Imaging of the small animal male reproductive system
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Abstract
Although radiography is useful in some instances to diagnose enlargement of the prostate, the cause of enlargement is not always obvious. It may also be difficult to determine whether a caudoventral opacity is the bladder or prostate. Ultrasonography can help differentiate between bladder and prostate and can characterize disease conditions within the prostate such as benign prostatic hyperplasia, prostatitis, abscesses, cysts, and neoplasia. Additionally, ultrasonography can be used to evaluate the kidneys, ureters, urethra, and lymph nodes which may be affected. Testicular lesions can also be evaluated with ultrasound. Radiography should be used to check for pulmonary metastasis when neoplasia is suspected.

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Normal male
On radiography, the prostate gland of an intact mature male is usually found cranial to the pelvic floor on the lateral projection. On the ventrodorsal projection, care should be taken to include the pelvic region, looking for the edge of the pubic bone, not the ilial wings to avoid exposing the radiograph too far cranially. The prostate is usually not visible in immature males or males that have been neutered at a young age.

For sonography of the prostate gland, the dog can be placed in either dorsal or lateral recumbency. With the dog in dorsal recumbency, the penis and prepuce can be displaced laterally to allow the probe to be aligned with the long axis of the bladder. With the dog in lateral recumbency, the probe needs to be held at about 45° to the long axis of the body to allow the beam to be oriented along the long axis of the bladder. For immature or neutered males, it may be necessary to tilt the probe so that the beam points dorsally into the pelvis. A high frequency transducer can usually be used because the prostate is superficial in most cases. A lower frequency transducer may be necessary for an enlarged prostate. To image the bladder in the transverse plane, the bladder is imaged as a circle or oval. Then the probe is slid caudally over the bladder trigone and urethra to the center of the prostate. When imaging the prostate in the longitudinal plane, the probe should be swept from side-to-side. The urinary tract and medial iliac lymph nodes should be evaluated also.

The normal prostate in the intact male should have a uniform, somewhat coarse echogenicity, similar to that of the spleen. The gland should be slightly hyperechoic especially in areas with high collagen content. Gas in the colon can create hyperechoic artifacts which should not be confused with disease because of side lobe or slice thickness artifact. The lobes of the prostate should have a similar size. In longitudinal images, the prostate should be round or oval with a smooth symmetrical shape. The urethra and urethralis muscle are seen as a linear hypoechoic area centrally. In transverse images, the two lobes are seen on either side of the central urethral region. The size of the prostate increases with age and size of the dog. In the neutered or immature male, the prostate is small, oval, walnut-sized, and hypoechoic. The bilobed nature of the prostate may not be obvious in transverse images. Tom cats have a diffuse prostate, which is very small and is usually not seen. Prostate problems are unlikely to occur in the cat.

Positive contrast urethrography can be useful to reliably determine the location of the urinary bladder when ultrasonography is unavailable. Margins of the urethra should be smooth. Although a small amount of contrast may enter the prostatic ducts, pockets of accumulated contrast should not be seen within the parenchyma. Conversely, fluid pockets such as cysts and abscesses may not communicate with the prostatic ducts so that a lack of contrast-filled areas cannot rule out these lesions.

It is not necessary to clip the scrotal hair in order to image the testicles. Because the testicles are small, a high frequency transducer is generally used. On a longitudinal image, the testicle is smooth,
homogenous, and elliptical. The rete (mediastinum) testis is hyperechoic and runs longitudinally through the testicle. The testis may be hypoechoic deep to the rete testis in both longitudinal and transverse planes. The epididymis can be followed as a hyperechoic structure running dorsally along the testis with the coarsely hypoechoic head and tail at either end. The vaginal tunics and tunica albuginea present as a combined hyperechoic structure seen peripherally. The pampiniform plexus shows as anechoic tortuous vessels dorsal to the head of the epididymis. Masses in the testicles are common and may or may not be significant.

Abdominal masses

Masses that might be seen in the mid-abdomen include a splenic mass (hemangiosarcoma, hematomas), a pedunculated mass from the liver, an enlarged lymph node, an intestinal mass, and in the male, a retained testicle. Dorsocaudal masses can be important in that they may indicate enlargement of the medial iliac lymph nodes. Enlargement of these nodes can signal inflammation or neoplasia in the prostate gland or bladder. Masses in the ventrocaudal region could be associated with enlargement of the prostate gland. Differentials for enlargement of the prostate gland include benign prostatic hyperplasia, prostatic neoplasia, prostatic abscess, and prostatic/paraprostatic cysts.

Benign prostatic hyperplasia

On radiography, the prostate gland is larger than expected as the volume increases in intercellular and ductal spaces. With benign prostatic hyperplasia (BPH), the prostate can be up to 4x its normal size. If the urinary bladder is full, two fluid opacities will be seen in the caudoventral abdomen. The more cranial opacity (the urinary bladder) will have a pear-shaped appearance and the caudal aspect will blend into the fluid opacity of the more caudal prostate gland. If the urinary bladder is empty, only one opacity may be apparent. Initially, with significant enlargement of the prostate gland, a triangular fat pad is apparent between the bladder cranially, the prostate caudally, and the abdominal wall. This fat pad becomes compressed and no longer visible when greater enlargement occurs. Dorsal displacement and compression of the colon occurs as the prostate enlarges.

On ultrasonography, there is usually symmetrical, hyperechoic enlargement and margins of the prostate appear smooth. Cysts are often seen in the parenchyma. On occasion, the gland can be asymmetric or nodular but there is greater concern for infection or neoplasia when the prostate has a complex appearance or marked asymmetry.

Prostatitis

Prostatitis can occur as a secondary complication of BPH and is hard to differentiate from uncomplicated BPH. Radiographically, the prostate gland is enlarged with an appearance similar to BPH. The sonographic appearance of prostatitis is also similar to that of BPH so that the two conditions cannot be differentiated on the basis of ultrasound alone. On sonography, the prostate gland may be somewhat more echogenic and inhomogeneous with prostatitis than with BPH. Although dystrophic mineralization can occur in chronic cases, mineralization should always be investigated as this can be a sign of neoplasia. Significant enlargement of the medial iliac lymph nodes should also sound an alarm. Some adjacent fluid can be present in acute cases.

Prostatic neoplasia

When an enlarged prostate gland is seen radiographically, care should be taken to look for warning signs of neoplasia. These include asymmetry, mineralization on the vertebrae or pelvic bones or in prostate/urethra, thickening of the adjacent abdominal wall, enlarged medial iliac lymph nodes, or pulmonary metastasis.

On sonography, margins of the prostate gland may appear asymmetric and irregular. Rather than uniform echogenicity, the prostate gland may have mixed echogenicity giving it a complex appearance. Hyperechoic areas with deep acoustic shadowing may indicate mineralization. The medial iliac or hypogastric lymph nodes may be enlarged and irregular with mixed echogenicity indicating metastasis.
Osseous proliferation may be apparent on the ventral aspect of the bodies of the caudal lumbar vertebrae. Changes may extend caudally into the urethra or cranially into the urinary bladder. If the trigone region is involved, obstruction of one or both ureters could result in hydrourerter and/or hydronephrosis. Always check both “upstream” and “downstream.” Thoracic radiographs should be exposed to evaluate for possible pulmonary metastasis. Aspiration or biopsy can be done to confirm neoplasia. Adenocarcinoma and transitional cell carcinoma are two of the more common neoplasms identified.

Urethrography can be used useful if ultrasonography is unavailable to evaluate the prostate. Large or irregular pockets of contrast that accumulate within the gland suggest neoplasia. Additionally, double contrast cystography and excretory urography can be used to investigate the bladder and kidneys respectively.

Neoplasia is a significant problem in neutered males. In males that have been neutered young, the prostate gland should be a small hypoechoic oval structure with smooth margins. Any evidence of mineralization or irregularity should be investigated. If the male is older and has been recently neutered, hyperechoic areas may represent resolving BPH. Acoustic shadowing suggests mineralization, which should be investigated. In either case, involvement of the urinary bladder or urethra suggests neoplasia.

**Prostatic abscess**

On radiography, smaller abscesses may not be apparent if they do not distort the margins of the prostate gland. Larger abscesses can cause the prostate to be enlarged and misshapen, suggesting the presence of neoplasia. On ultrasonography, an abscess is anechoic-to-hypoechoic. Abscessed areas may appear to contain cellular debris, which may swirl within the gland during real-time sonography. Hyperechoic areas in the gland may be caused by fibrosis, gas, or mineralization.

**Paraprostatic/prostatic cyst**

Cysts within the prostate are common and are often present in benign prostatic hyperplasia. Larger cysts are anechoic and may exhibit deep acoustic enhancement. Smaller cysts are more likely to be hypoechoic. Cysts that extend from the prostate gland may cause the impression of three bladders on radiography. Some cysts may appear cranial to bladder. Sonography can be useful to confirm the diagnosis and identify the real bladder. Most extra-parenchymal cysts can be traced back to the prostate gland and are prostatic cysts. Rarely, a paraprostatic cyst arises from a persistent Müllerian duct (uterus masculinus). A remnant of the Müllerian ducts or extension from prostatic lobe may be attached to the prostate by thin stalk or broad fibrous bands. Cystography can be performed to identify the bladder if sonography is not available.

**Retained testicle**

Retained testicles are often found cranial to the urinary bladder but may also be located at the inguinal ring or at the caudal aspect of the kidney. Smaller retained testicles will not be visible on radiography. Retained testicles may become neoplastic and quite large and may be visible radiographically. On sonography, some retained testicles appear similar to testicles found in the scrotal sac. Others are small and poorly formed. If present, the hyperechoic rete testis can help to identify the testicle. The tubular gubernaculum testis is sometimes seen extending from the caudal aspect of the testicle to the inguinal ring.

**Testicular nodules and masses**

Neoplasms in the testicle may be hypoechoic, hyperechoic, or complex. Although most nodules are benign, other nodules could represent a malignant neoplasm. The sonographic appearance of solid masses is non-specific and aspiration or biopsy is necessary to determine the nature of lesions. If the urethra cannot be readily identified, a catheter can be placed to determine its location allowing it to be avoided during the procedure. It is also important to realize that disease can be isoechoic. If a lesion doesn’t alter the reflective properties of the tissue, no echo will occur.
Testicular neoplasms include Leydig cell tumors, interstitial cell tumors, Sertoli cell tumors, and seminomas. Leydig cell tumors and interstitial cell tumors are usually benign while Sertoli cell tumors and seminomas have a greater potential for malignancy. Interstitial cell tumors are composed of small nodules that may become confluent. They are poorly encapsulated, may be associated with hormone changes, and may be bilateral. Sertoli cell tumors cause enlargement of the affected testicle while the other testicle usually becomes atrophied. This type of tumor may be hypoechoic and may be associated with feminizing syndrome and bone marrow suppression. The seminoma may be large, solitary, and unilateral with internal necrosis and hemorrhage. No hormone change is associated with this tumor. Tumors that occur in retained testicles are more likely to be malignant than those that are found in a testicle located in the scrotum.

**Testicular cysts**

Cysts are classically anechoic with deep acoustic enhancement and a well-defined far wall. Smaller cysts will appear hypoechoic rather than anechoic. Complicated cysts are hypoechoic due to infection or hemorrhage.

**Orchitis**

Inflammation or infection can cause the testicle to be increased or decreased in echogenicity. Initially, the testicle may be enlarged but the testicle may become atrophied and small if chronic changes occur. Fluid might be present in the scrotal sac or there may be scrotal thickening. Abscesses may be present in some cases. Prostatitis or urinary tract infection might also be present.

**Testicular atrophy**

The testicle may be smaller than normal due to aging change or as the result of disease. It may be hyperechoic-to-isoechoic on sonography.

**Testicular torsion**

The testicle may rotate causing vascular obstruction. With torsion, the testicle becomes enlarged with a swollen epididymis. On sonography, a decreased Doppler signal confirms compromise of the vasculature. Torsion is particularly likely to occur in retained testicles that have become neoplastic.

**Preputial lesions**

Variable lesions include cysts, edema, and neoplasia. Changes in opacity or echogenicity can be seen with these. Ultrasonography can be useful to further characterize the lesion and to help in a suitable area for aspiration.

**Selected references**


