

## THE URINARY SYSTEM

### THE KIDNEYS

The kidneys are bean shaped in appearance and are located in the retroperitoneal space in the cranial abdomen, one on either side of the aorta and caudal vena cava. They lie obliquely tilted in a craniodorsal to caudoventral direction. The left kidney is less firmly attached to the dorsal wall than the right and hence is more variable in position. The right kidney lies more cranially than the left and is in contact with the renal fossa of the caudate lobe of the liver.

#### Radiography

The kidneys are clearly seen in approximately 50% of plain studies of the abdomen of the dog. The left kidney is more often completely outlined by fat, whereas in many dogs only the outline of the caudal pole of the right kidney can be seen. When the kidneys are the prime source of interest on plain radiographs of the abdomen, visualization can be enhanced by adequate patient preparation.

#### Normal Appearance

The radiographic appearance of the kidneys varies with changes in the animal's posture. With the patient in lateral recumbency, the uppermost kidney rotates on its long axis, profiling the hilar notch. Both lateral views are therefore recommended for optimal demonstration of both kidneys.

#### Abnormalities

Radiographic examination does not always reveal characteristic signs of kidney or ureteral disease. It can, however, provide information regarding the number, size, position, shape, and opacity of the kidneys.

## Kidneys enlargement

Gross enlargement of the kidneys with a smooth margin may be unilateral or bilateral and attributable to a variety of causes, including hydronephrosis, cysts, neoplasia, perinephric pseudocysts, amyloidosis, or glomerulonephritis.

## Reduced Size.

Small kidneys are usually the result of chronic renal disease. In juvenile animals, small kidneys are usually caused by renal dysplasia or familial renal disease. Many pathologic processes, when they reach a chronic, irreversible stage, may eventually cause the kidneys to become small and irregular in outline.

## Hydronephrosis.

Hydronephrosis, a dilation of the renal outflow tract, may be congenital or acquired. Acquired hydronephrosis results from partial or complete obstruction of the urinary outflow tract, usually obstruction of a ureter.

- 1- The enlarged kidney is often seen as a round, smooth abdominal mass with fluid or soft tissue opacity.
- 2- The kidney displaces adjacent organs and extends ventrally into the abdominal cavity. It must be distinguished from other possible causes of abdominal masses.
- 3- Intravenous urography will outline the normal kidney.
- 4- There will be no excretion of contrast medium through the affected kidney if urine production has ceased.
- 5- Varying degrees of parenchymal opacification are seen depending on how much of the kidney is still functional.

## THE URETERS

The ureters are paired tubular structures that carry urine from the kidneys to the bladder. They begin at the renal pelvis, where they lie outside the peritoneum, and they course caudoventrally to the bladder, turn ventrally, and enter the bladder through oblique, slitlike openings at the trigone.

Normal ureters are not seen on plain radiographs or on ultrasonography. They are outlined by contrast medium during intravenous urography coursing between the kidney pelvis and the bladder.

### Abnormalities

**Ectopic Ureter.** Congenital ectopic ureter may be the cause of urinary incontinence in young dogs. Ectopic ureter in the male is not as common as in the female. In the female, an ectopic ureter may open into the vagina, urethra, neck of the bladder, uterine body, or uterine horn. Ectopic ureter may be unilateral or bilateral. It is frequently associated with some degree of dilation (megaloureter or hydroureter).

### Radiography.

An ectopic ureter may be demonstrated by intravenous urography. Concomitant pneumocystography aids in identifying the caudal ureters. A high-volume technique is said to give better filling of the ureters. To maximize visibility of the ureters, good patient preparation is necessary—that is, fasting for 24 hours before the study and a cleansing enema. Lateral, ventrodorsal, and ventrodorsal oblique views should be made. A right ventral, 30 degrees left dorsal oblique view profiles the left ureter, and vice versa.

The diagnosis of ectopic ureter may be difficult. The abnormal ureter will be seen to bypass the bladder and empty into the vagina. Usually some degree of dilation exists. A ureter may enter the bladder at the normal site and pass within the submucosa to an abnormal opening site.

### Ureteral Calculi.

Although ureteral calculi are uncommon, a small calculus passing down from the kidney to the bladder may occasionally obstruct a ureter. It is most often seen in older cats, which usually have concurrent chronic renal failure. The uroliths are usually of mineral opacity and most easily identified on survey abdominal radiographs.

### Radiology

Urine is aspirated, and a similar volume of iodinated contrast medium is injected. Lateral and ventrodorsal radiographs are made.

### THE BLADDER

The urinary bladder is a hollow organ located in the caudal abdomen. It varies in size and position depending on the amount of urine it contains.

### Radiography

When the bladder contains some urine, it is seen on plain radiographs. Fat in the omentum and the bladder ligaments aid in providing contrast, as do the small and large intestines. A distended bladder may reach the umbilicus.

- 1- Positive Contrast Cystography. The bladder is evacuated. Any aqueous organic iodide medium recommended for urography is suitable. The contrast medium should be diluted with sterile water or saline to a concentration of 10% to 20% weight/volume of iodine. The contrast medium is injected through a urinary catheter until the bladder is moderately distended.
- 2- Double-Contrast Cystography. A small quantity of 20% weight/volume of water-soluble iodinated contrast medium is first instilled into the evacuated bladder. In dogs the dose of positive contrast is 1 to 5 mL and in cats 0.5 to 1 mL.

## Neoplasia.

Hematuria is the common presenting sign of bladder neoplasia with frequency and/or painful micturition. Female dogs are affected more commonly than males.

### Radiologic Signs

- 1- With positive contrast cystography, a filling defect is seen caused by the tumor mass protruding into the lumen of the bladder or eroding the bladder mucosa.
- 2- On pneumocystography, the mass will be seen protruding into the bladder.
- 3- Infiltrative tumors that cause thickening of the bladder wall must be distinguished from thickening associated with chronic inflammation. Localized thickening is more suggestive of neoplasia.

## Rupture.

Rupture of the bladder may result from trauma, urethral obstruction or, rarely, from a difficult parturition. Rupture is often associated with road accidents.

### Radiologic Signs

- 1- The bladder shadow is absent or small and contracted.
- 2- Fluid within the peritoneal cavity causes a loss of intraabdominal detail. The amount of fluid present will depend on the length of time the rupture has been present and the degree of peritonitis provoked
- 3- functional ileus may be present secondary to peritonitis.
- 4- Positive contrast cystography will show leakage of contrast material into the peritoneal cavity or retroperitoneal space.
- 5- Intravenous urography will show whether there has been concomitant damage to the kidneys and ureters.

## THE URETHRA

**Congenital Anomalies.** Congenital anomalies of the urethra are rare in dogs and cats. Absence of the urethra has been reported. Abnormal openings of the urethra have been encountered on the ventral aspect of the penis (hypospadias).

**Calculi.** The common presenting signs of urethral obstruction are frequent attempts at micturition and the passage of small quantities of urine that is often blood stained. If obstruction is complete, no urine is voided and a full bladder can be palpated through the abdominal wall. Signs of uremia may develop. Urethral obstruction caused by calculi is rare in females.

**Rupture.** Severe trauma to the pelvic area may result in rupture of the urethra. Rupture may also occur during the passage of a catheter. A positive contrast retrograde urethrogram will show leakage of contrast medium into the periurethral tissues

**Stenosis.** Stenosis of the urethra may be congenital or follow fracture of the os penis, fracture of the pelvis, surgical interference, or inflammation. Positive contrast radiography is required for its demonstration. The urethra may be dilated proximal to the stenosis

**Fistulas.** Fistulas, congenital or acquired, are rare. Urethrorectal and urethrovaginal fistulas have been described. Positive contrast retrograde urethrography offers the best means of outlining fistulas.