ANATOMY AND PHYSIOLOGY

- The only accessory sex organ of male dogs.
- Male cats have a prostate and bulbourethral glands. Diseases of the accessory sex organs of male cats are very uncommon and will not be discussed.
- The prostate encircles the neck of the urinary bladder.
  - Prostatic fluid empties into the prostatic urethra via a number of small duct openings, the seminis colliculus.
  - Histologically, the prostate is made up of two major lobes with a fibrous median raphe.
  - The large lobes are made up of lobules of secretory tissue separated by bands of non-distensible connective tissue.
  - There is little smooth muscle tissue in the canine prostate.
- The prostate increases in size and vascularity with increasing age in intact dogs. This is a normal phenomenon and is not necessarily always associated with disease.
  - Androgens are primary effectors of prostate growth and function
    - Testosterone is converted to dihydrotestosterone (DHT) via the enzyme 5-alpha-reductase.
    - DHT has a higher binding affinity than testosterone and less readily dissociates from receptors, thereby exerting a greater effect than native testosterone
    - Castration causes discernible prostatic atrophy within days, with a 50% reduction in size by 3 weeks and a 70% reduction in size by 9 weeks after surgery
- Prostatic fluid secretion is constitutive in intact male dogs, with volume of fluid produced not associated with frequency of breeding
  - Prostatic fluid flows into the urinary bladder and into the urethra, creating the mucoid mass called smegma at the preputial orifice that is commonly seen in intact male dogs.
- Prostate disease is common in aged, intact male dogs and can occur in castrated males.
  - Overall prevalence of prostate disease in dogs in one study was reported as 75.6% in 500 dogs aged 1 to 21 years of age
  - Conditions that will be discussed are benign prostatic hypertrophy/hyperplasia (BPH), prostatitis / prostatic abscesses, paraprostatic cysts, and prostatic neoplasia (this will be covered in more detail by Dr. Saba).

DIAGNOSTIC TESTING (we have discussed previously)

- Physical examination
  - Rectal examination should be part of examination of all male dogs with clinical signs of lower urinary tract disease.
  - The prostate is palpable at the cranial aspect of the pubis; however, when enlarged it may be located more cranially.
  - By pushing dorsally and caudally on the caudal abdomen with the other hand, the prostate may be pushed to the cranial aspect of the pubis and may be palpable via rectal examination.
  - When enlarged, the prostate may be identified by abdominal palpation.
• Imaging of the prostate
  o In healthy intact male dogs, the prostate should be less than 70% of the distance between the sacral promontory and cranial aspect of the pubis on lateral survey abdominal radiography
  o It should be round and smooth.
  o A triangular-shaped fat pad is present between the craniocaudal aspect of the prostate and the caudoventral aspect of the urinary bladder
  o Ultrasonographically the prostate in a healthy intact male dog is round and smooth and has a diffuse inhomogeneous echotexture.
  o Contrast may reflux into the prostate gland of a healthy intact male dog on retrograde contrast urethrocystography; the prostatic urethral mucosa should be smooth and may be narrowed.
• Cytologic examination of prostatic fluid and tissue
  o Urinalysis and urine culture
    ▪ A complete urinalysis should be performed on all male dogs with signs of lower urinary tract disease.
    ▪ Microscopic examination of urine sediment may reveal hematuria, pyuria, or occasionally neoplastic cells.
    ▪ Aerobic bacteriologic culture of urine should also be performed
• Ejaculate
  o Manual ejaculation is the most common method of semen collection used in dogs.
  o Collect canine semen in a comfortable, quiet environment with non-slip flooring.
  o Most male dogs will ejaculate in the absence of a teaser bitch; however, use of a teaser bitch facilitates collection.
  o Dogs that are painful may resist ejaculation or be unable to ejaculate.
  o Semen should be collected using a latex artificial vagina attached to a sterile, graduated plastic centrifuge tube because this best simulates natural service and the copulatory lock.
  o The narrow end of the collecting cone is pulled over the sterile centrifuge tube.
  o The top of the latex collecting cone is folded over to form a final length such that the tip of the erect penis will be just above the centrifuge tube, minimizing contact of the ejaculate with the latex cone but not permitting the tip of the penis to be traumatized by the collecting tube.
  o A small amount of water-soluble lubricant is placed around the top fold of the collecting cone, which facilitates removal later.
  o Do not allow lubricant to come in contact with the ejaculate.
  o If a teaser bitch is used, two people should be present: one to hold the teaser bitch and the other for the male.
  o The handler of the bitch should kneel in front of her and keep her standing.
  o The male dog is allowed to sniff at the bitch’s hindquarters, and he may be allowed to mount her.
  o Brisk and enthusiastic massage of the bulbous glandis through the prepuce of the male will also elicit erection.
  o As soon as erection occurs, the hand manipulating the prepuce can be used to move the prepuce proximal to the bulbus glandis while the other hand introduces the collecting cone with attached centrifuge tube over the engorging penis.
  o Ideally, the collecting cone is passed to just proximal to the bulbus glandis and a tight grip maintained at the area.
Application of circumferential pressure proximal to the bulbus glandis simulates the pressure of the vulvar lips during the copulatory lock, and the pressure of the latex cone around the erect penis simulates intravaginal pressure.

The male will thrust vigorously for several minutes, ejaculating the pre-sperm and sperm-rich fractions of semen, on average 21 seconds after beginning manual stimulation.

Collected semen may be submitted for bacteriological culture and cytology.

**Prostatic massage**

- Prostatic massage is an alternative technique for collecting prostatic fluid from dogs where semen cannot be collected due to pain, inexperience, or temperament.
- In cases of suspected prostatic neoplasia with invasion of the prostatic urethra, specimens from prostatic massage are more likely to contain neoplastic cells than an ejaculate.
- After the dog is allowed to urinate, he is placed in lateral recumbency and a urinary catheter is passed transurethrally into the urinary bladder.
- The bladder is emptied and the residual urine submitted for urinalysis and aerobic bacterial urine culture if not previously performed.
- Flush the bladder several times with sterile fluid.
- Retract the urinary catheter to a position just distal to the prostate as determined by rectal palpation.
- The prostate is massaged per rectum or per abdomen or both for 1 to 2 minutes.
- Inject 5 to 10 ml of sterile 0.9% saline slowly through the catheter while manually occluding the urethral orifice around the catheter to prevent reflux.
- Gently aspirate through the catheter while advancing the catheter into the urinary bladder in order to collect epithelial cells from the prostatic and proximal urethra and the fluid that was injected into the urinary bladder.
- The fluid is submitted for cytologic examination and for culture.

**Fine needle aspiration**

- In cases where the prostate can be identified by abdominal palpation or using ultrasonographic guidance, fine needle aspiration of prostate tissue can be performed using a 22-guage, 1 1/2 – inch hypodermic needle and 6 to 12 ml syringe.
- Sedation rarely is necessary.
- The sample aspirated into the needle and/or syringe hub is then expelled onto microscopic slides and cytologic examination performed.
- Care must be taken with cystic disease or abscessation as rupture of the cyst or abscess may occur.

**Biopsy**

- Traumatic catheterization or brush biopsy
In cases where involvement of the prostatic urethra is suspected, a traumatic urinary catheter biopsy or urethral brush technique can be combined with prostatic massage.

Prostatic massage is performed as described previously except that after placing the urinary catheter in the prostatic urethra using guidance by rectal palpation, the urinary catheter is moved rapidly back and forth while applying negative pressure with a syringe and pushing ventrally on the prostate per rectum.

- Negative pressure is maintained as the catheter is then advanced into the urinary bladder for retrieval of infused sterile fluid.

Alternatively, urinary catheter biopsy can be performed independently of prostatic massage.

- Place approximately 6-ml of sterile physiologic saline in a 12-ml syringe attached to the urinary catheter.
- The catheter is inserted into the urethra and guided to the level of the prostatic urethra by rectal palpation.
- Inject 4 to 5 ml of the sterile saline through the catheter and move the catheter briskly back and forth while applying negative pressure on the syringe.
- Fluid can be submitted for cytological examination and pieces of tissue can be submitted for histopathologic examination.

Endoscopic and fluoroscopic biopsy of prostatic urethra

- In cases where prostatic urethral involvement is suspected, biopsy of the invading cancer through and in the uroepithelium can be obtained using endoscopy or fluoroscopic guidance.

Tru-cut biopsy

- Using ultrasonographic guidance, a Tru-cut biopsy sample may be obtained.
- Sedation of the patient is recommended prior to sampling.

Surgical biopsy

- Tru-cut or excisional biopsy of the prostate can be obtained through an open surgical approach.

PROSTATIC DISEASES

BENIGN PROSTATIC HYPERPLASIA

- Benign prostatic hyperplasia (BPH) in dogs is an increase in epithelial cell number and size, but the increase in number is more marked.
- It begins in dogs as young as 2.5 years of age.
  - There is histologic evidence of BPH in 16% of dogs by 2 years of age, with 50% having BPH by 4 to 5 years of age.
  - Scottish Terriers have a prostate that is 4 times larger than that of other dogs with similar body weight.
  - BPH does not occur in castrated males.
Urinary tract signs are associated with BPH in 27% of cases, with hematuria most commonly described:

- Variably sized intraparenchymal cysts containing clear amber fluid may develop.
- They may communicate with the urethra, leading to an intermittent hemorrhagic or clear, light yellow urethral discharge.
- Increased vascularity with hyperplasia occurs which leads to clinical signs of hemorrhagic urethral discharge and hematuria.
- The enlarged prostate may encroach on the rectal canal causing tenesmus.

Other than these clinical signs, affected dogs are usually normal, alert, active, and afebrile.
- On palpation, the prostate is symmetrically enlarged, has a variable consistency, and is not painful.

Definitive diagnosis is only possible by biopsy; however, a biopsy proven diagnosis is not needed to institute therapy if the clinical signs are typical.

Treatment is required if signs are present:

- If asymptomatic, the owner should be advised to watch for development of typical clinical signs.
- The most effective treatment is castration, which results in a 50% reduction in size within 3 weeks.
  - You should palpate the prostate gland 3 weeks post operatively to be sure it is involuting as expected.
  - If it is not, a more serious prostatic disease such as neoplasia may be present.
- If castration is not feasible, medical therapy can be attempted:
  - Finasteride (0.5-1 mg/kg/d; 5 mg once daily per os in dogs up to 50 kg of body weight) is a 5 alpha-reductase inhibitor (the final enzyme in the synthetic pathway for dihydrotestosterone), which produces a dose dependent decrease in prostatic size in dogs.
    - Most dogs show significant reduction in prostatomegaly and clinical signs within 2 to 4 weeks after institution of therapy.
    - No side-effects have been reported.
    - Prostate enlargement will recur after the drug is withdrawn.
    - Therapy with finasteride is recommended to control clinical signs of disease as a stopgap to permit the owners to achieve what they need to with that dog before castration is performed.
    - This may include showing the dog in conformation, breeding to specific bitches, or semen collection for cryopreservation.
  - Flutamide caused a significant decrease in prostatic size as detected by ultrasonography within 10 days
    - When administered to research dogs at 5 mg/kg/d PO for one year, there was no change in libido or sperm production.
Low doses of estrogens can be used, but may be associated with bone marrow depression, metaplasia of prostatic glandular epithelium, and secretory stasis resulting in prostatic enlargement and a predisposition to cyst formation, bacterial infection, and abscessation.

**Progestins**
- Megestrol acetate, a progestin, at a dose of 0.55 mg/kg/d PO for 4 weeks resulted in resolution of clinical signs of hyperplasia with no decrease in sperm production.
  - In dogs, increased appetite and weight gain, lethargy, change in behavior or hair color, mucometra, endometritis, pyometra, cystic endometrial hyperplasia, mammary enlargement and neoplasia, acromegaly, adrenocortical suppression or lactation (rare) may occur.
  - Diabetes mellitus may develop
- Medroxyprogesterone acetate, a progestin, (0.3 mg/kg SQ one time) given every 10 months
  - If administered subcutaneously, permanent local alopecia, atrophy, and depigmentation may occur.
    - If injecting SC, it is recommended to use the inguinal area to avoid these manifestations.
  - Adverse reactions that are possible include: increased appetite with increases in body weight and/or thirst, depression, lethargy, personality changes, adrenocortical depression, mammary changes (including enlargement, milk production, and neoplasms), diabetes mellitus, hypothyroidism, pyometra, and temporary inhibition of spermatogenesis
  - Acromegaly and increased growth hormone levels have been seen when used in patients with diabetes mellitus.

Phytotherapies (nutriceuticals) are popularly used in human beings; however, at least one, saw palmetto (Serenoa repens) was not effective in male dogs.

**ACUTE AND CHRONIC PROSTATITIS AND ABSCESSATION**
- Prostatitis and abscessation are inflammatory diseases of the prostate gland, and are usually due to bacterial infection.
  - Abscesses develop when the infection is severe and encapsulation of purulent material occurs.
    - The prostate is constantly exposed to micro-organisms that are part of the normal flora in the distal urethra.
    - Inherent protective mechanisms include retrograde flow of prostatic fluid and urine, the tight prostatic capsule, presence of local immune factors including IgA and antibacterial proteins, and persistent contractile activity emptying prostatic acini
    - Development of prostatitis implies some underlying problem in the prostate leading to a breakdown of these protective mechanisms.
      - Any dog with prostatitis should be evaluated for underlying BPH or prostatic neoplasia.
    - Bacterial prostatitis due to aerobic organisms is most common, with *E.coli*, *Staphylococcus* sp., *Klebsiella* sp., and *Proteus* sp. the most common organisms identified as causative
      - *Brucella canis* has been demonstrated experimentally as a cause of prostatitis in dogs
      - Anaerobic organisms have been identified in some cases of canine prostatitis
      - Fungal prostatitis also is reported, most commonly secondary to systemic blastomycosis
    - Although inflammation is present in chronic prostatitis, it is not severe enough to produce systemic sings.
      - However, the prostate may serve as a nidus of infection for the urinary tract and the prostatic infection may gradually abscess.
  - Clinical presentation of dogs with prostatitis varies with duration of disease.
Chronic prostatitis often is associated with the clinical presentation of the underlying disease. Acute prostatitis is associated with demonstration of a pain response when the prostate is palpated and is more likely to be associated with systemic signs of disease including fever, lethargy, abdominal pain, and dyschezia. Acute bacterial prostatitis can result in septicemia, which may be a sequela to an acute infection or may develop insidiously. Dogs with a prostatic abscess may present with virtually no clinical signs of disease or, with rupture into the peritoneal cavity, with acute abdomen and signs of septic shock.

**Treatment**

- For treatment of acute prostatitis, an antibiotic based on urine culture and sensitivity is administered for at least 28 days.
  - Culture of ejaculated prostatic fluid correctly permits diagnosis of prostatitis in about 60% of cases.
  - Culture of prostatic tissue is reported to be 25% more accurate than culture of prostatic fluid.
  - If the presenting signs are severe, the antibiotic is initially given intravenously.
    - An oral antimicrobial with prostatic penetrance is preferred for the remainder of the therapy.
    - Since acute infections may become chronic, reexamination is performed 7 days after completion of antibiotic therapy including urinalysis, urine culture, and examination of prostatic fluid by cytology and culture.

- Chronic bacterial prostatitis is very difficult to treat effectively because the blood-prostatic fluid barrier is intact.
  - Only those antibiotics that are highly lipid soluble, not highly protein-bound, and ionize at the pH of prostatic tissue, will penetrate and remain within the prostate.
    - Fibromuscular stroma separating the lobules within the canine prostate restrict flow of drugs within the tissue.
  - Current recommendations for choosing an antimicrobial agent depend on whether a gram positive or gram-negative organism is the infecting agent.
    - If the causative organism is gram positive, erythromycin, clindamycin, chloramphenicol, or trimethoprim-sulfa is chosen based on bacterial sensitivity.
    - If the organism is gram negative, chloramphenicol, fluoroquinolones, or trimethoprim-sulfa are best.
    - Fluoroquinolones are zwitterions, ionizing at multiple pHs, and it has been demonstrated that enrofloxacin moves into the prostate equally well when comparing normal dogs to dogs with chronic bacterial prostatitis.
    - Antibiotics are continued for at least 6 weeks.
  - Castration may be beneficial for resolution of chronic bacterial prostatitis.
  - Urine and prostatic fluid are re-cultured 7 days and 1 month after discontinuing antibiotics to ensure the infection has been elimination and not merely suppressed.
  - Relapse after discontinuing therapy is common.

- Prostatic abscesses historically were treated surgically, with marsupialization or omentialization of the abscess cavity.
  - These procedures require great surgical expertise and are associated with significant side effects.
  - More recently, ultrasound guided aspiration of abscesses has been described, with good long-term success.
    - The regimen includes initial ultrasound-guided drainage with rechecks every 1 to 6 weeks and repeated drainage if necessary, and supportive antibiotic therapy and castration.
    - In a study describing 8 dogs with prostatic abscesses, the median number of drainage procedures was two, clinical signs resolved in all dogs and no side effects were noted, and there was no recurrence of disease within the follow-up period of up to 5 months.
Another study described ultrasound-guided drainage of prostatic abscesses and subsequent filling of the abscess cavity with tea tree oil in 6 dogs; 67% of those dogs required two treatments, with complete resolution of clinical signs in all dogs by 6 weeks after initial diagnosis.

PARAPROSTATIC CYSTS
- Paraprostatic cysts are fluid-filled masses most commonly arising craniolateral or caudal to the prostate.
  - They are hypothesized to be remnants of the embryonic Wolffian ducts
  - Large and giant breed dogs appear to be over-represented.
- Clinical appearance of disease is not apparent until paraprostatic cysts are very large and impinge on neighboring structures.
  - Clinical signs may include rectal tenesmus and lethargy, with up to 45% of dogs presenting with systemic signs of illness
  - Urinary tract signs associated with paraprostatic cysts occur in 26% of cases and include stranguria and bloody urethral discharge
- Abdominal ultrasonography is the preferred technique for identification of paraprostatic cysts and for identification of these masses as separate from the urinary bladder.
  - The cysts are visible as large anechoic structures that may be septate
  - Because these masses usually do not directly communicate with the prostatic parenchyma, prostate diagnostics usually are unremarkable
- Surgical excision is the preferred therapy.
  - Surgery may be difficult if the cyst is large or has adhered to adjacent organs (White et al, 1987).
  - Urinary incontinence is an occasional post-operative complication, reported in 9% of dogs in one small study

NEOPLASIA
- There are many types of cancer that can involve the prostate; carcinoma is the most common type of primary prostatic cancer
- Dogs with adenocarcinoma have a mean age of 9 to 10 years and tend to be medium to large breeds.
  - Palpation of a prostate gland that would be of normal size for an intact male dog is abnormal in a neutered dog.
  - Hematuria and pyuria may be present, and atypical cells can occasionally be found on microscopic examination of urine sediment.
  - Approximately 50% of dogs have an increase in serum alkaline phosphatase activity.
  - Examine the lumbar vertebral bodies and the pelvic bones on abdominal radiographs for areas of lysis or proliferative changes suggestive of metastasis.
  - Metastasis may also occur to long bones, scapula, ribs, and digits.
  - Thoracic radiographs are indicated to check for metastasis to the lungs.
  - Even if thoracic radiographs show no evidence of metastasis, there is a 40% chance that metastases are present.
  - A biopsy or aspirate is necessary to determine the presence and type of neoplasm.
- In intact dogs when prostatomegaly is marked, neoplasia must be distinguished from prostatic abscessation and cysts.
  - In earlier stages neoplasia must be differentiated from BPH.
  - This is usually done by palpation and imaging as the prostate tends to be irregular and asymmetric in neoplasia, but symmetric and regular in BPH.
  - Response to castration can also be used to differentiate these two diseases.
  - If the dog was neutered before the development of signs related to prostatic disease, neoplasia is most likely.
  - Abscessation, however, is possible, especially if the dog has had urinary tract disease.
- Most cases are euthanized within two months of diagnosis because of progressive disease.
  - However, one case survived 19 months without therapy.
  - Therefore, the decision in regard to euthanasia should be based on the animal’s current quality of life.
- Radiation therapy is the treatment of choice for prostatic adenocarcinoma if metastatic disease is not evident.
- With intraoperative orthovoltage, median and mean survival times for 10 dogs were 114 and 196 days, respectively.
- The usual goal is temporary control of the tumor and amelioration of clinical signs; cure is unlikely.
- Prostatectomy is an alternative therapy, but the owners must be willing to accept the probable post-surgical development of urinary incontinence.
- The longest reported post-operative survival in dogs with prostatic adenocarcinoma has been 9 months.
- Castration has no beneficial effect in dogs; however, lack of decrease of prostatic size after castration may help differentiate neoplasia from other prostatic diseases.
- Chemotherapy for prostatic adenocarcinoma may be attempted with Adriamycin with or without cyclophosphamide; for transitional cell carcinoma, piroxicam (0.3 mg/kg/d) may be tried.

Table 1. Usual laboratory findings in BPH, cysts, prostatitis, and prostatic neoplasia.

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<th>Pyuria</th>
<th>Bacteruria</th>
<th>Hemorrhage</th>
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