**Urinary system (Renal system)**

 The kidneys lie in the retroperitoneal space lateral to the aorta and the caudal vena cava. They have a fibrous capsule and are held in position by sub-peritoneal connective tissue. The renal pelvis is the funnel shaped structure that receives urine and directs it into the ureter. The renal artery normally bifurcates into dorsal and ventral branches. The ureter begins at the renal pelvis and enters the dorsal surface of the bladder obliquely by means of two slit like orifices. The urinary system consist of four organs, these include: kidneys, ureters, urinary bladder and urethra.

1. **Kidney:**

**Affection of kidney:**

 Congenital affections:

1. **Polycystic Kidneys:**Polycystic kidneys have multiple cysts (enclosed, fluid-filled sacs) inside the functional part of the organ. The kidneys may be greatly enlarged, problems caused by this condition can range from none at all to progressive kidney failure. Diagnose polycystic kidneys by x-rays, performing ultrasonography, or performing exploratory abdominal surgery.
2. **Renal agenesis:** May be unilateral and if it’s bilateral it lead to death. Bilateral agenesis is incompatible with life.

**Clinical signs:** Single kidney is enlarged.

**Diagnosis:** Absence of a kidney may be confirmed by pyelography.

1. **Renal hypoplasia**: Maldevelopment and results in a very small kidney may be associated with other urinary tract abnormalities. Hypoplasia is deficiency in the total nephron population, the condition is rare and when unilateral the prognosis is good as the opposite kidney functioning normally.
2. **Fusion kidney**: This rare conditions result when the two metenephrons unite during fetal development.
3. **Renal ectopic**: One or both kidneys may be in unusual position, such as a pelvic kidney, high renal ectopic, this can result in an intra-thoracic kidney or in pelvic region.

**Acquired affections:**

**Kidney abscess:**

1. A renal abscess is one that confined to the kidney and is caused either by bacteria from an infection traveling to the kidneys through the bloodstream or by a urinary tract infection traveling to the kidney and then spreading to the kidney tissue.

2. Diffuse superlative pyelonephritis.

3. Trauma resulting from bacterial invasion of a renal.

4. Direct extension of infections from adjacent organ.

 **Symptoms:** Fever, abdominal pain, weight loss and a vague feeling of bodily discomfort. Urination may be painful and sometimes the urine is bloody (hematuria). Occasionally the recognition of the disease might be delayed since the symptoms are vague.

**Diagnosis:**

1. Lab. Examination (leukocytosis): Increased white blood cell count and bacteria often are present in the blood and urine.

2. X-ray findings depend on the extent and the duration of the infection. Small renal abscesses can be difficult to recognize. Ultrasounds and CT scans are most helpful in recognizing a renal abscess.

3. Abscesses vary from acute pain and fever to chronic, mild, intermittent nonspecific signs.

4. The kidney may feel enlarged, soft, and fluctuant.

**Treatment:**

 1. The treatment options for a renal abscess are intravenous antibiotics and drainage of the abscess by an open operation or by inserting a catheter through a needle in the skin overlying the kidney with ultrasound guidance. This more recent technique, called percutaneous drainage, has become the more frequent method of drainage

 2. Surgical drainage may be indicated in some patients with reduced function in the contralateral kidney; however, renal and per renal abscesses generally require nephrectomy. Major complications of nephrectomy are hemorrhage and urinary leakage. With percutaneous drainage, peritonitis is a possible and serious complication.

**Hematoma**: It is a sequel to renal trauma, it form and cause loss of function of the kidney.

Clinical signs:

1. History of injury.
2. Weight loss.
3. Anorexia.
4. Tenderness in the flanks.
5. Hematuria.
6. Leukocytosis.

Diagnosis:

1. X-rays.
2. Exploratory laparotomy.

Treatment: If hematoma involve small portion of kidney it may dissected. If is severed nephrectomy.

 **Neoplasia:**Nephroblastomasare rapidly developing, malignant mixed tumors that arise from embryonal elements of the kidney. Primary renal tumors are uncommon in dogs and cats. Approximately 85% of renal tumors are malignant, and thoracic metastatic disease is common. Benign tumor sub capsular lipoma, fibroma, and adenoma. Malignant tumor (carcinoma, lyphosarcoma).

Clinical signs: Renal failure, Hematuria, Abdominal distension, Polyuria, Anorexia, vomiting, diarrhea, anemia, emaciation.

Diagnosis:

1. History**:** Animals with primary renal tumors often have vague, nonspecific signs. The most common reported clinical signs are hematuria, in appetence, lethargy, and weight loss. Abdominal enlargement due to a renal mass may be the only sign. Renal failure is seen primarily with bilateral involvement. Dyspnea related to pulmonary metastasis occasionally is noted.

2. Renal enlargement may be identified on survey abdominal radiographs; however, ultrasonography is more sensitive and specific. Excretory urography may localize the neoplasm and define parenchymal involvement.

 **Differential diagnosis:** Renal neoplasia must be differentiated from other causes of renomegaly (e.g., hydronephrosis, polycystic disease, and abscess) or abdominal enlargement (e.g., splenic or hepatic neoplasia).

Treatment:

1. Preoperative medical management of animals with renal neoplasia is necessary if renal failure is present or if anemia is severe
2. Surgical treatment: Nephrectomy is indicated for malignant renal tumors if they are unilateral and without evident metastasis. However, metastasis typically is present at the time of diagnosis because of the late onset of clinical signs.
3. Adjuvant chemotherapy or radiation therapy may prolong the lives of dogs and cats with malignant renal neoplasia.

**Renal calculi**: Urolithiasis refers to the condition of having urinary calculi or uroliths (kidney, ureter, bladder, or urethra). Nephrolithotomy is performed to remove renal calculi from the renal pelvis by incising through kidney parenchyma.

**Clinical signs**: Affected animals may have pain, fever, and/or renal failure attributable to urinary outflow obstruction, fibrosis, or infection. Clinical signs of ureteroliths may also be nonspecific. Magnesium, ammonium, phosphate and calcium oxalate uroliths are the most common types in dogs; other types include urate, silicate, cystine, and mixed stones. Calcium oxalate nephroliths and ureteroliths are the most common types in cats. Removal of uninfected stones from the kidney may result in more damage than is caused by the stones themselves.

**Diagnosis:**

 **1.** Some animals have a higher incidence of urolithiasis because of breed predispositions, metabolic abnormalities, or underlying disease processes.

2. Clinical signs may be intermittent, particularly if the animal has been treated with antibiotics, hematuria is relatively common signs.

3. The most common clinical signs in cats with ureteral calculi are nonspecific (e.g., anorexia or in appetence, vomiting, weight loss, polyuria). Other less common clinical signs may include, hematuria, signs of abdominal pain, and hyper salivation.

4. Renal and ureteral calculi may be incidental radiographic or ultrasonography findings. Most renal and ureteral calculi are radio-opaque and appear as increased opacities in the renal pelvis or ureter.

**Treatment:** Surgical removal of renal and ureteral calculi should be considered when they are infected or cause obstruction.

**Trauma**: Injuries resulting from automobile accidents, bullets or sticks blow in the lumber region or damaged caused by handling kidney during surgery. The kidney injuries have been classified for into three categories:

Group 1: Simple contusion with or without minor parenchymal damage.

Group 2: major parenchymal disruption with rupture of capsule and extravasation of blood and urine into per renal tissue. There is coldness of extremities, weakness, rapid shallow breathing, rapid weak pulse, poor capillary refilling time, blanched m.m, accumulation of intra-abdominal fluid.

Group 3: Sever blood loss, shock and the mass of flank region rapidly increase in size.

Clinical signs:

1. Passage of blood stained urine.
2. Diameter of the abdomen can be increased.

Diagnosis:

1. Case history.
2. Clinical signs.
3. Flank may be sensitive.
4. X-rays.
5. Paracentesis large gauge needle is introduce through the linea alba cranial to the umbilicus.
6. Retroperitoneal hemorrhage.

Treatments:

Group 1: Whole blood or plasma expanders and fluid transfused to maintain perfusion, and give antibiotic.

Group 2: Control the source of hemorrhage. Blood or plasma transfusion, repair surgery.

Group 3: The kidney should be saved if possible. If the damage has been irreversible the kidney can be nephrectomy or partial nephrectomy.

**Hydronephrosis**: This lesion is result of obstruction to the outflow of urine cause partial or complete dilation of the urinary tract proximal to the obstruction and destruction of tissue parenchyma.

Causes:

1. External pressure on ureter by tumor or abscess.
2. Congenital or acquired stenosis of ureter.
3. Previous injury of the urinary tract.
4. Calculi may lodge in any part of urinary tract.
5. Sever cystitis and associated with inflammation of ureter.
6. Ureter ectopic.
7. Kidney worm (Dioctophyme renale).

.

Clinical signs:

Kidney enlargement.

Fever.

Frequent urination.

In bilateral hydronephrosis the formation of urine was impaired and subsequent increased in blood urea level.

Diagnosis: 1. Marked abdominal distension.

 2. Pyelography, the major collecting tubules are distended, renal pelvis is widened, ureter dilated.

Treatment: 1. Removal the cause. 2. Nephrectomy.

**Nephrectomy:**

 Nephrectomy is indicated for renal neoplasia, uncontrollable hemorrhage, persistent urine leakage, pyelonephritis resistant to medical therapy (e.g., associated with nephroliths), hydronephrosis, and ureteral abnormalities that defy surgical repair (e.g., avulsion, stricture, rupture, obstruction due to calculi). Before nephrectomy, renal function in the opposite kidney ideally should be assessed. Bilateral renal dysfunction may warrant a guarded prognosis. If renal neoplasia is suspected, radiography (thoracic and abdominal) and ultrasonography should be used to help rule out metastasis, including the opposite kidney. Grasp the peritoneum over the kidney and incise it. Using a combination of blunt and sharp dissection, free the kidney from its sublumbar attachments. Elevate the kidney and retract it medially to locate the renal artery and vein on the dorsal surface of the renal hilus. Identify all branches of the renal artery. Double ligate the renal artery with absorbable suture, close to the abdominal aorta to ensure that all branches have been ligated. Identify the renal vein and ligate it similarly. Avoid ligating the renal artery and vein together to prevent the formation of an arteriovenous fistula. Ligate the ureter near the bladder and remove the kidney and ureter.

**Ureter**

**Congenital affections:**

**Ureter agenesis**: Absence of ureter.

**Ectopic ureter**:Is a congenital anomaly in which one or both ureters empty outside the bladder. The ureter normally enters the dorsolateral caudal surface of the bladder and empties into the trigone after a short intramural course. The most common location for termination of ectopic ureters is in the urethra, although termination in the uterus and vagina can occur.

Symptom: Continues of urine.

Diagnosis: X-rays, clinical signs.

Treatment: Surgical correction is the treatment of choice for ectopic ureters even if marginal improvement occurs with medical management. Surgery should be performed as soon as possible to limit secondary abnormalities (i.e., hydroureter and hydronephrosis) caused by ascending urinary tract infections or outflow obstruction.

**Ureteral valves**: It is a transverse folds of vestigial mucosa made prominent by their underlying circular muscle fibers, the presents of valves obstructs urine outflow ureterectasis and hydronephrosis results.

**Acquired affections:**

**Rupture of ureter: U**reters are subject to injury; this is associated with renal trauma.

Clinical signs: Sensitive over the lumber region, lethargic, presence of urine in abdomen, vomiting, febrile.

Treatment: Uterocolostomy.

**Ureter calculi**: It is rare they results from fragmentation of a renal calculus.

Cl. S: Pain appear to be associated with passage of ureteral calculi.

Diagnosis:

1. Clinical signs.
2. X-rays.

Treatments:

1. Administration of narcotics and smooth muscle relaxant together.
2. Increase intake of fluid.
3. Surgical removal of calculi.

**Pyoureter**: Due to renal disease.

Clinical signs: Pyrexia, hematuria, abdominal pain.

Diagnosis: X-rays, clinical signs.

Treatment: Antibiotic.

**Urinary bladder**: The urinary bladder location varies depending on the amount of urine it currently contains; when empty, it lies primarily within the pelvic cavity. The bladder is divided into the trigone, which connects it to the urethra, and the body. The bladder receives its blood supply from the cranial and caudal vesical arteries, which are branches of the umbilical and urogenital arteries, respectively. Sympathetic innervation is from the hypogastric nerves, whereas parasympathetic innervation is via the pelvic nerve. The pudendal nerve supplies somatic innervation to the external bladder sphincter and striated musculature of the urethra. The urethra in male dogs and cats is divided into prostatic, membranous (pelvic), and penile portions.

**Congenital anomalies:**

**1. Cystic agenesis**: Total absence of the bladder in which the ureter emptied directly into the vagina has been reported. Transplantations of the distal ureters into the bowel in a fashion similar to transplantation of the ureters into the bladder wall is possible, but the risk of ascending infection in high indication are that infection in less if the ureter are anastomosed into an isolated section of bowel. Which in then anastomosed into the main bowel? In isolated rectum can be used as a substitute bladder in conjunction with a colostomy. Mechanical valves to achieve bladder control have not get achieve long term success.

**2. Previous urachus (persistent urachus) (patent urachns):** Embryologically the bladder in connected to allantion by atubular structure termed the urachus, which normally closes at birth if the entire tube remains patent urine collecting in the bladder discharge at the umbilicus. Failure of urachus to close completely at bladder may result in diverticulum of apex of bladder (inflammation). This condition in frequent in both calves and foals. Inter mittent dribbling of urine at the umbilical area. If condition persist for some time the complication:

1. Retrograde infection.
2. Abscess formation.
3. Peritonitis.
4. Cystitis.

Treatment 1- Repeat cauterization of urachus to produce swelling and closure. The urachus in cauterized for a distance 4-5 cm from umbilicus upward to bladder twice daily for several days. If infection or abscess around the umbilical area radical surgery is indicated under local or light g.a.

**Acquired Lesions**

1. **Urolithiasis (cystic calculi):** The wide urethra of the female allows smaller calculi to pass as urination occurs. Which in the male the small urethra prevents passage. The calculi may occur in kidney, ureter, bladder or urethra. In ox more at sigmoid flexure, in dog proximal to oss penis, horse in bladder or in pelvic part of urethra, ram at urethral process or sigmoid flexure. The diagnosis is not made until a calculus in passed into urethra and occludes it or the neck of the bladder and the urethral opening are occluded.

Etiology: 1- Inflammation of renal tissue.

 2- Vitamine D result in excessive concentration of calcium salt.

 3-Heriditary predisposition.

 4. Grass contain more than 2% silica may produce calculi

 5. Excessive proportion of certain salt (phosphate, carbonate oxalate)

 6. Nitrogen material in ration

 7. Avitaminosis A.

 8. Insufficient water intake.

**cl.s**: a- colic, b- arch hack, and c-Stiffness of limb, d- Few drop of a urine mixed with blood. These symptom disappear when rupture of bladder.

**Diagnosis**: Symptom, X-rays, rectal examination, catheterization.

**Treatments**:1. Catheterization.

 **2**. Spasmodic drug.

 3. Cystotomy

**Cystotomy:** Abdominal incision is made from the umbilicus caudal to the pubis. Cystotomy may be performed for removal of cystic and urethral calculi, identification and biopsy of masses, repair of ectopic ureters, or evaluation of urinary tract infection resistant to treatment. Isolate the bladder from the rest of the abdominal cavity by placing moistened laparotomy pads beneath it. Place stay sutures on the bladder apex and trigone to facilitate manipulation. Make a longitudinal incision in the ventral or dorsal aspect of the bladder, away from the ureters and urethra, and between major blood vessels. Remove urine by suction or perform intraoperative cystocentesis before cystotomy if suction is not available. Check the bladder apex for a diverticulum, and excise it if necessary. Examine the mucosa for defects, and pass a catheter down the urethra to check for patency. Close the bladder in a single layer using a continuous suture pattern with absorbable suture material. For a two-layer closure, suture the seromuscular layers with two continuous inverting suture lines e.g., Cushing, followed by Lembert.


Cystotomy:Isolate the bladder and place stay sutures in it to facilitate manipulation. Make the incision in the dorsal or ventral aspect of the bladder**,** Use a simple continuous suture to close the incision. If the bladder is thin and if leakage occurs, a two-layer closure can be used, but this is seldom necessary.

**Uroabdomen** (i.e., uroperitoneum) is the presence of urine in the abdominal cavity; urine may be leaking from the kidneys, ureters, bladder, or urethra

**b. Rupture of bladder:**

Etiology: External trauma, obstruction.

Symptom: Depression, anorexia, enlargement of abdomen, uremia, toxemia, anuria.

Diagnosis: Symptom, X-rays.

Treatment: Laparotomy, wash abdomen and repair of bladder.

**c. Prolapse of the bladder:** Occurs only in the female animals, the condition is most often:

 a. As complication of parturition.

 b. Increase intraabdominal pressure accompanied by straining.

 c. Complication of perineal hernia.

 d. Enlarge of prostate.

Symptom: a. The bladder everts through the urethra, charatererized smooth, glistering, bluish- white in colour.

 b. Tenesmus, frequent attempt to urinate.

Treatment: Under general anesthesia, or epidural anesthesia is necessary to control straining before the organ may be replaced, digital manipulation and use of a probang like instrument to force the bladder back through the urethra, after replace the bladder is filled with saline via catheter to ensure that it is completely everted cystitis often follows eversion a result of trauma and infection.

**Urethra:**

 The proximal urethra (i.e., prostatic urethra) can be reached by pelvic osteotomy or symphysiotomy is required for adequate exposure of the membranous urethra (i.e., from the caudal edge of the prostate to the ischial arch; The penile urethra begins at the ischial arch and extends to the external urethral penile orifice. The penile urethra may be approached in the perineal (perineal urethrotomy) or scrotal (scrotal urethrotomy) region, or between the scrotum and the external urethral orifice (prescrotal urethrotomy). The skin overlying the site is prepared for aseptic surgery in standard fashion before either approach is used. If the prepuce is to be left in the surgical field.

 **Urethral trauma:** (e.g., gunshot or bite wounds, rupture caused by vehicular trauma, obstruction with stones) or neoplasia may result in urinary obstruction. If the prostatic or penile urethra is torn, subcutaneous urine leakage may occur. Spontaneous rupture of the urethra is uncommon but may occur in dogs. Initial signs of subcutaneous urine leakage are bruising and/or swelling, especially of the inguinal tissue of male dogs. The skin and subcutaneous tissue can necrosis if left untreated. Management of patients with urethral rupture before surgery may necessitate placement of an indwelling urinary catheter and/or cutaneous urinary diversion.

**Perineal urethrotomy.** Perineal urethrotomy is occasionally used to remove calculi lodged at the ischial arch and to place catheters into the bladder of large male dogs. This urethrotomy site should be closed to prevent subcutaneous urine leakage. Place a purse-string suture in the anus. Place a sterile catheter into the urethra to the level of the bladder or the site of the obstruction. With the dog in sternal recumbency and the rear limbs hanging over the edge of the table, make a midline incision over the urethra, midway between the scrotum and the anus. Identify the retractor penis muscle, elevate it, and retract it. Separate the paired bulbospongiosus muscles at their raphe to expose the corpus spongiosum, then incise the corpus spongiosum to enter the urethral lumen, close the incision routinely.



**Perineal urethrotomy**

**Urethrostomy:** Urethrostomy is indicated for (1) recurrent obstructive calculi that cannot be managed medically; (2) calculi that cannot be removed by urethrotomy; (3) urethral stricture; (4) urethral or penile neoplasia or severe trauma; and (5) preputial neoplasia requiring penile amputation. Depending on the site of the lesion, ureterostomy can be prescrotal, scrotal, perineal, or prepubic in dogs. Scrotal urethrostomy is preferred if castration is an option and if the lesion is distal to the scrotum. Perineal urethrostomy is routinely performed in cats. Perineal urethrostomy often causes unacceptable urine scalding and is used only in dogs that have urinary problems that will not be solved by a scrotal or prescrotal urethrostomy. Make a 4- to 6-cm incision in skin and overlying tissue, and incise the perineal urethra as described for perineal urethrotomy. The urethral incision should be 1.5 to 2 cm in length. Suture the urethral mucosa to the skin.