THE REPRODUCTIVE SYSTEM OF REPTILES – ANATOMY, PHYSIOLOGY AND CLINICAL PERSPECTIVES

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Reproductive Anatomy of Reptiles

The gonads (ovaries and testes) of both sexes are located dorsally in the body cavity, posterior to the lungs, and ventral to the kidneys and peritoneal wall. They produce gametes and their ducts transmit eggs or sperm to the cloaca. The cloaca is the common chamber into which the ureters, gonadal ducts, rectum, and bladder empty. The cloaca leads to the outside of the body via the vent (Wake, 1979; Kardong, 2001).

Ovaries: The female reproductive tract is composed of paired ovaries, oviducts (Müllerian ducts) supported by mesenteries. In turtles, tortoises, and some lizards the cranial pole of the ovary is located just posterior to the lung and extends posteromedially toward the cloaca. In lizards, turtles and crocodilians at least the caudal part of each ovary is attached to the peritoneum along the ventromedial surface of each kidney. In some lizards with highly modified lungs, such as chameleons, the ovary may extend craniad between the two lungs. In snakes the ovaries tend to be well posterior to the lung(s) and air sac(s) and anterior to the kidneys. They are attached to the dorsal body wall by the attached by the mesovarium.

The ovary and oviduct change in size and composition with age and between breeding and nonbreeding seasons. Another mesentery, the mesotubarium, extends from the ovary to the oviduct. The oviduct lies lateral to the ovary and extends anteriorly, before curving medially and ending in a funnel shaped opening, the ostium. The ostium, which receives ovulated follicles, is supported by the mesosalpinx. The posterior end of each oviduct empties into urodeum of the cloaca.

In sexually mature reptiles, and especially in turtles, mature follicles tend to cluster along the cranial aspect of the ovaries. Immature follicles are most concentrated in the posterior third of the ovary. Mature reptiles that have nested previously will have scars from previously ovulated follicles, corpora albicans along the ovary. Recently ovulated follicles leave hormonally active "scars," the corpora luteum. The corpus luteum becomes a corpus albicans after it ceases to produce progesterone.

Testes: The male reproductive tract consists of paired testes, epididymi, vas deferens (deferent ducts or ductus deferens) and the mesenteries (mesorchia). The testes can be round or fusiform in shape. In snakes and lizards they are located anterior to the kidney (In turtles and crocodilians they are attached by the mesorchium to the peritoneum overlying the kidney (Jane, 1996; Wyneken, 2001). The testis is light tan or yellow in some species, and gray to pink in others, and pigmented black in some chameleons and turtles. Sperm are produced in the testis then travel via very small efferent ductules to the epididymus, which lies lateral or posterolateral to the testis. The

vas deferens leads from the epididymus to the cloaca at the base of the penis, demarked by the corpra cavernosum. The testis, epididymis, and vas deferens increase in size with age and during breeding season. Testes in mature breeding males are often twice as long as their diameter and filled with white fluid (sperm and accessory gland fluid).

The genital papilla on the ventral floor of the cloaca elongates into the penis or hemipenes during maturation. These structures are retracted except during mating, trauma, or death. The penis (or hemipenis – sing. form of hemipenes) is composed of a pair of corpora cavernosa and a "urethral groove" (sulcus spermaticus). In sqaumates and turtles the corpora cavernosa are supplied with blood via the hypogastric and internal iliac veins during mating. The crocodilians have a largely cartilaginous penis with relatively small cavernous components (Lane, 1996). When erect, the walls of the urethral groove meet dorsally to form a functional tube (sulcus spermaticus) through which sperm and fluids pass. Some species have ornamented structures, for example, spines or flaps on or near the glans penis of turtles or along the length of hemipenes in squamates. The intromittent organs of snakes and lizards are paired but are single in turtles and crocodilians. The hemipenes of lizards and snakes are located posterior to the vent and in the hemipenal chambers (Barten, 1996; Funk 1996). The hemipenes evaginate, usually unilaterally, during mating. A single penis is found in turtles and crocodilians. It is located on the cranio-ventral floor of the cloaca except during mating when it is extended out the vent (Boyer and Boyer 1996; Lane 1996). Tuatara's lack intromittent organs (Moffat, 1985).

Reproductive Ducts: The oviducts of immature reptiles are bilateral thin-walled tubes. As females mature, the walls of the oviduct thicken, differentiate and the lumen increases in diameter. The oviduct can be described functionally (but not reliably in gross structure) as having five regions: the ostium (or infundibulum), aglandular segment, magnum, shell gland, and vagina. The ostium remains thin-walled but increases in size as animals mature (Ewert, 1985; Miller, 1985; Ferguson, 1985). The oviduct of mature females is muscular and mobile. The ostium migrates across the ovary surface collecting the ovulated follicles. The follicles travel past the aglandular segment and into the magnum where layers of albumen are added. The follicles then pass to the shell gland where the protein and carbohydrate shell membrane (chorion) and the shell matrix are secreted. Eggs then pass to the vagina where they remain until deposition, several days later (Miller, 1985). During deposition, the posterior oviduct allows eggs to pass to the cloaca, then out the vent into the nest.

In some males, paired Müllerian ducts may persist as a pair of small, flat, thin-walled tubes. When present, they are located along the lateral body wall and attached by a mesotubarium from the duct to the testis or peritoneum overlying the kidney (Wake, 1979; Kardong 2002). They will often extend toward the anterior third of the body, lateral to the lung.

Ovipary, Ovovivipary and Vivipary: Most reptiles including all turtles and crocodilians are oviparous: they lay hard-shelled or parchment shelled eggs. Many lizards and snakes are also oviparous. However, some squamates retain the embryos within the oviduct and the embryos are nourished by the yolk. Other viviparous squamates

nourish their young through placentae that are modified from extraembryonic membranes. These may be either the chorioallantoic membrane or the yolk sac (Zug, 1993).

Clinical Perspectives

Reptilian practitioners are often faced with reproductive issues in clinical practice. This may be as seemingly simple as an "egg-bound" iguana to a challenging non-productive colony of valuable breeding animals. An understanding of the normal reproductive anatomy and physiology will help the practitioner diagnose problems.

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