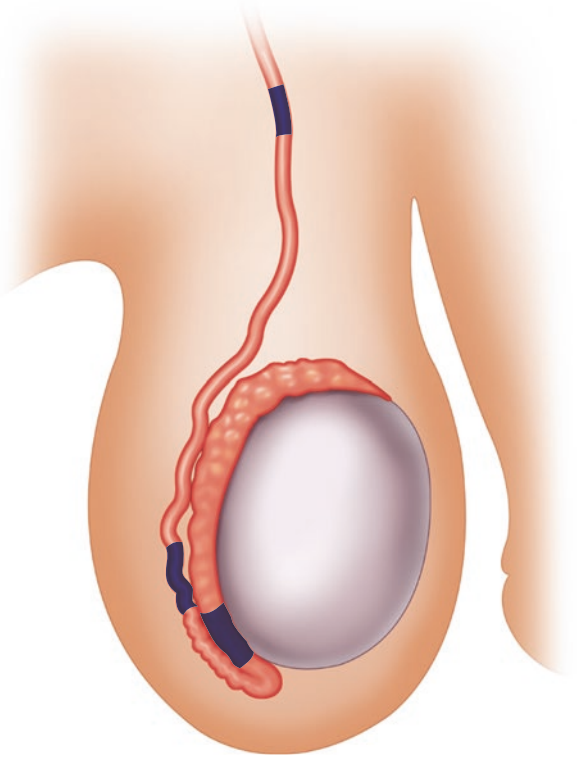

Fig. 5.2 The transscrotal vasectomy site can be very low, deep in the convoluted vas or even within the distal epididymis or very high in the scrotum, almost subinguinal

localize the vasectomy site and then in the future discuss options if the post-unilateral reversal results are not adequate. Another is to not proceed with the reversal at that time and instead advise the patient that a laparoscopic evaluation is indicated and either reschedule or refer to an expert experienced in robotic laparoscopic vasovasostomies. Another is to make an "educated guess" based on your experience where you think the vasectomy was performed and assess the patency of the abdominal and testicular vas to see if there is any proximal or distal obstruction that might localize the vasectomy site. If the abdominal vas on the contralateral side is open and healthy but there is epididymal obstruction, with known or presumed inguinal obstruction and no epididymal blockage on the ipsilateral side, it may be reasonable to perform a transseptal crossover where the long abdominal segment of the contralateral vas is brought over through the septum and anastomosed to the testicular vas above the healthy testicle and open epididymis [11, 12] (Fig. 5.3).

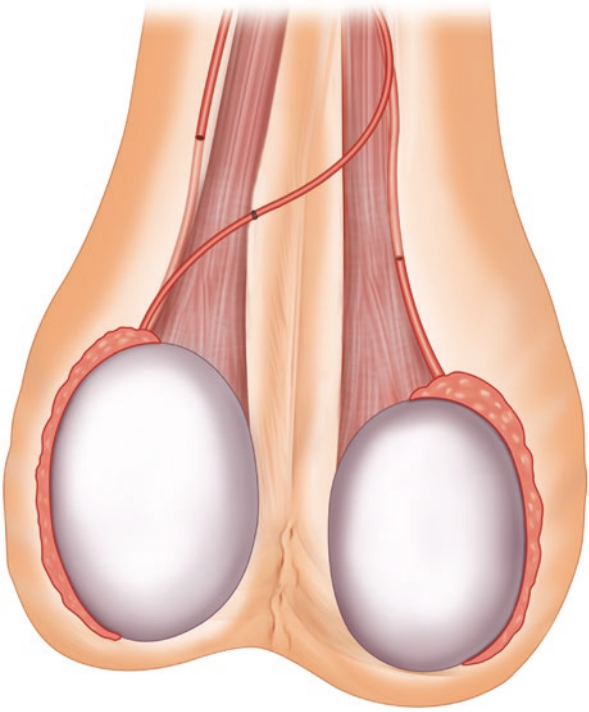

Fig. 5.3 A transseptal vasovasostomy with the long abdominal vas brought through the septum to be anastomosed to the contralateral testicular vas

Once the Vasectomy Site Is Localized

Evaluate the vas and defect for important information, to include the length of the vasal gap, extent of vasal damage and scar, presence and location of metal clips or ties, as well as possible calcifications in the vas. Though most often the vasal gap is one or two cm in length, there are occasions you may encounter a 5–7 cm gap between the abdominal and testicular vas. Many times, we have found that the actual extent of vasal damage from the vasectomy was much more than what would have been predicted by the pre-op palpation of the vasal gap. This can be from vasal damage from placement of metal clips across the vas many centimeters above and below the excised segment (Fig. 5.4) or from excessive intravasal or peri-vasal cautery at the time of the vasectomy (Fig. 5.5) or scarring from other intrascrotal surgery or trauma, post-reversal peri-vasal bleeding, hematoma, or infection.

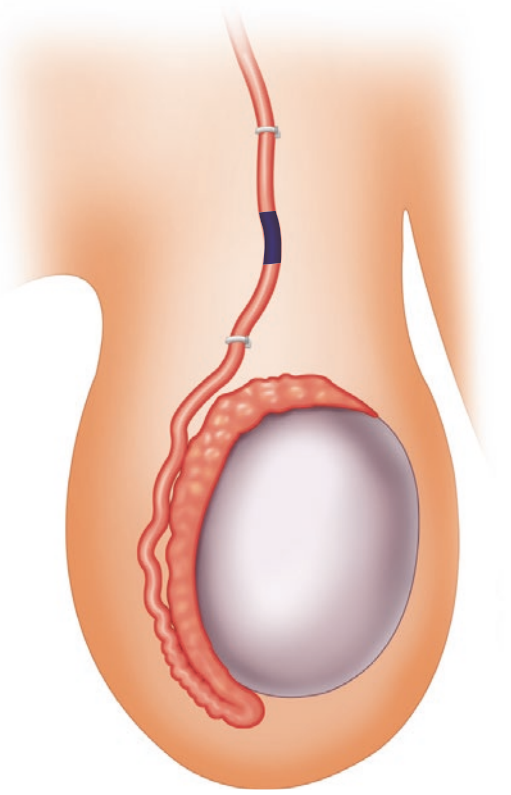

Fig. 5.4 Metal clips placed on the vas several cm above and below the small excised vasal segment

Delivery of the Vasectomy Site

There are two schools of thought when it comes to delivery of the vasectomy site through the incision. The first approach and the one that I use is to simply deliver just the portion of the vas that contains the vasectomy site so that it looks like strand of spaghetti looping out of a button hole. The other technique is to deliver the entire hemiscrotal contents (cord and testicle) on that side. Of course, it's about what works best for you and your patient.

Delivery of Just the Vas

Once you have identified the vasectomy site, then it is usually very simple to deliver and excise the portion of the vas that contains the vasectomy scar with enough vas to be able to easily perform the repair (Fig. 5.6). Then, if you need to proceed with a vasoepididymostomy, it is easy to extend the incision inferiorly as much as needed so that you can deliver the testicle. Most often the small incision is enough to bring out the testicle for the VE.

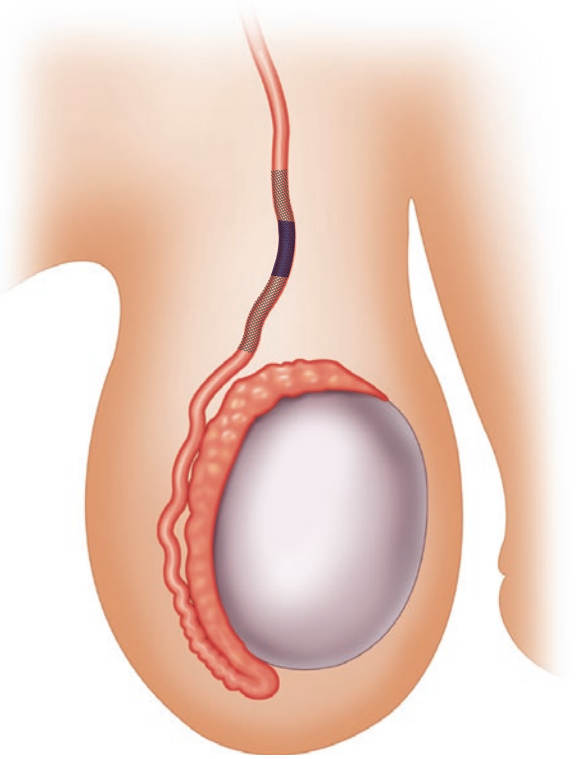

Fig. 5.5 Excessive vasal scarring proximal and distal to the vasectomy gap presumed from excessive intravasal or peri-vasal cautery

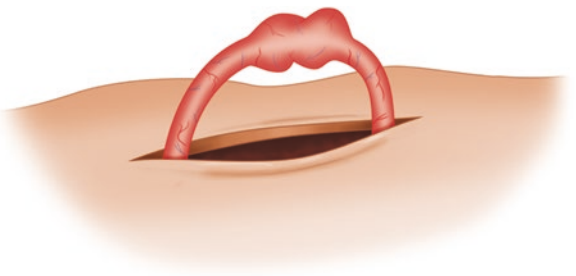

Fig. 5.6 Delivery of just the vasectomy site and adjacent healthy vas out of the incision

Delivery of the Hemiscrotal Contents

There are other reversal experts that prefer to deliver the hemiscrotal contents on each side, leaving the tunica vaginalis intact unless access to the epididymis is needed (Fig. 5.7). They feel that this approach provides for better visualization of the vas and testicle and allows for easier access to the epididymis for evaluation and/or vasoepididymostomy.

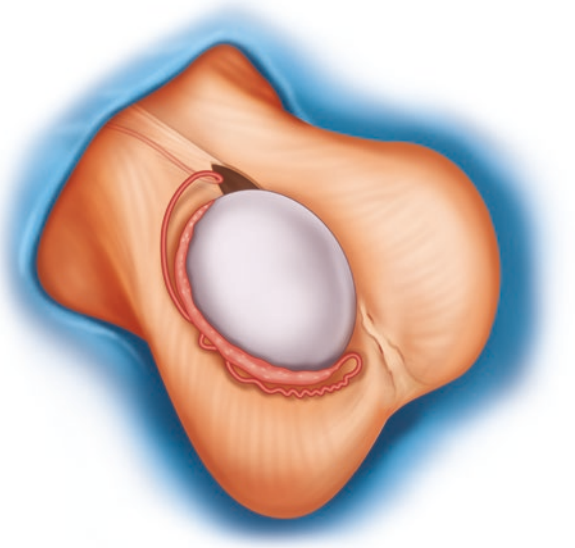

Fig. 5.7 Delivery of entire hemiscrotal contents

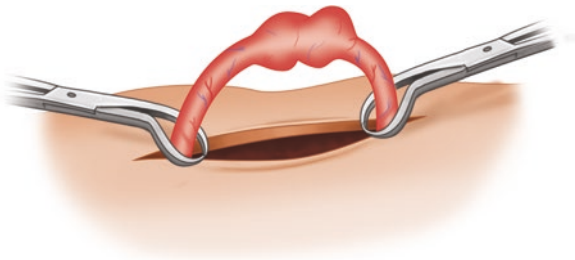

Fig. 5.8 Secure the vas with a fine-tipped towel clamp placed around the proximal and distal vas and peri-vasal tissues

Secure the Vas

It is important to quickly secure the vas, proximally and distally, prior to transection of the vas. I have found that fine-tipped sharp towel clamps work well in my practice to secure the vas, placed around the vas and peri-vasal tissues as far up and down the spermatic cord as you can (Fig. 5.8). Be careful to place the points of towel clamps behind the vas under direct vision to avoid inadvertently damaging any underlying peri-vasal vessels. Then, when the secured vas is transected, the cut ends of the vas won't retract and pull back deep inguinally or down to the testicle. If the vas is not properly secured and does pull away and retracts deeply, this can force you to go "hunting" for the transected end. This can be especially challenging if a small vessel is actively bleeding and distorting the normal anatomy, making localization and retrieval of the retracted vas more difficult. We then leave these securing towel clamps in place throughout the reversal and remove them only after the anastomosis is complete, and we have verified there is no bleeding.

Preserve and Protect the Peri-vasal Blood Supply

Absolutely no cautery should be used directly on or near the vas. Only use bipolar to control vasal bleeding and never on the transected face of the vas or at the lumen. Small peri-vasal vessels can be tied with nonabsorbable suture such as 5–0 to 7–0 nylon. It is best to avoid using absorbable sutures on or adjacent to the vas as the tissue reaction and inflammatory reabsorption process of the suture material may generalize into adjacent tissues and the vas and so theoretically might increase the risks for intravasal inflammation and scarring.

Do Not Skeletonize the Vas

Do not skeletonize the vas by peeling back or removing the adventitia to expose a "cleaner," more pristine vas in preparation for transection. To maintain the critical vasal blood supply, it is critical to allow the adventitial tissues to remain intact and adherent to the vas right up to the transected face throughout the reversal. Quite often when we perform a redo reversal, we encounter a nonviable, atretic segment of vas above and/or below the anastomosis site, which is consistent with a compromised blood supply to the ends of the vas at the time of the failed first repair. This will make an easier and more aesthetically pleasing repair but actually increases risks for ischemic scarring from devascularization.

The Microblade

Microblades used to transect the vas are extremely sharp and delicate, so they often become dull after just two or three passes through the vas. To ensure a smooth transection of the vas with minimal trauma, replace the blades frequently, especially if you inadvertently drag the blade across a metal clip. A dull blade causes more trauma as it tears and shears rather than slices cleanly through the vas. Be careful as some of the stainless steel microblades can be very brittle and easily break into multiple small pieces, which are difficult to find in the open wound. Do not try to force a blade that is too thick through the guide slot. Before you insert a microblade into the guide slot of the vas cutting forceps, inspect the blade under the surgical microscope to confirm that the blade is clean without any adherent debris, dried blood clots, or irregularities along the cutting edge. These can cause snagging or dragging of the blade as it is drawn though the vas, which can lead to an irregular, ragged transection of the vas.

There are a few tricks that can reduce costs and ensure that you have the sharpest blades. One is to cut the long 35 mm straight microblade (ASSI.CBS35) in half with standard heavy bandage scissors (Fig. 5.9). Instead of having one long blade,

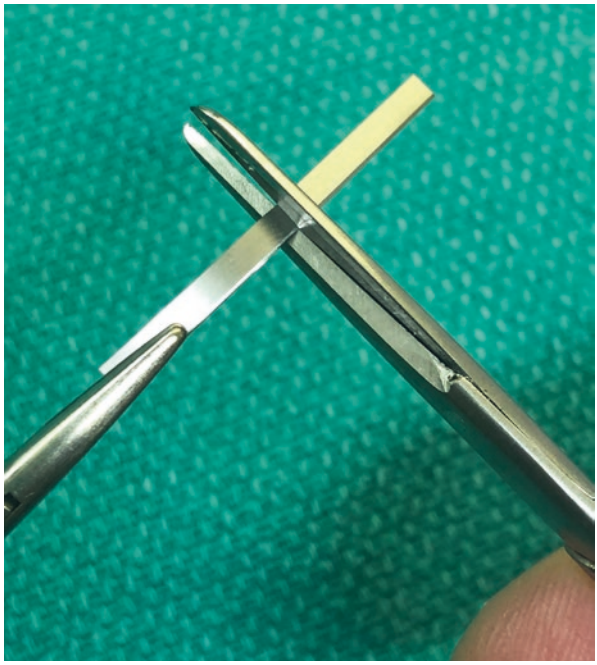

Fig. 5.9 Cut the microblade in half with heavy scissors to provide two blades, each with a fresh cutting surfaces on either end. (Photo Credit: Sheldon Marks)

now you have two halves, and each half can be used twice on each side for a total of four to six passes per half. After two passes on the first side, simply flip and secure the half blade in the blade holder (ASSI.BHS12), and you can usually use the unused half for the second side. This allows you to cut your costs so that in most instances you can use only ½ of a microblade for the entire reversal. If you find that you do need another blade, then the other half will already be sterilized and available. A second trick to have incredibly sharp blades and save even more money is to use a standard "old-fashioned" safety razor blade and simply cut off the long, thin connecting segments with heavy bandage scissors (Fig. 5.10). We have had very good results with this technique at a fraction of the cost of the standard surgical microblades.

Transection of the Vas

Transecting the vas above and below the vasectomy scar is not just cutting out the damaged vas and scar. It is critical to use the right tools with the best techniques to minimize trauma and ensure the ideal anatomy to make the technical anastomosis easier and minimize complications. These are the techniques, tips, and tricks we use when preparing the vas for the repair.

Fig. 5.10 Use heavy scissors to cut out the central arms of a safety razor blade, providing two long blades. (Photo Credit: Sheldon Marks)

Vas Cutting Forceps: Angled, Straight, or 11 Blade

The goal is to achieve a smooth, cleanly cut face of the vas to allow for a more precise coaptation of the abdominal and testicular vas. There are the options most top reversal experts use to hold and transect the vas. The most common three are:

1. Angled Marks Vas Cutting Forceps (ASSI.NHF-2.15, 2.5.15 or 3.15)
2. 90° blade slot vas/nerve holding forceps (ASSI.NHF-2, 2.5, or 3)
3. #11 scalpel blade over 6-inch sterile wood tongue depressor

Most experts prefer the use of a vas cutting forceps (also called a nerve holding clamp) (Fig. 5.11) with a fresh Dennis, Beaver, or similar microblade through the eccentrically located blade slot. This technique offers a more precise transection of the vas, which is held securely in place so there is less shearing and crushing trauma to the vas than with the use of a thicker 11 blade, where the vas is compressed down as it is cut over a sterile wood tongue depressor.

The angled Marks Vas Cutting Forceps with a 15° blade guide slot (Fig. 5.12) was developed with a leading expert in wound healing to create a slightly larger

Fig. 5.11 A 90° vas cutting forceps (ASSI). (Photo Credit: Sheldon Marks)

elliptical lumen of the vas and so increase the surface area rather than round lumen obtained with a standard right-angle transection [13]. A recent review demonstrated that the angled vas cutting forceps provides a higher success with reduced anastomotic stricturing and obstruction, presumed to be from larger elliptical lumen. When you use the angled vas cutting forceps, note the instrument labeling on the side of the forceps facing the surgeon to be replicated on the second vasal transection. This then ensures that the angled cut faces of the vas are aligned to maximize the approximation of the lumens (Figs. 5.13 and 5.14).

Positioning of the Vas Cutting Forceps

Place the vas cutting forceps over the entire vas, including the peri-vasal adventitia. This should be positioned in its natural orientation and on no traction within several mm just above or below the vasectomy site and any metal clips, in what feels and appears to be normal smooth vas, free of scarring and induration (Fig. 5.15). Confirm that the vas is mobilized enough so that when secured, the vas can be easily rotated at least 90° each way. When you transect the abdominal vas above the vasectomy

Fig. 5.12 The Marks angled vas cutting forceps by ASSI with a 15° blade slot to increase the elliptical surface area of the lumen. (Photo Credit: Sheldon Marks)

Fig. 5.13 Confirm that the same instrument labeling is always facing the surgeon when transecting both the abdominal and testicular vas so the angled of the face of the vas is consistent on both sides. (Photo Credit: Sheldon Marks)

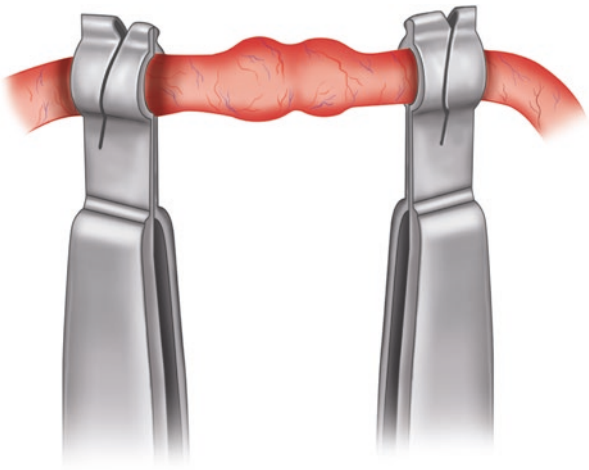

Fig. 5.14 Alignment of both the abdominal and testicular transected vas to maximize the increase elliptical lumen size

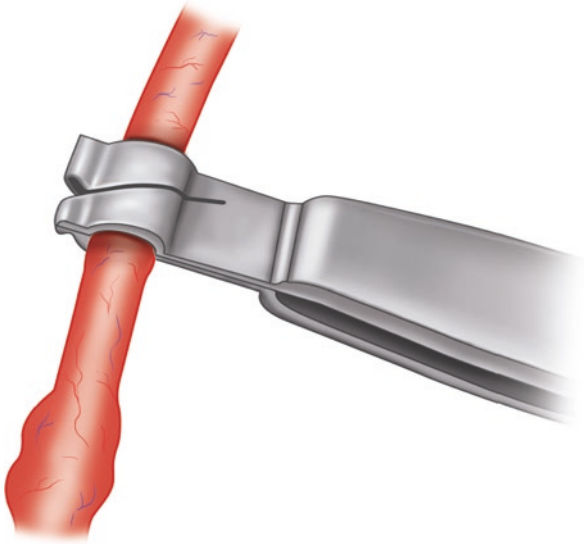

Fig. 5.15 Place the vas cutting forceps onto the vas several mm from the damaged vas, on no traction

scar, preserve as much vasal length as possible. The challenge is to be as close to the vasal defect as you can to ensure the transection is in healthy vas without any vasal damage or scarring from the vasectomy. Be sure the vas cutting forceps are holding the vas at a 90° angle to the line of the vas when you pass the blade (Fig. 5.16). Identify and do not include any large peri-vasal blood vessels in the vas cutting forceps.

Transecting the Vas

Under direct vision through the surgical microscope, insert the clean blade all the way through the top of the guide slot in the vas cutting forceps, above the vas, to the hilt of the blade holder (Fig. 5.17). If there is dense or especially thick peri-vasal adventitia, then you can also pass the blade up into the forceps guide slot from the open side. Having all three sizes of the slotted vas cutting forceps, 2.0, 2.5, and 3.0 will allow you to use the most appropriate vas cutting forceps that best fits the diameter of the vas (Fig. 5.18). Pull the blade with a gentle but firm downward minimal

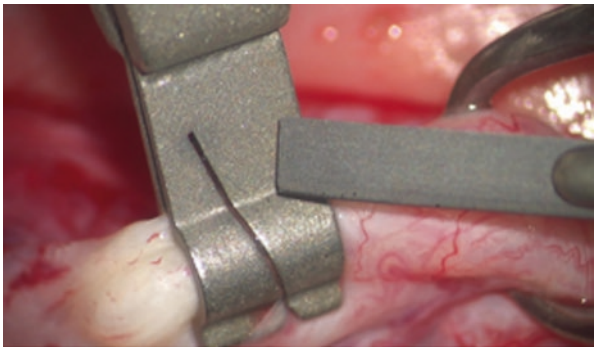

Fig. 5.16 Hold the vas cutting forceps at a right angle to the vas, avoiding any large peri-vasal blood vessels. (Photo Credit: Sheldon Marks)

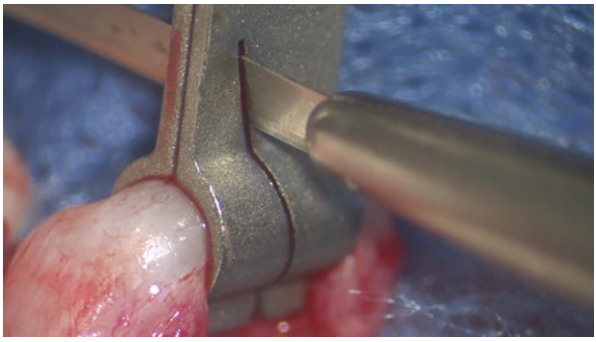

Fig. 5.17 Microblade is inserted completely into the top of the blade slot. (Photo Credit: Sheldon Marks)

Fig. 5.18 Use the most appropriate of the three sizes of the Marks angled vas cutting forceps, 2.0, 2.5, and 3.0. (Photo Credit: Accurate Surgical and Scientific Instruments, Corp. [ASSI])

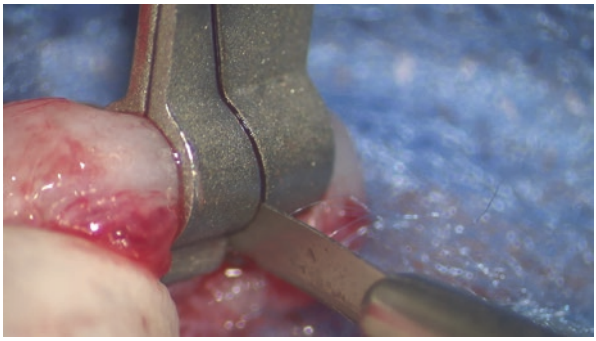

Fig. 5.19 With a single pass, draw the microblade toward the surgeon with gentle downward pressure. (Photo Credit: Sheldon Marks)

Fig. 5.20 Grasp the transected edge of the peri-vasal adventitia with microhemostat. (Photo Credit: Sheldon Marks)

pressure as you draw the blade toward yourself. Avoid a sawing, back-and-forth rocking motion (Fig. 5.19). This should be easy to do with a single pass when using a fresh, clean blade. If the blade only partially transects the vas or you feel a scraping, dragging sensation, then this tells you that the blade is dull or that you are cutting through scar or up against a metal clip. Replace with a new blade and recut the vas 1 or 2 mm over after you clean the blade guide slot to wash away any debris or clots.

After you have passed the blade, immediately grasp and secure the edge of the cut adventitia with the tip of a microhemostat (Fig. 5.20). Then take a moment to look through the surgical microscope at the small peri-vasal and adventitial blood vessels around the transected the vas as these vessels can be inadvertently partially incised or totally cut when the blade is passed. If any vessels have been cut, then tie or use bipolar to control any bleeding.

Remove or Leave the Vasal Scar/Granuloma

Whenever possible, we prefer to excise the damaged vasectomy scar and adjacent remnants. We always excise a sperm granuloma with any scar rather than leaving this inflammatory mass in place, adjacent to the new repair. Care must be taken removing a granuloma as often there may be significantly increased vascularity in

the peri-granuloma tissues. The only reason to bypass and leave the damaged vas in place is when there is multiple large blood vessels coursing through dense, perivasal scar or if there is a lengthy segment of very minimal scar in the gap between the ends of the vas (Fig. 5.21).

Examine the Transected Face and Vasal Lumen

Knowing what to look for after transecting the vas will significantly improve the ease and success of the anastomosis. Taking the time to be sure that transected vas is not still in scar or that the lumen is not ideal will make passing of the microsutures easier with fewer problems.

What's the Goal?

After the vas is transected, it is important to closely examine the face of the abdominal and testicular vas through the surgical microscope to be sure that you have a clean, healthy vasal face with no scarring or irregularities. The goal is a centrally located lumen with round, symmetric "bulls-eye" muscularis layers with a clean mucosal edge clearly defined (Fig. 5.22). Then examine the vasal lumen to be sure that the mucosal edge is visible, clean, and healthy appearing. If needed, you should be able to easily place the tip of microforceps just inside the lumen and gently open to better visualize a mm or 2 up inside the lumen (Fig. 5.23). You can use this

Fig. 5.21 Vasal remnant with minimal scar can be bypassed

Fig. 5.22 The goal is a centrally located lumen with round, symmetric "bulls-eye" muscularis layers with a clean mucosal edge clearly defined. (Photo Credit: Sheldon Marks)

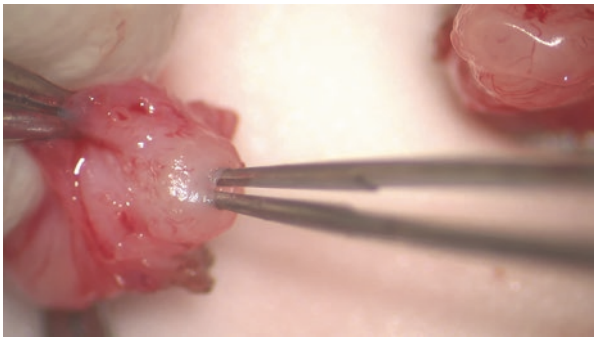

Fig. 5.23 Insert the tip of the microforceps just inside the lumen and gently open to better visualize a mm or 2 up inside the lumen. (Photo Credit: Sheldon Marks)

technique to better visualize the lumen and mucosal edge and provide countertraction when passing the luminal 70 or 100 micron needle.

Do Not Dilate the Lumen

It is not wise to forcibly dilate the lumen with lacrimal dilators or forceps. In fact, there is really no reason to use lacrimal dilators. This old technique is unnecessary and should be abandoned as it causes stretching, tearing, and microtrauma to the delicate luminal mucosa and so potentially increased risks for subsequent scarring. If the lumen is felt to be too tight from scar or because the transection is too close to the damaged portion of the vas, then the solution is to re-resect the vas a few mm more proximally or distally. It is acceptable to use the tips of the microforceps barely inserted into the lumen to gently separate the edges and allow for better visualization of the luminal edge when passing the needles. Sometimes you will find that the mucosal edge can retract several mm up into the abdominal lumen. There are other times where the abdominal vas can have a protruding, "pouchy" mucosa. For both of these situations, the vas should be recut a few mm more proximally or distally until the lumen mucosa is clean and in line with the transected face of the vas.

If the Vas Is Scarred or Irregular

If there is scarring or irregularity of the muscularis or if the transected vas is not ideal, then it is wise to recut the vas superiorly or inferiorly an additional 1–2 mm, again based on palpable and visual findings (Fig. 5.24). Continue to transect the vas, and reexamine through the microscope until a clean, smooth vas with a healthy bulls-eye appearance with central lumen and clean mucosal edge is visible.

Fig. 5.24 Irregular or scarred transected face of the vas

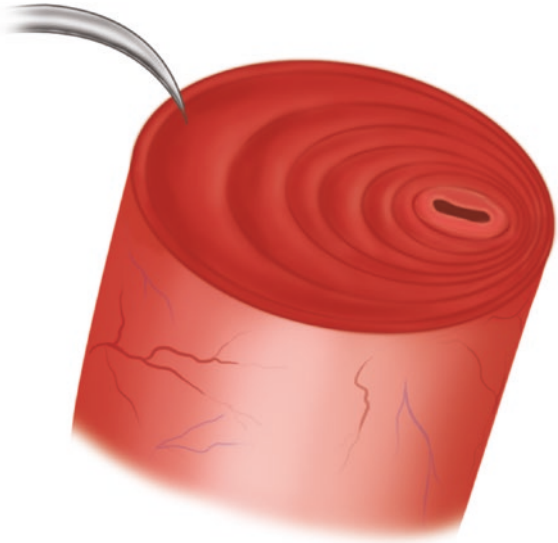

Fig. 5.25 Eccentric vasal lumen

Eccentric Lumen/Convoluted Vas

If an eccentric, angled lumen is seen, the vas should be retransected as this often has a thin overlying portion of the muscularis (Fig. 5.25). It may take several transections of the vas to find a more centrally located lumen. If the vas is convoluted and has a very thin wall on one side, then recut until you have a more central lumen.

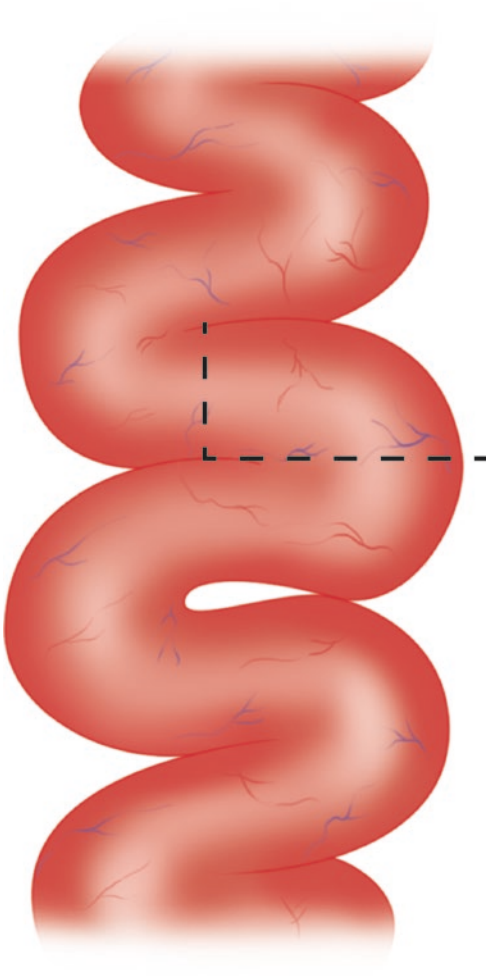

Fig. 5.26 Transect at the apex of the arch in the convoluted vas or along the straight portion in between the arches in convoluted vas to find a more centrally located lumen

If the testicular side is in located down in the convoluted vas, then finding a good central lumen can be challenging. It is best to transect the vas at the apex of arch of the convolution or in the mid vas equidistant from the two arching portions (Fig. 5.26). If there is adequate vasal muscularis around the lumen, then a less than central lumen may be acceptable [14, 15].

Confirm Abdominal Patency

The most common technique to confirm abdominal vasal patency is with a saline vasogram. To do this, cannulate the lumen of the abdominal vas through the surgical microscope with just the tip of a 24-gauge Angiocath on a 3 cc syringe. Gently instill 1–3 cc of heparinized saline or lactated Ringer's solution up into the lumen of

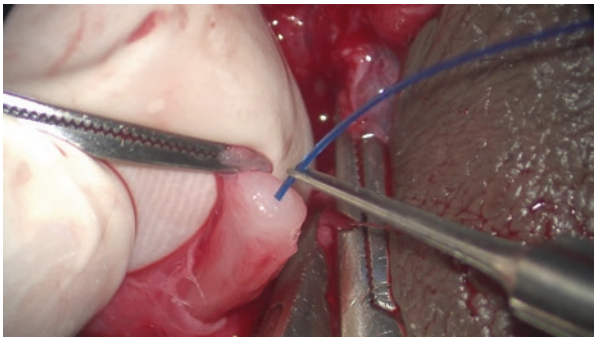

Fig. 5.27 Passing of the 0 polypropylene into the abdominal vas to identify the location of obstruction. (Photo Credit: Sheldon Marks)

the abdominal vas. If the fluid flows easily when instilled into the lumen, then this is presumptive evidence that the abdominal vas is open and not obstructed. Most often the fluid will flow easily. Do not forcibly push the fluid. There are times when the fluid will still flow, but more slowly.

If the fluid does not instill easily into the abdominal vas and instead sprays back when you try to introduce fluid into the lumen, this suggests a more proximal blockage such as in the groin or pelvis. We then gently pass the blunt end of a 0 polypropylene (Prolene®) up the lumen into the abdominal vas. Be careful to inspect the end of the polypropylene suture under the surgical microscope before you use it to be sure that it is not sharp or angled which might scrape and injure the delicate mucosa as it is passed up. If it is sharp, recut and smooth out the end of the polypropylene before it is inserted into the vas. If you encounter any obstruction when passing the suture so that the suture can't be passed any further, then we clamp a hemostat on the polypropylene where it enters the abdominal vas, withdraw the polypropylene, and measure the length of the suture from the hemostat to the end of the suture. We then place the length of polypropylene overlying the path of the vas up to localize the level of obstruction. Most often, in my experience, the blockage is usually in the inguinal region (Fig. 5.27).

There are other experts that prefer to perform a dye vasogram. They instill 2–3 ml of diluted indigo carmine in a 1 : 10 dilution into the abdominal vas via a 24-gauge Angiocath. After the dye is instilled into the vas, the bladder is catheterized, to obtain urine. The presence of blue to green urine verifies vasal patency. Repeating this on the second side adds the challenge of already having dye in the bladder from the previous vasogram on the first side. A formal radiographic vasogram, which is primarily beneficial before a robotic-assisted pelvic vasovasostomy to confirm and localize any obstruction, can be performed with 2–3 ml of diluted water-soluble contrast medium.

Vasal Fluid Analysis

Analysis of the vasal fluid is the most critical step that is often overlooked by many doctors that perform vasectomy reversals. The only correct way to decide whether to perform a VV or VE is with information from both the gross *and* microscopic

vasal fluid analysis. It is not in the patient's best interests nor does it meet the standard of care for the surgeon to not appropriately assess the vasal fluid. Some doctors instead make assumptions based exclusively on the obstructive interval and the gross fluid alone or use other parameters as the justification for the reversal technique used. There are others that will only perform a bilateral VV on every patient. It is generally agreed by leading experts that if you are going to offer your patients a reversal, then you have the responsibility to analyze the vasal fluid microscopically to dictate whether to perform either VV or VE so that they receive the correct technique with the best possible chances for success.

Gross Fluid Findings

Look at and document the color, consistency, and volume of the vasal fluid from the testicular vasal lumen. Though the fluid usually remains the same, you may note that the color, consistency, and/or volume can change during the repair. For example, there are times when the fluid may be a mild volume initially and then, with time, the vasal fluid volume can increase and become moderate or even copious.

The vasal fluid volume is described as none, minimal, mild, moderate, and copious. I record the best fluid volume seen. We rate the vasal fluid color as clear, murky, white, yellow, or brown. Consistency of the vasal fluid is rated as watery, creamy, thick or paste-like. There are times when the fluid is more gel-like or even like crankcase oil. Some prefer to describe the fluid consistency as water-soluble or water insoluble. I cannot emphasize enough that the gross vasal fluid findings alone are not appropriate to use as the sole determinant for whether to perform a VV or VE. On occasion, you might initially find creamy white fluid that you will think is most likely consistent with a deeper epididymal obstruction, only to find whole sperm in the fluid microscopically. In the case of indeterminate microscopic findings, it is then appropriate to include the gross fluid findings as suggestive to help in your decision-making.

Preparing the Glass Slide

After the vas is transected, most often fluid will efflux from the testicular lumen. Simply dab the end of a sterile glass onto the transected face of the testicular vas to obtain a small drop of vasal fluid from the lumen. Quickly pass the slide to the circulating nurse to immediately apply a cover slip so that the drop does not dry out, which would still allow for sperm to be visualized but would prevent seeing any motility. As noted, oftentimes the first drop out of the vas is not representative of fluid that follows in gross or even microscopic findings. Do not be in such a hurry to only look at one slide if it is not favorable for a VV, which will have a higher chance for success than a VE. There are occasions when you will only see sperm

debris, which during the anastomosis can progress to fluid with sperm with partial tails or even whole, motile sperm. I usually check several slides as the fluid starts to efflux if the first slides do not show adequate sperm or parts. To stay organized or if we need to look back at the slides, we attach to each slide a label with patient information and write on the slide with a Sharpie "right" or "left" and the number of slide, such as L1 or R4.

If the vasal fluid volume is minimal, then quickly add a small drop of heparinized saline, HTF, or LR to the drop of vasal fluid to keep it from drying out before the cover slip can be placed and the slide reviewed. If the vasal fluid is too creamy or thick, then we can add a small drop of irrigant and stir to dilute the fluid on the slide so that it becomes less dense, which makes it much easier to visualize any sperm that might be overlooked in the thicker specimen, dense with all the cellular debris. Another tip if there is no visible fluid at the lumen is to put a tiny drop of heparinized saline, HTF, or LR on the slide, and then touch this drop to testicular the end of the vas, as this will often pick up microscopic sperm. This absence of any vasal fluid is more common after excision of a sperm granuloma.

Techniques to Identify Sperm when None Are Seen in the Initial Vasal Fluid

1. *Review several consecutive slides* as sometimes sperm will be seen on subsequent slides even if none were present on the initial slides.
2. *Gentle milking* of the vas or even gentle distal epididymal compression may encourage fluid to efflux from testicular vas. Be aware that if there is a sperm granuloma, many times there will be only very minimal vasal fluid.
3. *Allow for time* to allow fluid deeper down to efflux from the vas. This can happen right away or may only start as you are tying the final mucosal sutures. There are occasions when I expect to see better results and so will pause that side and move to do the reversal on the contralateral side to allow for time to see if better fluid with sperm will be appear in the fluid.
4. *Gentle barbotage* of irrigant into the lumen via a 24-gauge Angiocath and then analyze the effluxing vasal fluid for sperm can show the presence of sperm when none were seen in the initial fluid.
5. *Sometimes small pulses* of room temperature irrigant onto the vas and epididymis can stimulate peristalsis of the testicular vas with increased flow of the vasal fluid now with whole sperm or sperm with long partial tails.

It is important to take your time and not be rushed, as the goal is to find the very best sperm that you can to drive you to perform a VV and if no whole sperm or parts are seen, then move to perform a VE. The surgeon or assistant would then review the slide under the adjacent lab microscope in the OR to look for sperm or sperm parts. Some doctors prefer to look at the slide themselves, while others use an andrologist. Then the circulator would pass the slide to the andrologist to analyze

under their lab microscope, looking for sperm or sperm parts. On occasion, when the surgeon is unable to find sperm and so is considering performing a VE, the andrologist, who has the time and expertise to do a more comprehensive slide review, is able to identify rare whole and sometimes motile sperm or sperm with partial tails which directs us to perform the more successful vasovasostomy.

OR and Lab Microscope

Unless you have your own andrology lab, it is essential for the surgeon or assistant to examine the vasal or epididymal fluid to look for sperm or sperm parts to decide whether a VV or VE is indicated. This is best performed with a high-quality, high-power, microscope in the OR. At our center we have both a high-power lab scope in our operating room next to the surgeon and another in the adjacent full-time andrology lab for our andrologist to analyze the fluid.

Intraoperative Decision-Making: Perform a VV or VE?

One of the key points that separates out the true experts from many other doctors that perform reversals is the ability to review the vasal fluid intraoperatively and then, based on the microscopic findings, decide and perform a vasovasostomy or a vasoepididymostomy, whichever is indicated. This is perhaps the singularly most critical step that is so often overlooked by many doctors. There can never be a justifiable reason to not perform microscopic vasal fluid analysis.

Role of the Microscopic Fluid Analysis

The most important step to decide whether to perform a VV or a VE is the microscopic examination of the testicular vasal fluid. If sperm or parts are seen, then the testis-epididymis-vas system is patent, and therefore a VV is indicated. If no sperm or sperm parts are seen microscopically, which is consistent with deeper epididymal obstruction, then a VE is the correct procedure [16]. Look for the best sperm (longest tail length) when analyzing the vasal fluid. The number of sperm/cc or high-power field is estimated for whole, complete sperm, the % motile sperm, sperm with partial tails/cc, sperm heads, and sperm tails, or if no sperm, this is noted as well as if "snow" or degenerated parts are noted (Fig. 5.28). We have found that the presence of sperm with partial tails is a positive finding most often consistent with an open system and so the need for a VV. Despite the fact that many experts consider favorable gross findings with azoospermia a reason to perform a VV, we have not

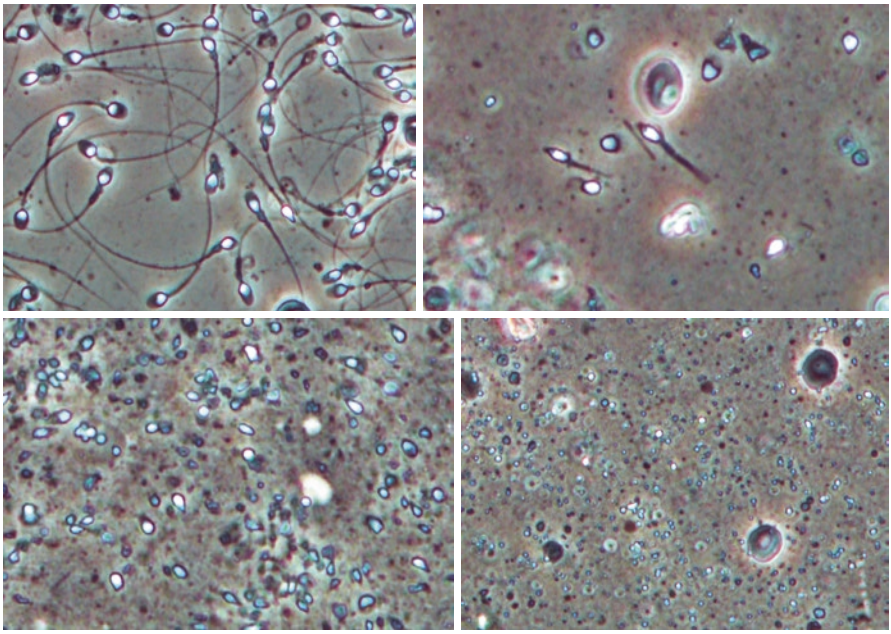

Fig. 5.28 Whole sperm, sperm with partial tails, sperm heads only, and "snow"-like debris. (Photo Credit: Sheldon Marks)

seen good results and so most often will proceed with a VE when no sperm are seen in the vasal fluid [16–28].

Here is our modification of the sperm grading system commonly used to categorize vasal sperm quality [29, 30].

Grade 1 – mainly normal, motile sperm
Grade 2 – mainly normal, nonmotile sperm
Grade 3 – sperm with partial tails
Grade 4 – mainly sperm heads
Grade 5 – only sperm heads
Grade 6 – no sperm

Indeterminate Vasal Fluid

When the vasal fluid is indeterminate and is not clearly consistent with an open system nor obvious deeper epididymal obstruction, then it is reasonable to take into account other fluid, patient, and partner factors to help with your decision-making re: whether to proceed with a vasovasostomy or move to perform a vasoepididymostomy. These include the gross fluid findings, the obstructive interval, the female

partner's age, and reproductive timeline as well as the couple's preferences that you discussed with them in your conversations pre-reversal. In our practice with our high success rates with VEs, we believe that if we are not seeing sperm or parts as evidence of a non-obstructed system, then more often than not we will perform a vasoepididymostomy on that side.

We have found over the years that if the vasal fluid is indeterminate and we are uncertain if there is indeed deeper epididymal blockage, then when we proceed with the vasoepididymostomy and analyze the epididymal tubule fluid we are impressed with the good sperm count and motility. This reinforces the idea that the system was indeed obstructed, confirming that a vasoepididymostomy was the correct technique with indeterminate fluid. It is often reasonable to include in your decision-making the fluid findings and procedure performed on the contralateral side. For example, if one side has sperm and so a vasovasostomy is performed, then with indeterminate fluid on the other side we are more likely to default to a vasoepididymostomy. If both sides are indeterminate, then it may be reasonable to do a vasoepididymostomy on one side and then a vasovasostomy on the other, in an attempt to cover "all the bases" and give your patient the best chance for success. If the patient has a history of testosterone use, then one must consider that suppression may be the cause of azoospermia in the vasal fluid or it may be because of epididymal obstruction and make the best decision considering all the factors. This might be a good time to move to a diagnostic TESE to determine if there is normal, suppressed, or nonexistent spermatogenesis to help you in your decision-making.

Cross Contamination

It is important to be aware of and take precautions to prevent potential confounding cross contamination of sperm from one side to the other. This can be seen when sperm from the vasal or epididymal fluid on the first side are inadvertently introduced into the fluid or onto the glass slide to be analyzed from the contralateral vas. This would then falsely suggest that the second side's system is open with no deeper obstruction, and so a vasovasostomy may be incorrectly performed when in fact no sperm are present because of an epididymal blowout.

There are two scenarios where we have found this to be a potential problem.

1. If the tip of an instrument or of the Angiocath is used to stir the drop of vasal fluid from one side with the diluent before the slide is passed off, then sperm will be present on the tip. If that instrument or tip of the Angiocath is reused to also stir the fluid on the second side, it is possible that this may introduce rare sperm into otherwise sperm-free vasal fluid. These sperm would then be seen as evidence of system patency on that second side, and so you might incorrectly perform a vasovasostomy when a vasoepididymostomy is indicated.

2. The other possibility is that if an Angiocath is used to aspirate or flush one side which has sperm, then there may be some residual sperm up in the fluid within the end of the Angiocath, and this could then be accidentally introduced in vasal fluid from the second side, also leading to mistaken interpretation of the microscopic findings with sperm seen when there may be none, and so a vasovasostomy would be incorrectly performed.

To solve this potential problem, we now use two separate 3 cc syringes during surgery, each clearly labeled "Right" and "Left," for any irrigation or vasal barbotage. The left syringe can only be on the Mayo stand or used when working on the left side and is removed to the back table and the right syringe moved up when on the right side. We also only stir the vasal fluid on the glass slide with the tip of the Angiocath for that side and not the tip of any surgical instruments. This should eliminate any risks for cross contamination of sperm from one side to another.

Sperm Cryopreservation

At time of surgery, if the fluid is felt to be bankable in the three critical parameters of fluid volume, sperm count, and motility, and the patient has requested banking, then we aspirate the vasal fluid into a 1 cc TB syringe primed with HTF via a 24-gauge Angiocath and instill this into a sterile test tube with 0.5 cc of warmed HTF. When enough fluid has been aspirated from the vas, the test tube is then passed to the andrologist for analysis to determine if we have provided enough bankable sperm or if more fluid is needed. If acceptable, the specimen is processed for cryopreservation.

To Bank or Not to Bank

There is much debate about the usefulness and cost-effectiveness of banking sperm at the time of the vasectomy reversal [31–33]. Whether you address this with your patients or not, the patients are well aware of using banked sperm for in vitro fertilization with intracytoplasmic sperm injection (IVF + ICSI) from their friends and family as well as in the popular media. If you don't discuss the pros and cons of cryopreservation or make this option available for them, they may come back at a later date and wonder why this was not offered or performed. We believe that banking of sperm, when possible, provides a reasonable backup option for couples that may use this frozen sperm at some point in the future if the reversal is unsuccessful or if there are other health or fertility issues.

Sperm cryopreservation may be even more relevant at the time of a bilateral VE because of the lower success and more variable timeline for adequate sperm to appear in the ejaculate [34–37]. Of course, the added costs as well as the increased maternal and child health risks associated with IVF/ICSI should be discussed when counseling patients about the banking options and the use of frozen sperm [38, 39]. This then creates a new dilemma whether the anastomosis is the priority or the banking of sperm. If the patient requests sperm banking and you are performing a unilateral and especially a bilateral vasoepididymostomy, is it better to use a more caudal epididymal tubule which should theoretically allow for better sperm maturation and a technically easier anastomosis with no fluid banked or is it smarter to move up to a more cephalad tubule with increased chances to obtain bankable sperm for future IVF though with reduced likelihood for motile sperm in the ejaculate? Unless there is a short timeline for conception because of advanced maternal age, then the technical aspects of performing the best vasoepididymostomy should be the priority over the cryopreservation of sperm, though there are other experts that would argue that obtaining sperm for banking in this situation makes more sense because of the lower success and pregnancy after bilateral VEs.

References

1. American Urological Association; American Academy of Orthopaedic Surgeons. Antibiotic prophylaxis for urological patients with total joint replacements. J Urol. 2003;169:1796–7.
2. Wolf JS Jr, Bennett CJ, Dmochowski RR, Hollenbeck BK, Pearle MS, Schaeffer AJ. Best practice policy statement on urologic surgery antimicrobial prophylaxis. J Urol. 2008;179(4):1379–90.
3. Lowe G. Optimizing outcomes in vasectomy: how to ensure sterility and prevent complications. Transl Androl Urol. 2016;5(2):176–80.
4. Jarvi K, Grober ED, Lo KC, Patry G. Mini-incision microsurgical vasectomy reversal using no-scalpel vasectomy principles and instruments. Urology. 2008;72:913–5.
5. Grober ED, Jarvi K, Lo KC, Shin EJ. Mini-incision vasectomy reversal using no-scalpel vasectomy principles: efficacy and postoperative pain compared with traditional approaches to vasectomy reversal. Urology. 2011;77:602–6.
6. Werthman P. Mini-incision microsurgical vasoepididymostomy: a new surgical approach. Urology. 2007;70:794–6.
7. Schulster ML, Cohn MR, Najari BB, Goldstein M. Microsurgically assisted inguinal hernia repair and simultaneous male fertility procedures: rationale, technique and outcomes. J Urol. 2017;198(5):1168–74.
8. Schulster ML, Cohn MR, Najari BB, Goldstein M. Microsurgically assisted inguinal hernia repair and simultaneous male fertility procedures: rationale, technique and outcomes. J Urol. 2017;198(5):1168–74.
9. Nagler HM, Belletete BA, Gerber E, Dinlenc CZ. Laparoscopic retrieval of retroperitoneal vas deferens in vasovasostomy for postinguinal herniorrhaphy obstructive azoospermia. Fertil Steril. 2005;83:1842.
10. Shaeer OK, Shaeer KZ. Pelviscrotal vasovasostomy: refining and troubleshooting. J Urol. 2005;174:1935–7.
11. Lizza EF, Marmar JL, Schmidt SS, Lanasa JA Jr, Sharlip ID, Thomas AJ, Belker AM, Nagler HM. Transseptal crossed vasovasostomy. J Urol. 1985;134:1131–2.

12. Sabanegh E, Thomas AJ. Effectiveness of crossover transseptal vasoepididymostomy in treating complex obstructive azoospermia. Fertil Steril. 1995;63(2):392–5.
13. Crosnoe LE, Kim ED, Perkins AR, Marks MB, Burrows PJ, Marks SH. Angled vas cutter for vasovasostomy: technique and results. Fertil Steril. 2014;101(3):636–9.
14. Patel SR, Sigman M. Comparison of outcomes of vasovasostomy performed in the convoluted and straight vas deferens. J Urol. 2008;179:256–9.
15. Sandlow JI, Kolettis PN. Vasovasostomy in the convoluted vas deferens: indications and outcomes. J Urol. 2005;173:540–2.
16. Ostrowski KA, Tadros NN, Polackwich AS, McClure RD, Fuchs EF, Hedges JC. Factors and practice patterns that affect the decision for vasoepididymostomy. Can J Urol. 2017;24(1):8651–5.
17. Elzanaty S, Dohle GR. Vasovasostomy and predictors of vasal patency: a systematic review. Scand J Urol Nephrol. 2012;46:241–6.
18. Hinz S, Rais-Bahrami S, Weiske WH, Kempkensteffen C, Schrader M, Miller K, et al. Prognostic value of intraoperative parameters observed during vasectomy reversal for predicting postoperative vas patency and fertility. World J Urol. 2009;27(6):781–5.
19. Kirby EW, Hockenberry M, Lipshultz LI. Vasectomy reversal: decision making and technical innovations. Transl Androl Urol. 2017;6(4):753–60.
20. Kolettis PN, Burns JR, Nangia AK, Sandlow JI. Outcomes for vasovasostomy performed when only sperm parts are present in the vasal fluid. J Androl. 2006;27:565–7.
21. Kolettis PN, D'Amico AM, Box L, et al. Outcomes for vasovasostomy with bilateral intravasal azoospermia. J Androl. 2003;24:22–4.
22. Jarow JP, Sigman M, Buch JP, Oates RD. Delayed appearance of sperm after end-to-side vasoepididymostomy. J Urol. 1995;153:1156–8.
23. Ramasamy R, Mata DA, Jain L, Perkins AR, Marks SH, Lipshultz LI. Microscopic visualization of intravasal spermatozoa is positively associated with patency after bilateral microsurgical vasovasostomy. Andrology. 2015;3(3):532–5.
24. Scovell JM, Mata DA, Ramasamy R, Herrel LA, Hsiao W, Lipshultz LI. Association between the presence of sperm in the vasal fluid during vasectomy reversal and postoperative patency: a systematic review and meta-analysis. Urology. 2015;85(4):809–13.
25. Sheynkin YR, Chen ME, Goldstein M. Intravasal azoospermia: a surgical dilemma. BJU Int. 2000;85:1089–92.
26. Shin YS, Sang KSD, Park JK. Preoperative factors influencing postoperative results after vasovasostomy. World J Mens Health. 2012;30(3):177–82.
27. Sigman M. The relationship between intravasal sperm quality and patency rates after vasovasostomy. J Urol. 2004;171:307–9.
28. Smith RP, Khanna A, Kovac JR, et al. The significance of sperm heads and tails within the vasal fluid during vasectomy reversal. Indian J Urol. 2014;30:164–8.
29. Belker AM, Thomas AJ Jr, Fuchs EF, Konnak JW, Sharlip ID. Results of 1,469 microsurgical vasectomy reversals by the Vasovasostomy study group. J Urol. 1991;145:505–11.
30. Silber SJ. Microscopic vasectomy reversal. Fertil Steril. 1977;28:1191–202.
31. Glazier DB, Marmar JL, Mayer E, Gibbs M, Corson SL. The fate of cryopreserved sperm acquired during vasectomy reversals. J Urol. 1999;161:463–6.
32. Boyle KE, Thomas AJ Jr, Marmar JL, Hirshberg S, Belker AM, Jarow JP. Sperm harvesting and cryopreservation during vasectomy reversal is not cost effective. Fertil Steril. 2006;85:961–4.
33. Schrepferman CG, Carson MR, Sparks AE, Sandlow JI. Need for sperm retrieval and cryopreservation at vasectomy reversal. J Urol. 2001;166:1787–9.
34. Chan PT. The evolution and refinement of vasoepididymostomy techniques. Asian J Androl. 2013;15:49–55.
35. Peng J, Yuan Y, Zhang Z, Gao B, Song W, et al. Patency rates of microsurgical vasoepididymostomy for patients with idiopathic obstructive azoospermia: a prospective analysis of factors associated with patency – single-center experience. Urology. 2012;79:119–22.

36. Baker K, Sabanegh E. Obstructive azoospermia: reconstructive techniques and results. Clinics (Sao Paulo). 2013;68(Suppl 1):61–73.
37. Chan PT, Brandell RA, Goldstein M. Prospective analysis of outcomes after microsurgical intussusception vasoepididymostomy. BJU Int. 2005;96:598–601.
38. Pavlovich CP, Schlegel PN. Fertility options after vasectomy: a cost-effectiveness analysis. Fertil Steril. 1997;67(1):133–41.
39. Shridharani A, Sandlow JI. Vasectomy reversal versus IVF with sperm retrieval: which is better? Curr Opin Urol. 2010;20:503–9.