Role of Imaging in the Evaluation of Male Infertility[1]

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Infertility is defined herein as the inability to achieve pregnancy after frequently engaging in unprotected sexual intercourse for 1 year. Among infertile couples, the cause of infertility involves the male partner in approximately 50% of cases. Male infertility is usually caused by conditions affecting sperm production, sperm function, or both, or blockages that prevent the delivery of sperm. Chronic health problems, injuries, lifestyle choices, anatomic problems, hormonal imbalances, and genetic defects can have a role in male infertility. The diagnostic workup of male infertility should include a thorough medical and reproductive history, physical examination, and semen analysis, followed by imaging. The main role of imaging is identification of the causes of infertility, such as congenital anomalies and disorders that obstruct sperm transport and may be correctable. Scrotal ultrasonography is the most common initially performed noninvasive examination used to image the male reproductive system, including the testes and extratesticular structures such as the epididymis. Magnetic resonance (MR) imaging is another noninvasive imaging modality used in the pelvis to evaluate possible obstructive lesions involving the ductal system. MR imaging of the brain is extremely useful for evaluating relevant neurologic abnormalities, such as pituitary gland disorders, that are suspected on the basis of hormone analysis results. Invasive techniques are usually reserved for therapeutic interventions in patients with known abnormalities. In this article, the causes and imaging findings of obstructive and nonobstructive azoospermia are discussed. In addition to detecting treatable conditions that are related to male infertility, identifying the life-threatening entities associated with infertility and the genetic conditions that could be transmitted to offspring—especially in patients who undergo assisted reproduction—is critical.

SA-CME LEARNING OBJECTIVES

After completing this journal-based SA-CME activity, participants will be able to:

- Describe the role of imaging in the identification of correctable causes of male infertility.
- Outline the imaging appearances of pretesticular, testicular, and posttesticular conditions that cause infertility in males.
- Discuss basic concepts related to male reproduction and the differential diagnosis and clinical evaluation of male infertility.

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Introduction

In approximately 20% of infertile couples, male infertility is the sole cause of the inability to conceive, and in 30%–40% of these couples, male and female factors are the causes. Therefore, a condition involving the male partner contributes to the infertility in approximately 50% of cases. The cause of impaired sperm production and function can be related to congenital or acquired factors that act at the pretesticular or posttesticular level or directly at the testicular level. The aims in performing the diagnostic workup in infertile men are to *(a)* identify treatable, reversible, and/or health-threatening conditions; *(b)* select patients who are suitable for assisted reproduction techniques; and *(c)* determine appropriate genetic counseling and prevention measures such as preimplantation and prenatal diagnosis to safeguard the health

TEACHING POINTS

- An isolated right-sided varicocele that does not decompress while the patient is supine should raise suspicion for a retroperitoneal mass, and the patient should undergo cross-sectional imaging.
- The goals in performing the diagnostic evaluation and administering antimicrobial therapy are to avoid the transmission of infection to the female partner and prevent the adverse effects of infection on semen quality and function and thus reduce the risk for infertility.
- In the absence of an intrascrotal testis at US, an undescended testis should be sought by scanning along the path of testicular descent, which includes the abdomen, through the pelvis and inguinal canal, and down to the scrotum.
- Whenever ejaculatory duct obstruction is being considered in a patient with low ejaculate volume, retrograde ejaculation should be ruled out by performing postejaculatory urinalysis to assess for the presence of sperm.
- The main role of imaging in the setting of erectile dysfunction is to differentiate between vascular and nonvascular causes of erectile dysfunction, and penile Doppler US is the modality of choice for this evaluation.

of future offspring. The diagnostic workup for infertility in the affected couple should be started after 1 year of the couple regularly engaging in unprotected sexual intercourse without spontaneous induction of pregnancy. However, half of couples who do not conceive during the 1st year do so in the 2nd year. The workup for infertility is usually initiated after the couple has attempted conception for more than 12 months, but it may be started earlier if there is high suspicion for infertility and the female partner is older than 35 years (1–3). Imaging has a critical role in the identification of potentially correctable causes of infertility, such as congenital abnormalities and disorders that obstruct sperm transport. The approach to the diagnostic workup should be systematic and structured. Semen analysis should be complemented with a comprehensive medical history, preferably obtained in the presence of the female partner, and physical examination. Relevant endocrine, genetic, and imaging examinations also should be conducted.

Evaluation of Male Infertility

The initial diagnostic workup for male infertility should include a thorough medical history, physical examination, semen and hormone analyses, and imaging examination; these should be performed systematically to elucidate prior factors that could have caused the infertility.

Medical History and Physical Examination

The medical history should be focused on the identification of risk factors and/or behavior that could affect fertility. These include duration of infertility, ages of the patient and his partner, any gynecologic cofactors involving the female partner, medications that could affect the hypothalamic-pituitary-gonadal axis, cryptorchidism, sexual or ejaculatory disorders, frequency of sexual intercourse, smoking history and alcohol intake, genital surgery, and pubertal development and disorders.

Semen and Hormone Analyses

Normal semen is defined as that having the following properties: volume greater than 1.5 mL, concentration greater than 15 million per milliliter, total progressive and nonprogressive motility greater than 40%, and greater than 4% normal consistency (2,4). If semen analysis reveals azoospermia—that is, a lack of sperm in the ejaculate—then laboratory analysis of follicle-stimulating hormone, luteinizing hormone, and testosterone levels, and testicular volume can be used to differentiate obstructive azoospermia due to obstruction of the male ductal system from nonobstructive azoospermia caused by defective spermatogenesis. The latter entity can be further divided into primary testicular failure and hypogonadotropic hypogonadism. The changes in gonadotropin and testosterone levels and testicular volume caused by azoospermia are outlined in the Table (5). Infertile males with obstructive azoospermia may be amenable to curative surgical treatment, whereas those with nonobstructive azoospermia should proceed directly to treatment with assisted reproduction techniques such as intracytoplasmic sperm injection (5,6).

Imaging

The main role of imaging is identification of the causes of infertility, such as congenital anomalies and disorders that obstruct sperm transport and may be correctable. Imaging can also be used to guide methods for impregnating the female partner, such as sperm aspiration from the epididymis or seminiferous tubules followed by in vitro fertilization or intracytoplasmic sperm injection (1). The imaging modalities routinely used to evaluate the male reproductive system are ultrasonography (US) and magnetic resonance (MR) imaging, as well as invasive techniques such as venography and vasography.

Ultrasonography.—Scrotal US is the preferred modality because it is noninvasive, safe, and inexpensive and allows multiplanar imaging. This examination can be used to evaluate potential testicular abnormalities, calculate the testicular volume, and identify peritesticular abnormalities such as varicocele, epididymal and prostatic ab-

Effects of Azoospermia on Gonadotropin and Testosterone Levels and Testicular Volume

Parameter	Nonobstructive Azoospermia: Primary Testicular Failure	Nonobstructive Azoospermia: Hypogonadotropic Hypogonadism	Obstructive Azoospermia
Follicle-stimulating hormone level	High	Low	Normal
Luteinizing hormone level	High	Low	Normal
Testosterone level	Low	Low	Normal
Testicular volume	Low	Low	Normal

Source.—Reference 9.
Note.—Obstructive azoospermia can be addressed with potentially curative surgery, whereas nonobstructive azoospermia—whether it is associated with primary testicular failure or hypogonadotropic hypogonadism—should be treated with use of assisted reproduction techniques.

normalities, and erectile dysfunction. Scrotal US is performed by using a high-frequency linear-array transducer. Transverse and longitudinal US of the testes and color flow Doppler US of testicular and spermatic cord vascularity are performed. Testicular volume measurements, which can correlate with semen profiles, also should be obtained (7). Testicular volume is calculated as (length × width × anteroposterior diameter) × π/6, and the normal value range is 15–20 mL (1).

Transrectal US can be used to evaluate the prostate and possibly identify more central sources of spermatic obstruction. A seminal vesicle diameter greater than 1.5 cm and an ejaculatory duct diameter greater than 2.3 mm are suggestive of ejaculatory duct obstruction, especially when they are associated with cysts or calcification along the duct (8). Operator dependency and the inability to evaluate small-caliber structures are known limitations of transrectal US that make MR imaging the superior noninvasive modality for evaluating the intrapelvic structures.

MR Imaging.—MR imaging is superior to transrectal US for examining patients with male infertility and can serve as an alternative to traditional invasive vasography (5,9,10). Owing to superior soft-tissue contrast and multiplanar capabilities, MR imaging can depict the detailed anatomy and pathophysiologic features of the reproductive tract, including the prostate, seminal vesicles, and ejaculatory ducts. MR imaging is the modality of choice for imaging the accessory sex glands and their ducts and can help guide diagnostic or corrective interventional procedures. The optimal magnetic field strength for imaging the pelvis is a matter of debate, but the minimal field strength for optimized pelvic MR imaging is 1.5 T. Although the use of an endorectal coil may facilitate a higher signal-to-noise ratio, it often results in obscuration of the pathologic condition owing to local field distortion and causes patient discomfort. Higher–field-strength (ie, 3.0-T) MR imaging systems facilitate higher signal-to-noise ratios, which may obviate an endorectal coil (11). T2-weighted MR images depict the prostate, seminal vesicles, and surrounding structures. Three-dimensional T2-weighted fast spin-echo MR imaging has advantages over two-dimensional MR imaging: it allows imaging with thinner sections without intersection gaps, it generates higher signal-to-noise ratios, and the acquired images can be reformatted in any desired plane (12). A hyperintense signal at nonenhanced T1-weighted MR imaging is indicative of hemorrhage. T2-weighted MR imaging with fat saturation is the best sequence for assessing inflammation. Dynamic contrast-enhanced MR imaging yields additional information regarding tissue perfusion that is particularly helpful for diagnosing malignant conditions.

Computed Tomography.—Computed tomography (CT) facilitates limited soft-tissue resolution and is used less frequently to evaluate infertility. CT is most useful for evaluating calcifications and stones along the reproductive tract that are causing obstruction.

Vasography.—Once considered the reference standard for evaluating the male reproductive system, vasography, also known as seminal vesiculography, involves cannulation of the vas deferens with anesthesia induced in the patient. Owing to the widespread acceptance of MR imaging, this invasive examination is no longer commonly used to evaluate the male reproductive system. Currently,

vasography may be performed to diagnose aplasia or occlusion of the ejaculatory ducts in males with azoospermia who are found to have normal spermatogenesis at testicular biopsy (13). This procedure involves risk for infection and strictures of the vas deferens at the injection site.

Causes of Male Infertility

The various causes of male infertility are reviewed in detail in the sections that follow. These causes include pretesticular, testicular, and posttesticular factors. Pretesticular factors are generalized or extratesticular pathologic entities, such as hormonal and chromosomal abnormalities or systemic illness, that result in inadequate sperm production. Posttesticular factors are ductal pathologic entities that result in impaired sperm transit.

Pretesticular Causes

Pelvic imaging and scrotal imaging have very limited roles in the evaluation of pretesticular causes of male infertility, which are usually endocrinopathies, chromosomal abnormalities, or chronic medical conditions. These causes can be diagnosed by means of biochemical and hormone assessments or genetic testing. MR imaging of the brain is helpful if a pituitary mass is suspected on the basis of hormone assay results or if there is a clinical history of the sudden loss of libido and erectile function. The most common endocrine disorders that result in infertility are described.

Primary Hypogonadism (Hypergonadotropic Hypogonadism).—Klinefelter syndrome, a sex chromosome disorder that results from the presence of a supranumerary X chromosome (karyotype 47,XXY), is the most common cause of primary hypogonadism in males and is 30 times more common in infertile men. Individuals with Klinefelter syndrome are severely oligospermic or azoospermic and account for 14% of all cases of azoospermia (14,15). These patients present with firm testes, increased height, female hair distribution, and obesity; have diabetes mellitus; and have an increased incidence of leukemia, nonseminomatous extragonadal germ cell tumors, infertility, and gynecomastia. Sclerosis and hyalinization of the seminiferous tubules result in reduced testicular volume. Leydig cells have a hyperplastic appearance but are usually normal in number. Approximately 10% of individuals with Klinefelter syndrome have chromosome 46,XY/47,XXY mosaicism, which is a less severe phenotype (16).

Secondary Hypogonadism (Hypogonadotropic Hypogonadism).—Kallman syndrome is an X-linked disorder of male infertility that is seen in one in 10 000 live births (16). A mutation in the *KAL1* gene results in a deficiency of gonadotropin-releasing hormone secreted from the hypothalamus, which occurs owing to developmental defects caused by defective neural adhesion molecules that alter hypothalamic development (17). A lack of stimulation of the testes by follicle-stimulating hormone and luteinizing hormone results in absent spermatogenesis and testosterone production. Patients with Kallman syndrome can also present with firm prepubertal-size testes, asymmetry of the cranium and face, cleft palate, cryptorchidism, a small penis, congenital deafness, anosmia, cerebellar dysfunction, and renal abnormalities (16).

Prader-Willi syndrome, which results from a mutation or deletion of the short arm of chromosome 15, is associated with secondary hypogonadism and is characterized by cryptorchidism, obesity, mental retardation, and infantile hypotonia (16).

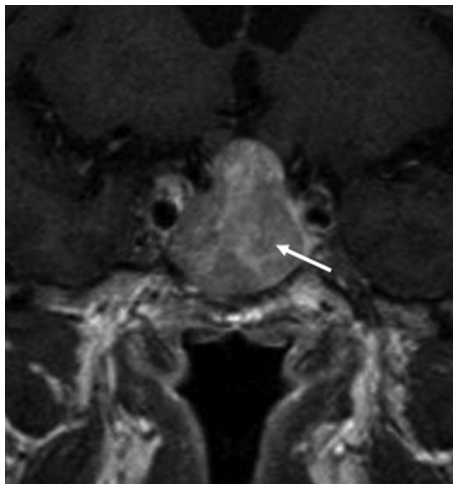
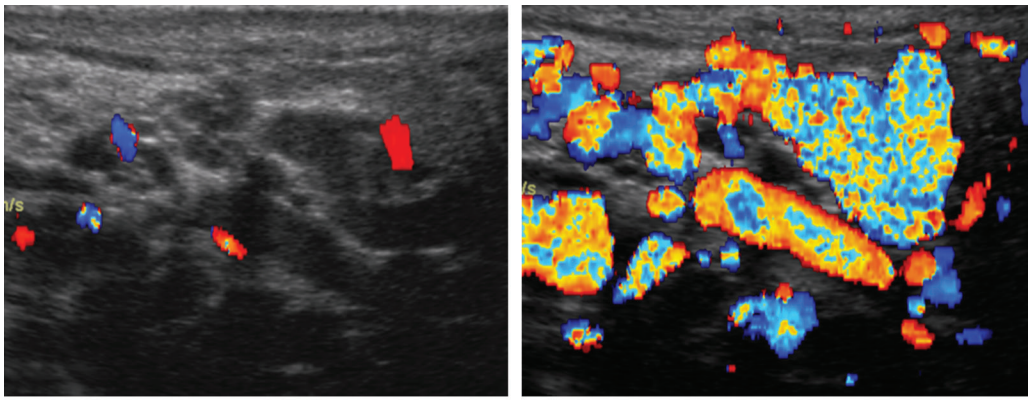


Figure 1. Prolactinoma in a 45-year-old man with a history of high prolactin levels and poor testicular function who presented for infertility evaluation. Coronal contrast-enhanced T1-weighted MR image through the pituitary gland shows a large heterogeneously enhancing tumor (arrow) consistent with prolactin-producing macroadenoma.

Pituitary Tumors.—Prolactinoma is the most common cause of infertility due to hyperprolactinemia and is seen in approximately 11% of individuals with oligozoospermia and 16% of individuals with erectile dysfunction (18,19). Prolactin-producing tumors in males tend to be macroadenomas (Fig 1). Elevated prolactin levels inhibit the normal pulsatile secretion of gonadotropin-releasing hormone. This leads to a decreased pulsatile release of follicle-stimulating hormone, luteinizing hormone, and testosterone and results in spermatogenic arrest and impaired sperm motility and quality. This condition later causes secondary hypogonadism with



a. b.

Figure 2. Varicocele in a 30-year-old man with a history of infertility. Longitudinal color Doppler US images of the left scrotum at rest **(a)** and during the Valsalva maneuver **(b)** show dilated peritesticular veins with little venous flow at rest but markedly increased venous flow during the Valsalva maneuver.

subsequent sexual dysfunction and infertility (19). Hyperprolactinemia also directly influences spermatogenesis and steroidogenesis by acting on the prolactin receptors on the surface of Sertoli and Leydig cells in the testes to cause primary hypogonadism (16,19).

Testicular Causes

Varicocele.—A varicocele is an abnormal dilatation of the pampiniform plexus and is a common entity that is seen in 15% of the general male population. However, the prevalence of this condition is 40% in males with primary infertility and 81% in males with secondary infertility (20). Varicocele is the most common correctable cause of male infertility (15). A varicocele may lead to symptoms that include scrotal pain and discomfort and failed testicular growth and development (1,21,22).

The diagnosis of a varicocele should be made clinically, with the patient in the standing position and performing the Valsalva maneuver. The diagnosis is confirmed at gray-scale US combined with color duplex US, which should reveal a reflux of blood and an increase in the venous diameter to at least 3 mm during the Valsalva maneuver (Fig 2) (1,21). On the basis of the degree of reflux during the Valsalva maneuver, a varicocele may be graded as follows (21,23): A subclinical varicocele is neither palpable nor visible at rest or during the Valsalva maneuver, but it is seen at US. A grade 1 varicocele is palpable during the Valsalva maneuver. A grade 2 varicocele is palpable but not visible at rest. A grade 3 varicocele is visible and palpable at rest.

Varicoceles are found more commonly on the left side or bilaterally than on the right side alone. Because the left testicular vein drains into the left renal vein at a perpendicular angle rather directly into the inferior vena cava, the left testicular vein is exposed to high pressure within the left renal vein (24). An isolated right-sided varicocele that does not decompress while the patient is supine should raise suspicion for a retroperitoneal mass, and the patient should undergo cross-sectional imaging (23).

The scrotal skin keeps the temperature of the scrotum 2°–4°C below the temperature of the rest of the body owing to a lack of subcutaneous fat and the countercurrent heat exchange mechanism involving the pampiniform plexus (9,15). The pathophysiologic feature of a varicocele that leads to infertility is thought to be either poor venous drainage that disrupts the countercurrent heat exchange in the spermatic cord or increased testicular perfusion, which causes an increase in scrotal temperature and subsequently leads to impaired spermatogenesis (15). Higher scrotal temperatures can also lead to decreased production of testosterone by Leydig cells, altered Sertoli cell function and morphology, germinal cell membrane injury, and decreased protein synthesis and amino acid transport (23). Another theory is that varicocele-associated oxygen deprivation causes impaired spermatogenesis, increased gonadotropin levels due to impaired venous drainage, and increased oxidant levels in the semen. These anomalies lead to sperm DNA damage that is directly related to the varicocele and independent of the fertility status (25).

With regard to infertility, treatment of a varicocele is not indicated in patients with normal semen parameters and a subclinical-grade varicocele, as there is not enough evidence that a subclinical varicocele affects fertility. Treatment of a varicocele is recommended for patients who have a clinically palpable varicocele, abnormal semen parameters, proven infertility, and a female partner with a normal fertility profile or potentially treatable cause of infertility (20).

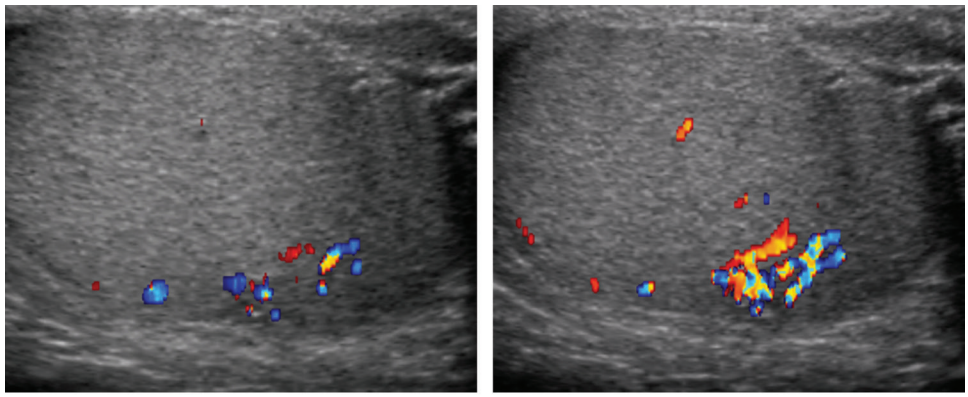


Figure 3. Intratesticular varicocele in a 28-year-old man with testicular pain and infertility. Longitudinal color Doppler US images of the left testis at rest **(a)** and during the Valsalva maneuver **(b)** show tubular structures with flow adjacent to the mediastinum testis at rest but increased dilatation and flow during the Valsalva maneuver.

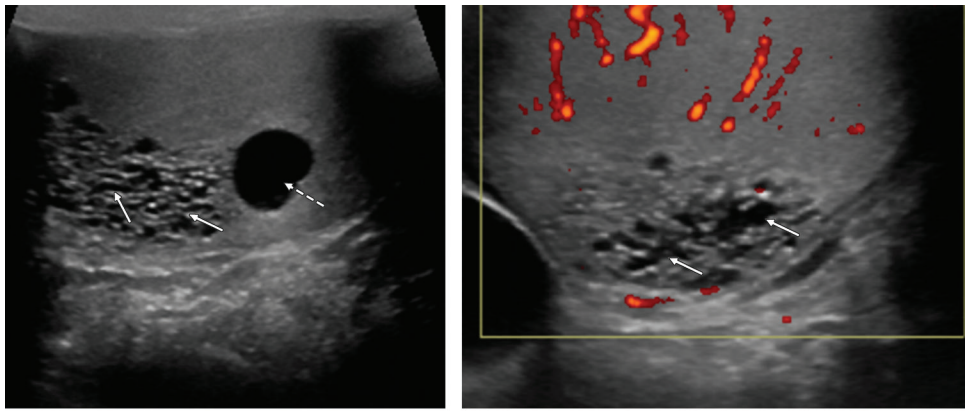


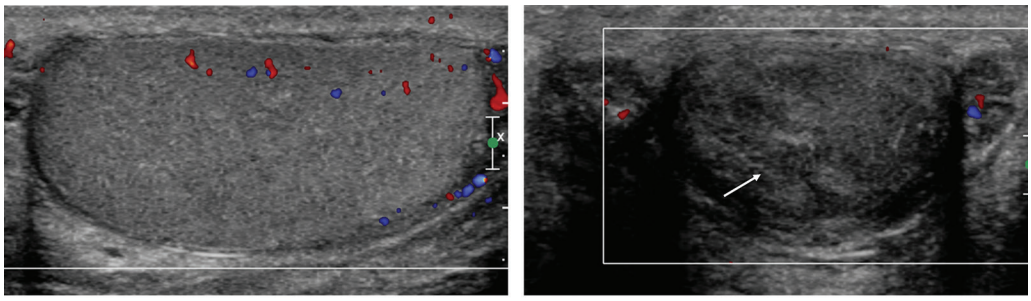
Figure 4. Tubular ectasia of the rete testis seen at workup for infertility in a 40-year-old man. Longitudinal gray-scale **(a)** and color Doppler **(b)** US images of the left testis show dilated branching tubules converging at the mediastinum testis and creating a "fishnet" appearance (solid arrows). These fluid-filled spaces are avascular, with no flow seen at color Doppler US. An associated intratesticular cyst (dashed arrow in **a**) is seen on the gray-scale US image.

Varicocele repair can be performed by means of surgical ligation of the dilated internal spermatic cord veins, radiographically guided embolization, or microsurgical techniques that spare the internal spermatic arteries and lymphatic system. This repair can improve not only sperm quality but also sperm penetration, oxidant level determinations, and DNA fragmentation. Varicocele repair also improves serum follicle-stimulating hormone and testosterone levels (23).

Intratesticular Varicocele.—Intratesticular varicoceles are rare and are seen in fewer than 2% of symptomatic males. They can occur in isolation or in conjunction with extratesticular varicoceles. The US features of intratesticular varicoceles are similar to those of extratesticular varicoceles. On US images, intratesticular varicoceles appear as dilated tubular intratesticular veins larger than 2 mm and in close proximity to the mediastinum. During the Valsalva maneuver at color Doppler US, intratesticular varicoceles show increased venous flow in the intratesticular tubular structures, as well as reflux (Fig 3) (26). Testicular pain is the most common clinical symptom at presentation and results from stretching of the tunica albugenia after active or passive congestion and dilatation of the veins. The pathogenesis of intratesticular varicoceles is believed to be similar to that of extratesticular varicoceles and thus may affect spermatogenesis and male fertility (27).

Intratesticular varicoceles adjacent to the mediastinum testis may mimic tubular ectasia. Tubular ectasia or cystic transformation of the rete testis—that is, dilatation of the rete testis—occurs as a result of partial or complete obstruction of the efferent ductules. It is often associated with spermatoceles and intratesticular cysts. On US images, it is seen as multiple anechoic avascular structures converging at the mediastinum testis and creating a lacelike appearance, but unlike intratesticular varicoceles, demonstrating no flow at color Doppler US (Fig 4) (28).

Testicular Atrophy.—Testicular atrophy is considered to be important if the volume of the affected



a. b.

Figure 5. Testicular atrophy in a 25-year-old man with a history of previous testicular torsion who reported being infertile. **(a)** Longitudinal color Doppler US image of the scrotum shows normal vascularity and size of the right testis, which has a calculated volume of 15.4 mL. **(b)** Longitudinal color Doppler US image shows that the left testis (arrow) has substantially decreased blood flow and a reduced size. The calculated testicular volume of 3.5 mL is due to chronic infarction.

testis is reduced to 50% of the volume of the unaffected testis (29). This anomaly is associated with reduced spermatogenesis and reduced fertility. Testicular atrophy may occur as a result of infarction, inflammation (epididymo-orchitis), cryptorchidism, varicocele, trauma, and/or a chronic mass effect. Scrotal trauma may lead to ischemia of viable parenchyma due to increased intratesticular pressure, and resorption of nonviable tissue leads to atrophy and scarring (29). A long-standing extratesticular mass effect such as that resulting from a hydrocele may compromise testicular blood flow and result in atrophy (30). Testicular size discrepancy is two times more common in infertile males with varicoceles than in those without varicoceles (31). Liver cirrhosis, estrogen treatment, and hypopituitary disorders also may cause testicular atrophy.

Torsion.—Torsion of the testes occurs when there is twisting of the spermatic cord that results in progressive impairment of venous drainage and ultimately arterial ischemia. If left untreated, this process may progress to testicular infarction. Testicular torsion affects one in 168 males younger than 25 years and is most common in 12–16-year-old boys (32). The most common predisposing factor is a bell clapper deformity, with which abnormal insertion of the tunica vaginalis allows wide mobility of the testes (33). Torsion when left untreated is one of the leading causes of acute scrotal pain and male-factor infertility. Infertile males with this anomaly present with long-term complications from an acute testicular torsion that occurred when they were younger. These complications include unilateral or bilateral anorchia, testicular atrophy, oligozoospermia, oligoasthenoteratospermia, and nonobstructive azoospermia. Approximately 40%–70% of males with a history of torsion have abnormal sperm. The ischemic changes of the testis depend on the duration and degree of rotation, which can range from 180° to 720°. Ischemia and reperfusion injuries result in germ cell apoptosis, testicular atrophy, and loss of spermatogenesis, usually 6 hours after the onset of torsion. After 12 hours, the testis loses its Leydig cell function (30). Detorsion within 4–6 hours of the acute onset has proven to be successful in salvaging a torsed testis in more than 90% of cases (30). Testicular torsions usually occur in the medial direction. Manual detorsion should be attempted away from the midline, and the disappearance of pain is considered a sign of a successful maneuver. Detorsion should be confirmed at US, and the patient should undergo surgical exploration and bilateral orchiopexy (30). US images obtained after detorsion show a global reduction in testis volume and decreased echogenicity and vascularity, and the epididymis is usually normal (Fig 5).

Orchitis and Epididymo-orchitis.—Infection and inflammation of the genitourinary tract are considered the most frequent causes of male infertility (1). Epididymitis mainly occurs unilaterally; however, in up to 60% of patients, the testis also is involved, and this condition is referred to as epididymo-orchitis (34). Inflammatory conditions of the testes and epididymis affect spermatogenesis and alter both the number and the quality of sperm because sperm storage, motility, and development, and the maturation of the sperm membrane that is necessary to complete fertility potentially occur in the epididymis (35). Scarring secondary to infection and inflammation may lead to obstructive azoospermia. Chronic epididymitis and epididymo-orchitis can result in testicular atrophy. In males younger than 35 years, epididymitis is usually caused by sexually transmitted organisms such as *Neisseria gonorrhoeae* and *Chlamydia trachomatis,* whereas in men older than 35 years, enteric organisms are usually involved. US images obtained in patients who have had an acute episode of epididymo-orchitis show testicular enlargement

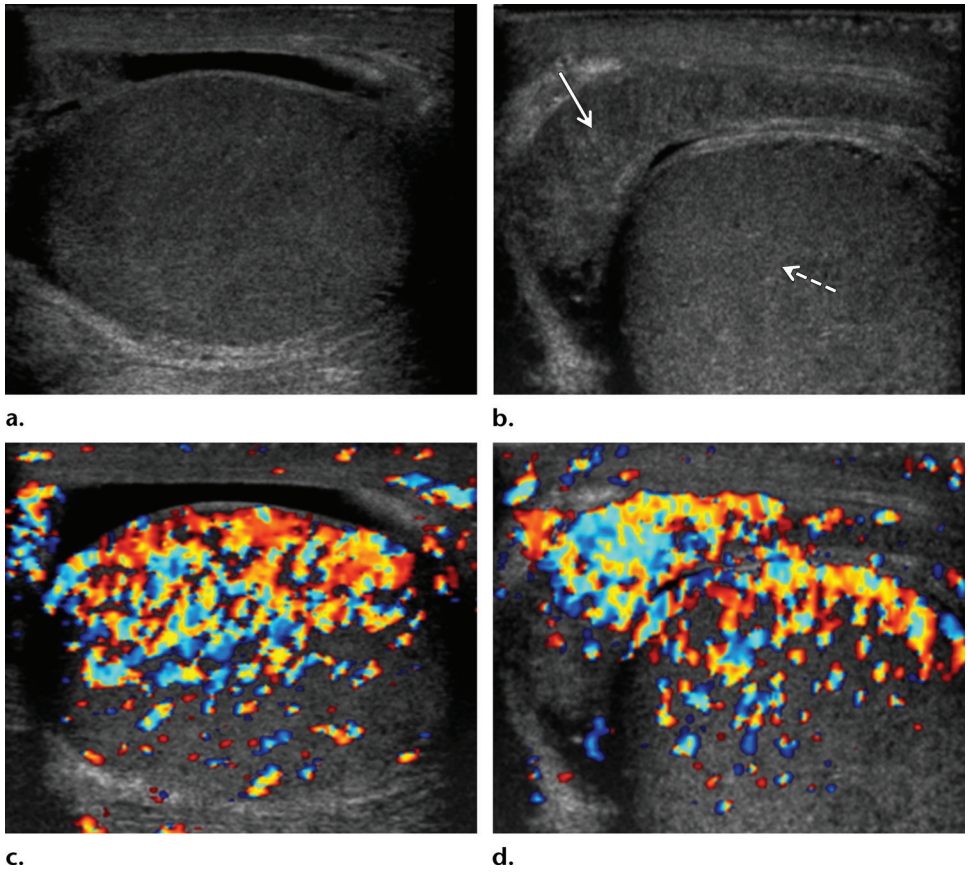


Figure 6. Epididymo-orchitis in a 25-year-old man who reported having testicular pain during infertility workup. Longitudinal gray-scale **(a, b)** and color Doppler **(c, d)** US images of the scrotum show heterogeneous enlargement of the right testis (dashed arrow in **b**) and epididymis (solid arrow in **b**), with increased flow in both structures compatible with hyperemia.

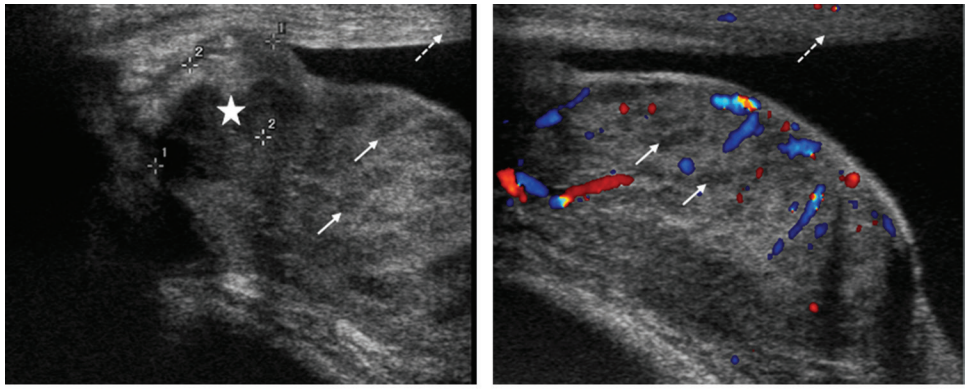


Figure 7. Granulomatous epididymo-orchitis seen in a 40-year-old man during infertility workup. Longitudinal gray-scale **(a)** and color Doppler **(b)** US images of the scrotum show multiple small hypoechoic nodules (solid arrows) diffusely scattered throughout the left testis in a miliary pattern. The head and tail of the epididymis are nodular, with inhomogeneous hypoechogenicity (☆ in **a**), consistent with tubercular epididymo-orchitis. Mild scrotal thickening (dashed arrow) and a hydrocele also are present.

and heterogeneous echogenicity in association with an enlarged heterogeneous epididymis. In addition, color Doppler US images show increased flow due to hyperemia in both the testis and the epididymis (Fig 6) (9). Pure orchitis is uncommon and most often results from the mumps. Chronic inflammation can occur as a result of granulomatous processes such as tuberculosis, syphilis, sarcoidosis, and other causes (Fig 7). The goals in performing the diagnostic evaluation and administering antimicrobial therapy are to avoid transmission of infection to the female partner and prevent the adverse effects of infection on semen quality and function and thus reduce the risk for infertility (9).

Testicular Microlithiasis.—Testicular microlithiasis is a rare condition that is present in 0.6%–9.0% of males with symptoms and in 2.4%–5.6% of adults without symptoms who are referred for US

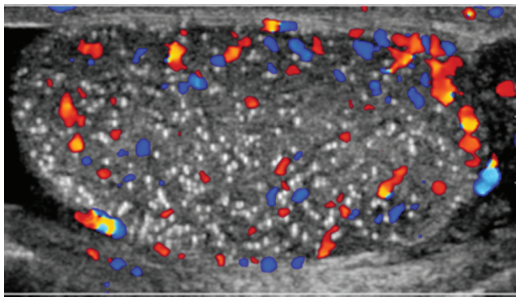


Figure 8. Testicular microlithiasis in a 26-year-old man who presented to the infertility clinic with abnormal semen analysis results. Longitudinal color Doppler US image of the left testis shows innumerable tiny, echogenic, nonshadowing foci in the testicular parenchyma, consistent with classic testicular microlithiasis.

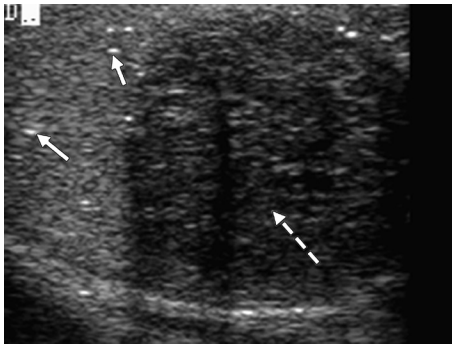


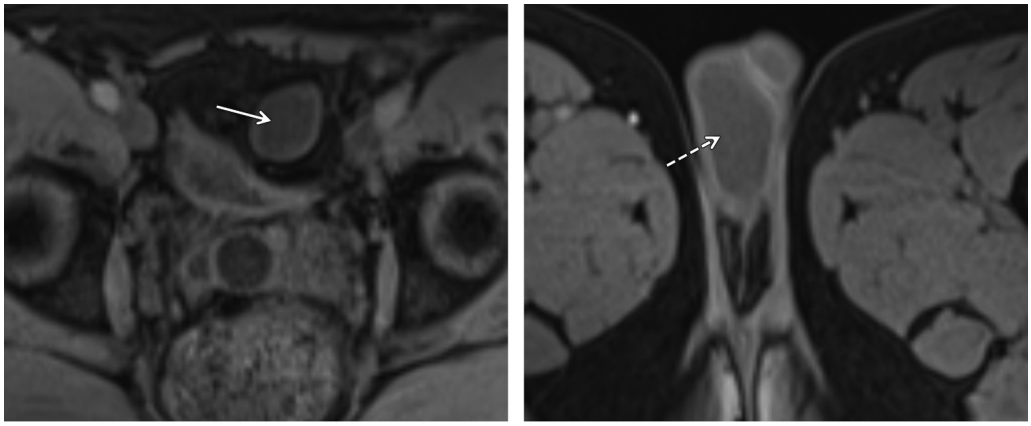
Figure 9. Testicular microlithiasis and seminoma in a 26-year-old man who presented to the urologist and reported having a testicular mass and infertility. Longitudinal gray-scale US image of the left testis shows testicular microlithiasis (solid arrows) and a well-defined hypoechoic mass (dashed arrow) consistent with a seminoma.

(36). Calcium deposits develop within the seminiferous tubules or arise from the basement component of tubules (36,37). Testicular microlithiasis is an imaging-based diagnosis that is rendered when US depicts five or more echogenic foci without posterior acoustic shadowing that are smaller than 3 mm per field of view (Fig 8). The presence of testicular microlithiasis has been associated with infertility, cryptorchidism, testicular atrophy, Klinefelter syndrome, hypogonadism, pseudohermaphroditism, and alveolar microlithiasis (36,37). The relationship between testicular microlithiasis and infertility is unclear, but it may involve degeneration of cells lining the seminiferous tubules. This results in epithelial sloughing of the degenerated cells inside obstructed tubules, failure of Sertoli cells to phagocytose debris, and the subsequent deposition of concentric rings of glycoprotein and calcium (37). Twenty to 60 percent of the seminiferous tubules are usually involved, with the resultant oligospermia and reduced sperm motility possibly explaining the association of testicular microlithiasis with infertility (38).

In addition, controversy exists regarding the association between microlithiasis and testicular malignancy. The rate of concomitant testicular malignancy is higher in individuals with microlithiasis than in those without microlithiasis (Fig 9) (39). Currently, there is no definitive evidence that testicular microlithiasis is a premalignancy condition, as the risk for developing testicular cancer in the setting of isolated testicular microlithiasis is extremely small (40). However, for individuals with testicular microlithiasis and a history of infertility, cryptorchidism, testicular cancer, and/or testicular atrophy, testicular biopsy and follow-up US are recommended. It is important to educate patients regarding the importance of self-examination, which may facilitate early detection of testicular germ cell tumors. Routine use of tumor markers, cross-sectional imaging, and testicular biopsy is not recommended for individuals with isolated testicular microlithiasis (21).

Cryptorchidism.—Cryptorchidism is the most frequent congenital abnormality of the male genitalia, with a prevalence of 2%–5% at birth and 1%–2% by age 3 months. It is caused by delayed spontaneous descent. After age 6 months, however, spontaneous descent becomes less likely (41). It is recommended that orchiopexy be performed in infants aged 6–12 months to decrease subfertility, as the fertility rate is inversely proportional to the age of the patient at the time of surgery (42). Cryptorchidism can also occur as an acquired disorder that is diagnosed during infancy and childhood, with ascent of the testis into the cryptorchid position after a normal scrotal position at birth. The cumulative incidence of cryptorchidism by age 24 months can be even higher than that at birth (3,9,43). Cryptorchidism can be a result of testicular dysgenesis, a developmental disorder of the gonads due to environmental and/or genetic influences early in pregnancy, which can result in maldescended testis, infertility, hypospadias, and a high risk for malignancy (44).

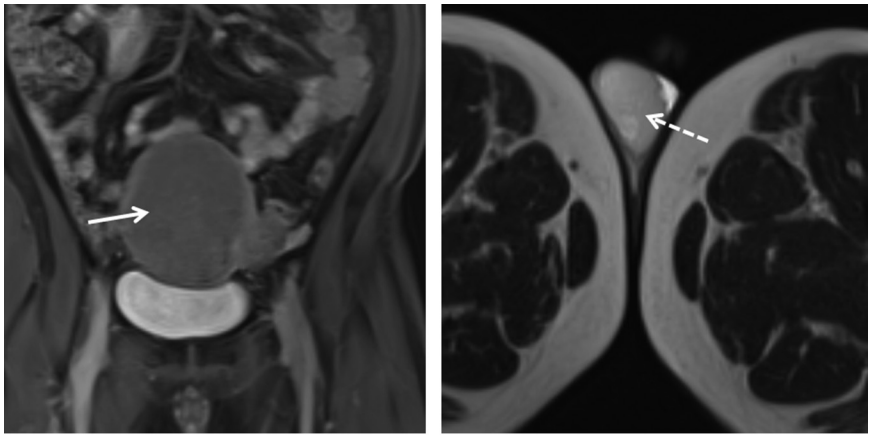
Cryptorchidism is present in 2%–9% of infertile males. The infertility in these individuals is due to the abnormal location of the testis outside of the scrotum, which results in impaired spermatogenesis. In 72% of cases, the testis is found in the inguinal canal (commonly seen as an oval mass); in 20% of cases, in a prescrotal location; and in 8% of cases, in an abdominal location (9,15) (Fig 10). The undescended testis has smaller seminiferous tubules, decreased spermatogenesis function, and a thickened basement membrane by the time the boy reaches 1½ years of age (45). Seventy percent of testes left in the undescended position reportedly are found to have only Sertoli cells at histolopathologic analysis when they are removed



a. b.

Figure 10. Cryptorchidism in a 31-year-old man who presented to the infertility clinic with a history of abnormal semen analysis results. **(a)** Axial nonenhanced T1-weighted MR image of the pelvis shows an ovoid hypointense structure (arrow) within the soft tissues of the left side of the pelvis and medial to the iliac vessels that is consistent with an undescended testis. **(b)** Axial nonenhanced T1-weighted MR image through the scrotum shows that the normally located right testis (arrow) in the right hemiscrotum also is hypointense.

Figure 11. Cryptorchidism and germ cell tumor in a 40-year-old man with a history of an undescended testis. **(a)** Coronal contrast-enhanced T1-weighted MR image through the pelvis shows a midline heterogeneously enhancing lobulated mass (arrow) consistent with a germ cell tumor involving an undescended testis. **(b)** Axial T2-weighted MR image through the scrotum shows a normally located right testis (arrow) .

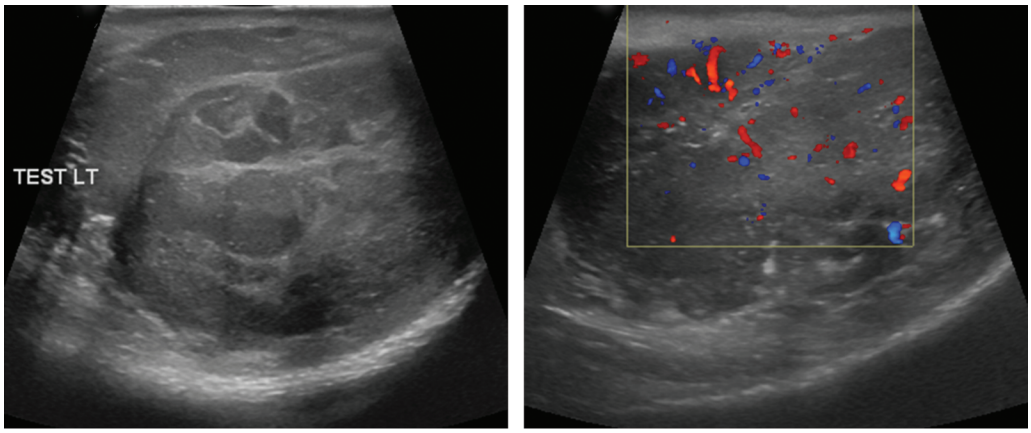


a. b.

after puberty (46). The prevalence of azoospermia asssociated with unilateral cryptorchidism is 13%; however, it is 89% in patients with nontreated bilateral cryptorchidism (41).

In the absence of an intrascrotal testis at US, an undescended testis should be sought by scanning along the path of testicular descent, which includes the abdomen, through the pelvis and inguinal canal, and down to the scrotum (47). MR imaging is useful for imaging the abdominopelvic testis (48). Another role of cross-sectional imaging in the setting of cryptorchidism is tumor surveillance, as 5%–10% of patients with testicular carcinoma (Fig 11) have undescended testes and 2%–8% have carcinoma in situ. Thus, it is highly recommended that postpubertal males with undescended testes have them surgically excised (49).

Testicular Cancer.—Testicular cancer is the most common cancer in males aged 15–35 years and is one of the most curable cancers worldwide, with a cure success rate of 95% (1,40). The risk of germ cell tumors in males with impaired fertility is 0.5%–1.0% after exclusion of the common risk factors for testicular cancer and infertility, such as cryptorchidism and chromosomal aberrations (50). Patients who have testicular tumors at presentation often have reduced semen quality and fertility, as the function of both the affected testis and the unaffected testis is impaired at the time of diagnosis. This impairment may be due to multiple factors, including disruption in the hypothalamic-pituitary-gonadal axis, immunologic or cytologic injury to the germinal epithelium, systemic cancer–related processes (eg, fever and malnutrition), and psychological conditions such as anxiety and depression. Sperm counts may actually recover once the cancerous testis is removed. Spermatogenesis is highly sensitive to the cytotoxic effects of radiation therapy and chemotherapy owing to the associated rapid cell division. Retroperitoneal lymph node dissection



a. b.

Figure 12. Testicular tumor in a 30-year-old man who reported having a left testicular mass at infertility workup. Longitudinal gray-scale **(a)** and color Doppler **(b)** US images show a heterogeneous lobulated mass with increased vascularity, consistent with a seminoma, in the left testis.

can affect ejaculation by causing sympathetic nerve plexus damage and resultant retrograde ejaculation or anejaculation (51). An increased incidence of cancer in the contralateral testis also has been reported; therefore, sperm banking before orchiectomy is advised (52). US is the modality of choice for evaluating testicular tumors. Although the US features of testicular malignancy are variable, most of these tumors are heterogeneous and hypoechogenic compared with the surrounding testicular parenchyma. Increased vascularity within the lesion also may be present (Fig 12).

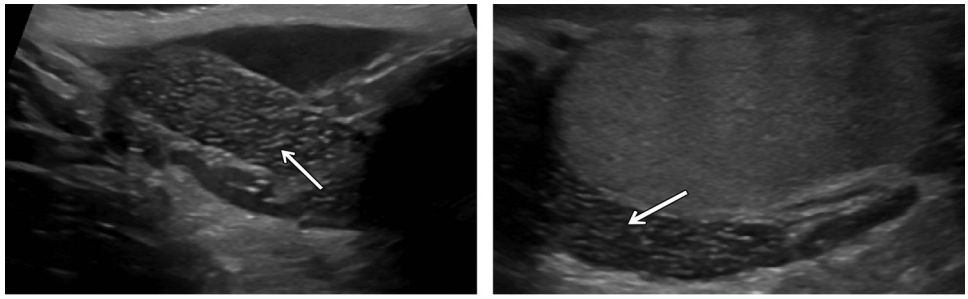
Posttesticular Causes

When physical examination and semen analysis results are normal, obstruction of the ductal system, which accounts for up to 40% of azoospermia cases, should be suspected (9). Both congenital and acquired causes along the ductal system should be considered. Careful attention should be paid to evaluating the ejaculatory duct, seminal vesicles, epididymis, vas deferens, and urethra.

Epididymal Obstruction.—In a patient who has oligozoospermia and azoospermia but normal ejaculate volume, epididymal obstruction should be suspected. Infection is the most common cause of obstruction along the course of the male reproductive tract, especially the epididymis. Gonococcal and chlamydial infections can lead to scarring and ultimately obstruction. Surgical removal of epididymal cysts (ie, spermatocelectomy) and trauma are other causes of obstruction. In certain cases, vasoepididymostomy, a microsurgical technique, can be used: the epididymis is anastomosed to the vas deferens, bypassing the level of obstruction. Pregnancy can be achieved for 20%–40% of patients after this procedure (1).

Vas Deferens (Vasal) Obstruction.—Obstruction of the vas deferens is most commonly caused by vasectomy, but it can result from inguinal hernia repair, improperly performed vasography, or contrast medium–induced irritation. Prior vasal obstruction can lead to increased intraluminal pressure that results in microrupture and obstruction of fragile epididymal tubules. Epididymal obstruction can occur in up to 60% of males 15 years after vasectomy (53). US images show the characteristic appearance of the postvasectomy epididymis: dilated tubular ectasia (Fig 13) (1). Two to eight percent of patients reportedly request a vasectomy reversal procedure, which is possible. However, the prolonged obstruction and potential for testicular fibrosis with impaired germ cell function may prevent the return to normal fertility after this procedure (54).

Ejaculatory Duct Obstruction.—Ejaculatory duct obstruction is an infrequent cause of azoospermia; it develops in fewer than 5% of patients (53,55). It is a potentially correctable cause of male infertility. Congenital conditions such as ductal atresia, stenosis, prostatic cysts, ejaculatory duct cysts, and seminal vesicle cysts can result in ejaculatory duct obstruction. Acquired conditions such as infection, scarring due to previous surgical procedures (ie, bladder neck repair), prolonged catheterization, inflammation, and stone formation in the distal duct at the level of the ampulla may lead to proximal duct dilatation (55). In most males, infertility is the first symptom of ejaculatory duct obstruction; other symptoms include decreased ejaculatory force, pain during ejaculation, hematospermia, perineal or testicular pain, and prostatitis-like symptoms (56). Semen analysis usually reveals low semen volume, low semen pH, and absent fructose



a. b.

Figure 13. Epididymal tubular ectasia in a 40-year-old man who underwent a vasectomy 15 years earlier and was interested in vasectomy reversal. Longitudinal gray-scale US images through the head **(a)** and tail **(b)** of the right epididymis show tubular structures with obstruction-induced dilatation (arrow) involving the right epididymis, consistent with tubular ectasia of the epididymis.

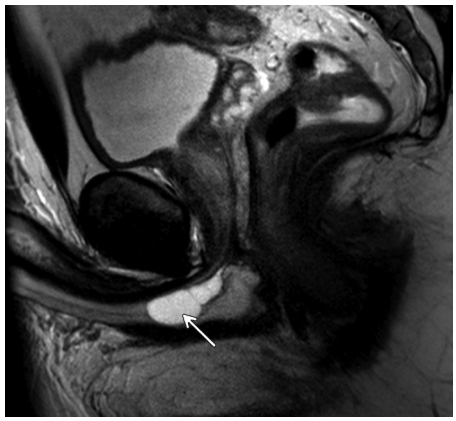


Figure 14. Cowper gland cyst in a 24-year-old man with infertility. Sagittal T2-weighted MR image shows a hyperintense lobulated ovoid cyst (arrow) in the posterolateral portion of the membranous urethra, consistent with a Cowper gland cyst.

in patients with ejaculatory duct obstruction (57). Use of a transurethral procedure can often ameliorate the obstruction and restore fertility in patients. Whenever ejaculatory duct obstruction is being considered in a patient with low ejaculate volume, retrograde ejaculation should be ruled out by performing postejaculatory urinalysis to assess for the presence of sperm (53).

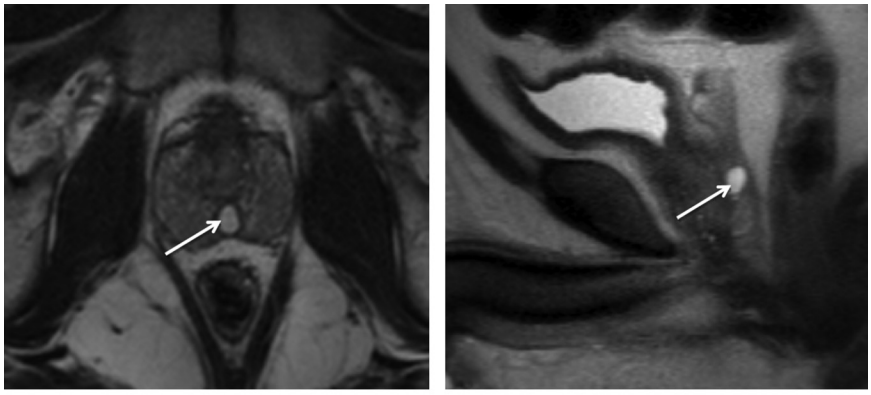
Cystic Lesions

Ejaculatory Duct Cysts

Ejaculatory duct cysts that develop in the wolffian duct system are unilocular, paramedian thin-walled cysts that occur as a result of partial distal obstruction of the ejaculatory duct. These cysts can be congenital or acquired, and unilateral or bilateral (58). Trauma, infection, and inflammation are acquired causes, whereas atresia and stenoses of the ejaculatory ducts are congenital causes. Smaller cysts are usually asymptomatic, whereas larger cysts can lead to ejaculatory pain, hematospermia, and azoospermia and infertility due to obstruction (5). At aspiration, the cystic fluid contains spermatozoa and fructose (59). On MR images, the cysts appear as thin-walled unilocular cystic lesions in a paramedian location along the course of the ejaculatory duct within the prostate gland, and they have low signal intensity on T1-weighted images and high signal intensity on T2-weighted images, similar to fluid.

Cysts and Syringoceles of the Cowper Gland Ducts

Cowper glands are paired accessory sex organs that secrete mucoid material, providing an alkaline milieu and lubrication for the spermatozoa just before ejaculation (60). Obstruction of Cowper gland ducts may cause retention cysts, which may be congenital or acquired, usually occur in children, and are rarely present in adults. The acquired cysts occur in adults as a result of trauma or infection. Cowper gland duct cysts are mainly asymptomatic. However, larger cysts may cause dysuria, frequent urination, urine retention, postvoid dribbling, urethral discharge, hematuria, hematospermia, and male infertility due to impaired ejaculation caused by obstruction of the bulbomembranous portion of the posterior urethra (61). The differential diagnosis includes a urethral web, anterior urethral valves, anterior urethral diverticulum, and stricture (62). Obstructed ejaculation due to strictures anywhere along the path of the urethra is another cause of infertility. Urethral strictures can occur as a result of infection, trauma, inflammation, or ischemia (63). On MR images, a Cowper gland duct cyst is seen as a unilocular T2-hyperintense cyst posterior or posterolateral to the bulbomembranous portion of the posterior urethra (Fig 14) (60). Sagittal T2-weighted images generally are useful for identifying the origin of Cowper gland duct cysts.



a. b.

Figure 15. Prostatic utricle cyst seen in a 32-year-old man at workup for infertility. Axial **(a)** and sagittal **(b)** T2-weighted MR images through the pelvis show a hyperintense midline subcentimeter cystic structure (arrow) confined to the prostate, consistent with a prostatic utricle cyst.

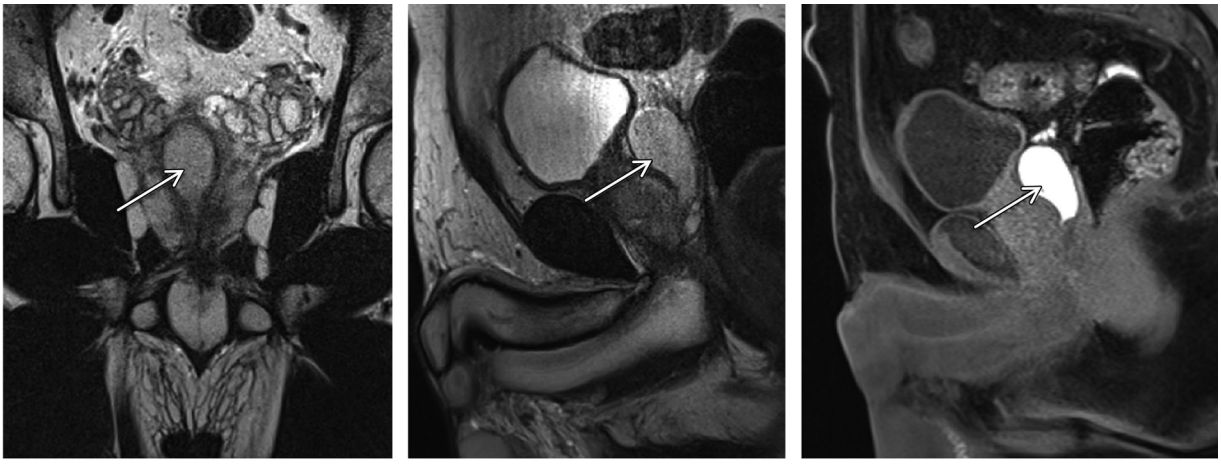
Prostatic Utricle and Müllerian Duct Cysts

Prostatic utricle and müllerian duct cysts are midline prostatic cysts located behind the upper aspect of the prostatic urethra, and they are difficult to differentiate from one another at imaging (4). Prostatic utricle cysts are endodermal in origin; they communicate with the posterior urethra or ejaculatory duct and thus contain spermatozoa (61). These cysts are most commonly found in males younger than 20 years and occur in 1%–5% of the general population (61). Prostatic utricle cysts are associated with genitourinary abnormalities such as cryptorchidism, hypospadia, intersexual problems, and posterior urethral valves. When detected incidentally at imaging, utricle cysts are usually not associated with other congenital anomalies. Prostatic utricle cysts do not extend above the base of the prostate and remain confined to the prostatic boundary (61). They are typically smaller than müllerian duct cysts and are usually not larger than 15 mm. When these cysts are large, they can compress the ejaculatory ducts and consequently result in altered semen parameters and azoospermia. Prostatic utricle cysts exhibit the signal intensity of fluid on T1- and T2-weighted MR images; however, in some cases; they have high T1 and T2 signal intensity owing to hemorrhage (61) (Fig 15).

Failure of müllerian ducts to regress causes saccular dilatation that results in müllerian duct cyst formation, which is mesodermal in origin (30). These cysts are not associated with genitourinary congenital conditions such as intersexual problems or hypospadias. They are usually asymptomatic, with a peak incidence in men aged 20–40 years and a reported prevalence of less than 1% (61). Müllerian duct cysts affect 5% of males with azoospermia (30). They may manifest in conjunction with urinary retention, urinary tract infection, ejaculatory impairment due to ejaculatory duct obstruction, and hematospermia. These cysts are located in the region of the verumontanum and extend beyond the prostate or lateral to the midline, and they are best characterized in the sagittal imaging plane. They do not communicate with the posterior urethra and do not contain spermatozoa (61). Müllerian duct cysts show the signal intensity of fluid on T1- and T2-weighted MR images, but they may show high T1 and T2 signal intensity owing to mucinous material, hemorrhage, or infection (61) (Fig 16).

Seminal Vesicle Cysts

Seminal vesicle cysts can be congenital or acquired and are most commonly found in males aged 10–40 years. They can be isolated or associated with upper urinary tract abnormalities such as ipsilateral renal agenesis and dysplasia (64). Acquired seminal vesicle cysts may occur as a result of infection or inflammation. The patient may present with recurrent urinary tract infections, recurrent epididymitis, painful ejaculation, hematuria, hematospermia, and/or pelvic pain secondary to infection, or he may be found to have a mass effect on adjacent organs. Seminal vesicle cysts are unilocular thin-walled cysts adjacent to the posterolateral aspect of the urinary bladder. They may be associated with ipsilateral ejaculatory duct dilatation and may protrude into the bladder, mimicking a ureterocele. Because these cysts communicate with the seminal vesicles, they contain spermatozoa and fructose (61). They demonstrate signal intensity isointense to fluid on T2-weighted MR images (Fig 17) and variable signal intensity on T1-weighted MR images (61). High T1 signal intensity can be attributed to hemorrhage or concentrated proteinaceous fluid; however, these cysts demonstrate no enhancement after contrast material administration. Autosomal dominant polycystic kidney disease (ADPKD) is usually associated with bilateral seminal vesicle cysts (64). ADPKD has also been associated with megavesicles, a phenomenon attributed to atonicity, which is a functional rather than



a. b. c.

Figure 16. Müllerian duct cyst in a 37-year-old man who reported having impaired ejaculation. **(a, b)** Coronal **(a)** and sagittal **(b)** T2-weighted MR images show an oblong cystic structure (arrow) with low-signal-intensity fluid content. **(c)** Corresponding sagittal T1-weighted MR image shows high-signal-intensity fluid (arrow), due to hemorrhage, that extends beyond the base of the prostate, consistent with a müllerian duct cyst.

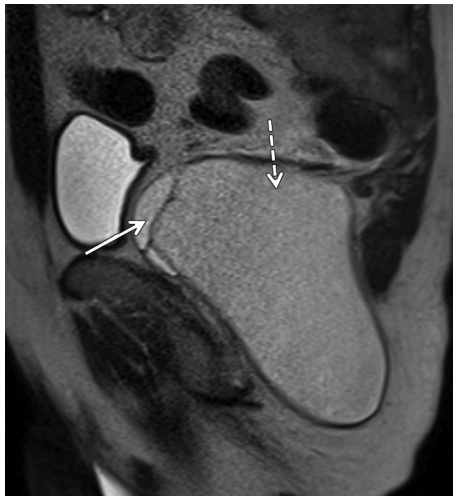
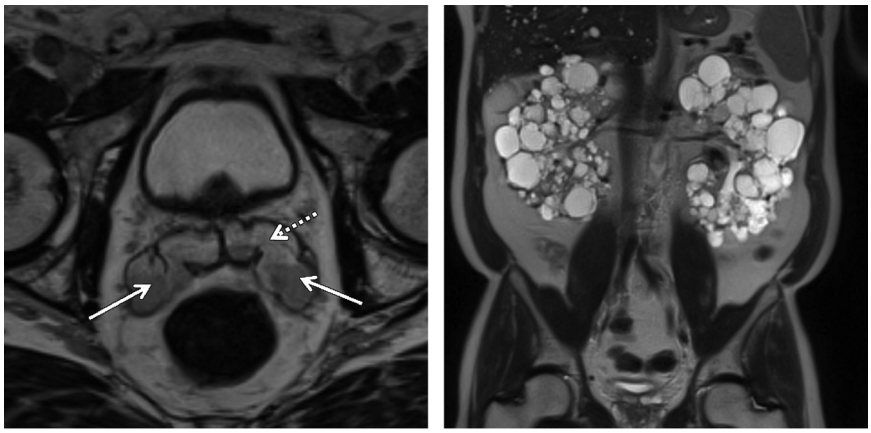


Figure 17. Seminal vesicle cyst in a 40-year-old man who presented with his spouse to the urology clinic and reported having pelvic pain and difficulties with ejaculation and conception. Sagittal T2-weighted MR image of the pelvis shows a fluid-signal-intensity cystic structure (dashed arrow) involving the right seminal vesicle (solid arrow) and extending posteriorly into the ischeorectal fossa, consistent with a seminal vesicle cyst.

mechanical obstruction (Fig 18) (9,57). The mechanisms underlying the male infertility and abnormal semen parameters seen with ADPKD could be due to the presence of cysts in the seminal vesicles and ejaculatory ducts that are causing obstruction to semen outflow or pathologic dilatation and necrospermia (57). Disruption of the hypothalamic-pituitary-gonadal axis due to uremia might cause testicular failure (65).

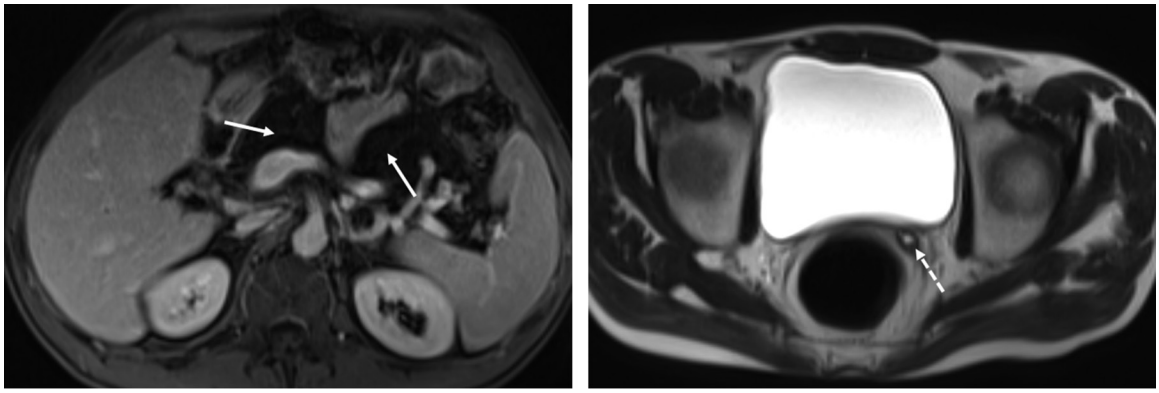
Congenital Bilateral Absence of the Vas Deferens

Congenital bilaterial absence of the vas deferens (CBAVD) is the most common cause of extratesticular ductal system obstruction; it affects 1%–2% of infertile males (15), 4%–17% of males with azoospermia, and 25% of males with obstructive azoospermia (30). Agenesis of the vas deferens can be unilateral or bilateral and partial or complete, and it can be associated with hypoplasia of the epididymis. Embryologically, the vas deferens arises from the wolffian duct at week 7 of gestation; therefore, aplasia of the vas deferens can occur as a result of fetal insult (30,66). Cystic fibrosis, a well-known cause of congenital bilateral or unilateral absence of the vas deferens, is an autosomal recessive disease in which the genetic mutation of the cystic fibrosis transmembrane conductance regulator (CFTR) gene located on the short arm of chromosome 7 causes secondary atresia of one or both vas deferentia during embryogenesis. One in 25 white individuals are carriers of this gene (67). Not all males with congenital absence of the vas deferens have cystic fibrosis, but up to 99% of individuals with CBAVD and 43% with unilateral congenital absence of vas deferens have at least one detectable CFTR gene mutation (30). Persons with vasal agenesis and associated renal anomalies usually do not have a cystic fibrosis gene mutation (68). The findings in individuals with CBAVD due to cystic fibrosis include agenesis of the vas deferens, hypoplastic or nonfunctioning seminal vesicles and ejaculatory ducts, and an epididymal remnant composed of a firm and distended caput region (Fig 19) (69). Spermatogenesis is not impaired in these patients, and sperm may be



a. b.

Figure 18. Cystic dilatation of the seminal vesicles (seminal megavesicles) in a 23-year-old man with a history of autosomal dominant polycystic kidney disease and infertility. **(a)** Axial T2-weighted MR image through the pelvis shows seminal megavesicles with a fluid-fluid level. The high-signal-intensity area (dashed arrow) is simple fluid, and the low-signal-intensity fluid (arrows) is due to hemorrhage. **(b)** Coronal T2-weighted MR image shows that both kidneys are completely replaced by cysts, consistent with autosomal dominant polycystic kidney disease.



a. b.

Figure 19. Congenital bilateral absence of the vas deferens in a 25-year-old man with a history of cystic fibrosis and azoospermia. **(a)** Axial contrast-enhanced T1-weighted MR image at the level of the pancreas and portosplenic junction shows complete fatty replacement of the pancreas (arrows). **(b)** Axial T2-weighted MR image through the pelvis does not show the right seminal vesicle or rudimentary left seminal vesicle (arrow).

harvested from the epididymis. However, the female partner should consider undergoing genetic counseling and screening for possible CFTR mutations before the sperm retrieval (15,30).

Miscellaneous Conditions That Cause Infertility

Erectile Dysfunction

Erectile dysfunction is defined as the persistent inability to achieve and/or maintain a penile erection sufficient to engage in satisfactory sexual activity. Approximately 52% of the male population aged 40–69 years have erectile dysfunction, and 10% of these individuals are affected severely (70). Erectile dysfunction can be due to organic causes, psychological causes, or both. In 10%–20% of individuals, the cause is solely psychological (71). Organic causes of erectile dysfunction include vascular, endothelial, myogenic, neurologic, local structural, and endocrine disorders. The majority of affected individuals have a vascular insufficiency (70).

The main role of imaging in the setting of erectile dysfunction is to differentiate between vascular and nonvascular causes of erectile dysfunction, and penile Doppler US is the modality of choice for this evaluation (71). Penile Doppler US is reserved for those patients in whom arterial or venous insufficiency is suspected and there is little or no functional response to phosphodiesterase-5 inhibitor agents (71). During an erection, relaxation of smooth muscle occurs by way of increased parasympathetic drive from the sacral nerve plexus due to nitric oxide release from the cavernosal endothelial cells. This relaxation results in decreased

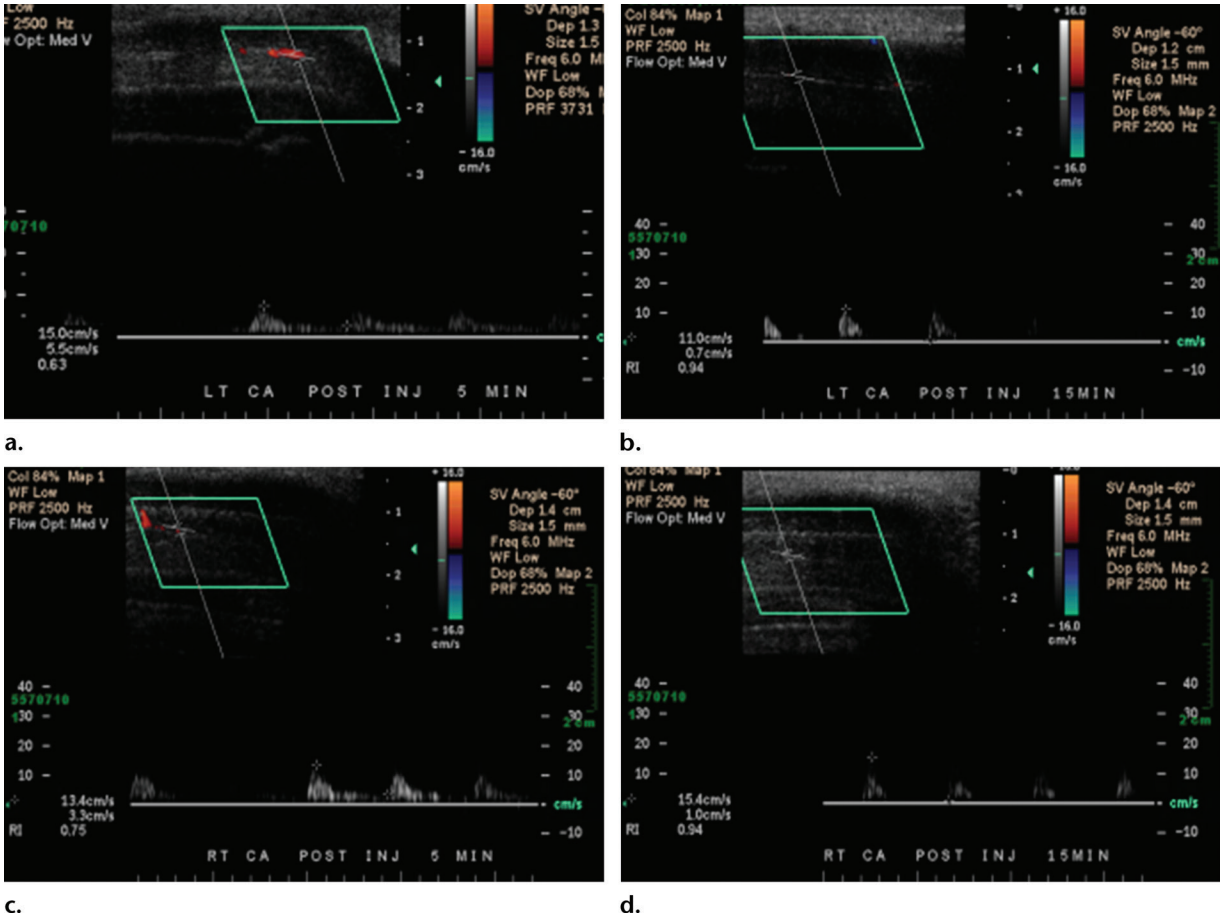


Figure 20. Erectile dysfunction in a 37-year-old man with a history of insufficient erections. Penile Doppler US images showed no erection after the intracavernosal injection of prostaglandin E_1. The left **(a, b)** and right **(c, d)** cavernosal arteries measured 0.4 and 0.5 mm, respectively, initially and 0.9 and 0.7 mm, respectively, after physiologic stimulation. In the left cavernosal arteries at 5 **(a)** and 15 **(b)** minutes after the prostaglandin E_1 injection, the peak systolic velocities were 15 and 11 cm/sec, respectively, and the end-diastolic velocities were 5.5 and 0.7 cm/sec, respectively. In the right cavernosal arteries at 5 **(c)** and 15 **(d)** minutes after the injection, the peak systolic velocities were 13.4 and 15.4 cm/sec, respectively, and the end-diastolic velocities were 3.3 cm/sec and 1.0 cm/sec, respectively. The peak systolic velocities were lower than 25 cm/sec and thus suggestive of arterial insufficiency. An end-diastoloic velocity greater than 5 cm/sec is suggestive of venous insufficiency. This patient was not successful in achieving a substantial erection at any time after the injection.

vascular resistance and markedly increased arterial flow, which causes engorgement of the cavernosal sinusoids and penile lengthening and tumescence. The exiting venules and emissary veins are compressed by engorged sinusoids, resulting in passive limitation of venous outflow (71).

Penile Doppler US is used to examine the cavernosal arteries and the response of spectral waveforms after intracavernosal injection of a derivative of prostaglandin E_1, a pharmaceutical agent. Repeated sampling of these waveforms in a stepwise manner at 5-minute intervals is performed until maximal peak systolic velocity and minimal diastolic velocity values are reached (72). The peak systolic velocity is considered normal if it is greater than 35 cm/sec, and the end-diastolic velocity is usually normal if it is a negative value or close to 0 cm/sec. A peak systolic velocity of less than 25 cm/sec indicates severe arterial disease (Fig 20). Dampened waveform and high velocity jets are indicative of proximal arterial stenosis. An end-diastolic velocity greater than 5 cm/sec suggests failed cavernosal engorgement and venous incompetence, which manifest as persistent diastolic flow. An end-diastolic velocity of 5–7 cm/sec is diagnostic for venous incompetency (71,72). Young patients may have false-positive Doppler US results that indicate venous leakage owing to anxiety and an increased sympathetic drive that causes a suboptimal response to prostaglandin E_1 therapy. Cavernosography is the reference standard imaging technique for diagnosing venous leakage; however, it is invasive and should be reserved for surgical planning (73). Standard gray-scale US is used to diagnose nonvascular abnormalities such as plaques, fibrosis, priapism, Peyronie disease, and other conditions. MR imaging is useful for problem solving in this setting.

Ejaculatory Dysfunction

A male with normal semen parameters can be infertile if he is unable to deliver ejaculate into the female partner. Normal erectile and ejaculatory functions are required for proper semen delivery into the partner. Ejaculatory dysfunctions that may interfere with male fertility include *(a)* premature ejaculation, the most common form of sexual dysfunction, in which ejaculation occurs too early and without control, causing marked distress; *(b)* anorgasmia—that is, the inability to achieve the sensation of orgasm, which results in semen transport failure; *(c)* retrograde ejaculation, in which semen enters the male's bladder instead of the vagina despite an erection; and *(d)* anejaculation, which is the inability to achieve antegrade or retrograde ejaculation due to either failed emission or anorgasmia (74).

Conclusion

The diagnostic workup of male infertility should be systematic and structured; however, it should not be started before the infertile couple has attempted to achieve pregnancy for 1 year. Semen analysis should be complemented with a comprehensive medical history in the presence of the female partner. Imaging has an important role in differentiating causes of obstructive azoospermia, which are potentially correctable causes of infertility, from causes of nonobstructive azoospermia. It is also critical to rule out the presence of life-threatening conditions associated with infertility and genetic conditions that can be transmitted to offspring.

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