Surgery of the prostate (dogs)

Anatomy

- Size varies with age, breed and body weight.
  - Normal dog volume (cm³) = (0.867 x BW (kg)) + (1.885 x age (year)) + 15.88
- Craniocaudal position is age dependent
  - Before 2m - Abdominal then urachal vestige breaks down and moves into pelvis
  - Puberty (20-32 weeks) - enlarges - partially abdominal position
  - By 4y - Hyperplastic enlargement - half gland is abdominal
  - Usually by 10y - the entire gland becomes abdominal
- Prostatic arteries branch from internal pudendal vessels (or umbilical arteries)
  - Divide into cranial, middle, caudal branches before distributing across dorsolateral surfaces to become subcapsular arteries that supply glandular tissue
  - Anastomoses between prostatic arteries and the urethral and rectal arteries
- Venous drainage by prostatic and urethral veins into internal iliac v.
- Lymphatic drainage to medial iliac and hypogastric nodes
- Autonomic nerve supply from hypogastric (sympathetic - ejection of fluid) and pelvic nerves (parasympathetic – increase in glandular secretion).
- Paired ductus deferentes enter the craniolateral aspect of each lobe and course caudoventrally before entering urethra adjacent to colliculus seminalis.
Diagnosis

- **CSx** = dyschezia, urethral bleeding, pyrexia
- Rectal examination – symmetry, mobility, septum, irregular outline, pain
- Cytology
  - Ejaculate sample, transurethral wash
  - FNA is specific, but risk for ‘seeding’ of neoplasia along needle tract

**NYLAND et al (2002)**
3 cases of tumour implantation TCC bladder/urethra/prostate following FNA
_VetRadiol&US_: 43:1,50-53

**POEW et al (2004)**
25 dogs with cytology (FNA and massage) and histopathology
80% agreement between cytology and histopathology (75% FNA alone)
_VetClinPath_: 33:150-154

- Radiology
  - Prostatomegaly
    - Considered enlarged if is >70% the width of the pelvic inlet
    - Cranial displacement of bladder, Dorsal displacement colon
  - Emphysematous change – likely prostatitis
  - Mineralisation – likely neoplasia if in castrated dog

**BRADBURY et al (2009)**
Rads and US of 55 dogs with prostatomegaly or prostatic mineralization
Mineralisation in castrated dogs – sensitivity 84%, specificity 100% for neoplasia
Mineralisation in intact dogs – sensitivity 67%, specificity 77% for neoplasia
_VetRadiol&US_: 50:2:167-171

- Ultrasonography – normal appears round/bilobed with homogenous echogenicity similar to spleen.

**ATALAN et al (1999)**
34 male dogs – radiographs and ultrasound performed
No difference in prostate length measurement between the modalities
Significant difference in prostatic depth between the modalities
_VetRadiol&US_: 40:4:408-412
**Non-surgical prostatic disease**

**Benign Prostatic Hyperplasia**

- Imbalance between oestrogen and androgen production which leads to increase in 5-dihydrotestosterone receptors → increase in receptor numbers → cell proliferation (Glandular, cystic and stromal hyperplasia)
- Middle aged – older, intact dogs (more than 80% of intact male dogs over 6y)
- CSx: usually asymptomatic, dyschezia, ribbon-like faeces
- Dx: prostatomegaly - symmetrically enlarged, pain free gland
  - US = Homogenous or mildly hyperechoic with occasional cysts
- Treatment = permanent suppression of secretory activity
  - Castration = involution of hypertrophic glandular tissue. 70% decrease in size within 7-10d
  - Medical: Anti-androgens (Tardak), Luteinizing hormone inhibitors (Ovaban), 5α-reductase inhibitor (Proscar), Luteinizing hormone-releasing (Lupron), Oestrogens.

**Squamous Metaplasia**

- Excessive oestrogen (sertoli cell tumour or exogenous) → squamous metaplasia
- Palpates similar to BPH, haemorrhagic urethral discharge, can have aplastic anaemia

**Prostatitis**

- Source = ascending urethral infection (most likely) or haematogenous.
- Urethral defense mechanisms are compromised from other (BPH, cysts, hyperplasia etc)
  - Normal defense mechanisms = shedding of uropathogens that are bound to exfoliating urethral cells, trapping bacteria by secreted mucous, intermittent washout with urine, local production of immunoglobins, cytokines and defensins, and mobilization of leukocytes.
- CSx: dyschezia, pain on defecation or urination, purulent/sanguinous penile discharge, hindlimb stiffness, pyrexia, lethargy, anorexia, +/- septic peritonitis, +/- oedema of hindlimbs if lymphatic obstruction
- Dx: Palpation painful, enlarged and asymmetrical, doughy sensation. Leukocytosis (>17 x 10⁹/L WBC) or leukopaenia if septic. Cytology = inflammatory exudate and bacteria. Ultrasound = slight inhomogenicity of parenchyma, numerous small cystic structures
- Most common organism – E.coli, Staphylococcal spp, Streptococcal spp, Proteus mirabilis, Klebsiella spp, mycoplasma canis and pseudomonas spp.
  - Myotic infections uncommon but include Blastomyces dermatitidis, Coccidioides immitis, Cryptococcus neoformans.
- Treatment
  - Resolves more rapidly with castration than in intact dogs (promotes involution of glandular hyperplasia and cystic changes). *(Cowan et al 1991 JAVMA)*
  - Antibiotics that diffuse well into prostatic tissue (enrofloxacin, marbofloxacin, TMS, chloramphenicol). Extended courses (4 weeks) without castration.
**Surgical prostatic disease**

**Prostatic Abscess**

- Often due to inappropriately treated prostatitis = infection → micro-abscesses → larger, lobulated abscesses
- CSx: as for prostatitis, + neutrophilia, increased ALP (gram –ive endotoxin stimulates)
- Ultrasound = focal cyst like lesion with anechoic to echogenic fluid, thick walls and irregular internal surface
- Treatment – drainage and antibiotic therapy (+ castration)
  - Per-cutaneous drainage [Boland JAAHA 2003]
  - Current technique = Omentalisation & Subtotal prostatectomy
  - Other techniques = Marsupialization (persistent discharge from stoma, chronic UTI or abscessation) & surgical drain placement

**Prostatic Retention Cysts**

- Develop as a result of accumulation of prostatic secretions caused by obstruction of parenchymal ducts within parenchyma of gland.
- Prevalence approx. 14% of adult, intact male dogs [Black et al JAAHA 1998]
- Can coexist with abscesses and may become infected in nearly 50% of cases.
- CSx = usually asymptomatic, can cause abnormal urination/defecation or perineal swellings.
- US = cystic changes appear as anechoic or hypoechoic structures with smooth margins. Mineralization seen in some cases.

**Paraprostatic cysts**

- Aetiology not defined, suggested to arise from remnant of mullerian duct system.
- No structural communication with prostate, urethra or bladder.
- Differential diagnosis for perineal swellings
- Tx: excision if narrow stalk, drainage, marsupialization, omentalisation + castration

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**BOLAND et al (2003)**

ULTRASOUND GUIDED PERCUTANEOUS DRAINAGE

13 dogs with prostatic abscesses (8) and cysts (5) – percutaneous ultrasound guided drainage

Median # drainage required 2 (1-4). No complications.
Useful alternative to surgical treatment in select dogs

*JAAHA 39:2:151-159*
Prostatic Neoplasia

- **Prostatic adenocarcinoma, undifferentiated carcinoma > TCC, SCC, leiomyosarcoma**

- **Predispositions in males, middle aged-old, medium-large breeds**
  - Shetland sheepdogs and Scottish terriers increased risk {Bryan et al, Prostate 2007;67:1174-81}

- **CSx:** asymmetrical, firm, nodular, painful prostate with concurrent lameness or neuro deficits in hindlimbs +/- urethral obstruction, stranguria, pollakiuria, haematuria

- **US = solitary or hyperechoic lesions with asymmetrically enlarged, irregular margins, mineralization (esp in castrated).**

- If untreated most animals die or are euthanized within 1 month of diagnosis
  - Metastasis to sublumbar nodes, bone and lungs reported in 63-89% of dogs are time of diagnosis. Bone in 22-25% (pelvic and lumbar 45%), 43% LN, 32% pulmonary, 15% carcinomatosis {L’Eplattenier 2006}{Sorenmo 2003}

- **Treatment**
  - Surgical exposure of tumour and intraoperative radiotherapy – MST 9m {Turrell 1987}
  - Total prostectomy can be curative if no metastasis, often associated with post-op urinary incontinence.
  - Cystoprostatourethrectomy with ureterocolic anastomosis – severe side effects such as ascending pyelonephritis, urosepsis {Stone Vet Surg 1988}
  - Subtotal prostatectomy with Nd:YAG laser

- **Palliative**
  - Cystostomy tube / urethral catherisation
  - Transurethral resection to relieve obstruction {Liptak VS 2004}

- **Inhibition of COX-2 (expressed in 88% of carcinomas) {Sorenmo 2004} decreases tumour cell proliferation, an increase in apoptosis of tumour cells, inhibition of tumour angiogenesis. Those treated with COX inhibitors survived significantly longer than those without.**

- **Survival times in literature - MST**
  - total prostatectomy 17d, subtotal prostatectomy 130d {Vlasin et al JSAP 2006;47:512-16}
  - partial prostatectomy with Nd:YAG laser 103d {L’Eplattenier et al VS 2006}
  - partial prostatectomy followed by intraoperative photodynamic therapy 41d {L’Eplattenier et al VJ 2008;178:202-207}
  - IORT 114d {Turrel JAVMA 1987;190;1:48-52}
**SORENMO et al (2003)**  
IMMUNOHISTOCHEMICAL CHARACTERISATION OF PROSTATE CARCINOMA AND CORRELATION WITH CAstration STATUS AND CASTRATION TIME  
71% castrated, 29% intact  
Castrated dogs at increased risk of prostate carcinoma (odds ratio 3.9)  
79% ductal/urothelial origin (CK 7 positive)  
Dogs castrated <2 y more likely to be CK 7 positive  
Dogs with CK 7 positive more likely to have metastasis, and bone met more common.  
*Vet Comp Oncology 1 (1): 48-56*

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**BELL et al (1991)**  
CLINICAL AND PATHOLOGIC FEATURES OF PROSTATE ADENOCARCINOMA IN SEXUALLY INTACT AND CASTRATED DOGS: 31 CASES  
Only significant difference between sexually intact and castrated dogs was increased prevalence of pulmonary metastasis in castrated dogs.  
*JAVMA 199;11:1623-30.*
**Surgical treatments**

Prostatic omentisation

- Treatment of choice for cavitary lesions
- Angiogenic and phagocytic properties, egress for residual secretions, lymphatic drainage, minimizes adhesions.
- Intracapsular or extracapsular following partial resection

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**WHITE & WILLIAMS (1995)**

**INTRACAPSULAR PROSTATIC OMENTALISATION: A NEW TECHNIQUE FOR MANAGEMENT OF PROSTATIC ABSCESSES IN DOGS**

20 dogs with prostatic abscess

Coelitomy, drainage and digital exploration through bilateral capsulectomy wounds

Omentum introduced into wounds and packed around prostatic urethra

No recurrence in 12m (19 dogs)

1 dog recurrent abscess that was managed with penrose drain

Tube cystotomy performed in 1 dog for transient dysuria

_Vetsurg_ 24:5:390-395

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**BRAY, WHITE & WILLIAMS (1997)**

**PARTIAL RESECTION AND OMENTALISATION: A NEW TECHNIQUE**

18 dogs with prostatic retention cysts

Cysts drained, resected and residual cyst cavities packed with omentum

Long term resolution in 100%

5/18 urinary incontinence post-op (persistent in 2)

_Vetsurg_ 26;3:202-209

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![Diagram of intracapsular prostatic omentisation](image-url)
Extracapsular (from Bray, White & Williams 1997)


3 dogs with para-prostatic cysts extending caudally – presented for perineal swelling
Concurrent BPH (2) and prostatitis (1)
Midline approach, and pubic osteotomy (2)
*JSAP 41:358-361*
Drain placement

- Now only recommended when omentalisation is not feasible
- **Technique**
  - Incision into ventrolateral surface of prostatic capsule
  - Abscess material removed by suction, digital debridement and lavage
  - Multiple drains exit prostatic capsule ventrally and laterally in each prostatic lobe
  - Drains exteriorised through abdominal wall
- **Complications**
  - Urinary incontinence 21-46%, Urethral fistulation 25%, re-abscessation in 20-35%

MULLEN, MATTHIESEN & SCAVELLI et al (1990)
RESULTS OF 92 DOGS TREATED FOR PROSTATIC ABSCESSEATION BY MULTIPLE PENROSE DRAIN TECHNIQUE.
- Short term complications: hypoproteinaemia, oedema of scrotum/prepuce/hindlimb, hypoglycaemia, anaemia, sepsis, shock, hypokalaemia, urine leakage, urinary incontinence
- Long term complications: urinary incontinence, UTI, prostatic re-abscessation, paraprostatic cyst, prostatic urethrocutaneous fistula (25%).
- 21 perioperative deaths – sepsis, shock, peritonitis
  
  JAAHA 26;4:369-379

GLENNON & FLANDERS (1993)
DECREASED INCIDENCE OF POSTOPERATIVE URINARY INCONTINENCE WITH A MODIFIED PENROSE DRAIN TECHNIQUE FOR TREATMENT OF PROSTATIC ABSCESSES IN DOGS.
- Modified technique that avoids dissection dorsal to prostate (17 dogs)
  - 3 dogs urinary incontinence – resolved spontaneously within 3 days
  - Excellent (71%), good (29%) outcome
  
  CornellVet 83;3:189-98

Marsupialization

- Surgical creation of large drainage fistula between abscess or cyst and ventral external body wall.
- Rarely performed – extensive post-operative management, complications include recurrence and persistent stoma. {Gourley & Osbourne Anim Hosp 1966; Hoffer et al JAAHA 1977}
Subtotal Prostatectomy

- Partially resect to treat stable patients with abscess, cysts, trauma, BPH, neoplasia
- Ventral or ventrolateral capsular incision
- Parenchyma removed with sharp/blunt dissection, electroscalpels, lasers, ultrasonic aspiration
- MST 103 – 130 days

**VLASIN et al (2006)**

**SUBTOTAL INTRACAPSULAR PROSTATECTOMY AS A USEFUL TREATMENT FOR ADVANCED STAGE PROSTATIC MALIGNANCIES**

Prospective randomized clinical study 21 dogs with adenocarcinoma or TCC
11 subtotal intracapsular prostatectomy ; 10 total prostactectomy
Survival time sig. longer in subtotal group compared to total
Hosp time increased for total compared to subtotal
Subtotal group: 2 severe complication, 5 minor (no urinary incontinence)
Total group: 3 severe, 7 major & minor
Longest survival (subtotal) was 220 days
Conclusion: subtotal had longer survival time and less complication
*JSAP 47 : 512-516*

**L’EPLATTENIER et al (2006)**

**PARTIAL PROSTATECTOMY USING ND:YAG LASER FOR MANAGEMENT OF PROSTATE CARCINOMA**

4 normal dogs, 8 cases prostatic carcinoma
Technique: subcapsular partial prostatectomy, preserving urethra and dorsal aspect of prostatic capsule using Neodymium:Yt trium Aluminium Garnet laser. In clinical cases received local application of interleukin-2 and systemic administration of meloxicam.
Normal dogs: histopathology following euthanasia: no damage to dorsal capsule or urethra.
Clinical cases: MST 103 days. 3 dogs died from complications within 16 days (severe dysuria present before surgery did not resolve, bilateral ureteral obstruction from tumour ingrowth into trigone region, hypoalbuminaemia/hindlimb oedema/coagulopathy). Others had improvement or resolution of clinical signs with MST 183 days. No urinary incontinence.
*VetSurg 35;4:406-411*

**HARDIE et al (1990)**

**SUBTOTAL PROSTATECTOMY WITH NEODYNMIUM:YTTRIUM ALUMINUM GARNET LASER**

6 normal dogs : Necrosis occurred if centro-lateral region within 5mm of urethra was photoablated at 35 watts for 2 seconds, or 60 watts for 0.5 seconds.Leakage of urethra in 2 dogs treated with 60 watt protocol
6 clinical cases : Intraoperative death (2) incontinence (4/4 surviving)
*Vet Surg 19 (5);348-55*
RAWLINGS et al (1997)
PARTIAL PROSTATECTOMY FOR PROSTATIC ABSCESS AND CYSTS
20 dogs with abscess (8) and cysts (5)
Partial prostatectomy performed using electrocautery to ventrally incise both poles of prostate then ultrasonic aspirator used to aspirate ~85% of glandular tissue
5/10 slight incontinence
1/20 recurrent abscess 18m post-op
1/20 recurrent cyst
11/16 no UTI 1y post-op
JAVMA 211;7:868-871

RAWLINGS et al (1994)
INTRACAPSULAR SUBTOTAL PROSTATECTOMY IN NORMAL DOGS: SURGICAL ASPIRATOR
Attempt to reduce post-op incontinence with excisional prostatectomy
Ventral incisions into prostate and surgical aspiratory (CAVITRON) used to aspirate ~85% of glandular tissue from inside capsule. Ventral portion of capsule excised and dorsal portions of capsule apposed to form periurethral cuff.
Pre-clinical research in 7 intact dogs. All continent following surgery.

KINCAIDE et al (1996)
EXPERIMENTAL TRIAL WITH TRANS-RECTAL HIGH-INTENSITY FOCUSED ULTRASOUND (HIFU) FOR SUBTOTAL ABLATION OF PROSTATE
Acute histology (4d) = 80-90% of gland underwent haemorrhagic, liquefactive necrosis
Long term – all dogs developed cystic cavities, no long term adverse effects
Effective method – further study of morbidity required
Am J Vet Res 57;8:1225-7
Total prostatectomy

- Technically difficult that results in post-operative complications, particularly urinary incontinence
  - 33% \{Goldsmid VS 1991\}
  - Previous reports 93-100% \{Hardie JAAHA 1984 & Basinger JAAA 1989\}
- Urodynamic changes associated with prostatic disease and surgery assessed in 23 dogs \{Basinger JAAA 1989\}
  - Causes of post-prostatectomy incontinence = Decreased urethral pressures (skeletal muscle external urethral sphincter)& detrusor instability . No response to phenylpropanolamine for urethral pressure dogs. Response to oxybutynin in detrusor instability dog.
- Technique
  - Pubic osteotomy or symphysis splitting may be required
  - Vas deferens and vessels ligated as close to prostatic capsule as possible
  - Prostate bluntly dissected from urethra working towards the middle of prostate
  - Final removal is via transurethral resection
  - Urethral anastomosis
  - Urinary catheterization for 7-10 days

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GOLDSMID & BELLINGER (1991)
URINARY INCONTINENCE AFTER PROSTATECTOMY IN DOGS

11 dogs : young dog with congenital malformation, 10 older dogs (7 prostatitis/cysts ; 3 neoplasia)
Short term complications: haematuria, proteinuria, stranguria, tenesmus, metabolic acidosis, hindlimb oedema
Long term complications: urinary incontinence (3) (5 dogs had pre-surgical incontinence)
Lower reported incidence of incontinence (33%) compared to previous reports (93-100%).
Prostatic neoplasia likely increased risk of incontinence following prostatectomy

Vet Surg 20;4:253-56
**TRANSURETHRAL RESECTION IN MANAGEMENT OF URETHRAL AND PROSTATIC NEOPLASIA**

- 6 dogs with prostatic or urethral neoplasia
  - Cystoscope performed to determine extent of neoplasia in urethra
  - Transurethral removal involved piecemeal removal of neoplastic tissue from ureteral lumen using electrocautery cutting loop. 2 dogs adjunctive treatment with IORT and chemotherapy.
  - Urethral perforation in 3 dogs.
  - Transurethral resection syndrome = excessive absorption of lavage fluids during procedure – circulatory overload, hyponatremia, glycine and ammonia toxicity, hypothermia. More likely following urethral perforation.

Palliative for urethral obstruction for male dogs with prostatic carcinoma. (not recommended in the female ureteral TCC cases because of high complication rate).

*Vet Surg* 33:505-516

### SORENMO et al (2004)
**EVALUATION OF COX-1 AND COX-2 EXPRESSION AND THE EFFECT OF COX INHIBITORS IN CANINE PROSTATIC CARCINOMA.**

- 94.1% expressed COX-1
- 88.2% expressed COX-2

Dogs treated with COX-inhibitors (piroxicam or carprofen) lived significantly longer than untreated dogs (6.9 vs 0.7 months).

*VCompOncol* 2;1:13-23

### TURREL (1987)
**INTRAOPERATIVE RADIOTHERAPY OF CARCINOMA OF THE PROSTATE GLAND IN 10 DOGS**

- 7 prostate/urethra only, 3 with lymph node involvement
  - Range 20-30Gy
  - ST 41-750 days
  - Median ST 114d, mean ST 196d
  - No sig difference in ST between those with and without node involvement
  - Complications (2): resulted in death

*JAVMA* 190;1:48-52

### L’EPPLANTIER et al (2008)
**INTRAOPERATIVE PHOTODYNAMIC THERAPY WITH 5-AMINOLEVULINIC ACID**

- 6 dogs with prostate carcinoma
  - Tx with subcapsular prostatectomy (Nd:YAG laser), intraop photodynamic therapy using halogen broad band lamp following administration of photosensitizer, and meloxicam.
  - MST 41d

*Vet Journal* 178:2;202-207
PHOTODYNAMIC THERAPY FOR PROSTATIC CARCINOMA IN A DOG
Oral photosensitizer given 4h prior to GA where light passed retrograde through urethra into prostate.
Resolved the pre-operative haematuria, although no decrease in size of prostate.
Euthanised 35 weeks following treatment for metastatic disease.
JVIM 17:235-237

GEIGY et al (2013)
UNUSUAL PRESENTATION OF ALVEOLAR ECHINOCOCCOSIS AS PROSTATIC AND PARAPROSTATIC CYSTS IN A DOG
Echinococcus multilocularis – seen in liver and prostate in 8y MN Lab
Cytological exam showed parasitic hyaline membranes typical of Echinococcus infection
Treated with albendazole and debulking
BMC Veterinary Research 9:159