

SURGICAL TECHNIQUES OF THE REPRODUCTIVE TRACTS

Mary A. McLoughlin DVM, MS, Diplomate ACVS
The Ohio State University
Columbus, Ohio

Introduction

Surgical procedures involving the reproductive tract of small animal patients may be indicated for a variety of reasons including diagnostic, prognostic and therapeutic reasons. Undoubtedly, elective sterilization procedures (ovariohysterectomy, ovariectomy and castration) are the most commonly performed surgical procedures involving the reproductive tracts of small animal patients. However in the population of small animal patients that owners elect to keep reproductively intact a variety of surgical procedures may be necessary.

Surgical Anatomy - Female

The ovaries and uterus are located in the dorsal aspect of the abdominal cavity in both dogs and cats. The ovaries are loosely fixed to the dorsolateral aspect of the body wall by the mesovarium. The mesovarium is continuous cranially with the suspensory ligament, firmly attaching the ovary to the lateral body wall at the last rib. The mesovarium is continuous caudally with the mesometrium attaching the uterine horns and body to the dorsolateral body wall. The round ligament is the firm band that is both palpable and visible on the leading edge of the mesometrium extending from the tip of the uterine horn through the inguinal canal ending between the groin and the vulva. The proper ligament is the caudal continuation of the suspensory ligament attaching the caudal pole of the ovary to the tip of the uterine horn. The uterus typically consists of the cervix, body and two uterine horns suspended dorsal to the bladder and ventral to the colon. Size and age of the patient, reproductive history, current stage of the reproductive cycle, and the presence of any pathologic disease process will impact the relative size and appearance of the uterus and /or ovaries. In diestrus, the cervix is approximately one inch long and typically positioned within the pelvic canal and not readily visible within the abdominal cavity. Gentle cranial or rostral traction on the uterine horns or apex of the bladder will expose the entire uterine body and cervix. There is a reflection of peritoneum between the dorsal aspect of the urethra and the ventral aspect of the vagina.

Surgical Approaches to the Reproductive Organs Within the Abdominal Cavity

Ventral Midline Celiotomy - considered the most standard approach to the abdominal cavity. There is minimal bleeding when performing the ventral midline approach if the incision to open the abdominal cavity is made directly through the linea alba without incising the external rectus fascia (ERF) covering the rectus abdominis muscles on either side of the linea alba. This surgical approach provides good exposure to the entire

abdominal cavity with the exception of the diaphragmatic surface of the liver, dorsal aspect of the diaphragm, cardia of the stomach, and structures such as the adrenal glands located intimately along the dorsal body wall.

Surgery - The dog is positioned in dorsal recumbency with its limbs loosely tied to the table. The abdomen is clipped and aseptically prepared for surgery from the xiphoid to the pubis. In female patients, four corner drapes are sterilely placed covering the mammary tissue laterally, exposing only the area to be surgically incised. An incision is made through the skin and subcutaneous tissues along ventral midline using a #10 scalpel blade. In male dogs, the prepuce is clipped and flushed with an antiseptic solution. The tip of the prepuce is clamped to either the right or the left of midline based on surgeon preference. The skin incision is curved paramedian to one side of the prepuce and penis. Hemostasis of the small bleeders should be performed with ligatures (4-0 gut) or cautery. Branches of the prepuce artery and vein are located lateral to the tip of the prepuce. These vessels should be isolated and require ligation. Minimal subcutaneous dissection is performed to expose the linea alba. The penis and prepuce of the male dog can be reflected laterally to expose the caudal midline. To open the abdominal cavity, the linea alba is grasped with thumb forceps near the umbilicus and gently elevated upward. In a controlled motion a scalpel blade (#10 or #15) can be gently inserted into the elevated tissue to create a small puncture. Mayo scissors are used to open the linea alba the complete length of the abdominal incision. Upon opening the abdominal cavity the ventral ligament of the bladder is identified extending from the ventral midline of the bladder to the umbilicus. The falciform ligament extends from the umbilicus cranially to the xiphoid. It may be necessary to breakdown or excise the falciform or ventral ligament of the bladder to improve visualization of the abdominal cavity.

Closure - The peritoneum (Internal Rectus Fascia) is not closed as a separate layer. The Linea Alba or the External Rectus Fascia is considered the holding layer of the abdominal cavity in small animal patients. It is essential that this layer be appropriately closed in an appositional pattern using a suture material of the appropriate type and size. The use of synthetic absorbable suture materials such as (PDS®, Maxon®, Vicryl®) is advocated for body wall closure. Simple interrupted or simple continuous sutures in an appositional pattern can be used effectively for body wall closure. The subcutaneous tissues are apposed with a simple continuous or interrupted pattern using a small (4-0) absorbable suture (chromic gut, PDS®, Maxon® or Monocryl®). Cosmetic apposition of the skin is achieved placing an intradermal suture using a continuous horizontal mattress pattern. The skin is closed with a 4-0 nonabsorbable monofilament suture or skin staples.

Paramedian Approach to the Abdominal Cavity - A limited caudal abdominal approach is indicated in male dogs to remove ectopic testicles retained within the abdominal cavity. In this situation, a limited paramedian approach may be chosen over the standard ventral midline approach to avoid the surgical trauma of reflecting the prepuce and penis laterally to expose the linea alba. A 6-8 cm. skin incision is made lateral to the prepuce and mammary chain. The incision extends through the subcutaneous tissues to expose the body wall. Paramedian incision through the body wall requires incising the muscle layers including external abdominal oblique, internal abdominal oblique and transverse

abdominal muscles. Hemorrhage from the incised muscles is controlled with cautery or ligatures. Similar to the ventral midline closure, the external rectus fascia is the holding layer of the abdominal cavity. Closure of individual muscle layers does not improve healing or strength of the body wall.

Selected Surgical Procedures of the Female Reproductive Tract

Uterine Biopsy – Uterine biopsy and culture is most commonly indicated in female patients of breeding age with a clinical history of reproductive failure or persistent vaginal discharge arising from the uterus. Uterine biopsy is performed for the purposes of diagnosis and prognosis. The uterus is exposed through a limited ventral midline approach. A 2-4 mm skin biopsy punch is used to obtain a core biopsy sample of either one of the uterine horns or the uterine body. A small sterile swab can be inserted into the uterine lumen to obtain a sterile surgical culture. The biopsy site is closed using a 4-0 or 5-0 synthetic absorbable monofilament suture (Monocryl®, PDS®) in an interrupted or cruciate pattern. The submucosa is the holding layer of the uterus. Care should be taken to avoid placing exposed suture material within the lumen of the uterus.

Ovariectomy – The primary indication for ovariectomy alone has been elective sterilization of small animal patients most frequently reported in countries outside of the United States. No definitive advantage has ever been shown for removal of the uterus in addition to the ovaries for routine neutering. Long-term follow up of bitches undergoing elective ovariectomy or ovariohysterectomy demonstrated no significant differences in the incidence of pyometra or urinary incontinence. Ovariectomy may also be considered for the surgical treatment of small animal patients with a mass lesion involving the ovary. However, if ovarian neoplasia is suspected, a complete abdominal exploratory for the purposes of examination, biopsy and staging a potential neoplasia is indicated in addition to a complete ovariohysterectomy. A ventral midline incision is made extending from the umbilicus caudally. The ovary is located along the dorsolateral body wall at the caudal pole of the kidney. The proper ligament is identified. A fenestration is made in the broad ligament below the uterine blood supply at the level of the proper ligament. An appropriate size hemostatic clamp is placed across the proper ligament including the uterine artery and vein. Gentle caudally directed traction is applied while the suspensory ligament is stretched or manually broken down to release the ovary to the level of the skin incision. The ovarian pedicle is isolated and clamped. This pedicle is double ligated or transfixed using an appropriate size chromic gut suture. The extent of the ovary is carefully palpated and the ovarian pedicle is transected between the ovary and the ligature. If any portion of the ovary is inadvertently remains within the abdomen, ovarian remnant syndrome can occur. The uterine artery and vein are also ligated below the clamp placed across the proper ligament using chromic gut suture. The ovary is removed.

Ovariohysterectomy (OVH) - The most commonly performed abdominal surgical procedure in small animal patients in North America. In addition to elective sterilization, ovariohysterectomy may be indicated for a variety of diseases affecting the uterus and ovaries including pyometra, mucometra, unresolving metritis, termination of unwanted

pregnancy, uterine prolapse, uterine rupture, uterine torsion, uterine neoplasia, cystic endometrial hyperplasia, ovarian cysts, ovarian neoplasia, prevention or treatment of vaginal hyperplasia, or prevention of hormonal fluctuations that may interfere with the pharmacological regulation of diseases such as diabetes mellitus and idiopathic epilepsy. An additional hallmark benefit of early OVH has been to decrease incidence of mammary neoplasia. OVH performed before the first estrus cycle has been shown to reduce the incidence of mammary neoplasia to less than 0.5%. When OVH is performed after the first estrus cycle the relative risk increases to approximately 8% and after two estrus cycles the risk increases to 26%. After approximately 21/2 years of age, OVH has no preventative effect on the formation of mammary tumors.¹⁰

Surgical Complications - Specific significant complications of OVH are relatively uncommon. Hemorrhage has been reported as the most common cause of death after OVH. Excessive hemorrhage during surgery can occur in patients with undetected bleeding disorders such as von Willebrand's disease (VWD) or specific clotting factor deficiency. In these situations control of hemorrhage can be achieved by the appropriate administration of transfusion products such as fresh frozen plasma or fresh whole blood. Known VWD patients can be successfully managed for OVH procedures. It is important to have the historical knowledge of the patient's bleeding tendencies such as spontaneous bleeding, previous trauma, surgery including tail docking and ear cropping as well as persistent bleeding during previous estrus cycles. It is also important to note that objective determination of the percentage of von Willebrand's factor (VWF) does not directly correlate with the likelihood of excessive hemorrhage during surgery. Established VWD patients, a preoperative complete blood count and buccal mucosal bleeding time are recommended to establish baseline values prior to surgery. Dogs with a history of bleeding tendencies are treated with a transfusion of fresh frozen plasma starting at the time of anesthetic induction. Desmopressin acetate (DDAVP®) enhanced fresh frozen plasma may also be used for VWD patients. Administration of Desmopressin acetate to the VWD patient may be beneficial releasing stored von Willebrand's factor from vascular endothelium or platelets. Since these VWD patients are deficient in von Willebrand's factor, the circulating amount may still not be adequate to control hemorrhage in a surgical environment. Hence, fresh frozen plasma collected from a normal donor will contain an adequate amount of VWF to control hemorrhage. The plasma transfusion is continued throughout surgery and into recovery. After surgery, an abdominal compression wrap is placed and the patient is monitored overnight for hemorrhage. If bleeding persists after surgery, a second plasma transfusion can be administered.

In normal patients, intra-operative and post-operative hemorrhage may occur due to iatrogenic causes or a failed ligature on either ovarian pedicle or the uterine body. Appropriate efforts should be employed if excessive hemorrhage occurs during surgery to identify the specific source of bleeding and apply an appropriate ligature. It may be necessary to extend the ventral midline incision cranially to gain more exposure to the ovarian pedicles at the base of the kidneys. Exposure is critical to identify the specific site of active bleeding. Mass ligation of the tissue at the base of the kidney is discouraged as the ureter lies in the retroperitoneal space near the ovarian pedicle and it could be

inadvertently ligated resulting in complete or partial obstruction of the associated kidney. Injury to one or both ureters is a well-recognized complication of gynecologic surgery in people as well as small animals. Inadvertent transection or ligation of a ureter can also occur during the process of ligating and transecting the uterine body. The ureters leave the retroperitoneal space and travel through the lateral ligaments of the bladder to enter the bladder on the dorsal surface at the trigone. If a ligature or clamp is applied to a ureter, the degree of injury may be difficult to assess during surgery. The severity of injury to the ureter and associated kidney is related to duration and extent of ureteral obstruction and damage to the local vascular supply. The effects of crushing and devascularizing injuries to the proximal portion of the ureter have been evaluated in dogs. This study demonstrated that renal function returned to normal and radiographic demonstration of the crushed area was resolved within 12 weeks after a crushing injury to the ureter lasting up to 60 minutes. However, almost half of the crushed sites formed aneurysmal dilatations that did not resolve. If only one ureter is ligated, clinical signs related to hydronephrosis are generally not recognized for a period of days, weeks or even months after surgery.

Urethral Sphincter Mechanism Incompetence (SMI) - Urethral sphincter mechanism incompetence (SMI) is the most common cause of urinary incontinence in adult female dogs. The term urethral sphincter mechanism incompetence (SMI) was first suggested to describe weakness of the 'urinary sphincter'. This term was coined since there is no true anatomic sphincter at the bladder neck or proximal urethra. Approximately 20% of female dogs have been reported to develop some degree of urinary incontinence after OVH. Clinical signs of incontinence typically occur within 3 years of the surgical procedure. The incidence of incontinence may be as high as 30% in large breed female dogs. Varying degrees of urinary incontinence have been noted in these patients. The majority of owners report leakage of urine when the dog is recumbent or sleeping. Incontinence that occurs after OVH may be partially, fully or transiently responsive to medical treatment including hormonal therapy such as estrogen (DES .5 – 1 mg/ day for 5 days then .5 – 1 mg given once every 5-14 days orally) may be partially, fully or transiently responsive to medical treatment including hormonal therapy such as estrogen (DES .5 – 1 mg/ day for 5 days then .5 – 1 mg given once every 5-14 days orally). In addition, the use of alpha-adrenergic drugs such as ephedrine, and phenylpropanolamine (1.5 mg/kg q 8 hours orally) may further enhance and improve the patient's continence status. Approximately half of the smooth muscle tone in the proximal urethra has been attributed to the sympathetic nervous system. This explains the positive effects of alpha-adrenergic drugs in improving patients with sphincter mechanism incompetence. In addition, estrogens have been noted to increase the sensitivity of the urethral smooth muscle to catecholamines, which further enhances the urethral closure response.

The diagnosis of SMI is established by ruling out other structural and functional abnormalities of the urogenital tract and a complete neurologic examination. A complete urinalysis and evaluation of bacteriologic cultures of urine samples collected by cystocentesis are a critical first step in the diagnosis and management of patients with urinary incontinence. Urinary tract infection or inflammation of the bladder or urethral

mucosa can result in urinary incontinence. If urinary tract infection exists, treatment with appropriate antibiotic therapy for 14 days followed by a urine culture re-evaluation 5-7 days after the completion of antibiotic therapy is performed prior to other diagnostic procedures. Sonographic evaluation of the abdomen provides information regarding bladder wall thickness, urolithiasis or other debris within the bladder lumen and proximal urethra. Uroendoscopy is useful diagnostic tool to evaluate the luminal surfaces of the lower urinary and reproductive systems under magnification. Specific confirmation of the diagnosis of SMI is made based on the results of urethral pressure profile (UPP). Patients with urethral sphincter mechanism incompetence have decreased urethral closure pressure.

Surgical treatment of urinary incontinence can be considered in patients that have failed to respond or have failed to maintain an adequate response to appropriate medical management with alpha-adrenergic and estrogen therapy. Chronic medical management of patients with SMI is not without potential complications. Irreversible bone marrow suppression has been reported in dogs after DES therapy. Agitation, hyper-excitability, hypertension and diarrhea have been reported in some patients on phenylpropanolamine therapy. The goal of any surgical treatment of urinary incontinence is to increase urethral resistance to urine outflow. A number of surgical treatments have been evaluated including submucosal and periurethral implantation of Teflon (polytetrafluoroethylene) or Collagen, colposuspension, cystourethropexy, urethral lengthening, transpelvic or urethral sling and artificial sphincters. None of the surgical techniques have meet with uniform success.

Colposuspension creates urethral resistance to urine outflow by placement of sutures between the vagina and the prepubic tendon. This procedure results in restoring the bladder, bladder neck and proximal urethra to a more intra-abdominal position. In addition the urethra is positioned over the edge of the pelvic brim thereby applying additional external compression. Colposuspension is reported to be curative in approximately 50% of the patients treated with an additional group of patients (approximately 40%) that were improved but not completely cured. The effects of colposuspension on urethral pressure profile have been examined. Urodynamic studies indicated that the total profile length and the functional profile length were significantly increased.

The ventral abdomen is clipped and aseptically prepared from xiphoid over the pubis and including the perineal region surrounding the vulva. A small (6 or 8 French) balloon tip urethral catheter is passed through the urethra into the bladder prior to surgery. A caudal ventral midline celiotomy is performed from the umbilicus to the pubis. The prepubic tendon is carefully identified. The bladder, urethra and uterus or vaginal stumps are exposed. A stay suture is placed in the apex of the bladder for cranial traction. Ovariohysterectomy can be performed at this time if the patient is intact. An Allis tissue forceps is placed on the cranial aspect of the uterine remnant for traction. The lateral walls of the vagina adjacent to the urethra (as far caudal as possible) are identified and grasped with traumatic (Babcock) forceps. If the vagina is displaced distally and cannot be reached from the abdomen, a blunt probe or index finger can be inserted through the

exposed vulva into the vagina to push it forward through the pelvic canal for the surgeon to reach. At least two 2-0-monofilament nonabsorbable sutures are preplaced on each side through the lateral wall of the vulva and through the prepubic tendon. The sutures are tied while placing cranial traction on the bladder and uterine remnant. The catheter is manipulated to make sure the urethral lumen is not completely obstructed. A hemostatic (mosquito) forceps should be able to be inserted between the ventral aspect of the urethra and the pelvic brim. The abdomen is closed in a routine manner. The urethral catheter is removed. Dysuria and stranguria can occur transiently after surgery due to partial urethral obstruction. Complete urethral obstruction rarely occurs following colposuspension. If obstruction occurs, replacement of the urinary catheter or removal of the sutures between the vaginal wall and the prepubic tendon may be necessary.

Cesarean Section – Surgical delivery of neonates via hysterotomy is routinely performed in small animal veterinary practice. Indications for cesarean section include prolonged gestation > 66 days, uterine inertia refractory to appropriate medical treatment, obstruction due to relative fetal size, uncorrectable fetal malposition, abnormalities of the maternal pelvic canal, uterine malposition i.e. uterine torsion or fetal death with putrefaction. Cesarean section is sometimes requested by an owner in an effort to minimize fetal loss during routine delivery. Without a past history of reproductive difficulty, or a physical indication that a problem may exist, this practice is considered questionable.

Anesthesia – A variety of anesthetic protocols have been recommended for use in pregnant animals. The goal of any anesthetic protocol for cesarean section is to provide visceral analgesia, maternal immobilization and minimize the use of drugs that readily cross the maternal-fetal blood barrier thereby resulting in fetal depression. Choice of the most appropriate anesthetic protocol should be based on the physical condition of both the dam and the fetuses. Historically, epidural analgesia has been considered to be the safest and most beneficial method of anesthesia for pregnant small animal patients. Ideally an anesthetic agent suitable for cesarean section should not cross the placenta. However if this occurs it is essential that the respiratory depression the anesthetic induces should be minimal and transient. Epidural administration of analgesic drugs has been shown to minimize these depressant effects and improves the survival of neonates. However, it is frequently necessary to administer additional sedation or some type of general anesthetic to the bitch or queen for immobilization during the surgical procedure. Administration of the epidural requires the technical skill and knowledge of the regional lumbar anatomy. In an effort to simplify the anesthetic protocol appropriate for cesarean section, more recent studies have evaluated the use of propofol (6.5 mg/kg I.V.) and isoflurane as an anesthetic regimen for cesarean section in dogs. Propofol and isoflurane were administered to 141 bitches undergoing cesarean section. Anesthetic induction, maintenance and recovery were considered routine in all patients. Viability of neonates was evaluated immediately after delivery. Survival rates of puppies from dams induced with propofol and maintained on isoflurane was similar to the survival rate of puppies from dams receiving epidural analgesia. Based on the results of this study, propofol (6.5 mg/kg IV) and isoflurane (.5 to 2% to effect) in oxygen are considered an acceptable anesthetic protocol for cesarean section in small animal patients.⁴

Surgery – The ventral abdomen is clipped and scrubbed with the patient resting quietly in lateral recumbency. As much of the surgical preparation as possible should be performed prior to the administration of any drug therapy. When the surgical team is prepared, the patient is moved to the operating room and rapidly anesthetized. The patient is placed in dorsal recumbency. There is no objective data to support tilting the patient to either side (10-15%) to prevent compression of the caudal vena cava by the gravid uterus offers any benefit to the maternal or fetal patients. A ventral midline block using a local anesthetic can be administer by the surgeon or assistant using a 22 or 25 gauge needle administering the local anesthetic in the subcutaneous tissues and body wall on the ventral midline. The abdomen is aseptically prepared for surgery and sterilely draped. A ventral midline incision is made from umbilicus to the pubis. Leakage of milk along the edges of the incision from the developed mammary glands is common. The linea alba is carefully opened due to the abdominal distension resulting from the gravid uterus. Moistened laparotomy sponges are placed along the incised edges of the abdominal incision to protect the incision, control hemorrhage and absorb milk. The uterus is gently exteriorized from the abdominal cavity and packed off from the remainder of the abdominal cavity with laparotomy sponges. An appropriate size incision is made into the body of the uterus near midline to facilitate removal of the fetuses from either horn. The incision should be large enough to rapidly remove each fetus without tearing or rupturing the uterus. Size of the fetus can be quite variable between breeds and individuals. Upon incision, a fetus located within the uterine body is removed first. The fetus is gently grasped and gentle traction is placed to detach and remove the placenta. The amniotic sac is broken and the fetus is removed from the sac. The fetus with the attached placenta are placed in a sterile towel and handed to an assistant. The mouth of the neonate is cleared of mucous and fluid. It may be necessary to suction the mouth and pharynx of the neonate with a pediatric nasal aspirator or gently invert the neonate to allow gravity drainage of the fluid. The umbilicus is clamped 1-2 cm from the body wall, ligated and transected. The fetus is then stimulated by gently rubbing along dorsal midline. It may be necessary to intermittently invert the neonate to continually clear accumulated fluids from the airways. Each successive fetus is methodically moved down the uterine horn to the hysterotomy incision by firm but gentle external pressure and manipulation. It should not be necessary to make multiple incisions.

Closure – The hysterotomy incision is closed using a 3-0 or 4-0 synthetic absorbable monofilament suture in a continuous or interrupted pattern. The surgical holding layer of the uterus is the submucosa. Care should be taken to avoid exposing suture material within the lumen of the uterus. The suture pattern is appositional or slightly inverting. En bloc ovariohysterectomy has been reported for the treatment of dystocia in dogs and cats. The neonatal survival rates were similar to those reported neonates delivered via hysterotomy incision.

Congenital Abnormalities of the Vestibule and Vagina

Abnormalities in the embryological development of the urogenital sinus may result in structural malformations that affect the vulva, vagina and vestibule including vulvar hypoplasia or agenesis, vaginal septum, persistent hymen or persistent paramesonephric remnant and vestibulovaginal narrowing or stenosis. Any of these conditions may prohibit or prevent natural or artificial insemination or may contribute to the susceptibility of the local environment to chronic or recurrent ascending infections.

Persistent hymen or persistent paramesonephric remnant - occurs as the paramesonephric ducts fail to unite with each other or fail to fuse or cannulate with the urogenital sinus resulting in a vertical septum or annular fibrous stricture at the vestibulovaginal opening. Incomplete fusion of the caudal paramesonephric ducts with retention of a medial partition results in an elongated vertical vaginal band, vaginal septum or rarely a bifid vagina¹³. Vertical or annular bands at the vestibulovaginal junction may result in clinical signs associated with mating difficulties, chronic vaginitis or vestibulitis, vaginal discharge, urine pooling or chronic cystitis, urethritis or UTI.¹³

A number of diagnostic techniques can be used to evaluate the vestibulovaginal anatomy including digital vaginal examination, urogenital endoscopy and positive contrast retrograde vaginocystography. Digital examination can be performed in the awake or sedated bitch. Diagnosis of a persistent hymen or septum is made when two small openings are identified on either side of a centrally oriented band. Bitches with annular or stenotic openings, digital penetration of the cranial vaginal vault is prevented. If vestibular or vaginal stenosis is of concern, the bitch should be evaluated during estrus when this opening should be at its widest. Direct visualization of the vestibular and vaginal region can be achieved using a rigid or flexible endoscope. Fluid insufflation will provide an optically clear environment and provide distension of the local tissues to improve visualization. Recently, positive contrast retrograde vaginourethrography has been advocated as a method to diagnosis vestibulovaginal stenosis in dogs. Controversy continues to exist regarding the specific radiographic measurements necessary to accurately make this diagnosis. No effort has been made to correlate clinical, endoscopic and radiographic findings in bitches with suspected vestibulovaginal stenosis.

Surgical correction of persistent hymens or vertical vaginal bands is indicated in bitches with persistent clinical signs or failure to successfully breed or whelp. Vertical vaginal bands are variable in size and thickness. Moderate and thin bands can be easily removed using cupped biopsy forceps through a rigid or flexible endoscope under direct visualization. The band is grasped with the forceps at its base and disrupted from its attachment along the vestibulovaginal junction. The tissue remnant is then disrupted from the opposite base of attachment and removed. A thick or broad based septum should be removed via a direct surgical approach using an episiotomy or using a surgical laser.

Episiotomy – The perineal region is clipped and aseptically prepared including the anal and perianal region dorsally extending below the vulvar commissure ventrally. The patient is positioned in sternal recumbency and the surgical table elevated to the Trendelenburg

position. A purse string suture is placed in the anal sphincter. A skin incision is made along the median raphe extending from the dorsal vulvar commissure towards the anus. Sharp dissection through the fascia and constrictor vestibular and vulvar muscles. Mayo scissors can be used to incise the vaginal mucosa to expose the vestibule and vagina. The vestibulovaginal junction is exposed to resect a wide based septum or an annular stricture.

Vaginoplasty - Complete resection of an annular stricture and anastomosis of the remaining vagina is extremely difficult and time-consuming surgery. Frequently a short (<1.5 cm) narrowed region of the vagina or vestibulovaginal junction can be opened using a vestibulovaginoplasty procedure. The episiotomy incision is extended longitudinally through the dorsal vaginal wall beyond the narrowed region. The longitudinal incision can then be closed in a “T” shaped manner or a complete transverse closure can be attempted to widen the narrowed region. The vaginal mucosa is closed in an interrupted or continuous pattern using a synthetic absorbable monofilament suture. The remaining episiotomy incision is closed in 3 layers using the same synthetic monofilament suture in an interrupted pattern. If possible, an intradermal closure is ideal to avoid skin sutures ventral to the anus and rectum.

Episioplasty or Vulvoplasty⁶ - a reconstructive surgical procedure that is most frequently recommended to remove excessive folds of skin from the perineal region around the vulva, that cause perivulvar dermatitis and a local skin fold pyoderma which may impact the urogenital system resulting in vaginitis, vaginal discharge, vestibulitis and chronic or recurrent ascending urogenital infections.

Skin fold pyoderma, also known as intertriginous dermatitis, occurs in the recesses of excessive skin folds. Heat, moisture, and body excretions accumulate within the folds creating an environment conducive to skin maceration, bacterial overgrowth, and inflammation. Constant microtrauma to the skin due to friction between opposing skin surfaces, in combination with maceration and inflammation, causes normal skin defense mechanisms to be overcome. These factors may allow secondary bacterial overgrowth and infections to occur. Intertriginous dermatitis may occur in any anatomic location where excessive skin folds exist. Common sites of skin fold pyoderma in small animal patients include nasal or facial folds of brachycephalic dogs, excessive lip folds, tail folds associated with ventral deviation of the terminal coccygeal vertebrae in brachycephalic dogs, and perivulvar skin folds in female dogs.

Perivulvar dermatitis has been reported to occur in obese female dogs with infantile or atretic vulvas. There is little information describing congenital or conformational abnormalities of the vulva pertaining to small animal patients. Vulvar hypoplasia has been described as a small or infantile vulva, which is frequently retracted into the perineal skin folds. However, the diagnosis of vulvar hypoplasia should not be related to obesity or body condition score. A tremendous variation in size, structure and location of the vulva exists between various breeds of dog as well as within specific breed standards. It is well recognized that the anatomical characteristics of the vulva are altered due to the hormonal influence of the estrus cycle. The size of the vulva generally does not change in

spayed female dogs. The vulva should be located on the perineal midline directly ventral to the anus. Although the size of the vulva varies between dogs, it should be readily visible in the standing dog when viewed from behind. The vulva should not be positioned ventrally between the rear legs so that it is no longer visible. The vulva should not be covered or obscured by regional skin folds. It should not be necessary to pull upwards on the perineal skin between the anus and the vulva to visualize the vulva. Assessment of vulvar size and location should be made independent of the presence of a regional skin fold. At one time it was theorized that vulvar hypoplasia resulted from OVH at an early age prior to development of secondary sex characteristics. This theory has not been objectively substantiated. Perivulvar skin folds may obscure both hypoplastic and normal sized vulvas. The presence of a significant perivulvar skin fold has been documented in some obese patients. However, there are a number of breeds of dogs that are conformationally predisposed to perivulvar skin folds as young dogs without being overweight. Such breeds include, Newfoundland, Labrador retriever, Mastiff, German Shepard and Bull terrier. When the vulva is recessed beneath a skin fold, moisture from vaginal secretions or urine can accumulate due to apposition between local skin folds. This scenario creates an environment conducive to superficial dermatitis. Superficial dermatitis in the particular region can result in a foul odor and discharge. Secondary clinical signs of chronic vestibulitis, vaginitis, and cystitis have also been reported.

The most common cause of lower urogenital infections in small animal patients is ascending bacterial colonization from more distal sites such as the distal urethra, or epithelial surfaces of the vestibule and vagina. *Escherichia coli*, *Staphylococcus*, *Streptococcus*, *Proteus*, *Klebsiella*, *Pseudomonas* and *Enterobacter* species are the most commonly identified pathogens associated with urinary tract infections in dogs and cats. Interference with normal micturition, congenital anatomic defects of the lower urinary tract, vagina, vestibule or vulva, alterations of the sphincter mechanism resulting in incontinence, abnormalities of the urothelium, altered volume, frequency or composition of urine, urolithiasis, foreign body and impaired immunocompetence are potential etiologies of urinary tract infections. Failure to identify, correct or resolve these abnormalities may result in failure to resolve an existing urinary tract infection or result in recurrence of the UTI.

Surgery - Following the induction of general anesthesia, the perineal and perivulvar region is clipped and aseptically prepared for surgery. A critical evaluation of the amount of perivulvar skin to be resected should be performed prior to positioning the patient on the surgery table. The patient is positioned in sternal recumbency and the surgical table elevated to the Trendlenburg position. A purse string suture is placed in the anus. Two crescent shaped incisions are made in the perivulvar skin with the first incision beginning lateral to the ventral commissure of the vulva, continuing dorsal to the vulva and ending at the contra-lateral commissure. The second incision was made parallel to the first but in a wider arc around the vulva. The skin and subcutaneous tissue directly associated with the skin is excised. Aggressive excision of local perivulvar subcutaneous fat is not routinely performed. The amount of skin excised should eliminate recession of the vulva and overlapping of the redundant skin folds. The subcutaneous tissues and skin are closed in

separate layers using an interrupted suture patterns. Elizabethan collars should be placed on all patients after surgery until suture removal to avoid patient induced trauma of the surgical site. Owners were instructed to restrict the dogs from rubbing or scooting on the incision line.

Vaginal Hyperplasia (Vaginal Edema) – The edematous thickening of the vaginal and vestibular mucosa occurring during the follicular phase of the estrous cycle. This broad base mucosal proliferation originates cranial to the external urethral orifice. The proliferative tissue may protrude through the vulvar opening as a smooth fleshy mass. Vaginal hyperplasia is most common recognized in young bitch during their first estrus cycle. The edematous tissue will spontaneously regress during diestrus. Although this disorder may affect any young bitch, it has been recognized with an increased frequency in several breeds including, Bulldogs, Boxers, and Labrador retrievers. Affected bitches may experience recurrence of the condition with each estrus cycle. Ovariohysterectomy is the surgical treatment of choice and appropriate for bitches that were not intended for breeding purposes. The proliferative tissue is kept moist and lubricated until it regresses following the spay procedure. Vaginal hyperplasia in young bitches intended for breeding purposes pose a number of issues to consider. The heritable nature of this disorder is unknown. Although breeding can be accomplished via artificial insemination the protruding mucosa must be managed until it regresses. As long as the tissue regresses, ability to whelp should not be affected. It is unknown whether affected bitches may be predisposed to vaginal prolapse. Surgical treatment of vaginal hyperplasia involving resection of the redundant mucosa should be avoided and does not prevent reoccurrence of redundant vaginal tissue at the next estrus cycle.

Vaginal Prolapse – Relatively uncommon in small animal patients and should not be confused with vaginal hyperplasia. Vaginal prolapse is also recognized during the estrus phase of the reproductive cycle or periods of hyperestrogenism. Complete or partial vaginal prolapses can occur. Vaginal prolapse presents as a protrusion of the complete vaginal circumference including the external urethral orifice, which is positioned ventrally. If the cervix protrudes from the vulva, a complete vaginal prolapse has occurred. The underlying etiology remains unknown. Brachycephalic breeds seem to have an increased predisposition compared to other breeds of dogs for the development of vaginal prolapse. Swelling and protrusion of the vaginal mucosa rapidly results in venous congestion and discoloration of the tissues. These tissues are friable and ulcerate readily. A mild prolapse may resolve during diestrus. Exposed tissues should be kept clean and moist. If possible, the exposed tissues should be reduced to a more normal anatomical position. Topical application of a hyperosmotic solution such as 50% Dextrose to the exposed tissue after cleaning may assist in reducing some of the edema. Episiotomy may also aid in the manual reduction of the displaced vaginal tissues. If manual reduction is successful, a sterile balloon tipped catheter should be placed through the urethra into the bladder and attached to a closed urinary collection system. The labia of the vulva can be sutured closed using a nonabsorbable, monofilament suture until the swelling resolves. OVH is recommended for bitches that are not intended for breeding purposes. Owners wanting to salvage a potential breeding bitch should be counseled that reoccurrence is possible. Surgical pexy of the uterine body or horns to the dorsolateral

body wall is performed using several synthetic nonabsorbable monofilament sutures (Prolene®) placed in a mattress pattern through the seromuscular layer of the uterus. Care should be taken to avoid placement of exposed suture material within the uterine lumen. Objective evaluation of uterine pexy on future reproduction status is unknown.

Severe vaginal prolapse may present as an acute or chronic condition with congestion, ulceration, infection and necrosis of the affected tissues. Attempts at reduction and replacement of the devitalized tissues are contraindicated. The patient should be evaluated for systemic infection. Surgical resection of devitalized tissue may be necessary on an emergency basis. Following induction of general anesthesia and regional block with an epidural, the perineal region is clipped and aseptically prepared including the anal and perianal region dorsally extending below the vulvar commissures ventrally. The patient is positioned in sternal recumbency and the surgical table elevated to the Trendelenburg position. A purse string suture is placed in the anus. An episiotomy is performed. The external urethral orifice is identified and a sterile balloon tipped catheter is passed through the urethra into the urinary bladder. The extent of the devitalized tissue should be evaluated. A circumferential resection is performed. A scalpel blade is used to make a 5-6 cm incision through the outer exposed mucosal layer. Appropriate sized stay sutures can be intermittently placed along the incised edge of the vaginal mucosa that will be used for the anastomosis to prevent retraction of the tissues. A second incision is made through the inner non-everted mucosa. Again, stay sutures can be intermittently placed along the incised mucosa that will be used for the anastomosis. Additional 5-6 cm incisions are made in the same manner until the devitalized prolapsed mucosa is completely excised. The internal and external mucosal edges are realigned and manipulated using the attached stay sutures. Anastomosis of the vaginal mucosa is performed using an absorbable monofilament or multifilament (Monocryl®, PDS® or Vicryl®) in a simple interrupted pattern. Re-evaluation of the surgical site via digital vaginal examination should be performed at 2 weeks and again before the next estrus cycle to evaluate continuity of healing and to be sure a stricture has not occurred.

Selected Surgical Procedures of the Male Reproductive tract

Surgical Anatomy - Testicle - Normal testicles should be positioned within the scrotum with the long axis directed dorsocaudally. As the testis, spermatic cord and epididymis pass through the inguinal ring they are covered by peritoneum from the abdominal cavity. The parietal vaginal tunic is the outer layer and the visceral vaginal tunic is continuous with the parietal peritoneum of the abdominal cavity. The tunica albuginea is the dense fibrous capsule deep to the vaginal tunic. The testicular blood supply is from the testicular artery arising from the aorta at approximately the fourth lumbar space. The right testicular artery arises cranial to the left. The testicular vein forms an extensive pampiniform plexus within the spermatic cord. The right testicular vein exits the inguinal ring and empties into the caudal vena cava while the left empties into the left renal vein. The epididymis is divided into three sections head, body and tail. The tail of the epididymis is continuous with the ductus deferens. The ductus deferens runs along the

dorsomedial border of the testicle and ascends in the spermatic cord and connects the epididymis to the pelvic urethra at the colliculus seminalis.³

Testicular Biopsy – Biopsy procedures may be indicated in male dogs with clinical symptoms of reproductive failure due to persistently low or absent sperm counts. The testicles should be carefully palpated for size, symmetry and presence of mass lesions. Sonographic evaluation of the testicles may be indicated. With the patient under general anesthesia, a small area on the lateral side of the scrotum is gently clipped and aseptically prepared. The scrotal skin is particularly sensitive to many antiseptics. A small 1-2 cm incision is made through the scrotum to expose the testicle. The testicle is positioned to expose the lateral surface. The head and body of the epididymis are palpated and protected. A 2-3 mm biopsy punch is used to obtain a core sample of testicle. A 4-0 chromic gut suture can be used to close the tunica albuginea with an interrupted or cruciate suture. Hemorrhage will be controlled upon closure of the tunic. Pressure can be applied to the site for 10 minutes. A 4-0 monofilament nonabsorbable suture is used to close the scrotum.

Cryptorchidism – Failure of one or both testicles to descend from the abdominal cavity through the inguinal rings into the scrotal sac is the most common congenital testicular disorder. Although testicles are typically descended between 6 and 10 weeks in most small animal patients, the diagnosis of cryptorchidism is generally not made until 6 months of age. Cryptorchidism is considered to be a sex-linked autosomal recessive trait. Cryptorchidism may be unilateral or bilateral. The abnormal location of the testicle may be subcutaneous, inguinal or abdominal. In situations of unilateral cryptorchidism, the right testicle is more frequently ectopic than the left. Ectopic testicles are at an increased risk for both testicular torsion and tumor formation. Testicular torsion occurs when the testicle rotates along the long axis of the spermatic cord resulting in vascular occlusion. Testicular torsion frequently results in swelling of the testicle and spermatic cord distal to the site of venous occlusion. The hallmark of testicular torsion is pain. Clinical signs are variable. Ectopic testicles are at a greater risk for torsion or displacement as they are not fixed or stabilized within the scrotal sac. Cryptorchid dogs have an increased risk of testicular tumors that is 13.6% greater than normal dogs.³ The abnormal temperature and environment within the abdominal cavity may partially contribute to the neoplastic transformation. Common testicular neoplasia of ectopic testes includes Sertoli cell neoplasia and seminomas. Signs of feminization have been observed more commonly in cryptorchid patients with Sertoli cell tumors. Surgical treatment of cryptorchidism in dogs and cats has focused on removal of both descended and undescended testicles. Once the diagnosis of cryptorchidism has been made based on physical examination, surgical treatment is recommended.

Surgery – Surgical removal of ectopic testicles is based on location. Testicles located in the subcutaneous tissues of the prescrotal region are generally palpable with the dog in dorsal recumbency. An incision can be made through the skin directly over the ectopic subcutaneous testicle. A routine castration is performed. Abdominal testicles are removed using either a caudal abdominal ventral midline approach or a paramedian approach. Once the abdominal cavity is exposed, the ductus deferens is identified dorsal

to the bladder as it crosses over the ureter within the lateral ligament of the bladder. Gentle traction is placed on the ductus deferens to expose the testicle. The testes can be located anywhere between the caudal pole of the kidney and the inguinal ring. Identification of the ductus deferens facilitates finding the ectopic testes minimizing surgical trauma within the abdominal cavity. Once the testis is located the vessels and ductus deferens are separately ligated as in an open castration. The testicle is removed and submitted for biopsy. Routine closure of the abdominal cavity is performed.

Scrotal Ablation – Removal of the scrotal sac may be indicated for a variety of reasons including cutaneous neoplasia including mast cell, melanoma, hemangiosarcoma squamous cell carcinoma and lymphangiosarcoma, trauma or injury, self mutilation, severe swelling, ischemia, cosmetics and surgical approach to the scrotal and prescrotal urethra. The patient is positioned in dorsal recumbency. The entire scrotal and prescrotal regions are clipped and aseptically prepared. Following routine open or closed castration, two curvilinear incisions are made along each side of the scrotum approximately 1-1.5 cm from its base providing adequate skin for closure without tension. Hemorrhage is meticulously controlled. A 4-0 nonabsorbable, monofilament is used to close the skin. If neoplasia is suspected, the scrotum should be submitted for biopsy.

Surgical Anatomy - Prostate Gland - The ovoid to spherical accessory sex gland encircling the proximal urethra at the neck of the urinary bladder. The prostate gland is divided into two distinct lobes by a dorsal and ventral midline sulcus. The dorsal sulcus is continuous within the prostate gland creating a median septum. Connective septae radiate throughout the parenchymal tissue separating each lobe into distinct lobules. The prostate is composed of compound tubuloalveolar glands that empty through 12-20 terminal prostatic ducts directly into the prostatic urethra. The tubuloalveolar glands are lined by epithelium ranging from cuboidal to columnar, all exhibiting secretory activity. The glandular tissue of the prostate composes approximately 90% of the prostatic mass. A fibromuscular capsule surrounds the prostate gland. The ductus deferens attach and enter on the craniodorsal aspect of the prostate traversing caudoventrally to enter the urethra at the colliculus seminalis. The normal adult prostate gland typically lies within the pelvic canal and can be digitally palpated per rectum. An enlarged prostate gland assumes a more cranial position on the pelvic brim or within the abdominal cavity.¹

Surgical Diseases of the Prostate Gland

Benign Prostatic Hyperplasia (BPH) – Symmetrical, nonpainful gradual enlargement of the prostate gland in aging intact male dogs due to the influence of androgenic hormone (testosterone) stimulation. BPH has been considered a normal aging change. Clinical signs associated with BPH are quite variable and often depend on the degree of glandular enlargement. Clinical signs can include stranguria, constipation, tenesmus, altered stool diameter, decreased fertility and perineal hernia formation as a result of disruption the pelvic diaphragm secondary to tenesmus. BPH rarely results in complete urinary outflow obstruction unless the urinary bladder should retroflex from the abdominal cavity into a perineal hernia as a result of straining or tensmus. The treatment of choice for male dogs

with clinical signs related to BPH is routine castration. Removal of the androgenic stimulation results in permanent involution of the prostate gland within 4-6 weeks.

Suppurative Prostatitis and Prostatic Abscess - Infection within the prostatic parenchyma may result from established ascending urinary tract infection, orchitis or septicemia. Ascending urinary tract infections occur less frequently in male dogs due to urethral length, established urethral high pressure zones, mechanical flushing of the urethra during urinations, prostatic secretions and surface characteristics of the urethral mucosal epithelium. The prostatic epithelium is composed of a lipid bilayer creating a blood-prostatic barrier. Lipid soluble drugs are the most effective in crossing this barrier to provide therapeutic levels within the prostatic parenchymal tissues. Basic antibiotics, because they are less ionized at physiologic pH, tend to concentrate in prostatic fluids. Specific antibiotics, which are able to reach therapeutic levels within the prostate, include, fluoroquinolones (including, ciprofloxacin, norfloxacin, enrofloxacin), erythromycin, clindamycin and trimethoprim sulfa.

Prostatic infections occur when pathogenic organisms overwhelm the local host defense mechanisms and colonize within the prostatic parenchyma. Infected regions within the parenchyma may coalesce leading to the formation of larger pockets or prostatic abscesses. It is possible for parenchymal abscesses to break through the prostatic capsule and become quite large. Clinical symptoms associated with suppurative prostatitis or prostatic abscess are widely variable and may include, failure to breed, decreased fertility, abdominal or lumbar pain, rear limb lameness or weakness, fever, depression, anorexia, shock and collapse. In addition to digital examination of the prostate per rectum, sonographic evaluation of the size and architecture of the prostate gland as well as cytological examination of fluid obtained from the prostate gland via ultrasound guided fine needle aspiration or prostatic fluid obtained via the urethra. Cytological examination typically reveals highly cellular smears predominated by neutrophils (may be degenerate or nondegenerate) and a smaller number of macrophages, epithelial cells, red blood cells and possibly some lymphocytes. Cellular distribution may depend on chronicity of the inflammatory disease. Suppurative or septic prostatitis may be treated with castration and long-term antibiotic therapy provided the patient is stable and there is no evidence of systemic disease. Serial sonographic evaluations of the prostate gland can monitor response to therapy. In situations where multiple or large prostatic abscesses are identified or the patient is systemically ill, prostatic drainage and omentalization should be considered in addition to castration and long-term antibiotic therapy.

Prostatic Parenchymal Cysts and Paraprostatic Cysts – Enlargement of the prostate gland due to single or multiple cystic regions within the prostatic parenchyma or cystic structures adjacent to the prostate gland. Prostatic parenchymal cysts are contained within or have physical communication with the prostatic parenchyma. Fluid accumulation results from ductal occlusion and subsequent stasis of glandular secretions. Small cystic areas may coalesce to form larger cysts. Paraprostatic cysts are located adjacent to the prostate gland and may be attached to it at the capsular level but paraprostatic cysts do not communicate with the prostatic parenchyma. It has been theorized that paraprostatic cysts arise from remnants of the uterine masculinus.

Paraprostatic cysts are generally very large and typically non painful. However the asymmetrical enlargement may cause clinical signs related to compression of surrounding structures in the caudal abdomen and pelvic canal. Typical clinical signs may include dysuria, hematuria, constipation, tenesmus, abdominal discomfort and perineal hernia formation. Digital palpation of the prostate gland may not be possible as the prostate moves forward into the abdominal cavity. Specific diagnosis of prostatic cysts can be confirmed using sonographic evaluation of the size and architecture of the prostate gland and surrounding structures or positive contrast retrograde urethrocytography to characterize the origin of large fluid filled structures in the caudal abdomen. Choice of treatment is based on the size and number of prostatic cysts. Castration alone may be adequate if the parenchymal cysts are relatively small. Large parenchymal cysts and paraprostatic cysts should be treated with prostatic drainage, deroofting of the cystic structures and omentalization in addition to castration.

Surgery – The patient is positioned in dorsal recumbency with the abdomen clipped and aseptically prepared from xiphoid to the scrotum. A sterile urethral catheter should be placed through the urethra into the urinary bladder prior to surgery. The catheter can be clamped to prevent leakage of urine. A ventral midline celiotomy from cranial to the umbilicus to the pubic brim is performed and the abdominal cavity is completely explored. The urinary bladder is exposed from the abdominal cavity. A 2-0 silk stay suture is placed in the apex of the bladder for manipulation and cranial traction to expose the entire prostate gland. The urinary bladder and the prostate are packed off from the remainder of the abdominal cavity with moistened laparotomy sponges. The prostate is thoroughly palpated for soft or fluctuant regions. Pockets of accumulated fluid are opened and drained using a scalpel blade. Sterile cultures are obtained from the prostatic parenchyma. Digital exploration of the cyst or abscess is performed to breakdown any septae that would prevent drainage. Several small pockets may be manually coalesced into a common site. Thorough lavage and suction of the cyst or abscess site is performed. If the cyst or abscess is large a partial prostatectomy is performed to derooft the cavity creating a larger opening to prevent accumulation of fluid and debris. The prostatic wall is resected to the base of the prostate surrounding the urethra. The presence of the urethral catheter aids in identification of the urethra to avoid its transection. The omentum is then unfolded and brought to the level of the prostate gland. The omentum is gently packed into any remaining cavitory regions of the prostate gland. The omentum provides a space occupying tissue with a large surface area for the absorption of fluids and small particulate debris. In addition, the omentum has a rich lymphatic component, which may aid in local immune response. The omentum can be tacked into position using chromic gut sutures. Serial ultrasound examinations are performed to monitor the size and structure of the prostate gland after surgery.

References

1. Arnold S, Hubler M, Lott-Stolz G, Rusch, P. Treatment of urinary incontinence in bitches by endoscopic injection of glutaraldehyde cross-linked collagen. *J Sm Anim Prac* 1996;37:163-168.
2. Basinger RR, Luther PB: Prostatic disease. In Bjorab MJ (ed.): *Disease Mechanisms in Small Animal Surgery*. Lea & Febiger, Philadelphia, 1993, p 538.
3. Booth HW: Testes and Epididymides. In Slatter D (ed.) *Textbook of Small Animal Surgery*, 3rd ed. WB Saunders, Philadelphia, 2003, p1521.
4. Funkquist PME, Nyman GC, Lofgren AJ et al. Use of propofol-isoflurane as an anesthetic regimen for cesarean section in dogs. *J Am Vet Med Assoc* 1997; 211(3)313-317.
5. Gilson SD, Cesarean Section. In Slatter D (ed.) *Textbook of Small Animal Surgery*, 3rd ed. WB Saunders, Philadelphia, 2003, p1517.
6. Lightner BA, McLoughlin MA, Chew DJ, Beardsley SM, Matthews HK. Efficacy of episiotomy for the treatment of perivulvar dermatitis and chronic urinary tract infections secondary to vulvar conformational abnormalities: 32 Cases (1983 - 2000). *J Am Vet Med Assoc* 2001; 219(11):1577-1581.
7. Probst CW, Webb AI, Postural influences on systemic blood pressure, gas exchange and acid-base status in the term-pregnant bitch during general anesthesia. *Am J Vet Res* 44:1963, 1983.
8. Probst CW, et al. Postural influences systemic blood pressure in large full-term pregnant bitches during general anesthesia. *Vet Surg* 16:471, 1987.
9. Robbins M, Mullins HS, En bloc ovariohysterectomy is a treatment for dystocia in dogs and cats. *Vet Surg* 23:48,1994.
10. Stone EA: Ovary and Uterus. In Slatter D (ed.) *Textbook of Small Animal Surgery*, 3rd ed. WB Saunders, Philadelphia, 2003, p1487
11. White RAS, Williams JM; Intracapsular prostatic omentization: a new technique for management of prostatic abscesses in the dog. *Vet Surg* 24:390, 1995.
12. White RAS et al., The diagnosis and management of paraprostatic and prostatic retention cysts in the dog. *J Sm Anim Pract* 28:551,1987.
13. Wykes PM. Diseases of the vagina and vulva in the bitch. In: Morrow D (ed) *Current Therapy in Theriogenology*. Philadelphia: WB Saunders Co, 1986:476-481.