Rethinking the Value of Sending Vasectomy Specimens for Histologic Examination

An Analysis of Arterial Vasculature and Failure to Transect the Vas Deferens

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ABSTRACT

Objectives: The testicular, deferential, and cremasteric arteries and their branches surround the vas deferens (VD), leaving them susceptible to injury during vasectomy. Literature describing the caliber of arteries seen in vasectomy specimens is lacking, making it difficult to categorize the significance of an observed artery. We aimed to establish reference values for arterial size typically encountered in vasectomy specimens and assess our institutional experience with failure to transect the VD.

Methods: The luminal diameter of the largest artery in 231 consecutive VD specimens from 116 patients was measured microscopically. For comparison, the diameter of the largest artery within 10 spermatic cord cross-sections from inguinal orchitectomies was obtained. The immediate vasectomy failure rate based on histologic assessment was calculated using specimens from 2008 to 2012.

Results: The luminal diameter of the largest artery encountered in a vasectomy specimen was 1.00 mm or less in 96.5% of cases. Artery sizes greater than or equal to 2.50 mm were only seen in spermatic cord resections. From 2008 to 2012, three (0.36%) of 837 patients undergoing vasectomy had specimens that showed failure to transect both VD.

Conclusions: Although the American Urologic Association and European Association of Urology state that histologic evaluation of vasectomy specimens is not required, we encourage the surgeon to send VD specimens for histologic examination. Doing so allows early identification of the failure to transect the VD and the resection of surrounding vasculature, providing quality control feedback to the surgeon.

Vasectomy is a common surgical procedure performed worldwide for permanent male sterilization. In the United States, more than 500,000 men undergo this procedure annually,1 and it is the most common nondiagnostic operation performed by urologists.2 According to the National Survey of Family Growth, 13.1% of married men surveyed from 2006 to 2008 reported having a vasectomy.3 Various techniques are used to carry out this procedure, from a no-scalpel approach in the office to a small open incision in the operating room. Regardless of the method, a key step involves identifying and transecting the vas deferens (VD). Complications are uncommon, and those that do occur are mostly minor, such as hematoma, infection, sperm granuloma, and chronic orchalgia.4

Isolated instances have been reported of complications with significant morbidity, including Fournier gangrene,5-7 subtotal testicular infarction,8 and testicular necrosis.9 Blood is supplied to the testicle via the cremasteric, testicular, and deferential arteries.10 These arteries and their branches lie within close proximity to the VD in the spermatic cord.
making them susceptible to damage during a vasectomy. One of these rare complications is illustrated by a case for which we were consulted, wherein a patient underwent an office vasectomy. Histologic examination of the right-sided specimen showed a 1.5-mm artery but no VD. A repeat right vasectomy did show the presence of VD, along with a large 3.30-mm artery. Unfortunately, this patient subsequently developed right-sided ischemic testicular necrosis treated with a delayed right orchiectomy.

There is a lack of literature describing the caliber of arteries histologically present in vasectomy specimens, and thus the significance of an observed artery is currently unknown. We measured the diameter of the largest artery seen within vasectomy specimens and compared it with those seen in cross-sections of the spermatic cord from orchiectomy specimens. We thus aimed to establish reference arterial diameter values for arteries encountered in vasectomy specimens and assess our institutional experience in failing to transect the VD.

**Materials and Methods**

For the study, 231 consecutively submitted VD specimens to The Ohio State University Department of Pathology (Columbus, OH) from July 2011 to January 2012 were identified. All specimens were submitted in entirety, formalin-fixed, paraffin-embedded, cut at 5 mm, and stained with H&E. All specimens were initially reviewed by a subspecialty genitourinary pathologist and were retrospectively reviewed by one urology resident (A.P.P.) who was trained by a genitourinary pathologist (D.L.Z.). Institutional review board approval was obtained. The investigators were blinded to both surgeon and patient information.

**Image 1** Histologic specimens from a case received in consultation. A, Right vasectomy specimen (×10). Arrow shows a 1.5-mm muscular artery. There is no vas deferens (VD) in the specimen. B, Repeat right vasectomy specimen (×2). Arrow shows a large 3.3-mm muscular artery. Arrowhead shows VD. C, Orchiectomy specimen with necrotic testicular parenchyma (×20).
Charts were reviewed to obtain the patient’s age, name of surgeon, and the length and diameter of each VD specimen. All histologic sections were inspected using an Olympus microscope (Olympus America, Center Valley, PA). Veins and arteries were differentiated by examining their diameter along with the number of smooth muscle cell layers in the tunica media, with veins having only two to three smooth muscle layers and a typical small artery having eight to ten layers. The largest artery was identified and its luminal diameter was microscopically measured. The VD was identified by its pseudostratified apical columnar epithelium with stereocilia and cuboidal basal cells overlying loose connective tissue stroma and a well-developed, thick, three-layered muscular coat. For specimens with extreme oblique cuts, the specimen was reviewed by the genitourinary pathologist, and a joint decision of the luminal diameter was made.

Ten inguinal orchiectomy specimens submitted with intact spermatic cords from July 2011 to August 2012 were randomly chosen. All of these specimens were from radical inguinal orchiectomies performed for suspicion of testicular cancer. These spermatic cord cross-sections should include all vasculature surrounding the VD that the surgeon could theoretically injure during a vasectomy. For each specimen, the midpoint of the spermatic cord was analyzed, and the diameter of the largest artery within these cross-sections was measured with the same microscope.

Statistics were performed using StatPlus 2009 (Analyst-Soft, Vancouver, Canada). Normality was assessed with the Shapiro-Wilk W test. One-way analysis of variance with Bonferroni test was used to test for differences between the means of the spermatic cord and vasectomy specimens and between the means of the VD specimens amongst pairs of surgeons. Significance was defined as $P < .05$.

In addition, to assess the immediate surgical failure rate, all vasectomy specimens submitted during the 5-year period from January 2008 to December 2012 were identified. For each specimen, the histologic presence or absence of VD was noted. Charts of patients with an absence of VD and those with arterial sizes in the third and fourth quartiles were reviewed to determine the clinical outcome.

### Results

Nine surgeons submitted 231 VD specimens from 116 patients (one patient only had one VD). Four surgeons submitted the majority of specimens (94.8%). The median age of vasectomy patients was 37 years (range, 21-56 years). The median length and diameter of VD were 1.0 cm (range, 0.4-3.4 cm) and 0.3 cm (range, 0.3-0.5 cm), respectively.

The mean diameter of the largest artery in the VD specimen was 0.03 mm, with the median being 0.03 mm, and the range was 0.01 to 1.70 mm. The percentage of specimens with luminal diameter of the largest artery in the following quartiles was as follows: 0.01-0.42 mm, 71.0%; 0.43-0.85 mm, 23.4%; 0.86-1.19 mm, 2.2%; 1.20 mm or more, 3.5% (mean, 0.03 mm; median, 0.03 mm; range, 0.01-1.70 mm).

For the 10 spermatic cord specimens obtained via an orchiectomy, the median patient age was 35 years (range, 21-55 years). The luminal diameter of the largest artery ranged from 2.50 to 4.10 mm, with a median of 3.40 mm. The midpoint of the spermatic cord ranged from 3.35 to 7.55 cm, with a median of 4.75 cm away from the testicular hilum.

The Shapiro-Wilk W test failed to show normality among the VD specimens but did show normality among the spermatic cord specimens. The difference in the mean arterial sizes seen in the vasectomy specimens vs the spermatic cord specimens was statistically significant ($P = 0$).

The difference between the mean arterial size seen in VD specimens for surgeon 3 and surgeon 4 was also statistically significant ($P = .02$).

During the 5-year period from 2008 to 2012, histologic examination in three of 837 patients (1,674 vasectomy specimens) failed to reveal transection of both VD (rate of vasectomy failure, 0.36%). For the first patient, the surgeon suspected missing the VD during the office procedure after spending longer than the usual amount of time searching for the VD and only finding atretic-appearing tissue. Histologic examination showed vascular channels but no VD and the patient underwent repeat vasectomy in the operating room under general anesthesia with a larger incision. The repeat histologic examination verified the presence of VD in the specimen. The second patient was morbidly obese, and the surgeon was uncomfortable performing the procedure in the office because of concern regarding the inability to isolate the VD. This patient underwent a vasectomy in the operating room, and the surgeon noted difficulty in isolating the VD. Histologic examination showed only skeletal muscle fibers. After learning of the one-sided vasectomy failure, the patient elected not to proceed with repeat vasectomy and underwent a postvasectomy semen analysis (PVSA) after 10 weeks. Motile sperm were found, the patient then elected to undergo repeat vasectomy, and the surgeon intraoperatively confirmed the transection of VD with a frozen section. The third patient underwent an office vasectomy, and histologic examination showed scant blood vessels without VD. The patient did not keep his follow-up appointment. For unknown reasons, he underwent PVSA 1 year after the vasectomy, which showed presence of motile sperm. The surgeon was able to contact the patient via telephone, but the patient did not follow up for completion vasectomy. Of note, resident physician participation was limited to the procedure for the second patient.
Discussion

Vasectomy is one of the most common procedures performed worldwide for permanent male sterilization. Measurement of success is clinically important and is ultimately established by azoospermia in PVSA. A histologic examination report generally comments only on either the presence or absence of VD; no data are available to assess the nature of perivascular vasculature. We conducted our study to examine the caliber of arterial vasculature typically seen in vasectomy specimens and to evaluate our immediate vasectomy failure rate.

At our institution, the arterial size routinely encountered in a VD specimen was 1.0 mm or less in 96.5% of cases, and the largest artery was 1.7 mm. Artery sizes of 2.5 mm or more were only seen in spermatic cord resections. We demonstrated statistically significant intersurgeon variability in the mean arterial diameter in the VD specimens, likely a result of differences in surgical technique. Although no previous work has reported arterial sizes in VD specimens, Raman and Goldstein intraoperatively measured the diameter of each arter...
artery in the spermatic cord at the external inguinal ring during 120 microsurgical subinguinal varicocelectomies. They found that the testicular artery diameter ranged from 0.2 to 1.9 mm (mean, 1.0 mm), deferential artery diameter ranged from 0.2 to 1.8 mm (mean, 0.6 mm), and cremasteric artery ranged from 0.1 to 1.5 mm (mean, 0.5 mm). Yalcin et al measured arterial diameter in cadaveric orchiectomy specimens and found the mean diameters of testicular, deferential, and cremasteric arteries to be 1.7 mm, 1.1 mm, and 0.5 mm.

**Table 1** Comparison of the Diameter of the Largest Artery in Vasectomy vs Spermatic Cord Specimens

<table>
<thead>
<tr>
<th>Diameter of the Largest Artery, mm</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vasectomy specimens (n = 231)</td>
<td>0.001</td>
<td>0.17</td>
<td>0.03</td>
<td>0.03</td>
<td>0</td>
</tr>
<tr>
<td>Spermatic cord specimens (n = 10)</td>
<td>2.5</td>
<td>4.1</td>
<td>3.4</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

SD, standard deviation.

**Table 2** Intersurgeon Comparison of the Mean Diameters of the Largest Arteries in Vas Deferens Specimens

<table>
<thead>
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<th>Surgeon vs Surgeon</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>1 vs 2</td>
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<tr>
<td>1 vs 4</td>
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<tr>
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</tr>
<tr>
<td>2 vs 3</td>
<td>.08</td>
</tr>
<tr>
<td>3 vs 4</td>
<td>.02</td>
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**Image 3** Vasectomy specimens without the presence of the vas deferens. The specimens show (A) vascular channels (×2), (B) skeletal muscle fibers (×4), and (C) small blood vessels (×10).
respectively. In both of these investigations, arterial diameter was measured using a microruler of a nontransected artery. In contrast, our data are more clinically applicable because the arterial luminal diameters in the vasectomy specimens were measured after routine histologic fixation.

Studies have shown that the primary branch point for the testicular artery occurs during its course through the inguinal canal,10,14,15 indicating that the largest-caliber artery found at the level of the midsperrmatic cord (median of 4.75 cm away from the testicular hilum in our study) most likely represents not the main artery but one of its branches. Because the testicular artery branches proximal to the region of the spermatic cord encountered during vasectomy and given the trimodal blood supply to the testicle, even if a large-caliber artery is transected during a vasectomy, redundancy of arterial flow to the testicle likely ensures parenchymal survival. However, if the testicular vasculature suffers repeated insult, testicular ischemic necrosis is possible, as illustrated by our aforementioned case and other case reports.8,9

The usual reason for histologic analysis of VD specimens is to confirm the presence of VD. However, both the American Urological Association and the European Association of Urology state that histologic assessment of vasectomy specimens is no longer required and leave it to the discretion of the surgeon to send the excised tissues for histology.2,16 This recommendation is based on expert opinion. Surgeons worldwide do send the specimens for histologic review. No large studies have been conducted on the percentage of surgeons, but in a small survey of surgeons in England, 63 (75%) of 84 sent the vas routinely for histology.17 In addition to our anecdotal experience with academic centers in the United States, reports from France, Finland, England, and New Zealand have described surgeons and institutions routinely sending vasectomy specimens for analysis (the rationale varies from legal support to historical practice to early identification of failure to transect the vas).18,19 The most recent American Urologic Association vasectomy guideline recommends isolating the VD from perivasal tissue and only transecting a “bare vas.”20 At times, more perivasal tissue may intentionally be taken to speed up the procedure or because the assistant happens to take a larger cut. Although the urologist is able to roughly gauge the likelihood of transection of a significant artery at the time of the procedure, histologic analysis can augment what the urologist sees and provide an additional assessment of technical adequacy and quality control feedback. Another practical application of the histologic analysis is the surgeon’s ability to recognize the risk of testicular infarction with subsequent procedures that may injure the testicular artery, such as a hernia repair, varicocelectomy, nephrectomy, or aortic aneurysm repair. We do not advocate measuring perivasal vessels in every case or mentioning this in the pathology report. However, a good guideline is that if the vessel is similar in size or larger than the vas, it may be worth mentioning because it may be clinically relevant in preventing future complications and providing the surgeon with quality control feedback.

Previous articles have reported vasectomy failures, but ours is the only study detailing immediate surgical failure to transect VD defined by histologic analysis.4,8,20,21 In addition, to our knowledge, this is the first report of the use of a frozen section for VD confirmation. Assuming our surgical skill and patient level of complexity applies to the estimated 500,000 vasectomies performed annually in the United States, a failure rate of 0.36% leaves 1,800 postvasectomy patients still fertile. Without submitting the VD specimen for histologic analysis, the surgeon has to wait until the patient provides a PVSA to learn of the vasectomy failure. However, multiple publications have shown a trend of poor patient compliance, with 30% to 45% of patients never returning to provide a PVSA, even with proper follow-up instructions.22-25 As such, of these 1,800 patients, a 30% noncompliance with PVSA leaves 540 patients annually with an unrecognized risk of pregnancy. A subsequent unplanned pregnancy can lead to emotional, social, and financial strains on the patient and partner(s), leading to the high rate of “wrongful conception” litigation in this population.

We used the 2013 United States Medicare allowable billing for the Current Procedural Terminology (CPT) code to determine the cost of a vasectomy. The charge for office-based vasectomy by the surgeon, including the PVSA, is $1,320 (CPT code: 55250). The billing for surgical pathology examination for one VD removed for sterilization is $44.59 (CPT code: 88304) and two separately submitted VD is $89.18 (two units of CPT code: 88304). Histologic examination therefore increases the total cost of a vasectomy by 6.8%. Given the litigious aspect of the vasectomy procedure26 and the poor PSVA compliance rate, surgeons should strongly consider this cost-effective method of having histologic confirmation of a transected VD. Histologic analysis is also useful for persistent sperm in a PVSA. Histologic examination cannot differentiate the laterality of the specimen and is solely dependent on the labeling at the time of specimen acquisition. However, histologic proof that two VD specimens were transected provides encouragement to the surgeon to conduct another PVSA rather than subject the patient to a repeat procedure. On the other hand, failure to histologically identify a transected VD is a critical result in which the pathologist should immediately contact the surgeon, facilitating rapid communication from the surgeon to the patient for scheduling a repeat procedure.

This investigation does have limitations. A perfect perpendiculard histologic cross-section was rare, and as such, small measurement errors may have been introduced in estimating the luminal diameter of these oblique cross-sections. Only one researcher examined the specimens, which were processed at a single institution; hence, there is a need for confirmation
by additional investigators at other locations. Because all our specimens were fixed with formalin, the measurements in our study will not be applicable to in vivo measurements of intact nonfixed tissue. The exact location of VD transection during a vasectomy was not known, limiting the comparison with spermatic cord specimens, whose exact point of fixation along the spermatic cord was known. In addition, three of the four surgeons performing the majority of procedures routinely had resident physicians assisting, thus limiting the comparability among surgeons. However, the lack of normal distribution in the diameter of the largest artery for all VD specimens is consistent with differences in surgical technique affecting the size. Moreover, the presence of a normal distribution in the spermatic cord specimens is reassuring because the surgical technique used to obtain these specimens is similar.

In conclusion, we found that arterial size routinely encountered in histologic examination of vasectomy specimens was 1.0 mm or less in 96.5% of cases. Artery sizes greater than 2.5 mm were only seen in spermatic cord resections. Surgical failure to transect the vas is rare but does occur (0.36% of cases). Although the expert opinion statement of the American Urologic Association and the European Association of Urology states that histologic confirmation of vasectomy specimens is not required, we recommend that the VD specimen be sent for histologic examination. Doing so allows rapid identification of failure to transect the VD; provides risk assessment for future inguinal, scrotal, or retroperitoneal surgeries that may compromise the testicular artery; and encourages the surgeon to repeat a PVSA in case of persistent sperm on semen analysis. Histologic confirmation of VD transection may be a valuable asset at the time of litigation for wrongful conception, and identification of transection of the surrounding vasculature also provides feedback to improve surgical quality and patient care.

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References

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