

Gonads and their ducts (Comparative Anatomy) ①

Vertebrates are sexually reproducing animals and the sexes are separate (dioecious). The male reproductive organs are called testis while the female reproductive organs are called ovary.

In the embryo gonads originate as a pair of thick elevated folds or genital ridges of coelomic epithelium from the roof of coelom, one on either side of the mesentery, it is much larger than the adult gonads. The functional adult gonad is derived from the middle or gonad part of genital ridge, its anterior pregonad and posterior epigonad parts remain sterile. Gonads remain suspended in coelom from dorsal body wall by a fold of dorsal mesentery, called mesorchium in males and mesovarium in females generally one pair of gonad is present but some vertebrates have a single gonad due to fusion of both genital ridges.

Associated with gonads are special gonoducts or genital ducts, vasa deferentia in males and oviducts in females to transmit gametes to cloaca and outside the body.

(A) Testis and male genital ducts - Testis of vertebrates are paired organs of moderate size, usually found attached to kidneys. Each testis is a compact gland, covered by coelomic epithelium and composed of numerous highly coiled seminiferous tubules embedded in connective tissue, tubules are lined by germinal epithelium which gives rise to billions of sperms which moves towards the genital ducts.

(2)

Some cyclostomes have a single median testis without a genital duct. Sperms are released in the coelom from where they pass through abdominal pore, located at posterior part of coelom. In dogfish the two testis are elongated bodies. In most anamniotes, the opisthonephros is differentiated into anterior genital and posterior renal portions. Some uriniferous tubules lost their excretory function and becomes seminiferous tubules. The mesonephric or Wolffian duct forms a urinogenital duct, serving the purpose of both ureter and sperm duct. The anterior genital part of kidney along with the part of mesonephric duct forms and epididymis.

In the embryos of anurans each testis is made of two parts. The anterior portion is called the Bidder's organ contains large immature ova.

In male amniotes a metanephros develops as a adult functional kidney with its own urinary duct or ureter to transport urine. The Wolffian duct becomes vas deferens. The remnants of embryonic mesonephros and a coiled portion of mesonephric duct becomes the epididymis of adult kidney, from each testis sperm pass first through epididymis and then through vas deferens to reach albatra.

In most mammals testis descends permanently into extra abdominal skin bags called scrotal sacs. In rabbits bats and rodents they are lowered into scrotum and can be retracted at will. The passage through which the testis descends is called the inguinal canal.

(3)

However in other mammals such as monotremes, insectivores, elephants and whales they lack derotal sacs and the testis resemble intra abdominal like ovaries.

(B) Copulatory organs. — Copulatory organs are absent in anamniotes due to external fertilization, but in amniotes the fertilization is internal and preceded by copulation or mating. Male amniotes develop intromittant or copulatory organs. In elasmobranchs bases of pelvic fins are modified as intromittant organs called claspers. These are grooved, cylindrical structures that are inserted into the female cloaca to inject sperm. In dogfishes and some allied forms there is a blind muscular sac called diaphan, located at the base of claspers. This sac gets filled with sea water which is used to force the spermatic fluid into the cloaca of female. In teleosts the anal fin is modified as a gonopodium for sperm transfer. Snakes and lizards have a pair of retractile, grooved and sac like hemipenes which can be everted through cloaca. Their retraction is controlled by modified body wall musculature. Turtles, crocodiles, some birds and prototherian mammals have an unpaired, grooved and erectile penis formed as a thickening of cloacal floor, only higher mammals have a true external, erectile penis with a tubular groove continuous with a spongy urethra. A series of accessory sex glands associated with penis secrete a fluid in which sperm are carried.

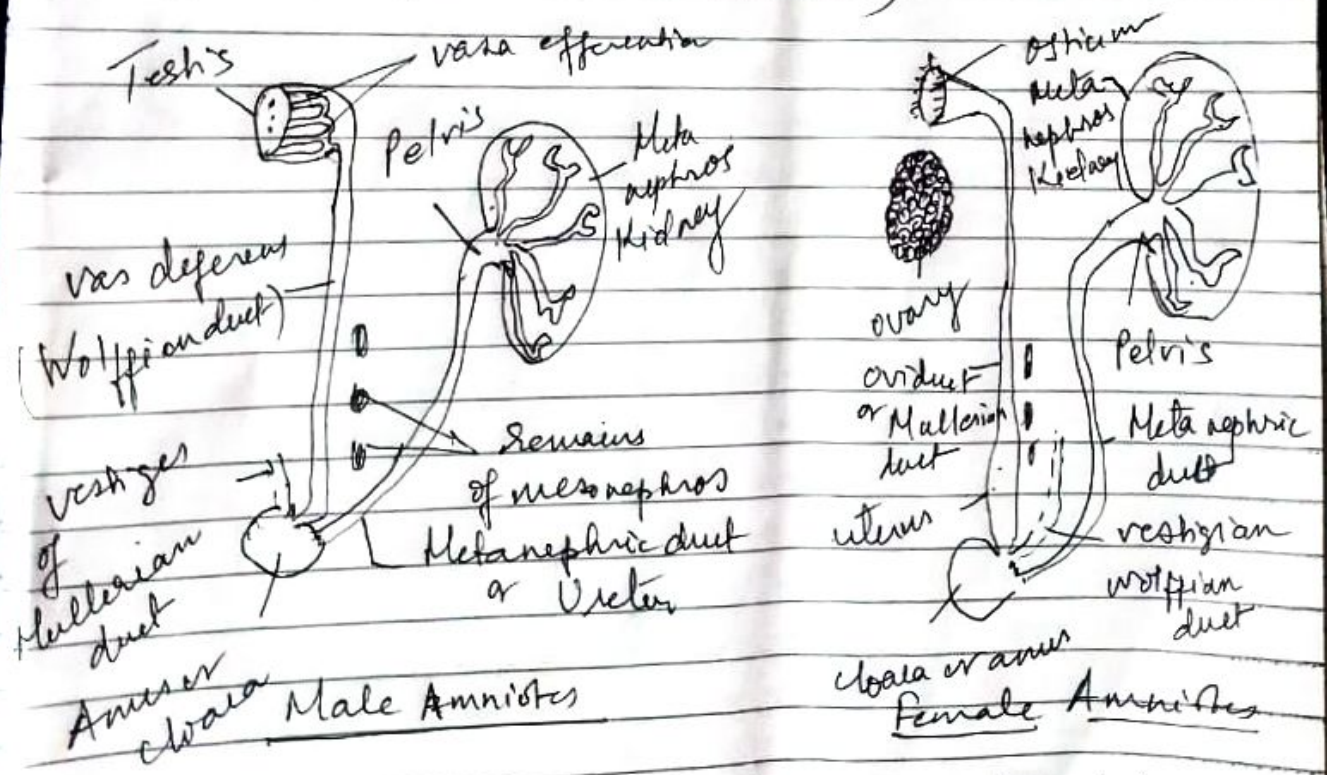
(1) ovaries - In female anamniotes, ovaries are large occupying much of body cavity and produce thousands of eggs as fertilization is external. In amniotes, ovaries produce fewer eggs because fertilization is internal. ovaries of reptiles and birds are still large and the eggs produced contain much yolk. However, mammalian eggs contain very little yolk, so that their ovaries also remain quite small.

Ovaries are generally paired structure, but only a single median ovary occurs in cyclostomes, as also in some teleosts. They are not attached to kidney like testes in the males. Only the right ovary is functional in many elasmobranchs whereas only the left ovary becomes mature in birds and some primitive mammals (eg - Ornithonyctus).

In all vertebrate embryos the coelomic epithelium on the outside of mesonephric duct develops a groove which becomes closed to form a tube called Mullerian duct. In adult males Mullerian duct becomes vestigial and functionless. In adult females, it grows larger and becomes the female genital duct or oviduct. It opens anteriorly into cloaca, in the region of degenerating pronephros, by a coelomic fluid or ostium, and terminates posteriorly into cloaca.

In female elasmobranch the Mullerian duct is formed differently by the longitudinal splitting of the pronephric duct. Thus in adult female anamniotes both the Mullerian duct and the Wolffian duct are present, but in adult female amniotes, with the development of adult metanephros and its ureter mesonephros degenerates leaving only a vestige called pro ovarium.

In viviparous mammals, Posterior ends of both the Mullerian ducts become fused and are modified into a uterus in which the embryos develop and a vagina which receives the male intromittent parts or oviducts are relatively short, narrow and convoluted and called the fallopian tubes. Condition of uteri varies in different mammals, when uteri remain double, without fusion, it is called duplex uterus (marsupials) when uteri partially fuse so as to form two horns and two separate lumens inside. It is called bipartite uterus (hamster, rabbit) when there are two horns but a single internal cavity it is termed bicornate uterus (ungulates) when uterine horns are absent and both uteri fuse completely with single internal cavity, it is termed simplex uterus (Primates, bats and armadillos)



Schematic representation of evolution of urinogenital organs and their ducts in vertebrates. By Dr. Bibha Verma, Dept of Zoology.