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Specific Anatomical Structures of Some Wild Animals in East Anatolian of Turkey

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Abstract: Anatomical features are the most important criterion for distinguishing the species and identification. The anatomical structures in bone, tissue and organ of some species show remarkable distinctive features. In this review, the current data related to some specific macro and micro-anatomical findings are presented in some wild species with a common population such as porcupine, squirrel, badger, marten, wolf, fox, lynx and long-legged buzzard in East Anatolian of Turkey. The results of this review may contribute to the data in this area of science.

Key words: Anatomy, porcupine, squirrel, badger, marten, wolf, fox, lynx, long-legged buzzard

INTRODUCTION

Wild animal species such as porcupine, squirrel, badger, marten, wolf, fox, lynx and long-legged buzzard are frequently encountered in Turkey, especially East Anatolian region. These animal species are known to be differences in their specific macro and micro-anatomical structures.

The porcupine belongs to the Hystricidae family (Cigremis *et al*., 2008; Yaman *et al*., 2008; Ozdemir and Atalar, 2009) and squirrel belongs to the Sciuiridae family that constitute a small group of the order Rodentia. The badger and marten belong to Mustalidae (Atalar *et al*., 2004), the wolf and fox belong to Canidae, the lynx belong to Felidae family constitute a small groups of the order carnivores. Together with these species long-legged buzzard belong to Accipitridae family that constitute a small group of the order Avian is one of the most encountered species in this region.

The aim of this review was for the first time to describe the macro and micro anatomical findings of some system and organs in some wild species with a common population such as porcupine, squirrel, badger, marten, wolf, fox, lynx and long-legged buzzard in East Anatolian of Turkey. The results of this review may contribute to the data in this area of science.

PORCUPINE (*Hystrix cristata*)

Vascular system: At the level of ascending aorta, the a. coronaria sinistra and a. coronaria dextra are responsible for the vascularisation of the heart. The branches of the left coronary artery give off ramus interventricularis paraconalis, ramus circumflexus sinister, ramus septalis, ramus collateralis sinister proximalis et distalis, ramus marginis ventriculi sinistri, ramus proximalis ventriculi sinistri, ramus distalis ventriculi sinistri, ramus interventricularis subsinosus, ramus coni arteriosi and rami septales. The branches of the right coronary artery give off ramus circumflexus dexter, ramus proximalis ventriculi dextri, ramus marginis ventriculis dextri, ramus distalis ventriculi dextri and right ramus coni arteriosi. It has been reported that the coronary arteries of porcupine have an intramyocardial course like other rodents and vascularisation of the heart is of the left coronary type which shows similarity with carnivores and ruminants (Atalar *et al*., 2003a).

Three arteries branch off from arcus aorta in porcupine. These are truncus brachiocephalicus, a. carotis communis sinistra and a. subclavia sinistra. Such branching shows similarity to that observes in the rat and laboratory mouse. Truncus brachiocephalicus gives off a. carotis dextra and a. subclavia dextra in porcupine. A. subclavia sinistra give off truncus costocervicalis sinistra, a. vertebralis sinistra, a. axillaris sinistra and a. thoracica interna sinistra. It has been also noted that both left and right axillary arteries seem to be a continuation of subclavia arteries (Atalar *et al*., 2003b).

The branches of the a. celiaca in the porcupine reported that are called as a. linealis and a. hepatica. After nearly 1 cm from a. celiaca starting point, it gives off a thin branch known as the a. phrenica caudalis to the diaphragm. A. linealis gives off ramus pancreaticus, a. diverticuli, ramus gastrolinealis, rami lineales. The a. linealis after from the extramitas ventralis of the spleen through to the curvature ventriculi major of the stomach named as the a. gastroepiploica sinistra. A. hepatica is observed as the continuity of the a. celiaca. The a. hepatica gives off the a. gastrica dextra, a. gastrica

sinistra, a. gastroduodenalis, ramus dexter et sinister. The a. cystic and the a. lobi caudate arise from the ramus dexter in porcupines (Atalar and Yilmaz, 2004a).

The venous drainage of the heart in porcupine is made by the v. cordis magna, v. distalis ventriculi sinistri, v. proximalis ventriculi sinistri, v. cordis caudalis, v. cordis media and vv. vordis dextrae. The cardiac veins take a subepicardial course in the porcupines. It has been reported that the sinus coronarius is located just beneath the v. cava caudalis. V. cordis magna and v. distalis ventriculi sinistri of porcupine are opened to the sinus coronarius. R. interventricularis paraconalis emerge from the sulcus interventricularis paraconalis near the apex cordis. V. cordis caudalis originates from near the apex cordis and empties into the v. cava caudalis. The right cardiac vein is seen to open to the right atrium and it also receives the right v. coni arteriosi, right proximal ventricular vein and right proximal atrial vein (Atalar *et al*., 2004).

The cranial mesenteric artery in the porcupine is the thickest of the vessels which originated from the aorta abdominalis. It gives off and is divided into two branches, the a. colica media and a. colica dextra and then gives off a. pancreatica duadenalis, the a. jejunales and the truncus jejunalis continuing its way under the name a. ileocolica (Atalar and Yilmaz, 2005).

Macro-anatomical investigation of renal arteries in porcupine shows that a. renalis dextra and sinistra give off rami adrenales (supra) caudales, ramus uretericus and rami renales (Atalar and Yilmaz, 2004b).

Lungs: Morphology of lungs in porcupines has observed that the upper air-conducting airways of the lung are lined by an epithelium characterized by ciliated cells among which are dispersed goblet cells. The alveolar surface is honeycombed in appearance with the walls of multiple capillaries bulging into the alveolar space. The terminal airways show pseudostratified ciliated columnar epithelium with numerous goblet cells and occasionally brush cells (Ozdemir *et al*., 2006).

Tongue: The morphology of the tongue in the porcupine has observed that the tongue has a slender anterior protrusion and the tip of the tongue is round. There is a profound fossa in the middle of dorsal surface of the tongue. The median sulcus is extended to the area except for the posterior part. The fungiform papillae are mushroom form and covered squamous epithelium. These papillae are absent on the dorsal midline and apex of the tongue. Papilla vallata is one each in both side of median line in dorsal surface of the tongue base. There is taste buds only inner wall of ditch of papilla. Maximum 9 taste buds are found on one side. Additionally, there are micropits and microridges on cell surfaces (Atalar and Karan, 2011).

Ovaries: Ovaries of porcupine are located in the sublumbar area and under the third or fourth lumbar vertebra. Ovarian histology, over the portions of the ovary covered by low columnar or cuboidal epithelium cells appeared to be detaching from the surface. Primordial follicles in the ovary of the porcupine are distributed under tunica albuginea and extend deeply for a short distance into the cortical tissue. Secondary follicles are composed of a primary oocyte surrounded by a stratified epithelium of granulose cells. Tertiary follicles are composed of a primary oocyte surrounded by a stratified epithelium of follicular cumulus cells (Ozdemir *et al*., 2005).

Penis: The penis in the porcupine is directed caudally. There is an obvious collum penis after glans penis which is black in colour. There are cornified papillae on the dorsal surface of both corpus and glans penis. Two nails are found in the erectile penis, approximately 2-3 mm length and 1-2 mm width at the right and left sides. There is an os penis in the shape of a grooved catheter immediately under the lamina interna of preputium located at the dorsal section of the corpus penis at the transversal section of the penis (Atalar and Ceribasi, 2006).

Some immunohistochemical findings: Some results of immunohistochemical studies in porcupine have revealed that positive GnRH receptors in pancreas (Tarakci *et al*., 2007), somatostatin receptors in bulbus olfactorius and the positive receptors of serotonin, CGRP, somatostatin-14 and neurotensin in gastrointestinal tract (Yaman *et al*., 2007) are found.

BADGER (*Meles meles*)

Vascular system: The branches of the a. celiaca in the badger have been reported by a. hepatica, a. gastric sinistra and a. linealis. A. celiaca is a short vessel in badger. A. hepatica which after arising from the a. celiaca, turns toward to liver extending to porta hepatis on the visceral surface of the liver. There, it is divided into the r. sinister, r. dexter medialis and r. dexter lateralis. The a. cystica arises from the r. dexter medialis. A. hepatica also gives off a. gastric dextra. A. gastric sinistra is the second and the smallest branch of the a. celiaca. A. linealis represents the continuation of the a. celiaca. It gives off the r. pancreaticus and rr. lineales (Yilmaz *et al*., 2004).

Skeleton system: Macro-anatomical investigations on the skeleton of the badgers were observed that the fossa supraspinata is larger than the fossa infraspinata. Deltoid

tuberosity is crest-shaped. Lateral supracondylar crest is very well developed. Trochlea radii is more developed than caput radii. The joints are present at proximal and distal of between the radius and ulna.

Duodenum: The epithelial lining of duodenum of badger consists of columnar and goblet cells. The apical borders of columnar cells have many microvilli arranged orderly resulting in striated border. The goblet cells are irregularly scattered among the columnar cells. The epithelium covering the villi and crypts is of the simple columnar type. Columnar cells have an ovoid nucleus and numerous mitochondria. Secreted granules are situated in apical region of the cells (Ozdemir *et al*., 2004).

Testes: In badger, it is seen that the testicular parenchyma consists of lining cells of the seminiferous tubules and their ducts as well as interstitial cells. It is determined that the Sertoli cells rest on the basal lamina of tubule. Their cytoplasm contains a number of mitochondria with different shape. Leydig cells are large and acidophilic cells. Spermatogonia are characterised by a large round or oval nucleus with condensed chromatin (Karan *et al*., 2010).

SQUIRREL (*Sciurus vulgaris*)

Skeleton system: Macro-anatomical investigations on the skeletons of squirrels have been reported that the area of fossa supraspinata is larger than fossa infraspinata. The processus hamatus and processus suprahamatus are present. The processus coracoideus is oriented to medial by twisting in the shape of hook. Tuberositas deltoidea is crest-shaped. Crista supracondylaris lateralis is very well developed. Ulna bone is thicker than radius. Foramen obturatum is very large and tuber ischiadicum have one prominence. Trochanter tertius is over developed. The fibula is both proximally and distally attached to the tibia. Caput tali is distally enlarged and collum tali is over developed. Each tarsal bone is considerably flattened in both sides at its proximal half while it is oval at its distal half. The important features of skull of squirrel have been observed that the zygomatic process of the frontal bone, the facial tubercle and the tympanic bulla are very well developed. The supraorbital foramen is absent. The infraorbital foramen is small. The mental foramen and angular process of the mandible are present. The ninth thoracic vertebra is reported as anticlinal vertebra. Hemal arches are present on ventral surface of the caudal ends of the bodies of the caudal vertebrae (Atalar and Yilmaz, 2004b).

MARTEN (*Martes foina*)

Skeleton system: The macro-anatomical investigations on the skeletons of martens are observed that the area of supraspinous fossa is larger than infraspinous fossa. Processus hamatus and processus suprahamatus are present. Incisura scapula and incisura glenoidalis are rather evident. Deltoid tuberosity is crest-shaped. Lateral supracondylar ridge is very well developed. The trochlea of radius is more developed than the heat of the radius. Left hip bone and right hip bone are parallel to each other, obturator foramen is very large and ischical tuberosity has a single prominence. Area lateralis m. recti femoris is quite deep. Articular surface for lateral and medial sesamoid bones look like little hollows. Arciform grooves of the cochlea tibia are oblique and there are proximally and distally formed joints between tibia and fibula. Os metatarsale-I is the smallest between metatarsal bones.

Some immunohistochemical findings: Some results of immunohistochemical studies in marten have revealed that positive calbidin-D28 receptors in the cerebellum (Timurkaan *et al*., 2006) and kidney (Karan *et al*., 2007), insulin, glucagon and somatostatin receptors in the pancreas (Karan *et al*., 2008) are found.

LYNX (*Lynx lynx*), WOLF (*Canis lupus*) AND FOX (*Vulpes vulpes*) (COMPARATIVELY)

Skeleton system: In these species, the dorsal surface of the neurocranium consists of a paired parietal and frontal bones. Crista sagittalis externa is more pronounced in the wolf than in other species. Processus mastoideus is developed in all species. There are two foramen laterally on the each side of the condylus occipitalis in the wolf. These foramens are not seen in other species. Processus paracondylaris is projected caudally and slightly in the lynx.

The supraorbital foramen is absent in all species. Protuberentia occipitalis externa is seen as distinct structure in the fox (Atalar *et al*., 2009). The incisura nasoincisivum is very pronounced in lynx but not wolf and fox. Foramen palatinum majus is seen on the joining location of the horizontal lamina of the palatine bone and maxilla bone in the fox and wolf however, this foramen is located on the horizontal lamina of the palatine bone in the lynx. Spina nasalis caudalis is very developed in the fox and wolf however, is slight in the lynx. Margo interalveolaris is absent in the fox and wolf however is pronounced in the lynx.

LONG-LEGGED BUZZARD (*Buteo rufinus*)

Skeleton system: The morphological investigations in the long-legged buzzard are showed that the humerus a highly pneumatic and strong one among the bones of the wing, composed of prominently developed dorsal and ventral tubercles. Well-developed capital groove is present, located between the articular surface of the head of the humerus and ventral tubercle. The transversal groove resembles a deep fovea. The pneumatic foramen is single and wide. Antebrachium is the longest bone of the wing, possessing the longer and stronger ulna and smaller and medially located radius. The olecranon is less developed while the radia incisura is prominent. The ventral remigal papillae for attachment for the ligaments of the follicles of the secondary flight feathers are hardly observable. The bicipital tubercle is very well developed. The dorsal supcondylar tubercle is distinct while the ventral one is relatively less developed. There is a larger and prominent ulnar os capri and a smaller and less developed radial os carpi. The major metacarpal bone is a strong and smooth bone while the minor metacarpal bone is week, possessing a slightly concave structure (Atalar *et al*., 2007).

Some immunohistochemical findings: Some results of immunohistochemical studies in marten have revealed that positive SOM-14, SP, NPY, CGRP, CCK-8 and galanin receptors are found in endocrine and exocrine pancreas of long-legged buzzard (Bayrakdar *et al*., 2011).

CONCLUSION

This review will be a reference for anatomical investigations in these species. It was judged that this first report provided significant anatomical information on some wild animals in East Anatolian of Turkey.

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