

Anatomy of Urogenital System

- countless chemical reactions take place in a living system, some of which produce substances that are useful to body, while others leave things which are superfluous, harmful or of no use, these are called wastes.
- Animal takes nitrogen in the form of proteins and put out nitrogenous wastes such as ammonia, urea and uric acid.
- Nitrogenous wastes and excess water as waste of osmoregulation are removed by special organs called urinary or renal organs, the final 'discharge' is called the urine.
- living system has some device to put out the sperm, and also ova in some vertebrates. these are produced in the gonads and taken to the outside usually by means of genital ducts.
- the organs of 'urinary discharge' and 'sexual discharge' in vertebrates are of mesodermal origin and although develop in the embryo independent of each other, yet specially in the males, they come together closely serve to serve a common cause. therefore, the two systems are together spoken of as "urogenital system".
- Except in Branchiostoma, the urogenital system in all vertebrates has a basic plan from which variations develop in various classes of vertebrates.
- Branchiostoma is unique in the phylum in having excretory organs similar to the nephridia of Polychaete Annelids.

The Archinephros:

- Most primitive form of kidney is the one, with one nephric tubule per segmental nephrostome on each side and all the tubules of one side connected with a longitudinal duct leading into the cloaca. Such a kidney is termed an archinephros or a holonephros and its duct, the archinephric duct.
- No living adult vertebrate has an archinephros, however the kidney of larval hagfish Myxine and the larvae of some limbless amphibians have kidney very much like the archinephros.

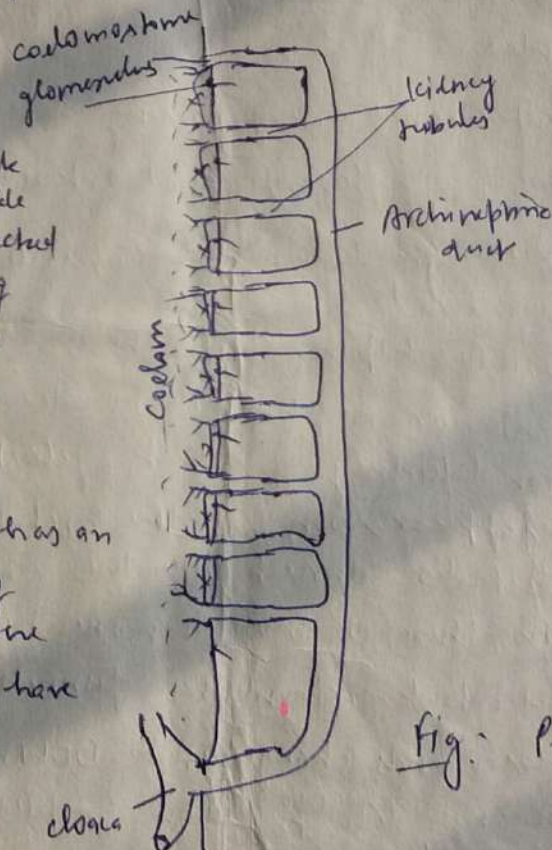


Fig. Plan of Archinephros

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- the archinephric kidney at least provide us with a basic plan, from which kidney of the present vertebrates can be derived.
- changes take place even in lower vertebrates as the hag fishes (cyclostomes) such as Bdellostoma, where some of the tubules disappear in the ~~adult~~ adult, leaving an anterior set of tubules making the anterior kidney or head kidney or the ~~pronephros~~ pronephros, separated from the remaining posterior tubules making the hind kidney or the opisthonephros.
- Pronephros functions in the larvae of cyclostomes, fishes and amphibians only for a short while, then degenerates, the opisthonephros becomes the functional kidney of the larval and ~~adult~~ adult fishes and amphibians (collectively called Anamniota).

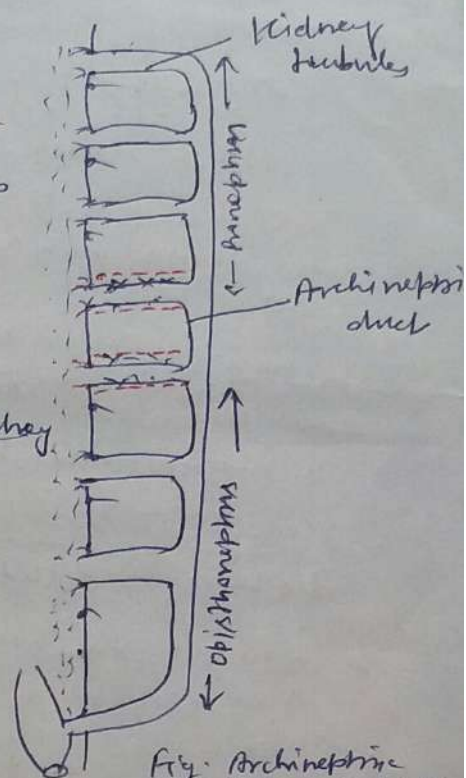


Fig. Archinephric kidney of Adult hagfish (Bdellostoma)

Kidneys of Anamniota

Pronephros: The first set of nephric tubules, about 3-15, to appear in the embryo of anamniotes develop from the anterior nephrostomes, these make the pronephros. Anamniotes

- A pronephric tubule has a ciliated funnel with a wide mouth or Coelomostome. The other end of the tubule meets a similar end of the next tubule behind to form the archinephric duct, which extends far back outside the coelomic peritoneum on the dorsolateral side to open into the cloaca. Behind the Coelomostome some part of the pronephric tubules becomes invaginated to form a Bowman's Capsule.

The segmented renal artery arising directly from the dorsal aorta divides into a number of afferent renal arterials which break into capillary loops within the Bowman's capsule to form the glomerulus.

Opisthonephros:

- Nephric tubules, developing from the middle and posterior, also from some of the anterior nephrostomes, make the opisthonephros, which becomes the functional kidney of adult cyclostomes, fishes and amphibians.
- Pronephric tubules disappear soon, but the archinephric duct remains and the opisthonephric tubules connect with the archinephric duct.
- In the opisthonephros, there are more than one tubules per segment.
- Moreover, only a few tubules retain their funnels, all others shut off from the Coelom, the closed ends change into Bowman's capsule and later on become Malpighian corpuscles, each containing an internal glomerulus.

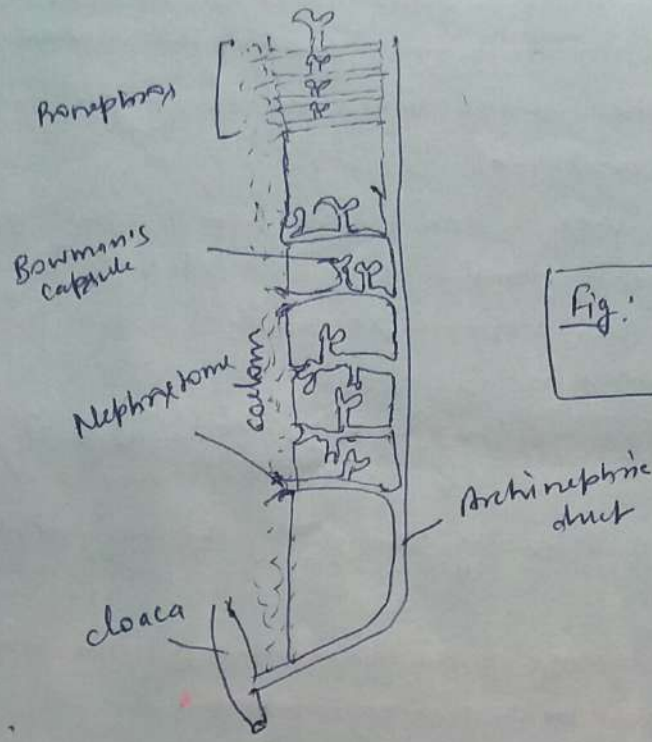


Fig: The kidney of Adult Amniote

Kidney of Amniote:

- Reptiles, Birds and mammals have three kinds of kidneys, developing in the embryo one after the other in succession and representing anterior, middle and posterior levels of the archinephros.
- The pronephros is the first to appear from the anterior nephrostomes, the mesonephros or middle kidney and the metanephros or posterior kidney follow in sequence behind the pronephros.

Pronephros:

- Pronephros develops in the same way as described for the ~~amniote~~ ^{amniote}.
- Tubules are first solid, then become hollowed, one end connects with the coelom by means of a funnel, the other end bends backward to join the similar end of the next tubule.
- All pronephric tubules, thus join to form the pronephric duct which opens into the urogenital sinus.

Mesonephros:

- It follows only after the pronephros has degenerated. It develops from the middle nephrostomes, which are always more numerous than the pronephric nephrostomes.
- Mesonephric tubules, at first solid, then hollow, rarely have nephrostomes, instead they develop malpighian corpuscles at their coelomic ends.

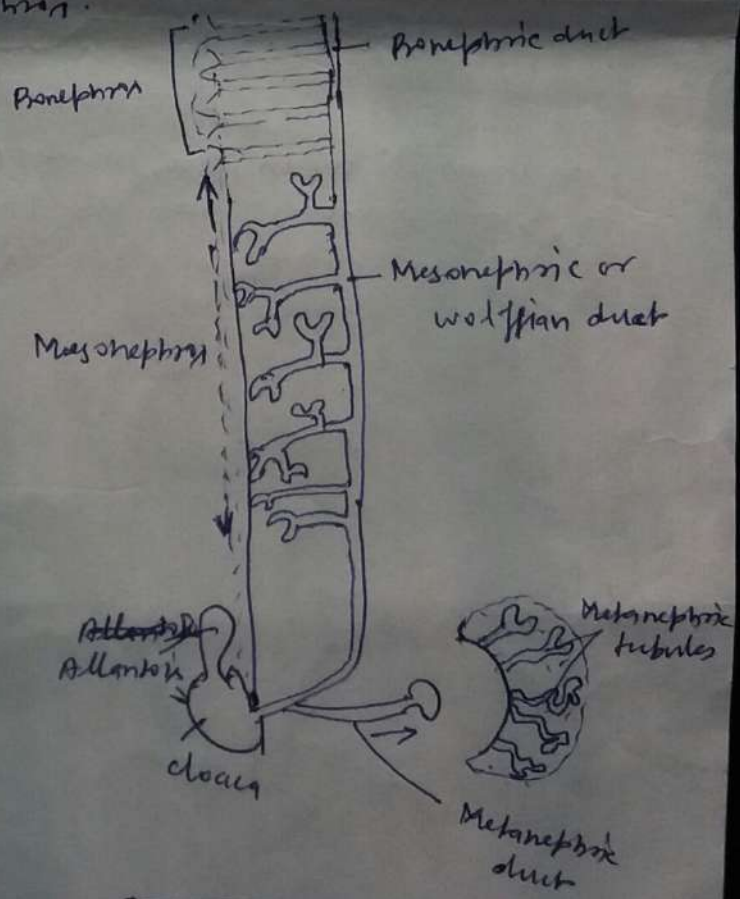


Fig: Plan of Amniote kidney in the embryo

- At the other end, they simply connect with the pronephric duct developed much earlier. The pronephric duct now becomes the mesonephric duct or wolffian duct and the tubules connected to it are collectively called the wolffian body (mesonephros).
- Like the opisthonephros of anamniota here in the mesonephros, too, the segmented arrangement of tubules becomes distorted, there are more than one mesonephric tubules per nephric segment and the Malpighian corpuscles per tubule are numerous.
- Mesonephros remains the functional kidney of the embryonic amniots, only in some forms, it appears for the name's sake.
- Mesonephros is functionally replaced by the metanephros developing behind it.

Metanephros:

- It is the functional kidney of the later stages of the embryo and of the adult.
- It develops from the posterior nephrotomes.
- The metanephric tubules neither develop ciliated funnels nor follow any kind of segmented discipline.
- The tubules at one end develop Malpighian corpuscles, at the other, they do not join the wolffian duct.
- While metanephric tubules are developing a diverticulum called ureteric bud or metanephric diverticulum, grows forward from the posterior end of the wolffian duct.
- This tubular growth of the diverticulum penetrates the metanephrogenous area in which metanephric tubules are developing and branches repeatedly to form a number of ~~open~~ collecting tubules, which connect with the distal end of the metanephric tubules.

⑤ Comparative Anatomy of Urogenital System

1. Cyclostomes:

- The hag fishes have the most primitive type of urogenital system. The kidney are of the archinephric type.
 - In the adult, however some archinephric tubules degenerate, thus leave some anterior tubules forming the pronephros, separated from the remaining tubules forming the opisthonephros.
 - All tubules of one side are connected with the archinephric duct of the same side.
- * Lampreys are advanced in the sense that pronephros functions only in the larval stage and the kidney of the adult is the opisthonephros.

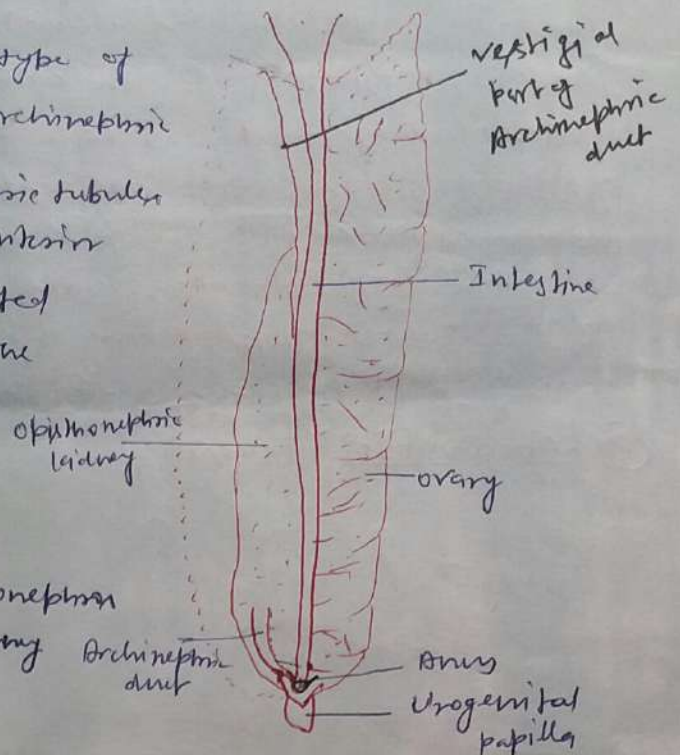


Fig: Urogenital system of female lamprey (ventral view), part of the ovary of right side (left in the figure) has been removed to show the kidney of that side, outline of ovary has been marked on the same side by a broken line.

2. Fishes:

Differences are found in the elasmobranch and teleosts and also in the two sexes; hence a type of each fish will be

Self Sex Scroden - Male urogenital system:

opisthonephros is the functional kidney of the adult. two ribbon shaped kidney extend from one end of the body cavity to the other on either side of the mid-dorsal line. Pronephric tubules and some anterior opisthonephric tubules which degenerate earlier in the embryo, remain in the adult as the head kidney. Nephric tubules in the genital part are extremely thin and have nothing to do with excretion, through AHA connected with the archinephric duct.

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female: Urogenital System of Scyliorhinus

- There is no direct connection between the kidneys and the genital organs in female. The anterior parts of the kidneys are very much reduced. A pair of flattened kidney occupy the same positions as they had in the male. Anterior part of the kidney corresponding to the genital part of the male kidney is thin and not so well-developed. The archinephric duct, all the way from one end of the kidney to the other, receives nephric tubules. The two archinephric ducts join just before opening into the urinary sinus inside a small urinary papilla opening into the cloaca.

② Labeo rohita (Teleost)

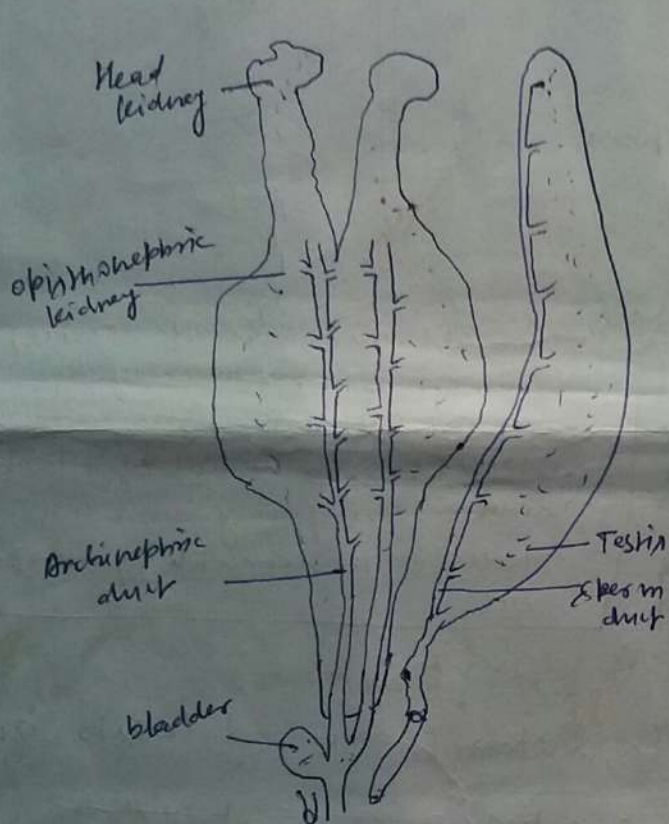


Fig: Urogenital system male Labeo rohita, testis of one side removed

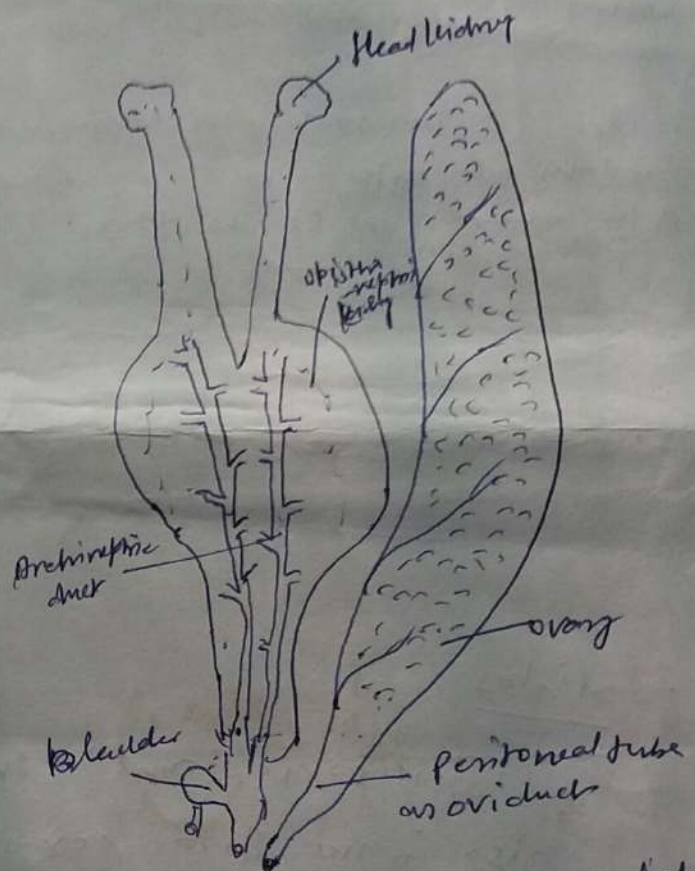


Fig Urogenital System of female Labeo rohita, ovary of one side removed

Male Urogenital system:

- The opisthonephric kidney are elongated, brown masses above the air bladder. Their anterior parts are separated, but middle and posterior parts are fused. The extreme anterior end have degenerated nephric tubules, representing the pronephros, here known as head kidney. The archinephric duct runs the whole length of each kidney.

Near the posterior end the ducts of the two sides join, the common duct is enlarged to form a bladder, which being mesodermal, is quite different from the endodermal bladder of teleosts. Since cloaca is absent in teleosts, the bladder communicates directly with the outside by the urinary opening behind the anus.

Female Urogenital System

The kidneys and their ducts have the same plan as in the male.
The archinephric duct have nothing to do with the genital organs.

Amphibia

Neonephros is functional only for a short time and soon degenerates in all amphibians except in the Anurans, where the larval kidney is like that of larval bony fish. In all adult tail-less amphibians the larval kidney is opisthonephric.

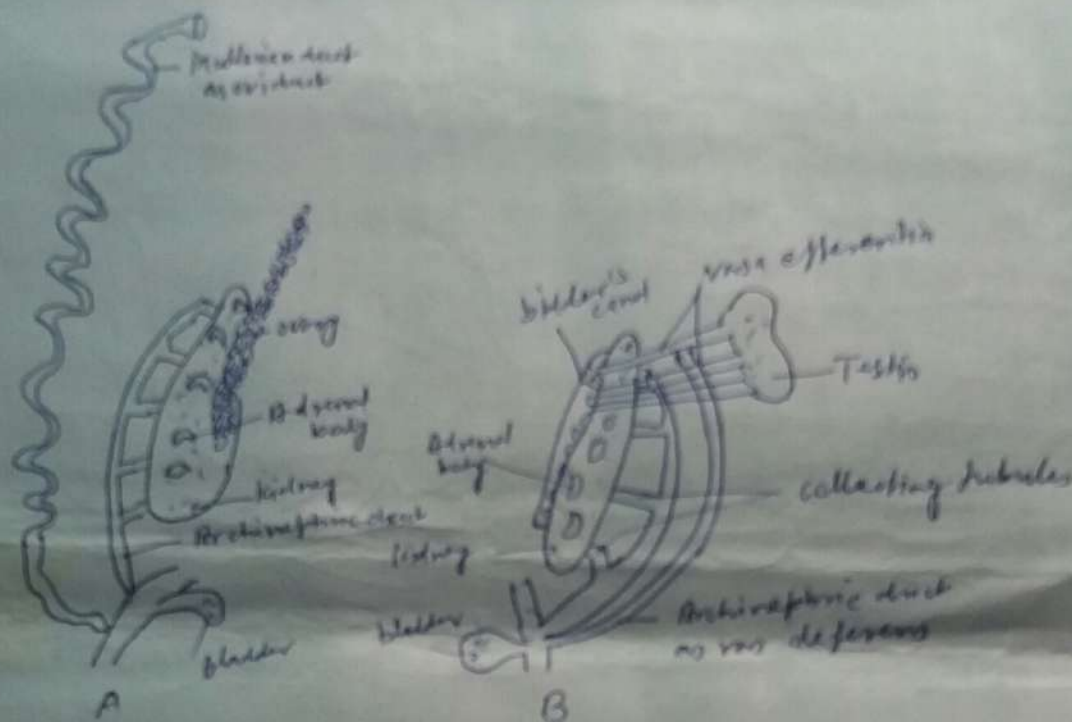


Fig: Urogenital system of (A) female (B) male *Triturus*

In the tailed amphibians such as *Triturus*, the kidneys are not much different from those of fishes and consists of an anterior narrow part, and a flattened, better developed posterior part with renal function alone. The archinephric duct runs outside the kidney and receives collecting tubules from both parts of the kidney and opens into the cloaca.

Female Urogenital System:

In female newts, such as *Triturus*, the kidneys are elongated bodies as in the males, but no part of the kidney is genital in function. Collecting tubules from the entire kidney carry out excretory wastes into the archinephric duct.

Male Urogenital System:

- In males, some tubules connect with the testis and transport the sperms into the Bidder's canal running along the medial edge and outside the kidney. The canal is connected with the archinephric duct through some nephric tubules in the anterior part of the kidney. The archinephric duct in male is thus a urogenital duct.

④ Reptiles:

Chondrich Sand lizards Uromastix

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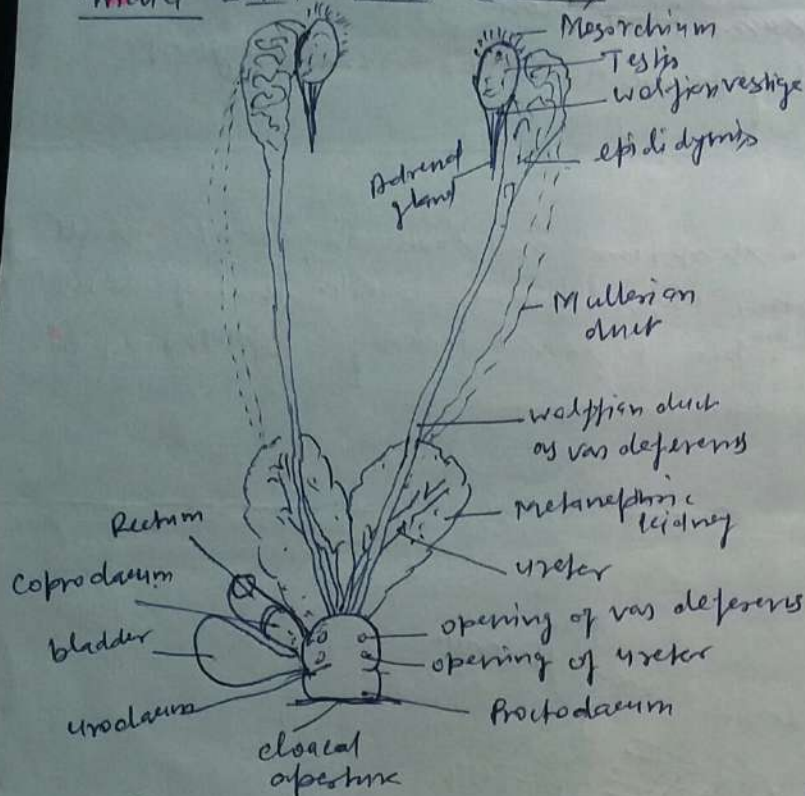


Fig: Uromastix: Male Urogenital system

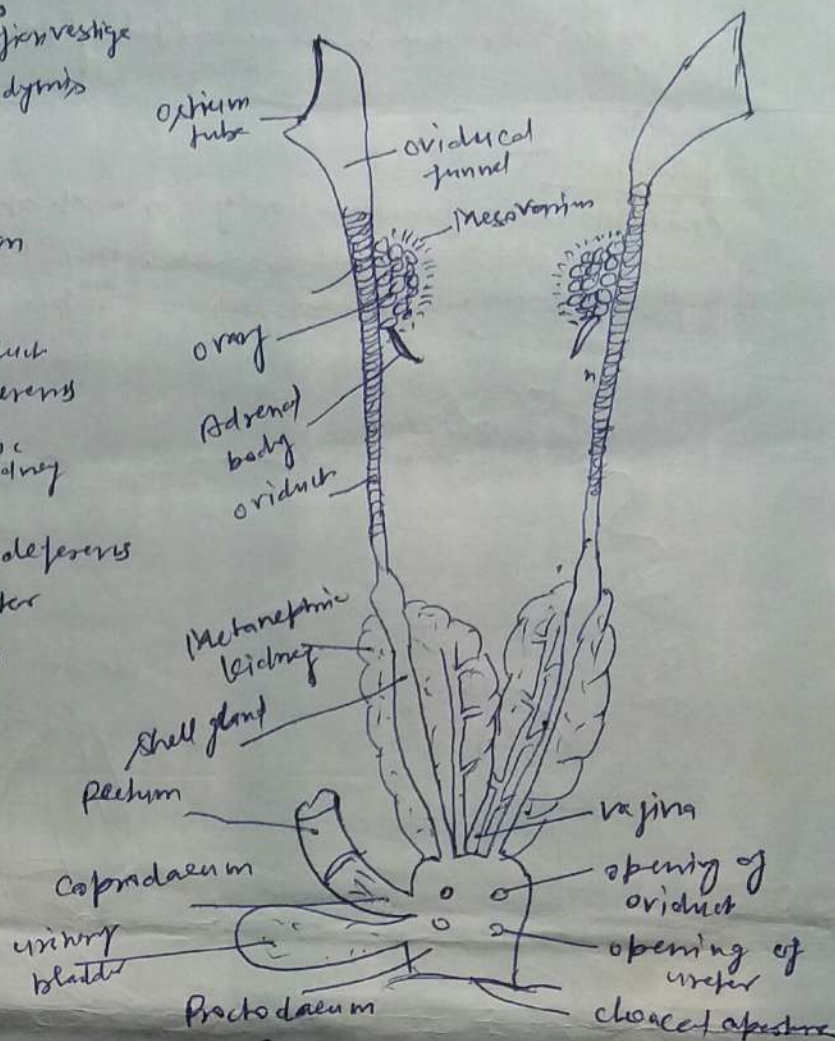


Fig: Uromastix: Female Urogenital system

Male Urogenital System:

Pronephros disappears quickly and mesonephros become the functional kidney of the embryo till metanephros is fully developed. Whereas the functional kidney of the adult is the metanephros, parts of the mesonephros are retained in the male for the genital purpose. Kidneys of the adult placed in the posterior half of the abdominal cavity in the pelvic region. Kidney of the two sides show various degrees of fusion such as in Uromastix.

Male urogenital system:

Two flattened pea-shaped and chocolate-coloured metanephric kidney are placed in the pelvic region of the abdominal cavity. Their broad posterior halves are fused, giving a 'V' shape to kidney. The ureters arise from the anterior one-third of the ventro-lateral region of the kidneys, each passes backwards, embedded in the central connective tissues inside the peritoneum covering the ventral surface of the kidney and opens in the middle compartment (urodaeum) of the cloaca. The opening of the ureters, placed over small papillae are separate and distinct from the opening of the genital ducts in the same compartment.

Female Urogenital System:

- The position and arrangement of kidneys and ureters is the same as in the male. Embryonic mesonephros is left as wolffian vestige. In both the sand-lizard and garden lizard the ureters and genital ducts open independently in the cloaca in its dorsal wall. The opening of the ureters lie behind those of the oviducts.

Birds:

Metanephric kidneys of birds are large-sized lobulated and always situated in the pelvic region of the body cavity. The ureters are, therefore, short and open independently in the urodaeum. Concentrated urine is in the form of a viscous fluid that enters the urodaeum, then passes up into the Coprodaeum, where more water is extracted after which urine returns to the proctodaeum. A urinary bladder is absent in all the birds of flight.

Urogenital System of the Pigeon - *Columba livia*.

Male Urogenital System:

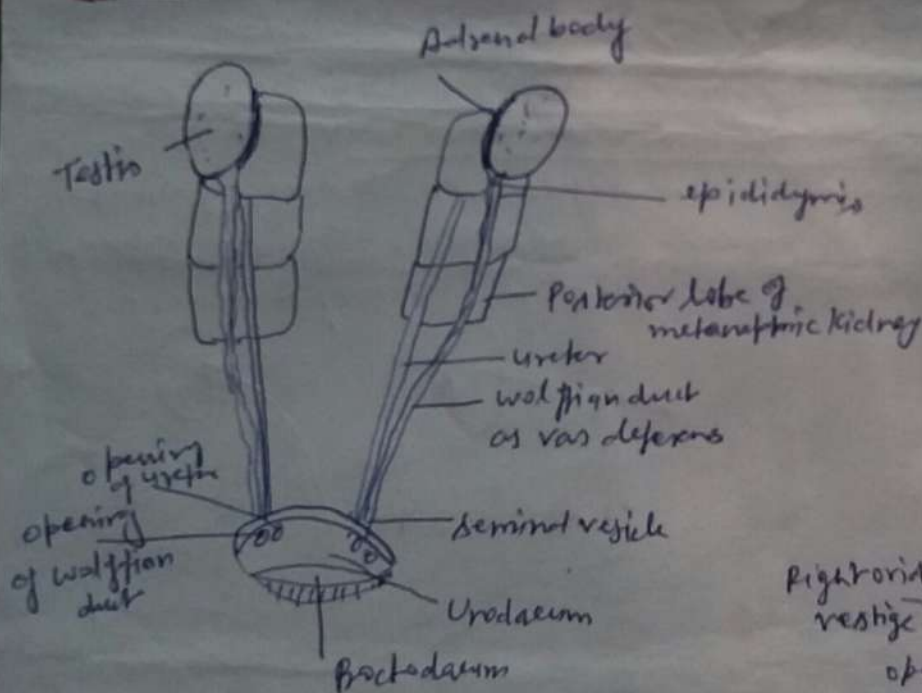


Fig. *Columba*: Male urogenital system

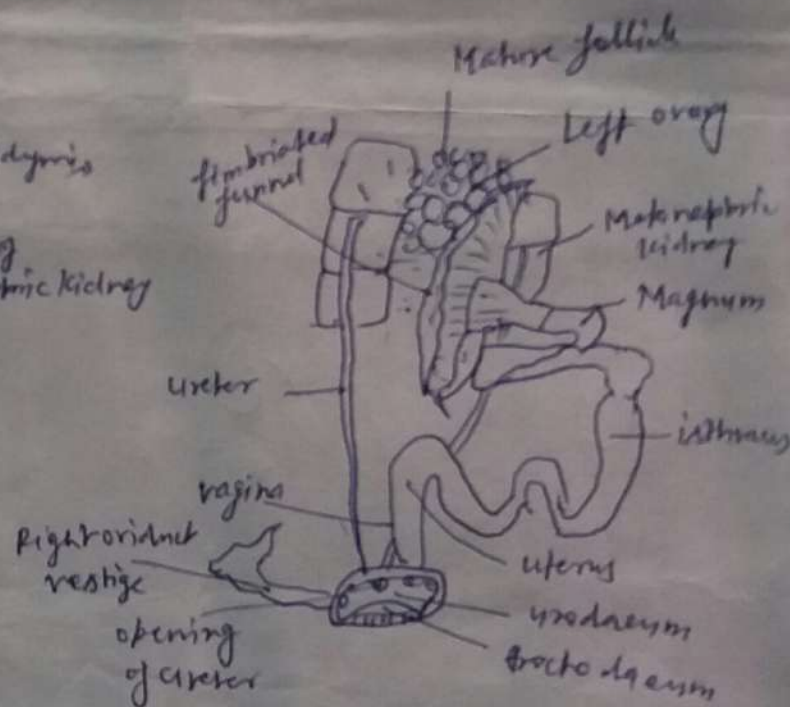


Fig. *Columba*: female urogenital system

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Large chocolate-coloured and flattened kidney lie in the pelvic region. Each is divided into three lobes by deep fissures. Ureters arise from the first lobe of each kidney and pass straight onto the uracaecum into which they open separately.

Female Urogenital System:

Kidneys and ureters occupy the same place in the female. Both the ovaries are present in the embryo but later on the right-side ovary and the right oviduct degenerate.

Mammals:

Urogenital system reaches the climax of complexity in the eutherian mammals. The metanephric kidneys are compact and bean-shaped, but in the embryo, they show marked lobulation. Lobulation remains in the adult kidney of mammals such as whales, elephants and certain carnivora. Generally the right kidney lies slightly lower than the left because of the liver on the right side of body cavity.

A ureter leaves the kidney of each side from a depression (hilum) along its median side. Urinary bladder is derived partly from the ventral cloacal wall and partly from a portion of the allantoic stalk. Embryonic cloaca, in all eutherian mammals becomes separated into two distinct parts, each having its opening independent of the other. On the absence of a cloaca in the adult, the ureters open into the urinary bladder.

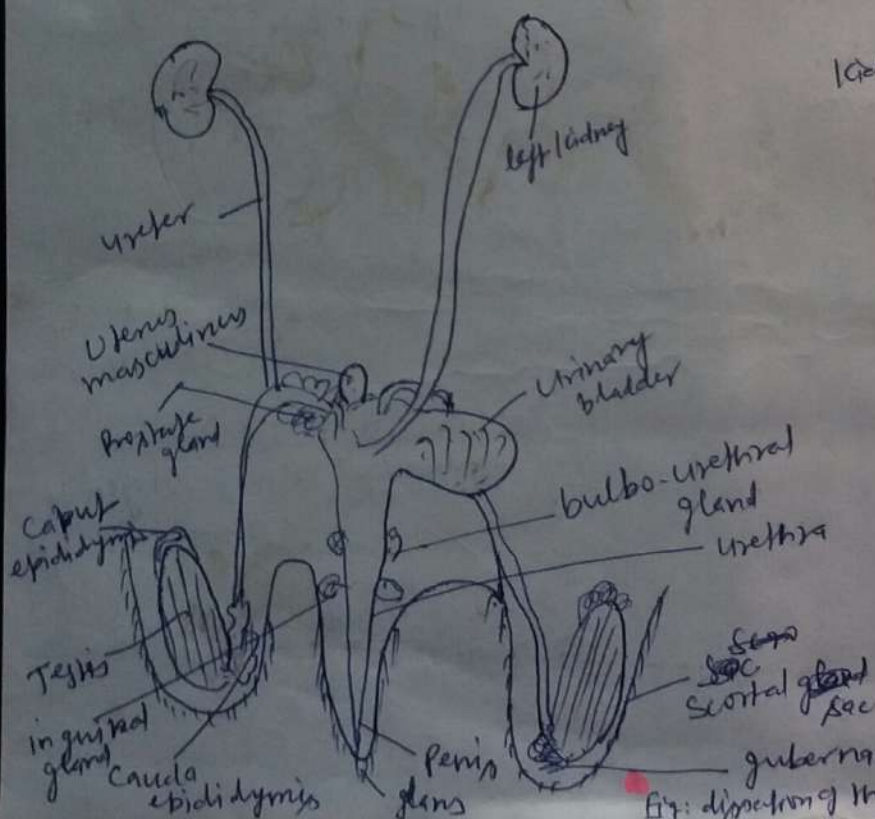


Fig: dissection of the male urogenital system

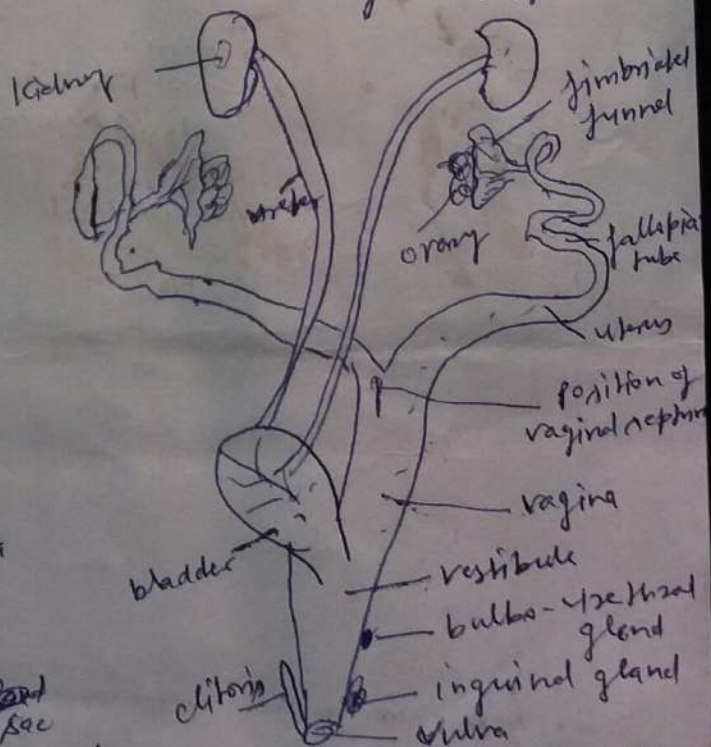


Fig: dissection of the female urogenital system