

Urogenital and Perineal Surgery for Advanced Practitioners Mini Series

Session Three: Urinary Trauma and Urinary Neoplasia

**Benito de la Puerta DVM Cert SAS Dip ECVS
MRCVS
European and RCVS Specialist in Small Animal
Surgery**



Surgery of the female genital tract:

Anatomy:

The ovaries are located caudal to the kidneys, occasionally the left ovary can be larger than the right. Along the outer surface connective tissue condenses to form a capsule or tunica albuginea that is covered by peritoneum. A double fold of peritoneum forms the ovarian bursa. In dogs the bursa is can be covered by fat obscuring the ovary. In the cat there is very little fat. The mesovarium attaches the ovary to the body wall dorsolateral and contains the utero-ovarian vessels. Cranially it encloses the suspensory ligament which attaches to the last rib. Caudally the suspensory ligament is continued by the proper ligament that attaches the cranial end of each uterine horn. The mesovarium is continuous with the mesometrium together they form the broad ligament and attach the uterus and ovaries to the dorsolateral body and pelvic walls.

The ovarian arteries arise from the aorta caudal to the renal arteries. The right ovarian vein drains into the caudal vena cava but the left ovarian vein drains into the left renal vein.

The Y shaped uterus consists of a neck, body and two horns. The uterus receives vascular supply from the anastomosing ovarian and uterine arteries.

Ovariectomy/ Ovariohysterectomy

Indications and benefits of Ovariectomy/ ovariohysterectomy:

- Population control by preventing reproduction
- May correct sexually dimorphic aggression, a negative behavioral interaction that occurs between females or between males housed with females. Nonsexual dimorphic behaviours are not usually resolved by gonadectomy
- Reduces the risk of mammary cancer, if its done before the first estrus the risk is almost nullified. Spaying female dogs which have developed cancer at the time of mammary surgery experience longer survival than intact females.
- Eliminates the risk of pyometra. Around 23% of dogs which are not spayed will develop a pyometra by 10 years.

Consequences of ovariohysterectomy:

- Certain tumours types like transitional cell carcinoma, osteosarcoma and hemangiosarcoma have been over represented in gonadectomized animals.
- Gonadectomy increases the risk of diabetes in cats
- Hypothyroidism in female dogs
- Increases obesity, spayed female dogs have an increase food intake and appetite after OHE due to loss of estrogen. In cats their metabolic rate decreases.
- USMI also due to decreased estrogen. Occurs in around 20% of spayed bitches compared to 0.2-0.3% in intact bitches. Although other factors also contribute to this
- Increased risk of developing UTI

Prepubertal OVHE:

Because sexual maturity varies among species and breed a specific age that defines prepubertal surgery cannot be determined but the recommendation for gonadectomy of owned pets are at 4 months or older. A study comparing the effect of OVHE on skeletal, physical and behavioural development found no differences after 15 months in dogs spayed at 7 weeks and those spayed at 7 months of age.

Ovaryhysterectomy:

- Open Surgical approach
- Laparoscopy OVHE: results in less postoperative pain and has a faster recovery than open procedures. Additional advantages includes minimal wound inflammation, fewer wound infections and superior visualization.

Ovariectomy vs ovariohysterectomy

Long term studies have failed to show significant advantage of the ovariohysterectomy compared to ovariectomy alone unless the uterus has pathologic changes. Because the endogenous source of progesterone has been removed, pyometra should not occur. But exogenous administration of progestins should be avoided as hormonal influence on the uterus could lead to cystic endometrial hyperplasia and pyometra or stump pyometra. Other long term complications as urinary incontinence and obesity are not significant different between the two. Therefore ovariectomy is an acceptable procedure.

Disorders of the ovary

Unless there are very large they are not palpable and imaging need to be performed for assessment. Ultrasound is the preferred imaging modality to assess the ovaries.

Ovarian neoplasia:

This are uncommon partly for the high rate of spaying. The tumours may be germ cell, epithelial or sex cord stromal in origin. Metastasis is uncommon.

Small ovarian tumors are located caudal to the kidney. The are not visible on radiographs. Large tumours are pendulous and mimic mid abdominal mass. Evidence of calcification may indicate a teratoma. Metastasis in the thorax are rarely noted. Abdominal ultrasound is highly sensitive for diagnosis. Transabdominal cytology is not recommended because of the risk for seeding the peritoneal surface.

Canine ovarian tumours;

Epithelial tumors:

- Papillary adenoma and adenocarcinoma
- Cystadenoma
- Undifferentiated carcinoma

Compromise 40-50 % of reported tumours. Normally they are unilateral. Papillary adenocarcinoma is more associated with metastasis.

Sex cord stromal neoplasia:

- Granulosa cell tumours
- Dysgerminomas
- Teratomas
- Teratocarcinomas

The prognosis of all types of ovarian tumors are similar. Single non metastatized tumors that are completely excised, the prognosis is good.

Feline ovarian tumours:

Epithelial tumours

Sex cord stromal neoplasia: this are more commonly reported. granulosa cell tumours are malignant in cats. They produce hormones and metastatize in the body.

Ovarian Cysts

- Non functional cysts: they are incidental finding.
- Functional cysts: ovarian cysts are lined with granulosa cells. Follicular cysts that secrete significant amounts of estrogen produce prolonged estrus, if small amounts of progesterone are also secreted they produce signs of prolonged estrus. Luteinized cysts secrete only progesterone, resulting in prolonged diestrus. This is more common seen in dogs younger than 3 years. They are associated with vaginal bleeding and attractiveness to males. Cats often show persistent estrus when follicular cysts are present. Follicular cysts are diagnosed by vaginal cytology and hormone concentration. Abdominal ultrasonography is usually diagnostic and helps rule out different diagnosis such as pyometra. Cysts may spontaneously resolve. If medical management fails ovariectomy is curative.

Ovarian remnant syndrome

In small animals the syndrome results from improper surgical technique, decreased visualization by an inappropriately limited incision increases the risk. Ovarian tissue may revascularize if dropped into the abdomen.

Clinical signs are primarily recurrent estrus, vulvar enlargement in dogs and attraction of males and willingness to breed in both species. The diagnosis is based on history of OHE and vaginal cytology. Other tests hormone assays, estradiol and progesterone are high. Treatment includes surgical removal of tissue located at the ovarian pedicle. Care should be taken not to damage the ureters.

Disorders of the uterus

Pyometra

Common in middle aged intact bitches, average of 8 years. Incidence is around 23-25% of dogs within 10 years. It is also reported in cats. Hormonal changes lead to cystic endometrial hyperplasia, which then predisposes the uterus to secondary infection and subsequent pyometra. Exogenous administration of progesterone can lead to pyometra. Estrogen can enhance the effect of progesterone. Progesterone stimulates endometrial glandular secretion and suppresses contraction creating an environment predisposed to bacterial growth. The predominant bacteria is E coli but you can also find Pasteurella multocida, Pseudomonas proteus, Klebsiella, Streptococcus canis and others. The route of infection can be ascending, hematogenous or lymphogenous. In 70% of dogs they also have UTI most likely due to purulent drainage from the uterus infecting the urinary tract.

- The most common signs are polyuria, lethargy, vomiting and inappetence with vaginal discharge
- Abdominal palpation reveals abdominal pain
- Hematology will reveal an inflammatory leukogram with marked increase in total WBC. Normocytic normochromic anemia is also identified.
- Biochemistry: decreased albumin, increased globulins, bilirubin, cholesterol ALP, ALT.
- Radiography: enlarged uterus
- Ultrasound: superior in diagnosis

Surgical treatment: the treatment of choice is OVHE, results in rapid recovery of the patient with minimal risk for recurrence. Stabilization of the patient prior to surgery may be important. Medical treatment: is only indicated if patient is well, drains vaginally and has high breeding value. Prostaglandin F2 are the treatment of choice as causes contraction of myometrium and relaxation of cervical canal. Plus antibiotics.

Cystic endometrial hyperplasia mucometra, hydrometra and hematometra.

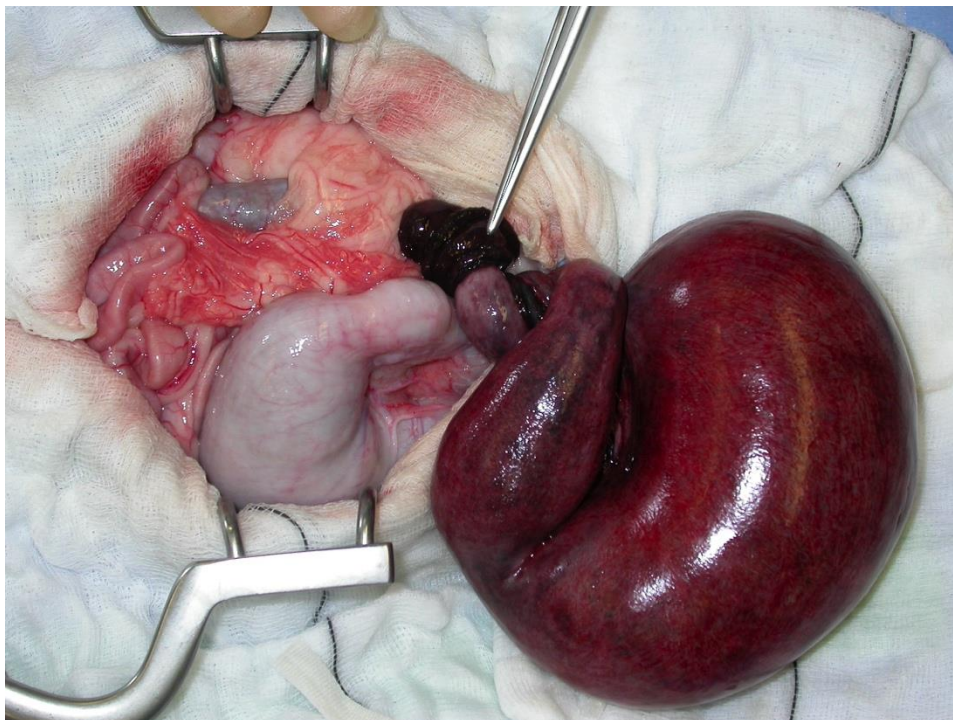
Cystic endometrial hyperplasia can lead to intraluminal accumulation of mucoid, serous or hemorrhagic uterine fluid resulting in mucometra, hydrometra or hematometra. CEH occur due to progesterone influence. Clinical signs can be similar to pyometra but the blood work tends to be normal. Diagnosis will be with ultrasound and treatment would be OVHE but its not an emergency procedure.

Metritis

May result in severe systemic illness similar to pyometra but is associated with the postpartum rather than diestrus. Treatment is medical with antibiotics and support and only surgery if there is retained placenta devitalized uterine tissue or the dog can not be stabilized.

Uterine torsion

Its normally associated with a pregnant uterus but has been also diagnosed in non pregnant females, can be associated to pyometra, hematometra and cystic endometrial hyperplasia. They present with acute signs of abdominal pain, distension and straining. Diagnosis per se can be difficult with radiographs and ultrasound and normally an exploratory laparotomy will confirm the diagnosis. The treatment is OVHe after stabilization of the patient. The uterus should not be de rotated.



Uterine Prolapse

Is rare. Its considered a complication to parturition occurring up to 48hr after delivery of the last fetus. A protusion of a mass from the vulva is observed. This can lead to shock and toxemia. Diagnosis is based on history of recent whelping and a vaginal mass being observed. Treatment would be reduction of the uterus and OVHE.

Uterine rupture

Rupture of the pregnant uterus is a rare condition in dogs and cat has been reported with dystocia or vehicular trauma. Rupture of sterile, pregnant uterus may produce minimal clinical signs.

Fetuses may become mummified, resorb, or remain intact in which can cause peritonitis. The diagnosis is suspected with ultrasound and confirmed with surgery. The treatment is OVHE in valuable breeding animals one sided resection of ovary and horn can be performed. Rupture of a pyometra often lead to septic peritonitis and becomes life threatening.

Uterine neoplasia

They are rare and usually incidental unless there is so big that compress adjacent viscera or are associated with pyometra

The majority of canine tumours are benign and of mesenchymal origin. Leiomyomas represent around 90% with leiomyosarcomas the other 10 %. Normally OVHE will be curative with malignant tumours prognosis is also good unless there is metastasis.

In cats adenocarcinomas are more common. Metastatic disease is more common, preoperative staging is more important in this cases. Because of this prognosis is guarded.

Vaginal fold prolapse

Vaginal fold prolapse (VFP) is defined as the protrusion of oedematous vaginal mucosa into the vaginal lumen and, often, through the vulvar cleft.

It has been traditionally referred to as vaginal hyperplasia, estral hypertrophy, vaginal prolapse, vaginal eversion and vaginal protrusion but the terms vaginal fold prolapse or vaginal oedema are more appropriate.

In fact, differently from other species, this is not a true organ prolapse as only the mucosa is involved. Also, the prolapsed tissue is histologically characterised by oedema and fibroplasia and is not more hyperplastic than the rest of the vaginal mucosa under oestrogen stimulation.

Aethiology and pathophysiology

During the follicular phase of the oestrus cycle the vaginal mucosa physiologically becomes oedematous, hyperaemic and keratinized. In patients presenting a VFP these changes are more severe as a result of an exaggerated response of the mucosa to the oestrogen stimulation. Oestrogens, therefore, play the major role in the pathogenesis of this condition and this can be confirmed by the fact that:

- The disorder has an high incidence during pro-oestrus and oestrus, when plasma oestrogens level is maximum
- It is usually possible to observe a spontaneous regression of the fold prolapse during diestrus, when the follicular phase of the cycle and ovarian production of oestrogen elapse
- Performing an ovariectomy/ovariohysterectomy cause shrinkage and disappearance of the prolapsed tissue

The reason why in some bitches there is this increased reaction is undetermined.

Even if hyper-oestrogenism hasn't been identified in affected bitches, an excessive oestrogen production from cystic ovaries has been suggested as a potential cause.

Administration of exogenous oestrogens for therapeutic purposes has been reported to be a contributory factor in the development of this condition.

VFP can, also, affect bitches during the last weeks of pregnancy when the level of plasma oestrogens is slightly less than during proestrus. In this phase, oestrogens cause relaxation of the pelvic ligaments, vulvar and perivulvar musculature and associated tissues. The aetiology in these patients is considered a combination of pregnancy related elevated oestrogen and increased intra-abdominal pressure.

Signalment

This condition is uncommon and usually affects young (<2 years) and intact bitches primarily during proestrus or early oestrus.

It has also been reported during late pregnancy, after administration of estrogenic drugs and, on rare occasions, it can recur later in the same cycle at the end of diestrus.

If the affected bitch is not properly treated, it is common to observe recurrences, characterised by different severity, during each oestrus cycle.

The incidence of VFP is higher in large breed dogs, especially brachycephalic breeds (e.g. Boxer, Bull Mastiff, English Bulldog). Some families of purebred dogs were reported to have an increased risk to develop the disease and a potential hereditary component was suggested. For this reason, affected bitches should not be bred.

Clinical signs and physical examination findings

The most common clinical signs are the presence of a mass of varying sizes protruding from the vulvar cleft and vulvar discharge or bleeding. Despite the fact that the oedematous tissue lies over the external urethral orifice, urine flow is rarely impeded and anuria, dysuria, pollakiuria or stranguria are uncommon clinical signs. Other less commonly reported clinical signs include increased perineal licking, perineal enlargement and swelling, tenesmus, inability or unwillingness to breed.

Performing a careful vaginal examination and palpation, it is possible to classify a VFP in three types, based upon the degree of protrusion:

- **Type I:** slight to moderate eversion of vaginal mucosa originating from the vaginal floor contained within the vagina lumen and vestibule. The prolapsed tissue is usually very smooth, pale pink to opalescent and glistening.
- **Type II:** eversion of a tongue/pear-shaped vaginal mucosa through the vulvar labia. The fold prolapse originates from the floor and lateral walls of the vagina and is often reducible. When the condition is chronic the tissue can appear dry, dull, wrinkled and damaged by self-mutilation (Fig. 1).
- **Type III:** the prolapsed vaginal tissue involves the entire circumference of the vagina, has a typical doughnut-shape and it is usually accompanied by exteriorization of the urethral orifice. The tissue can be very dry, ulcerated, fissured, necrotic and damaged by licking or rubbing. It is, usually, not possible to reduce (Fig. 2).

In case of type II or type I VFP the vaginal lumen is dorsal to the everted mucosa, while in case of type III is centrally located. The urethral orifice is always localized ventrally to the fold prolapse (Fig. 3) and the rest of the vaginal mucosa appears normal.



diagnostic procedures

Vaginal cytology and measurement of serum progesterone (P4) concentration are useful to confirm the stage of the oestrus cycle:

- Non-cornified vaginal smear and serum P4 concentration less than 2.0 ng/ml: pro-oestrus;
- Cornified vaginal smear and serum P4 concentration less than 2.0 ng/ml: early oestrus;
- Cornified vaginal smear and serum P4 concentration more than 2.0 ng/ml: late oestrus.

Haematology, biochemistry and urinalysis are, usually, within normal limits.

Abdominal radiographs and ultrasound are unnecessary unless to exclude neoplasia or visceral herniation.

Fine-needle aspiration or punch biopsy is recommended in middle-aged and old bitches to differentiate from a neoplastic lesion.

differential diagnosis

A vaginal protruding mass is a clinical finding that characterizes several genital diseases. Detailed patient signalment, reproductive history, clinical examination, site of origin of the mass, changes of the mass with the oestrus cycle, hormonal assay and vaginal cytology are important to differentiate these conditions.

Differential diagnosis for VFP include vaginal and vulvar tumors, clitoral hypertrophy, true vaginal prolapse, urethral tumors and uterine prolapse.

Treatment

There are different treatment options and they depend on the extent of the fold prolapse, the purpose for which the animal is kept and the stage of the oestrous cycle that the bitch exhibits.

Conservative treatment

The conservative approach is usually chosen for breeding bitches and when owners refuse any type of surgical procedure to the reproductive tract.

The aim of this treatment is 1) keeping the prolapsed tissue clean and moist, 2) protecting it from trauma and self-mutilation, 3) preventing infection until the vaginal fold prolapse resolves spontaneously at the end of the follicular phase of the cycle.

This can be accomplished using lubricating jelly, topical antibiotic or antibiotic-steroid ointments, artificial tears, warm saline solutions, protective pants and an Elizabethan collar. Attention must be paid to the edges of the collar to avoid further trauma to the mass, and potentially irritating bedding should be removed. Furthermore, the perineal and vulvar skin needs to be kept dry as may be subject to maceration.

Vaginal smears and serum P4 measurements should be continued periodically during the conservative approach in order to monitor the cycle of the bitch.

The use of gonadotropin-releasing hormone (GnRH) or human chorionic gonadotropin (hCG), to shorten oestrus and induce premature ovulation, has been used with limited success. Progestagens have been suggested for treatment and for prevention but they can have side effects, such as cystic endometrial hyperplasia or endometritis leading to pyometra, especially when administered during an oestrogen-dominated phase.

The conservative approach is not ideal, as this condition tends to recur, even if with different degrees of severity, every oestrus cycle.

Artificial insemination may be considered when a valuable bitch will not allow intromission and the owners insist on breeding. The condition will resolve spontaneously as soon as the pregnancy starts and unlikely recurs and causes dystocia at the time of parturition.

If in exceptional cases a fold prolapse develops just prior to whelping, the conservative approach is, in general, used and parturition can normally take place without problems.

Ovariectomy/ovariohysterectomy

Ovariectomy or ovariohysterectomy (OHE) is the treatment of choice for non-breeding bitches presented with uncomplicated type II or I VFP as ensures a permanent regression of the condition and eliminates the risk of recurrence. Spaying should be performed in anoestrus as during oestrus the risk of haemorrhage is higher and during the luteal phase of the cycle pseudopregnancy symptoms, even if just transient, can be induced.

During surgery is good practice to take a biopsy of the mass to rule out neoplasia.

While waiting for the best moment to perform the OHE the patient can be managed using a conservative approach as described before.

Prognosis after ovariectomy/ovariohysterectomy is excellent for non-traumatised and non-ulcerated cases, and regression of the oedematous tissue usually occur within several days to three weeks.

Resection

Resection can be performed with or without ovariectomy/ovariohysterectomy and should be considered when

- The prolapsed mass is severely damaged or necrotic;
- One is dealing with a breeding bitch: resection without OHE is not recommended as the procedure is associated with significant haemorrhage and does not prevent recurrence during subsequent oestrus cycles. The severity of the prolapse, however, may be markedly reduced and the incidence of recurrence can be reduced to 4%.
- The condition is chronic or the extent of prolapse doesn't allow a complete regression despite the surgical removal of the oestrogen source (type III VFP).

The prolapsed mass is usually highly vascularized and surgery is generally characterised by considerable blood loss.

Prior to surgery, urethral catheterisation should be performed to prevent damaging the urethra (Fig. 4) and a purse-string suture should be placed around the anus to help keep the surgery field clean.

An episiotomy procedure can be considered to better visualize the surgical area and exteriorise the mass.

The surgical approach is different whether the VFP is a type II or a type III.

With a type II the mass is resected at the level of the base as close as possible to the vaginal floor and the resulting mucosal defect is closed with monofilament absorbable suture in a continuous or interrupted appositional pattern.

In case of type III a circumferential incision is made and the adjacent mucosal edges are apposed with simple interrupted absorbable sutures (Fig. 5 and Fig. 6).

During both procedures severe bleeding during surgery can be controlled with electrocoagulation and reduced substantially by placing horizontal mattress suture before making the incision.

Following surgery, urination should be checked daily to make sure the urethra or the urethral orifice haven't been damaged.

Correct haemostasis during surgery should prevent post-surgical bleeding. However, if the surgical area continues to bleed after the surgery, a vaginal tampon may be placed for up to 12 hours.

Episiotomy

Vaginal and vestibular lesions are most frequently approached by episiotomy. The patient is placed in a perineal position with the pelvic limbs and perineum suspended over the end of the surgical table. Padding should be placed between the table edge and the cranial thigh to avoid inadvertent nerve or muscle injury. The skin is incised, starting at the dorsal commissure of the vulva and extending along the perineal raphe toward the anus. The dorsal extent of the vestibule can be assessed by inserting a blunt instrument into the vulvar fissure and directing it dorsally until the limits of the vestibule are determined. This instrument may also be retained to provide resistance during scalpel incision and to prevent inadvertent trauma to the underlying tissue. The incision is progressively deepened until the vestibular constrictor muscle and mucosa have been transected. Alternatively, a single-stage full-thickness incision can be performed using sharp Mayo scissors.

Hemostasis is achieved through judicious use of electrocoagulation or by placement of atraumatic Doyen forceps across the tissues lateral to the incision edges. After placement of a self-retaining Gelpi or Weitlaner retractor, the clitoral fossa, vestibule, urethral tubercle, and vestibulovaginal junction can be visualized. Catheterization of the urethra is typically performed to identify this structure. Closure of the mucosa and muscular layers is performed separately using a rapidly absorbed suture material in a continuous or interrupted pattern.

Surgery of the Canine Male Genital Tract:

Scrotum, Testes and Epididymides

Anatomy and Physiology:

The male genital organs comprise the scrotum, testes, epididymides, deferent ducts, prostate gland, urethra, penis and prepuce.

The Scrotum (Fig 1)

The canine scrotum is a membranous pouch of skin located between the thighs. It has a spherical shape which is divided by a median septum into two cavities, each of which contains a testis, epididymis and spermatic cord. The testes, epididymis, deferent ducts and associated vessels and nerves are covered by the visceral and parietal vaginal tunic and spermatic fascia. The scrotal wall consists of two layers, the skin and the dartos. The skin is thin, pigmented and sparsely-haired and contains sebaceous and sudoriparous glands. The dartos is formed of a layer of smooth muscle with mixed collagenous and elastic fibres.

The scrotum functions as a temperature regulator for the cauda epididymides. Contraction of the dartos and cremaster muscle causes the integument of the scrotum to retract and draw the testes closer to the body.

The principal blood vessels to the scrotum are the external pudendal artery and vein, which are branches of the external iliac artery and vein. The scrotum is innervated by the superficial perineal nerve which is a branch of the pudendal nerve.

The Testes (Fig 1)

The male gonad is located within the scrotum with its long axis in a dorsocaudal direction. The surface of the testes is formed by the tough tunica albuginea and divided into lobules by connective tissue (septula testis). Inside these lobules the seminiferous tubules containing the spermatogenic cells and the sustentacular (Sertoli) cells, as well as the glandular (Leydig) cells are encountered.

The testicular artery and artery of the ductus deferens supply the testis and epididymides. The testicular artery (homologue of the ovarian artery) arises from the ventral surface of the aorta at the level of the fourth lumbar vertebra. The ductus deferens artery is a branch of the prostatic artery from the internal iliac artery.

The testicular vein follows the artery but forms an extensive pampiniform plexus in the spermatic cord. The right testicular vein drains into the caudal vena cava and the left testicular vein drains into the left renal vein, in a similar fashion to the ovarian veins.

In the testes, spermatogenesis occurs in the seminiferous tubules, and is a continuous process that is controlled by gonadotropins from the pituitary gland. The Leydig cells produce androgens which are involved with spermatogenesis, maintenance of the accessory glands and secondary sexual characteristics as well as changes associated with sexual maturity. Sertoli cells are a probable source of oestrogens in the normal dog.

Epididymides (Fig1)

The epididymis lies along the dorsolateral border of the testis. The epididymis is composed of a head, body and tail. The head lies on the medial aspect of the testis, communicating with the testis, and then twists around the cranial and lateral aspect to become the body that runs along the dorsolateral surface to become the tail which attaches to the caudal aspect of the testis through the proper ligament of the testis and continues with the ductus deferens. The spermatozoa complete their maturation process and are stored in the tail of the epididymis before ejaculation.

Surgical Diseases of the scrotum, testes and epididymides

Scrotum

Scrotal trauma

Scrotal injury with involvement of the vaginal tunic or testes causes infection and orchitis. Minor abrasions and laceration of the skin can be treated by gentle cleaning of the wound, analgesia, appropriate antibiotics and prevention of self-trauma (fig 2). Extensive wounds can be sutured after local wound management. Severe tissue damage or infection may require scrotal ablation and orchiectomy.

Scrotal Tumours

Neoplasia of the scrotum is rare. The most common tumours are mast cell tumours (fig 3) and squamous cell carcinoma although any cutaneous tumour may occur in this location. Local or wide local excision, which may necessitate scrotal ablation and orchiectomy, is the treatment of choice.

Testes

Anorchism and Monorchism

Congenital absence of one or both testes is rare. Monorchism has been reported, with the left testis usually being absent. A diagnosis of these conditions is made once it has been determined that there are no testicles in the scrotum, inguinal region and abdomen, through careful palpation, ultrasound, exploratory celiotomy or hormonal tests (testosterone and pituitary gonadotropins).

Testicular hypoplasia

Testicular hypoplasia is a congenital, possibly hereditary disorder that results from a marked reduction of spermatogonia in the gonads. It may also be a component of intersex states. This may be a unilateral or bilateral condition. This condition results in small testes with usually normal to soft consistency, although sometimes they can have excessive connective tissue making them firmer and more difficult to palpate. They are incapable of spermatogenesis but the Leydig cells may be functional thus maintaining the libido. Histologic evaluation reveals underdeveloped seminiferous tubules, lack of germinal epithelium, and variable number of Leydig cells. A diagnosis of hypoplasia should not be made until the dog is mature. There is no treatment. The prognosis for fertility depends on the severity of the hypoplasia.

Cryptorchidism

This is a congenital defect in which complete descent of one or both testes into the scrotum does not occur by eight weeks of age. Testicular descent is the process by which testes move from their developmental position at the caudal aspect of the kidneys into the scrotal sac. An underdeveloped or aberrant outgrowth of the gubernaculum and failure of the gubernaculum to regress and pull the testis into the scrotum result in cryptorchidism. This process is mediated by testicular hormones, testosterone. By 35-40 days after birth the testes should have reached the scrotum but it can take up to 6 months of age.

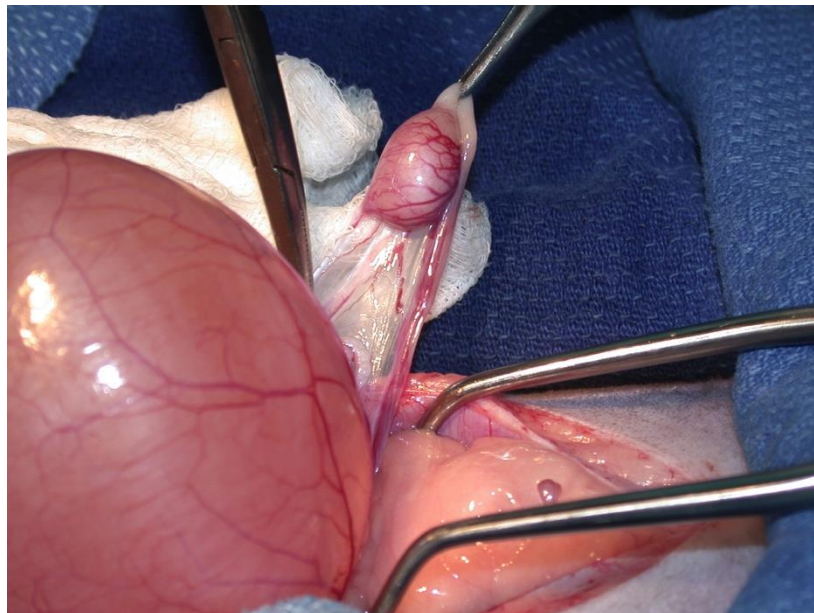
Cryptorchidism is considered a sex-linked autosomal recessive trait. It may be unilateral or bilateral, and the position of the testes may be abdominal (fig 4), inguinal (fig 5) or prescrotal. Unilateral cryptorchidism is more common than bilateral, with the right testis more commonly undescended (Yates 2003).

The ectopic testis is exposed to a normal body temperature, which causes degeneration of the germinal epithelium, but the Sertoli and Leydig cells continue to function keeping the normal endocrine function of the testis. Unilateral cryptorchid dogs are potentially fertile. Intra-abdominal testes are more susceptible to torsion and neoplasia, particularly Sertoli cell tumours and seminomas. However, because temperature does not influence interstitial cells, the incidence of interstitial cell tumours is unchanged. The risk of testicular neoplasia is 10 times greater in cryptorchid dogs than in a normal dog (Hayes 1985). Testicular torsion can be associated with testicular neoplasia due to the increased size and weight of the neoplastic testicle.

Diagnosis can be particularly difficult in young puppies because of the small size of the testicle and its capacity to move freely between the scrotum and the inguinal region. The testes of inguinal cryptorchids are smaller and softer with a prominent epididymis. Intra-abdominal testes are very difficult to palpate unless neoplastic or diseased. A thorough abdominal ultrasound and/or a plasma testosterone determination would be needed for diagnosis. In an animal with a single scrotal testicle, Cryptorchidism is far more likely than monorchism.

Small breed dogs are 2.7 times more likely to develop cryptorchidism than other breeds. This disease is more common in Chihuahua, miniature chnauzer, Pomeranian, poodle, Shetland sheepdog, Siberian Husky and Yorkshire terrier.

Medical and surgical attempts to move ectopic testes into the scrotum have been unsuccessful in dogs and are unethical since this is an inherited disease, orchiopexy should not be considered. In unilateral cryptorchid animals, a higher incidence of testicular neoplasia in the contralateral descended testis justifies the recommendation of prophylactic bilateral orchietomy. The surgical technique varies depending on the location of the testis. Extra-abdominal testes would be performed in the same way as a pre-scrotal castration except for performing the surgical incision over the testis. Intra-abdominal ectopic testes are approached through a ventral celiotomy (fig 4) or laparoscopically. The testes should be evaluated histologically because of the increased incidence of neoplasia.



Testicular torsion

Rotation of the testis on its horizontal axis results in torsion of the spermatic cord, occlusion of the venous drainage from the testis, and subsequent testicular engorgement and necrosis. Testicular torsion is rare and is more common in an enlarged neoplastic intra-abdominal testis. The cause of scrotal testicular torsion is unknown, but could be related to rupture of the scrotal ligament following trauma or excessive activity. Scrotal testes that have suffered torsion normally have no histological evidence of disease.

Dogs present with acute pain, scrotal swelling and reluctance to stand or walk. Physical examination reveals an enlarged firm testis and pain on manipulation. A thick spermatic cord may also be palpable. A patient with an intra-abdominal torsion presents with acute abdominal pain. Scrotal or abdominal ultrasound may be used to confirm the diagnosis. Ultrasound findings include testicular enlargement with a uniform decrease in parenchymal echogenicity, enlargement of the epididymis and spermatic cord and lack of blood flow to the testis on colour-flow Doppler.

Testicular torsion is a surgical emergency. If presented in shock the dog should be stabilized followed by an orchiectomy and supportive care following surgery. At the time of orchiectomy the testicle should not be de-rotated to prevent liberation of inflammatory mediators. Prognosis is good unless caused by a neoplastic process. The testicle should be submitted for histopathology to rule out neoplasia.

Orchitis/ Epididymitis

Because of their close proximity and connection via the duct system, any inflammatory or infectious process is likely to affect both structures.

Orchitis/epididymitis is normally caused by bacteria which gain access through direct trauma, retrograde passage of infected urine or prostatic secretions, bacteraemia, or infected lymph. Bacteria commonly found include *Escherichia coli*, *Staphylococcus* species, *Streptococcus* species and *Mycoplasma* species. It can also be caused by *Brucella canis* (Taylor 1980). Orchitis has also been reported in cases of canine distemper virus, systemic mycoses and canine ehrlichiosis.

Dogs present with acute pain, scrotal swelling (fig 6) and reluctance to stand or walk. For a proper examination the dog may need to be sedated. Examination reveals swelling of the testis and/or epididymis, with local hyperthermia and pain on manipulation. Unilateral involvement is more common than bilateral disease. A mucopurulent discharge may be present on the scrotum if a suppurative process with abscessation has occurred. Rectal palpation may reveal an enlarged and painful prostate gland indicating acute prostatitis.

Ultrasonographic evaluation of the scrotum and testicles will aid diagnosis and identify abscessation as well as aid in the collection of samples. Blood, urine, prostatic fluid as well as a sample of a draining tract should be sent for culture and sensitivity to isolate the aetiological agent.

Treatment depends on whether the dog is intended for breeding purposes. If fertility is of no concern the dog should be stabilized, treated with broad spectrum antibiotics and then castrated. Primary disease should also be identified and treated. Initial antibiotics of choice would be amoxicillin-clavulanate, trimethoprim sulphonamide or enrofloxacin. If orchiectomy is not an option, supportive care with antimicrobial therapy, analgesia plus local hypothermia therapy to minimise thermal damage to the germinal epithelium can be performed. Prognosis for maintaining fertility is guarded.

Chronic orchitis/epididymitis may develop following an acute episode and the prognosis for breeding is guarded to poor, with orchiectomy being the treatment of choice.

Testicular trauma

It is uncommon for testes to be traumatized although they are localized in a relatively exposed area. Trauma to the testes may also involve the scrotum, epididymis or spermatic cord. The expansile nature of the scrotum may lead to large hematomas even after rupture of small vessels. Damage to the testis may lead to leakage of sperm into the interstitial tissue producing spermatic granuloma or immune-mediated orchitis, due to the antigenic properties of the sperm. Inflammation and the subsequent hyperthermia may reduce fertility temporarily or permanently. Trauma can lead to orchitis/epididymitis.

Clinical signs may include local pain, swelling or bruising of the scrotum or an open wound. The diagnosis is made on physical examination. Ultrasound can be used to assess the integrity of the tunic albuginea and epididymides.

Medical treatment is indicated with minor trauma. Local hypothermia, analgesia, and appropriate antimicrobial therapy are indicated, as well as prevention of self trauma. If there is continuous bleeding, persistent pain or swelling, or massive trauma to the scrotum or testes, surgical exploration with or without scrotal ablation and orchiectomy would be indicated. In breeding dogs surgical exploration through a cranial approach to the scrotum can be performed. The tunica albuginea or the vaginal tunics can be repaired using fine absorbable sutures (e.g. polygecaprone, Monocryl®, Ethicon) and bleeding vessels can be ligated or cauterized to control haemostasis.

Testicular tumours

Testicular tumours are common in the dog, being the second most common tumour in male dogs. The three most common tumours are Sertoli cell tumours, seminomas and interstitial cell tumours. Embryonal carcinoma, granulosa cell tumour, haemangioma, fibrosarcoma, neurofibrosarcoma, and undifferentiated carcinoma and sarcoma have also been reported but they are rare. Tumours can occur individually, although two or more tumours can be seen in the same testicle. There is a 10 times greater incidence of testicular neoplasia in cryptorchid testes than in scrotal testes.

Sertoli cell tumour, which arises from the Sertoli cell of the seminiferous tubules, are usually slow growing and non-invasive. They can become very large when they involve an intra-abdominal testicle. These tumours are firm and nodular on palpation. Approximately 10-20% are malignant with metastasis occurring to the inguinal, iliac and sublumbar lymph nodes and to lungs, liver, spleen, kidneys and pancreas. The male feminizing syndrome is most commonly seen in this type of tumours, although it can also be seen in seminomas and less likely with interstitial cell tumours. This syndrome results from increased production of oestrogens by tumour cells. The most common sign (fig 7) is bilateral, symmetrical, non-pruritic alopecia affecting the perineum, genital region, ventral and lateral abdomen, which may extend to the thorax, as well as hyperpigmentation, gynaecomastia, galactorrhea and a pendulous prepuce. Bone marrow hypoplasia and pancytopenia can occur in these dogs.

Seminomas arise from the spermatogenic cells of the seminiferous tubules and are usually benign, although 5-10% can metastasise to the same sites as Sertoli cell tumours. They range in size from less than 1 to 10 cm and they are soft on palpation. Androgen secretion is more common in these tumours.

Interstitial cell tumours derived from the Leydig cells. They are usually small, less than 2 cm and non palpable, they are soft and nodular on palpation. They are normally incidental finding and almost always benign.

The presence of a testicular tumour can be suspected if there is an asymmetrical testicular enlargement (fig 8) or male feminizing syndrome. Abdominal radiographs or ultrasound can be used to identify an intra-abdominal neoplastic testis and assess for metastasis. Scrotal ultrasound can be helpful in assessing for neoplastic scrotal testes, and providing guidance for biopsy. If a testicular neoplasia is diagnosed, radiography and ultrasonography should be performed to assess for the presence of metastasis before surgery. The treatment of choice is scrotal ablation and castration. The prognosis for canine tumours is good to excellent, with most dogs being cured due to their low metastatic rate. In dogs with metastasis, chemotherapy is indicated, there are several protocols, combination chemotherapy using vinblastine, cyclophosphamide, and methotrexate has been reported as well as cisplatin. In these cases the prognosis is poor.

Surgical Techniques:

Orchiectomy

Canine orchiectomy can be performed via pre-scrotal incision or by scrotal ablation; and by either an open or closed technique. The advantage of an open approach is that vascular ligations are direct and more secure and this technique may be recommended in dogs over 20 kg. The disadvantages are the opening of an extension of the peritoneal cavity with the possible risk of intestinal content herniation. This can be resolved by suturing the vaginal tunic together once the orchiectomy has been performed, although this is not a clinical concern in most animals. A closed method should always be performed when performing an orchiectomy for testicular neoplasia.

Open method:

The testis is pushed cranially and a ventral midline prescrotal skin incision is performed (fig 9). The subcutaneous tissue and spermatic fascia are incised over the testis while keeping traction on the testis exposing the parietal vaginal tunic (fig 10). The latter structure is a distinct white, glistening layer. Once the spermatic fascia has been divided, the tunica covered testis can be extruded through the skin incision. To permit the complete exteriorization of the testicle, the scrotal ligament is incised. Fat and fascia surrounding the parietal vaginal tunic are reflected with a gauze sponge giving a better exposure of the spermatic cord and cremaster muscle. The vaginal tunic, is incised, being careful not to cut through the tunic albuginea as this would expose the testicular parenchyma. The ligament of the tail of the epididymides is separated from the tunic; ligation is only needed if a large blood vessel is present. The tunic is reflected proximally exposing the ductus deferens and pampiniform plexus (fig 11). The proximal portion of the spermatic cord is triple clamped (fig 12), the most proximal haemostat is removed and a transfixion suture (e.g. polyglactin 910 Vicryl® Ethicon) is placed through the ductus deferens and encircling the pampiniform plexus and a second encircling ligature is placed next to it (fig 13). The spermatic cord is transected distal to the ligatures between the two haemostats to prevent backflow haemorrhage from the testis (fig 14). The remaining portion of the cord is returned to its normal position and is inspected for bleeding. Control during the release of the cord is important because the vessels shorten and dilate, so ligature slippage can occur at this time. The other testis is removed in the same manner and through the same skin incision. The surgical incision is closed routinely using 2 metric monofilament absorbable suture (e.g. polygecaprone Monocryl®) in a simple continuous pattern for the subcutaneous tissue, ensuring that connective tissue surrounding the retractor penis muscle is incorporated to obliterate dead space, being careful not to invade the urethra. The subdermal layer is closed with 2 metric monofilament absorbable suture in a simple continuous pattern and the skin is closed using 2 metric monofilament non absorbable suture (e.g. polyamide, Ethilon®, Ethicon) in a simple interrupted pattern.

Closed method:

The surgical approach is the same as for the open approach. Once the testicle is exteriorized, the proximal portion of the spermatic cord is triple clamped, the most proximal haemostat is removed and the spermatic cord is double ligated using one transfixion ligature, through the cremaster muscle to reduce the risk of ligature slip; and one encircling ligature next to each other, using 2 or 3 metric synthetic absorbable multifilament suture (e.g. polyglactin 910, Vicryl®).

Complications

The reported incidence of postoperative complications in dogs is 6.1%, most of them being minor complications (Pollari 1996). Complications include scrotal bruising and swelling, haemorrhage (fig 15), scrotal haematoma, infection and self trauma. Scrotal bruising and swelling can be decreased by gentle manipulation of the tissues and avoiding an incision into the scrotum. Haemorrhage can be a serious condition if the vessels are bleeding into the abdomen. This patients may need a second surgical intervention to explore the wound, either through the original surgical site or via a laparotomy, to ligate the bleeding pedicle. Infection may need drainage and flushing of the wound plus appropriate antimicrobial therapy following culture and sensitivity results. Scrotal haematoma can be treated with analgesia, local hypothermia and an Elizabeth collar to prevent self mutilation.

Cryptorchid castration

If the testis is localized in the inguinal region, the skin incision is made over the testis and the testis is removed using a standard open or closed method (fig 5) .

If the testis is not located in the inguinal region, a caudal ventral midline laparotomy incision is made. The testis may be present anywhere along the line of its descent from the caudal pole of the kidney to the inguinal canal. The ductus deferens is localized by reflecting the bladder caudoventrally and tracing the ductus from its prostatic termination to the testis (fig 4). The testicle may be very small and whatever tissue is found at the termination of the ductus deferens is excised.

Once located, the ductus deferens and vessels are clamped, ligated and divided, the vessels are checked for bleeding and the abdominal cavity is closed in a routine manner. Histological examination of the excised tissue should be performed to ensure that a testicle has been removed and to rule out neoplasia.

Scrotal ablation

Indications for scrotal ablation include scrotal neoplasia, scrotal trauma, abscesses, ischemia, and when performed in conjunction with scrotal urethrostomy.

The scrotum and testicles are elevated from the body wall and an elliptical incision towards the scrotum is performed at the base of the scrotum, making sure that enough skin is left to close the incision without tension (fig 16)-17. Often the skin of the ventral scrotum is pigmented and the incision can be made at the junction of the pigmented and non-pigmented skin. Haemorrhage is controlled by electrocautery or ligation. Orchiectomy can be performed with a closed or open method (fig 18).

Vasectomy

The ductus deferens can be interrupted anywhere along its course from the epididymis to the prostatic urethra. A 1 to 3 cm incision is made in the inguinal region over the spermatic cord as it transverses from the scrotum to the inguinal canal. Caudal traction of the scrotum will put tension on the spermatic cord, allowing easier identification. The cord is gently dissected from the surrounding fascia and fat. Once localized a small incision is made through the vaginal tunic. The testicular vessels lie in one fold of the tunica vaginalis visceralis, while the ductus deferens and its vessels in the other fold. The ductus is isolated and the artery and vein are dissected from the surface of the duct. The duct is clamped, ligated and divided. Ligation should be routinely performed, as recanalization has been reported when the duct is only severed. The tunica vaginalis is sutured with fine absorbable suture. The rest of the layers are closed in a routine manner. The surgery is repeated on the other side.

Penis and Prepuce

Anatomy and Physiology:

Penis

The penis is composed of three different divisions; the root, the body and the glans. The root is attached to the tuber ischii by the left and right crura. Each crus is composed of the corpus cavernosum and the ischiocavernosus muscle covering it. The body begins at the blending of the crura and extends beyond the proximal end of the os penis. The corpus cavernosum and corpus spongiosum forms the main substance of the body. The corpus spongiosum surrounds the penile urethra which is situated ventral to the os penis. The glans is divided into bulbus glandis and pars longa glandis. The bulbus glandis surrounds the proximal part of the os penis and has the greatest potential for expansion.

The os penis forms the rigid axis of the glans penis. The urethral groove runs along the ventral aspect of the os penis. Due to the narrow entrance of the groove at the base of the os penis, it is a common site of obstruction by uroliths.

The primary blood supply to the penis is from three branches of the artery of the penis, which is a continuation of the internal pudendal artery (fig 3). These three branches are the artery of the bulb, deep artery of the penis and the dorsal artery of the penis, which anastomose with one another. Venous drainage occurs through the internal and external pudendal veins. The penis is supplied by nerves from the pelvic and sacral plexuses. These are the paired pudendal nerve and pelvic nerve.

Prepuce

The prepuce is a complete tubular sheath that covers the pars longa glandis and the bulbus glandis in the nonerect penis. It is attached to the skin of the ventral abdominal wall. It consists of an external lamina and an internal lamina which are continuous at the ostium preputiale. The preputial muscle is a small strip of cutaneous trunci muscle, which has two functions: to prevent the cranial free end of the prepuce from hanging loosely; and to pull the prepuce back over the glans penis after retraction of the prepuce.

The blood supply is derived from the dorsal artery of the penis, the external pudendal artery and the caudal superficial epigastric artery.

Surgical Disease of the Penis and Prepuce

Hypospadias

Hypospadias is a congenital defect characterised by an abnormal termination of the urethra ventral and caudal to the normal opening at the tip of the glans penis (fig 4). Hypospadias results from failure of fusion of the urogenital folds and incomplete formation of the penile urethra. It is categorized as glandular, penile, scrotal or perineal depending on the location of the urethral opening. Other abnormalities have been seen in dogs with hypospadias, including short or deviated penis, malformed os penis, incomplete preputial closure, and a defect in the development of the scrotum. Hypospadias is most commonly seen in Boston terriers.

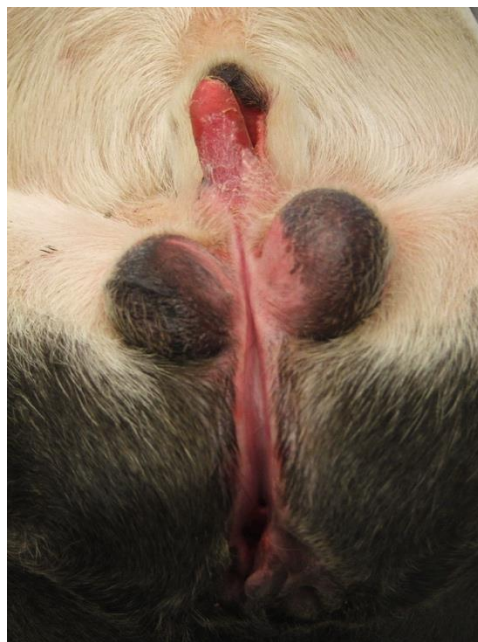
In addition to the visual abnormalities, these dogs can present with urinary tract infection, urinary incontinence and urinary scalding. The diagnosis is made by visual examination and catheterization of the urethra.

Small defects usually require no urethral surgery. Surgical correction can be considered when the urethral meatus is localized near the anus, which increases the incidence of recurrent ascending urinary tract infections (Pavletic, 2007). Excision of the remnants of the prepuce or penis, osteotomy or removal of the os penis, scrotal or perineal urethrostomy, or other reconstructive procedures may be necessary. Orchiectomy is recommended because they are not suitable candidates for breeding.

Congenital deformity of the os penis

Deformity may result in deviation of the penis and, depending on the severity, inability to retract the penis into the preputial sheath. The persistent exposure of the glans penis may result in desiccation, trauma and necrosis.

Treatment depends on the severity of the deformity and the intended use of the dog. Severe deviations may require osteotomy and stabilization of the os penis or partial penile amputation. Therapy may not be indicated if the dog is not intended for breeding, and if paraphimosis or dysuria are not present.



Fracture of the os penis

Fractures are rare. Dogs may present with dysuria and haematuria. Urethral obstruction may be present, caused by the displacement of the fragments or callus formation. Minimally displaced simple fractures do not require immobilization (fig 5). More severe fractures may need immobilization using a urethral catheter with a closed collection system, left in place for around 7 days. Fractures can also be reduced and stabilized using small bone plates. In severe cases partial penile amputation or complete penile amputation with scrotal urethrostomy can be performed.

Penile Trauma (fig 6)

The penis occupies an exposed location which makes it vulnerable to injury. Repeated haemorrhage, which may be profuse especially after excitement, is the most common clinical sign. Urinary dysfunction can also be observed. Rupture of the penile urethra can present with a fluctuant subcutaneous swelling associated with leakage of urine. Radiography should be performed to evaluate the integrity of the os penis. Minor lacerations are usually allowed to heal by second intention and excitement is prevented with sedation. If there is significant ongoing haemorrhage, additional treatment should be performed. (fig 7) A tourniquet could be placed for a short period of time to control bleeding, arterial bleeding can be controlled by ligation and cavernous bleeding is controlled by suturing the tunica albuginea. Wounds of the penile urethra can be treated by using a urinary catheter as a stent, attached to a closed urine collecting system. The catheter should be left in place for 7-10 days. Severe wounds may need partial (fig 8) or total penile amputation with or without scrotal urethrostomy.

Penile tumours

Tumours involving the penis in the dog include mast cell tumours, squamous cell carcinoma, fibroma, lymphoma, papilloma (fig 9) and transmissible venereal tumour. Osteosarcoma, osteoma and chondrosarcoma have been reported affecting the os penis. Clinical signs include swelling of the prepuce, presence of a mass, abnormal preputial discharge, licking, penile prolapse, hematuria, and dysuria. Definitive diagnosis is made through an impression smear, FNA or biopsy of the mass. Therapy and prognosis depends on the type of neoplasm, which ranges from chemotherapy, radiotherapy to partial or complete penile amputation.

Preputial tumours

The prepuce is affected by the same tumours as skin in other locations (fig 10). Mast cell tumours are the most frequently reported tumours. If surgical excision is indicated, it is important to take into consideration that the penis must remain covered by the prepuce, and if that is not possible, a partial or complete penile amputation should be performed.

Persistent penile frenulum

The epithelial surface of the penis and prepuce are fused ventrally at birth and can remain so until puberty. If persistent, surgical incision of the frenulum can be performed with minimal bleeding. This condition occurs more commonly in cocker spaniel, miniature poodles, Pekinese and mixed breed dogs.

Paraphimosis

Paraphimosis is the inability to retract the penis into the preputial sheath. Interference with the venous drainage of the cavernous tissues results in enlargement of the glans penis. Congenital and acquired causes have been described. Congenital causes include a narrowed preputial orifice and an abnormal, shortened prepuce. Acquired causes include trauma, balanoposthitis and neoplasia. It also follows masturbation, coitus, or constriction of preputial hair around the penis.

Paraphimosis is an emergency, since failure or delay of treatment increases the risk of urethral obstruction, ischaemic necrosis and gangrene of the penis. Amputation of the penis may be necessary if there is a delay in diagnosis or if medical treatment fails. The goal of the treatment is to reduce the size of the penis and to replace the penis in the prepuce. A tranquilizer (acepromazine) can be administered to induce relaxation and mild hypotension. Any hair or foreign bodies are removed from the tip of the penis. Lubricant (K-Y jelly®), hygroscopic agents, such as sugar, or cold solutions are given to reduce the size of the penis (. If replacement cannot be accomplished immediately a urinary catheter can be placed (fig 14). If the penis can be replaced in its normal position and there is no anatomical abnormality, narrowing of the preputial opening with a temporary purse string can be performed.

Several surgical procedures have been described. Castration, temporary or permanent narrowing of the preputial orifice, enlargement of the preputial orifice, as well as preputial lengthening (preputioplasty) or phallopey (Somerville 2001). Penile amputation and scrotal urethrostomy will prevent recurrence but is not necessary unless there is irreversible damage to the penis. Following replacement or surgical correction, daily penile extrusion is recommended to decrease the likelihood of adhesions.

Phimosis

This is the inability to extrude the penis from the prepuce, as a result of an abnormally small preputial orifice. It may be congenital (intersex, preputial stenosis) or acquired (secondary to inflammation, oedema, infection, neoplasia or scar tissue formation).

Congenital phimosis can be accompanied by a distended prepuce and the inability to urinate normally. Urinary retention results in balanoposthitis. More commonly phimosis interferes with the extrusion of the penis during mating. Diagnosis is made by attempting to extrude the penis from the prepuce.

Surgical enlargement of the preputial orifice and correction of the primary condition successfully alleviate the problem. Prognosis after repair is good.

Priapism

This is persistent erection not associated with sexual excitement. This condition is rare in small animals. Penile erection occurs from parasympathetic stimuli via the pelvic nerve. It is usually secondary to spinal cord injury, thromboembolic occlusion or a mass lesion. It can be differentiated from paraphimosis because the penis can be introduced into the prepuce. Although this may resolve spontaneously, treatment is directed at identifying and eliminating the primary cause. If the underlying cause cannot be eliminated penile amputation and scrotal urethrostomy may be indicated.

Urethral prolapse

Urethral prolapse is an uncommon condition characterised by protrusion of the urethral mucosa from the tip of the penis. This condition is often seen in young intact male brachycephalic dogs but has been reported also in Yorkshire terriers.

The cause is unknown but it is thought to be related to sexual excitement, excessive straining following urogenital tract infection or a combination of both. The initial clinical presentation is intermittent bleeding from the tip of the penis. The urethral prolapse can be intermittent, occurring after excitement, or permanent. The treatment of choice is surgical resection of the prolapsed mucosa, plus castration especially if it is related to sexual excitement. Following surgical excision recurrence is uncommon.



Surgical Techniques

Surgical correction for Phimosis

Surgical reconstruction of the prepuce is indicated if the phimosis interferes with the ability to urinate. A triangular full thickness incision is performed in the craniodorsal aspect of the preputial orifice, with its base at the mucocutaneous junction; if the incision is made caudoventrally this could cause persistent extrusion of the glans. The size of the defect will depend on the severity of the phimosis and its underlying cause, but care should be taken to ensure the penis remains covered by the prepuce. The preputial mucosa is sutured to the skin with simple interrupted using 2 metric non absorbable suture (polyamide, Ethilon, Ethicon)

Preputiotomy

Preputiotomy is used in conjunction with other surgical techniques as phallopey, partial penile amputation or for the management of paraphimosis to help with the placement of the penis into the prepuce. A full thickness dorsal or ventral linear incision in the prepuce is performed. If the preputial orifice is of normal size, the mucosa is apposed with simple interrupted appositional synthetic reabsorbable sutures (polygecaprone, Monocryl®, Ethicon) and skin (polyamide, Ethilon, Ethicon) in separate layers.

Preputial Advancement

This technique is indicated for the treatment of paraphimosis. A crescent-shaped piece of skin, with the concave area oriented toward the prepuce, is removed from the body wall just cranial to the prepuce. Care should be taken to preserve the preputial vessels. The paired preputial muscles are elevated from the underlying rectus abdominis fascia. The muscles are shortened by overlapping a section of muscle and suturing through the layers, or by segmental excision and reapposition. This results in cranial advancement of the prepuce. The subcutaneous and skin are closed in two layers to further advance skin cranially.

Phallopey

This technique is used to treat paraphimosis. It creates a permanent adhesion between the dorsal surface of the penile shaft and the adjacent surface of the preputial mucosa. This technique eliminates the risk of recurrent paraphimosis and subsequent penile trauma (Somerville 2001).

A preputiotomy is performed beginning 2.5 cm caudal to the preputial orifice making a full thickness incision into the preputial lumen at the junction of the prepuce and the body wall. The incision is extended caudally 2-3 cm. The penis is retracted laterally. A 0.5 cm wide by 1.5 cm long strip of preputial mucosa is excised. The penile shaft is retracted cranially through the preputial orifice and the same length of penile mucosa is excised from the dorsal aspect of the glans, starting 2 cm caudal to the urethral opening. The penis is replaced within the prepuce and the penile and preputial incisions are apposed with a simple interrupted pattern using 2 metric monofilament absorbable suture (polydioxanone, PDS® or polygecaprone, Monocryl®, Ethicon). The most cranial suture is placed first and the prepuce is retracted to ensure that the sutures prevent exteriorisation of the penis. The pexy is completed by placing 6 to 8 more sutures and the preputiotomy is closed in a standard fashion.

Penile Amputation

Partial penile amputation

The urethra is catheterised, and the penis is withdrawn from the prepuce and kept exteriorized with a rubber tourniquet (e.g. Penrose drain) placed caudal to the proposed site of amputation (fig 18). If the penis can not be exteriorized a ventral midline preputiotomy is performed. A V-shaped incision is made through the tunica albuginea and cavernous tissue on each side of the urethra and os penis. The urethra is dissected from the os penis (fig 19) and transected 1-2 cm cranial to the penile transection. The dorsal aspect of the urethra is then spatulated and the os penis is transected with bone cutter as far caudally as possible without traumatizing the urethra. The tourniquet is loosened to identify bleeding vessels, which are ligated, paying special attention to the dorsal artery of the penis. The urethral mucosa is sutured to the tunica albuginea incorporating cavernous tissue in each bite, using simple interrupted appositional 1.5- 0.7 metric monofilament absorbable sutures (fig 20). The preputial tissue may need to be shortened when a large part of the glans penis has been resected. The length of prepuce to be removed should be the same as the length of the penile resection, remembering that the tip of the prepuce should cover the tip of the penis by approximately 1 cm.

Complete penile amputation

Complete resection of the penis and prepuce needs to be combined with scrotal ablation and scrotal urethrostomy.

An elliptical incision is made around the prepuce and scrotum, preserving enough skin for closure. Branches from the caudal superficial epigastric vessels are ligated. The spermatic cords are isolated, ligated and resected. The penis is isolated cranial to the scrotum and a tourniquet is placed temporarily using a Penrose drain proximal to the proposed transection site. The penis and prepuce are resected from the body wall in a caudal direction, the dorsal vessels of the penis and the superficial veins of the glands are located and ligated. The

prepuce, penis, os penis, testes and scrotum are resected and removed, the shaft of the penis is resected in a wedge fashion. The distal end of the amputated penis is sutured closed. The tunica albuginea is sutured over the vascular cavernous tissue. The tourniquet is carefully released. If haemorrhage occurs, mattress sutures can be used to further occlude the cavernous tissue. A scrotal urethrostomy is then performed.

Scrotal urethrostomy.

A urethral catheter is placed to locate the urethra. The retractor penis muscle is located, elevated from the penis and retracted laterally (Fig 24). A urethral incision that is at least five times the diameter of the urethra is recommended to ensure a urethral stoma of adequate size after the wound contracts (fig 25). The incision should not be extended beyond the level at which the urethra curves dorsally. The subcutaneous tissue is closed in a routine manner to close dead space and bring the urethral mucosa into close apposition with the skin. Simple interrupted appositional sutures of 1-1.5 metric monofilament nonabsorbable suture (nylon, ethilon®, Ethicon) are used. The distal end of the amputated penis remains under the subcutis and skin (fig 26). It is not uncommon for dogs to bleed from the urethrostomy for a few days, especially after urination or when excited.



Surgical resection of urethral prolapse.

The penis is extruded, a urethral catheter is placed and a Penrose drain is used around the base to decrease bleeding and to keep the prepuce retracted. A 180° degree incision over the base of the protruded mucosa is performed, the incised urethral mucosa is sutured to the penile mucosa with 1.5 metric non absorbable suture (nylon, ethilon®, Ethicon) in a simple interrupted suture. The procedure is repeated for the remaining 180°. This interrupted cut and sew technique avoids retraction of the urethral mucosa into the tip of the penis. Haemorrhage following urination is common for 5-7 days post-operatively.