# Surgery of Kidney

Surgery of kidneys tends to focus on

1. obtaining tissue samples (biopsy),
2. extracting calculi, and
3. providing treatment for traumatic injury or neoplastic conditions.

The importance of the kidneys in

1. removal of metabolic waste products,
2. maintenance of normal fluid balance, and
3. regulation of blood pressure

**Anatomy:**

The kidneys are located in the retroperitoneal space directly beneath the sublumbar muscles.

The left kidney is generally more mobile than the right kidney

The kidney is covered by fibrous capsule, it is divided into the outer cortex (is composed of glomeruli and adjacent structures) and the inner medulla (is striated in appearance and projects into the renal pelvis as the renal crest).

The renal arteries arise of the abdominal aorta. The renal vein returns blood back into the caudal vena cava.

When vascular injury is minimal, connective tissue and collagen rapidly repair renal parenchymal wounds.

## PERIOPERATIVE MANAGEMENT

1. Diagnostic Tests: A complete blood count, biochemistry and coagulation panels, urinalysis, urine culture, and blood pressure should be evaluated.
2. **Renal Imaging**

a. **Abdominal radiographs and renal ultrasonography** are performed in most affected animals to evaluate renal structure, identify and locate calculi, examine the kidneys and other organs for primary or metastatic neoplasia, and obtain fluid or tissue samples.

b. ***Intravascular Contrast Studies*** Radiographic imaging of the kidney can be enhanced by administration of intravenous (IV) contrast agents that are filtered or excreted by the urinary system. The resulting study is called an excretory urogram or intravenous pyelogram.

c. ***Pyelography***: direct injection into the renal pelvis. This procedure is indicated when there is concern about giving a systemic dose of contrast or when the renal artery is obstructed.

d. ***Ultrasonography*** Major ultrasound findings in affected dogs included renal pelvic dilatation (usually with proximal ureteral dilatation) and hyperechoic mucosal margins within the renal pelvis, proximal ureter, or both
e. ***Computed Tomography*** provides good images of the kidney, particularly when contrast enhancement is performed.
f. ***Magnetic Resonance Imaging*** Contrast-enhanced magnetic resonance angiography (MRA) has been used for quantitative and qualitative evaluation of renal vessels in humans
g. ***Scintigraphy*** is used to determine the glomerular filtration rate of the kidney.

3. **Anesthesia:** Animals with renal dysfunction are often premedicated with an anticholinergic drug and opioids and induced with IV propofol or an inhalant anesthetic delivered by mask. Anesthesia is maintained with isoflurane or sevoflurane, and blood pressure and urine output should be monitored during the procedure.

### Postoperative Care

Intravenous fluids are continued after surgery to maintain renal perfusion and prevent blood clot formation within the urinary tract. Postoperative analgesia can be delivered by intermittent intravenous injections or a constant rate infusion of opioids.

## ABNORMALITIES OF THE KIDNEY

### 1. Developmental Anomalies

#### *a) Renal Agenesis*

During development, the kidneys normally "ascend" from the pelvic region to the level of the thoracolumbar junction. Ectopic kidneys are usually found within the pelvic area, although they may be found anywhere along the normal path of ascension or even in the thorax.

Ectopic kidneys should function normally and may be found incidentally during routine abdominal imaging or exploratory surgery.

#### *b) Fused Kidney*

Results from convergence of the developing kidneys as they ascend. The fused kidney is often shaped more like a horseshoe rather than the more typical bean shape. Most fused kidneys function normally.

#### *c) Polycystic Kidney Disease*

It is a common finding in Persian cats and breeds originating from Persian cats, The cysts form from renal tubular cells that eventually become separated from the originating nephron.

In the end, slow progression of polycystic renal disease leads to renal failure as a result of expansion of cysts with subsequent compression of surrounding parenchyma and development of chronic interstitial lesions

Percutaneous aspiration provides temporary relief**,** Aspiration and infusion of renal cysts with a combination of iodized oil and n-butyl cyanoacrylate. Treatment options in veterinary patients are not widely reported.

2. Renal Calculi

Renal calculi (nephroliths or renoliths) form because of oversaturation of urine with calculogenic substances.

Plasma concentrations of calculogenic substances may be increased by a variety of causes such as:

a. organ dysfunction (e.g., hyperammonemia secondary to liver disease or enzyme deficiency),
b. neoplasia (e.g., hypercalcemia secondary to parathyroid tumors or paraneoplastic syndrome),
c. increased calcium intake,
d. drugs, increased intestinal absorption,
e. impaired renal reabsorption, and
f. excessive skeletal mobilization.

The incidence of nephroliths is apparently increasing in dogs and cats

**Notice:** one of the most frequent reasons for performing renal surgery.

Most feline calculi are composed of calcium salts (calcium oxalates, calcium phosphates), and the frequency of calcium nephroliths may be on the rise in dogs.

Radiographs may be useful because most of the renal calculi are radiopaque, calculi will be detectable on ultrasonography

***Treatment***:

Nephroliths are most commonly composed of calcium oxalate and cannot be dissolved with medical protocols. Treatment options for stone removal include lithotripsy, nephrotomy, or pyelolithotomy.

Nephrectomy should be considered in animals with a unilateral severely hydronephrotic, infected, or nonfunctional kidney.

**3. Renal Neoplasia**

***Types of Neoplasia***

Primary renal tumors are uncommon in dogs and cats, accounting for less than 2% of all tumors. The majority of primary renal tumors are malignant.

Lymphoma is the most common renal tumor in cats. Renal cell carcinoma is the most common kidney tumor in dogs

**4. Renal Abscesses**

Renal abscesses are rare in dogs. An abscess may develop within renal parenchyma or surrounding the kidney (perinephric abscessation). The diagnosis is made on

ultrasonography with confirmation of the abscess based on fluid cytology and culture. Treatment includes supportive care and nephrectomy.

### 5. Renal Trauma

Reports of renal trauma are extremely rare in the veterinary literature
The kidney, or its blood supply, can be injured by blunt trauma, such as vehicular accidents, or by sharp penetration with projectiles, animal bites.

Trauma can result in capsular tears, parenchymal fractures, perirenal or renal hematomas, crush injuries, vascular avulsion, or renal prolapse. In humans, extensive renal damage has been successfully managed conservatively, and devascularized kidneys may be left in place to atrophy

## SURGICAL TECHNIQUES

### *1.* Renal Biopsy

#### *Indications*

Histopathologic evaluation of samples from diseased kidneys may be required to determine the underlying pathology causing renal dysfunction

Coagulation testing should be considered for patients with unknown histories or potential bleeding disorders or that are taking medications that may affect their clotting ability.

Tissue samples may be obtained by parenchymal incision during an open approach or with a needle biopsy instrument through a percutaneous, laparoscopic, or open approach. Needle sizes of 14- to 18-gauge have been recommended by various authors.

#### *Approaches*

**a) Percutaneous Biopsy.**

After the kidney was manually restrained, the biopsy needle was introduced and fired. Compression of the kidney against the body wall was continued for several minutes to aid with hemostasis.

**b) Ultrasound-Guided Biopsy.**

The biopsy needle is lined up with the ultrasound probe and, while visualized again on ultrasonography, is advanced into the abdominal cavity until it is in contact with the kidney.

**c) Keyhole Biopsy.**

A small incision is made over the flank. The surgeon introduces a finger into the abdominal cavity to palpate the kidney and force it against the body wall or into the incision. The biopsy needle is introduced and the sample obtained.

**d) Laparoscopic Biopsy.**

A small skin incision is made in the abdominal wall over the kidney. A 16-cm long biopsy needle is inserted through the incision into the abdomen while the surgeon visualizes its entry with the laparoscope. The biopsy needle is positioned tangential to the surface of the kidney, and the spring mechanism is activated. Tamponade of the site with an elongated cotton-tipped applicator aids hemostasis.

**e) Wedge or Incisional Biopsy.**

A ventral midline celiotomy. A crescent-shaped incision 5 to 10 mm long and about 5 mm deep is made into the renal cortex with a #11 or 15 scalpel blade.

If the artery is properly occluded, venous and parenchymal hemorrhage will be dark and flow continuously. If the artery is not occluded, hemorrhage will be bright red and pulsating.

The two ends of the crescent-shaped incision are connected with a straight cut that is angled inward into the cortex to sever remaining parenchymal attachments. The defect is closed with simple interrupted or cruciate sutures of 3-0 or 4-0 absorbable monofilament material on a taper needle.

## *2.* Nephrotomy

### *Indications*

Incision of renal parenchyma is performed

1. to obtain tissue samples (wedge biopsy) or
2. to gain access to the renal pelvis for removal of nephroliths or other obstructive lesions.
3. In case of persistent hematuria of renal origin.

### *Surgical Technique*

Non crushing a vascular clamp (e.g., Satinsky) can be passed dorsal to the kidney and closed just enough to occlude renal blood flow.

The kidney is incised on the midline through the renal Capsule. The renal parenchyma is then sharply incised, with the length of the parenchymal incision based on the amount of exposure required. The renal pelvis and its recesses are gently explored to dislodge and remove any calculi or fragments.

Recesses can be emptied by sweeping them with a blunted nerve hook or a right-angle forceps or flushing them with saline jets delivered by syringe and red rubber catheter. Catheter should be advanced down the ureter into the bladder to ensure patency.

**Closure of the kidney:** Direct compression across the incision for 1 to 5 minutes allows formation of a fibrin seal between the wound Edges

The renal capsule is then closed with a continuous suture of a fine monofilament absorbable material. A small portion of the renal cortex may be included in the continuous suture line.

## *3.* Nephrectomy and Nephroureterectomy

Indications for nephrectomy or nephroureterectomy include irreparable trauma, persistent infection, renomegaly, obstructive calculi with persistent hydronephrosis

***Surgical Technique***: A ventral midline incision provided by extending the incision from the xiphoid two thirds of the distance to the pubis. Self-retaining (e.g., Balfour) retractors are placed.

The kidney of interest is exposed and freed from its retroperitoneal attachments with a combination of sharp and blunt dissection. The perirenal fat surrounding the renal hilus is separated to allow identification of the renal artery and vein.

The renal vein lies ventral to the renal artery. Renal artery and vein are each dissected free from surrounding tissues, and at least two sutures are preplaced around each vessel. A transfixing ligature on the portion of the vessel to remain in the animal and an encircling ligature to prevent backflow from the portion of the vessel to be removed with the kidney.

After ligation and transection of the renal artery and vein have been accomplished, the kidney is freed from any remaining retroperitoneal attachments.

The ureter is easily dissected from its retroperitoneal position down to the bladder. The ureter is ligated close to the bladder and transected. The same combination of a ligature and a vascular clip can be used, and they are placed against the bladder wall, leaving the smallest ureteral remnant possible.

Surgeons may be concerned that a distal ureteral remnant permits urine reflux with resultant persistence or development of urinary tract infection

### *4.* Renal Autotransplantation

An accidentally traumatized kidney or a kidney with a damaged ureter that cannot be reimplanted from its normal location

The renal artery and vein are anastomosed to the aorta and caudal vena cava, respectively, to restore blood flow, after which the ureter, if transected, is reimplanted into the bladder.