

# **Renal system**

## **Kidneys**

- **The kidney is the part of the urinary tract where blood is filtered and urine is produced.**
- **The kidneys are paired and lie in a retroperitoneal position.**
- **They are positioned in the caudo-dorsal abdomen.**
- **They lie within a splitting of the sublumbar fascia. This also often contains a large quantity of fat to cushion and protect the kidneys from the pressure of other organs**
- **The right kidney is most cranial in all species except the pig and grasscutter.**
- **In species where the right kidney is most cranial it lies in a small fossa of the caudate liver lobe.**
- **However the left kidney is the most mobile.**
- **During development all species begin with a multi-lobed structure but a varying degree of fusion occurs between the species giving rise to the various different characteristics seen**

# **Kidney has two main parts**

## **Renal cortex**

- **2 Parts**
- **External zone**
- **Internal zone (juxtamedullar)**
- **Contains the following parts of the nephron**
  - ❖ **Renal corpuscle**
  - ❖ **Proximal convoluted tubules**
  - ❖ **Distal convoluted tubules**
  - ❖ **Medullary rays**

## **Renal Medulla**

- **Contains medullary pyramids**
- **The part nearest the cortex is the base of the pyramid which narrows to form the inner part - renal papilla**
- **The medulla can be split into two parts, the outer and the inner**
- **Different parts of the nephron reside in these areas**

	<b>Anterior</b>	<b>Posterior</b>
<b>Left</b>	<b>Suprarenal gland</b> <b>Spleen</b> <b>Stomach</b> <b>Pancreas</b> <b>Left colic flexure</b> <b>Jejunum</b>	<b>Diaphragm</b> <b>11th and 12th ribs</b> <b>Psoas major, quadratus</b> <b>lumborum and transversus</b> <b>abdominis</b> <b>Subcostal, iliohypogastric and</b> <b>ilioinguinal nerves</b>
<b>Right</b>	<b>Suprarenal gland</b> <b>Liver</b> <b>Duodenum</b> <b>Right colic flexure</b>	<b>Diaphragm</b> <b>12th rib</b> <b>Psoas major, quadratus</b> <b>lumborum and transversus</b> <b>abdominis</b> <b>Subcostal, iliohypogastric and</b> <b>ilioinguinal nerves</b>

**Ventral aorta** →

**Renal artery** →

**Renal artery inside kidney divided into posterior and anterior renal arteries**

**posterior and anterior renal arteries give 5 segmental arteries**

**Each segmental artery divides to form interlobar arteries. They are situated either side every renal pyramid.**

**These interlobar arteries undergo further division to form the arcuate arteries.**

**The interlobular arteries pass through the cortex, dividing one last time to form afferent arterioles.**

**The afferent arterioles form a capillary network, the glomerulus, where filtration takes place.**

**The capillaries come together to form the efferent arterioles.**

## **Neural innervation**

Innervation of the kidney includes both afferent and efferent fibers of the renal plexus.

This plexus is a combination of fibers originating from the celiac plexus, intermesenteric plexus, and lumbar splanchnic nerves. Nerves from these plexuses attach along the renal artery and vein, entering the hilus of the kidney.

Sympathetic fibres synapse in coeliac ganglion and cranial mesenteric ganglion

# Canine, Feline, and Ovine

These species all have similar renal anatomy. Their kidneys are relatively short and thick and they are the traditional kidney bean shape. They have a smooth outer surface and have a single renal papilla. The renal pelvis is large and irregular with recesses which are finger like processes

## Bovine

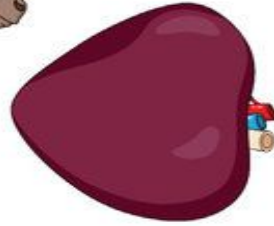
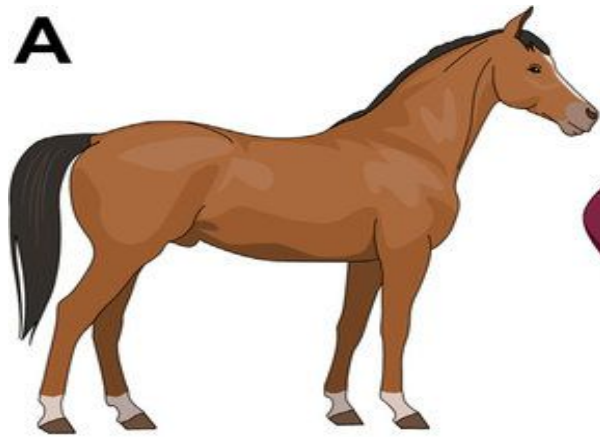
The kidneys of the bovine do not lose their foetal lobulation. In fact the surface of each kidney is divided into approximately 12 lobules. The right kidney is flattened and ellipsoidal where as the left kidney is thicker at the caudal end than the cranial. Each kidney is surrounded by the capsula adiposa; a layer of fat. The bovine kidney has no renal pelvis but rather the [Ureters](#) enters the kidney and divide into a cranial and caudal branch. These branches then subdivide and the papilla at the apex of the pyramids open and drain into these.

## Equine

The equine kidneys not only have very different shapes compared to the rest of the domestic species but they also each have a different shape. The right kidney is described as heart shaped whilst the left is described as being pyramidal. Each organ weighs approximately 700g and both are dorsoventrally flattened.

## Porcine

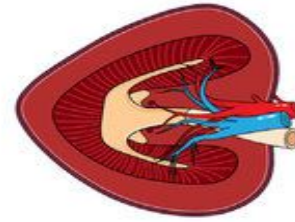
The kidneys are dorsoventrally flattened. The renal pelvis opens into quite a large space of two major calyces from which bud about 10 minor calyces. These attach to one renal papilla each. The kidneys have a smooth surface.

**A**

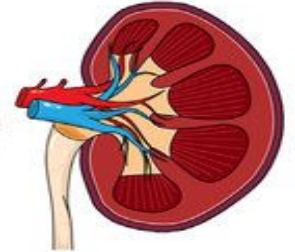
Rt. kidney



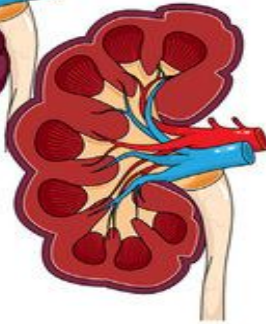
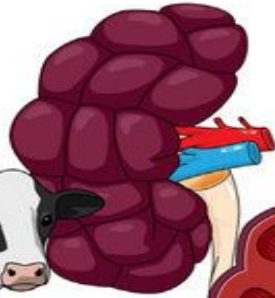
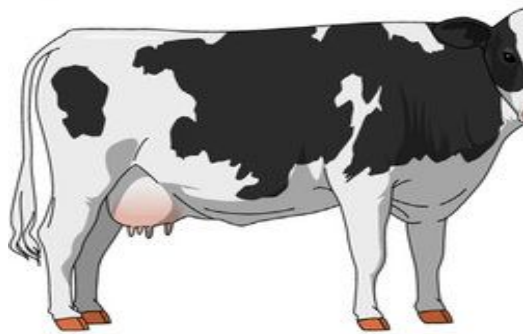
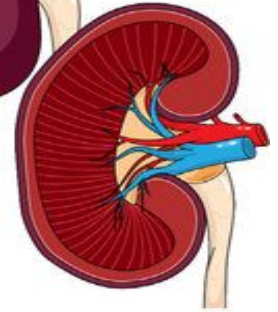
Lt. kidney



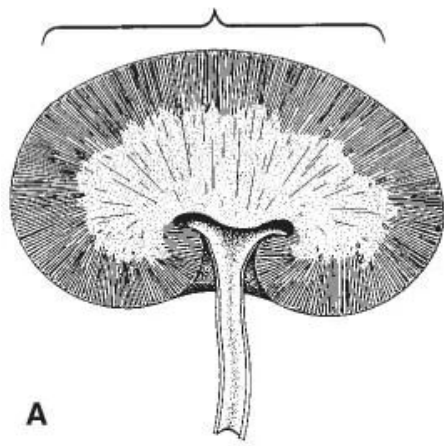
Rt. kidney



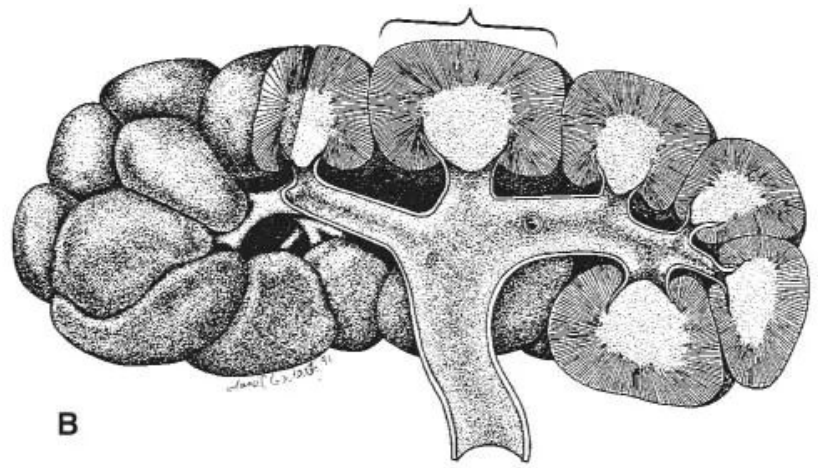
Lt. kidney

**B****C**

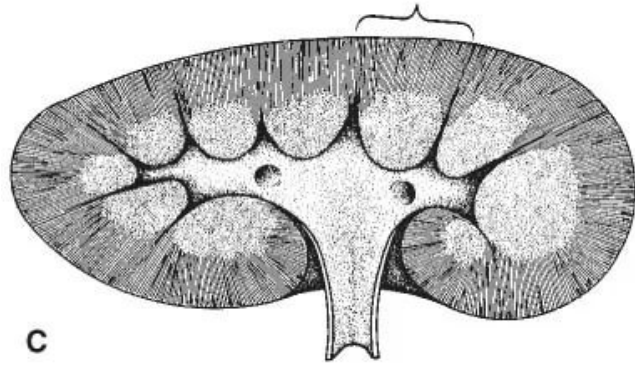




A



B



C

# Ureter

The ureters convey urine from the renal pelvis to the bladder. There are two of them, one for each kidney. The ureters run retroperitoneally along the roof of the abdominal cavity and then enters the pelvis. Once entering the pelvis it moves medially in the broad ligament of the female or the genital fold of the male. It ends at its junction on the dorsolateral surface of the bladder within the lateral ligament.

## Ureter Wall

It has an internal mucosa layer

It is formed from transitional epithelium

Protects against urine

Followed by a muscularis layer

This is well developed for peristalsis, though can enter into spasm on irritation

And finally an external adventitia

# **Vascular Supply**

## ***Renal pelvis and proximal ureter***

Renal artery

## ***Distal ureter***

Cranial vesicular artery and the vaginal (female) / prostatic (male)

# **Lymphatic Drainage**

Lumbar lymph nodes

# Bladder

It is a hollow, muscular organ

It is divided for descriptive purposes into three parts

- Cranial Pole

- Intermediate body

- Caudal neck

Its wall comprises a muscle layer covered in transitional epithelium.

# Muscles of the Bladder

## Detrusor Muscle

**This network of smooth muscle fibres lie in three sheets within the bladder wall and are supplied by both parasympathetic and sympathetic nerves. It is responsible for storage and expression of urine from the bladder.**

## Internal Urethral Sphincter

**A thickening of the bladder musculature found at the neck of the bladder which is continuous with the detrusor and is therefore smooth muscle. However, unlike the detrusor its innervation is purely from sympathetic fibres.**

## External Urethral Sphincter

**This third component is more appropriately included in the anatomy section of the urethra**

# The Ligaments of the Bladder

## Two lateral ligaments

Insert in the dorsal abdominal wall

## Median ligament

Connects the bladder to pelvic floor and linea alba

## Blood Supply

The bladder is supplied by cranial and a caudal vesical arteries.

**Cranial Vesicular Artery:** Branch of the umbilical artery which branches directly off the internal iliac a

**Caudal Vesicular Artery** Branch of the vaginal or prostatic artery. These in turn are branches of the internal pudendal artery which in turn is a branch of the internal iliac.

**URETHRA** This muscular tube is the connection between the bladder and the external environment. The layers of the walls of the urethra are largely similar to those of the **urinary bladder** apart from one significant difference; in both the male and the female the urethral submucosa has a network of veins which may contribute to continence by forming a kind of erectile tissue.

## Female

- Empties at the external urethral orifice on the ventral wall of the vagina
- This is often at the vestibulo vaginal junction
- Only urine passes through it
- Length and diameter is species specific
  - Short and wide - mare
  - 2 fossa - bitch
  - Suburethral diverticulum - cow and sow

## Male

- Empties at tip of penis
- Divided into 3 parts
  - Pre-prostatic - bladder neck to seminal hillock
  - Prostatic portion - openings of deferant, vesicular and prostatic ducts
  - Penile portion - ischial arch to penile tip
  - Note the first 2 combined are called the pelvic portion

# **Muscles of the Urethra**

**The urethralis muscle runs the entire length of the urethra and forms the external urethral sphincter. Unlike the internal sphincter the external sphincter is composed of striated muscle fibres which are under the voluntary control of the somatic nervous system.**

## **Somatic Motor Supply - External Urethral Sphincter**

- **S1-S2**
- **Pudendal Nerve**

# **Blood Supply**

**Blood Supply comes from the Urethral Artery which is a branch of the vaginal artery which in turn is a branch of the internal pudendal which is a branch of the internal iliac.**



Spinal Cord

RK

LK

Colon

The Kidneys  
The Ureters  
The Bladder and Urethra  
Testicle and Ductus Deferens  
Prostate  
Corpus Spongiosum  
Corpus Cavernosum  
Glans Penis  
Retractor Penis m.

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