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# MACROANATOMY OF BASAL NUCLEI IN BACTRIAN CAMEL (*Camelus bactrianus*)

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## ABSTRACT

The brains of 10 bactrian camels were dissected to study the shape, location of the basal nucleus. Seven coronal slices of brain were uniformly taken between callosal genu and splenium and 6 uniform sagittal slices of left cerebral hemisphere of brain were examined. The corpus striatum is the great basal muclei of the hemisphere. It is situated rostral to the thalamus and the cerebral crus. The entire complex is often referred to as the coupus striatum, which is subdivided into the paleostriatum (pallidum or globus pallidus), the neostriatum (caudate nucleus and putamen) and the archistriatum (amygdaloid bod). The caudate nucleus is a large grey mass forming the floor of the lateral ventricle. The pallidum is covered externally by putamen which is surrounded by fibres. Amygdaloid body is situated lateroventrocaudally to lateral ventricle within the caudal part of the piriform lobe. The diameter of this nucleus is about one cm.

**Key words:** Bactrian camels, basal nucleus, brain

Bactrian camel (*Camelus bactrianus*) is vital to the productive system of Chinese desert and semi-desert areas, and is well adapted to the harsh climatic conditions. Nervous system may play important role in adaptation of bactrian camel, hence its anatomical study is required. Morphological study of cerebrum and magnatic resonances imaging of brain of bactrian camel have been studied previously (Xie *et al*, 2006; Xie and Wang, 2008). Nervous system of the horse, donkey and ox have been reported by Dellmanns and McClure (1975) and Xie (1987). The investigation of Nokitenko *et al* (1970) compared the brains of 13 species of Artiodactyla (that order of ungulates having an even number of toes). Hunan Research Group (1984) profoundly described the brain of the Chinese water buffalo. Smuts and Bezuidenhout (1987) in its monograph expounded in dromedary (*Camelus dromedarius*). However, no information is available on the basal nucoleus in bactrian camels. In addition, a number of the domestic animals, including equine, ruminants, porcine and carnivores show species differences with regard to the pattern of distribution of basal nucleus (Dellmanns and McClure, 1975). In the present investigation, the gross anatomy of the basal nuclei in bactrian camels is studied.

## Materials and Methods

Ten brains belonging to adult healthy bactrian camels of both sexes were obtained from a slaughter house of the Right Alashan Banner Food Company in Inner Mongolia Automomous Region, China. Each specimen of the head of bactrian camel was isolated and immersed in formalin (10%, pH 7.4) and fixed for four months. The pertinent details were followed as described by Xie (2006). The coronal sections of brain (Fig 1) were uniformly taken between callosal genu and splenium and successive sagittal sections (Fig 2) of left cerebral hemisphere of brain were examined.

Anatomical nomenclature of the coronary arteries used was according to the fifth edition of the Nomina Anatomica Veterinaria (International Committee on Veterinary Gross Anatomical Nomenclature (ICVGAN, 2005).

## Result

The basal nuleus was located deep within the cerebral hemispheres in the telencephalon region of the brain. It consisted of the corpus stratium, subthalamic nucleus and the substantia nigra. The corpus striatum was the great basal muclei of the hemisphere. It was situated rostral to the thalamus and the cerebral crus. The entire complex was

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often referred to as the corpus striatum, which was subdivided into the paleostriatum (pallidum or globus pallidus), the neostriatum (caudate nucleus and putamen) and the archistriatum (amygdaloid body).

### *Caudate nucleus*

The caudate nucleus was a large grey mass forming the floor of the lateral ventricle. It has the shape of an elongated pear, with its narrow part directed dorsocaudolaterally. Viewed from transverse plane which was in front of the optic chiasm 0.5 cm. The rostral caudate nucleus was large convex and termed the head and extended progressively broad towards the caudal end and separated the putamen by internal capsule. The caudate nucleus faced the corpus callosum where the ventricle was reduced to a very narrow cavity. The caudate nucleus was bounded laterally and ventrally by the internal capsule and at the lateral limit of the lateral ventricle. Medially the caudate nucleus was immediately adjacent to the thalamus and the lateral geniculate body. In the rostromedioventrally from the head of the caudate nucleus was the accumbens nucleus, between it and the free ventromedial surface of the hemisphere and ventrolateral to the rostrum of the corpus callosum. This nucleus accubers was pierced by the rostral commissure.

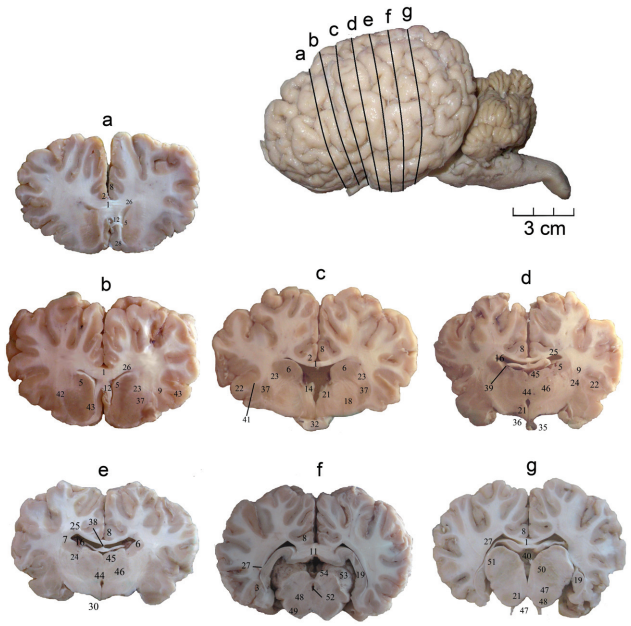


**Fig 1.** Coronal slices (a-g) of bactrian camel brain were taken between callosal genu and splenium. 1, corpus callosum (body); 2, callosal sucus; 3, Amygdaloid body; 4, anterior commissure; 5, caudate nucleus (head); 6, caudate nucleus(body); 7,choroids plexus; 8, cingulated gyrus; 9, claustrum; 10, corpus callosum (genu); 11, corpus callosum (splenium); 12, corpus callosum (forceps); 13, fornix (body); 14, fornix (column); 15, fornix (fimbria); 16, 17,interventricular foramen; 18, globus pallidus; 19, hippocampus; 21, hypothalamus; 20, hypothalamic sulcus; 22, insula; 23, internal capsule (anterior limb); 24, internal capsule (posterior limb); 25, lateral ventricle (body); 26, lateral ventricle (anterior/frontal horn); 27, lateral ventricle (inferior/temporal horn); 28, lateral ventricle (olfactory recess); 29, lateral ventricle (posterior horn); 30, mammillary body; 31, optic nerve: 32,opotic chiasm; 33, olfactory nerve; 34, parahippocampal gyrus; 35, pituitary; 36, pituitary stalk; 37, putamen; 38, septum; 39, stria terminalis; 40, third ventricle; 41,extremal capsule; 42,external capsule; 43, extremal capsule; 44, third ventricle; 45, thalamic nucleus (anterior); 46,thalamic nucleus (anterior-ventral); 47, oculomotor nerve; 48, red nucleus; 49, substantia nigra; 50, thalamic nucleus (central); 51,thalamic nucleus (lateral); 52, cerebral aqueduct; 53, superior colliculi; 54,inferior colliculi.

### *Putamen and pallidum*

The putamen lied lateral to the caudate nucleus and was separated from it by the internal capsule. It was an elongated and closely related rostrally to the ventrolateral part of the head of the caudate nucleus. It was slightly oblique dorsomediocaudally. Its rostral end was thicker than its caudal one, the nucleus was thick as compared to the dorsal edge, which was particularly sharp in its caudal part. It lateral surface is somewhat convex and was convered by the external capsule, its medial surface was slightly concave and houses the pallidum, which was hard to demonstrate macroscopically. Viewed from transverse plane, putamen and caudate nucleus, internal capsule and external capsule rounded approximately circle plan.

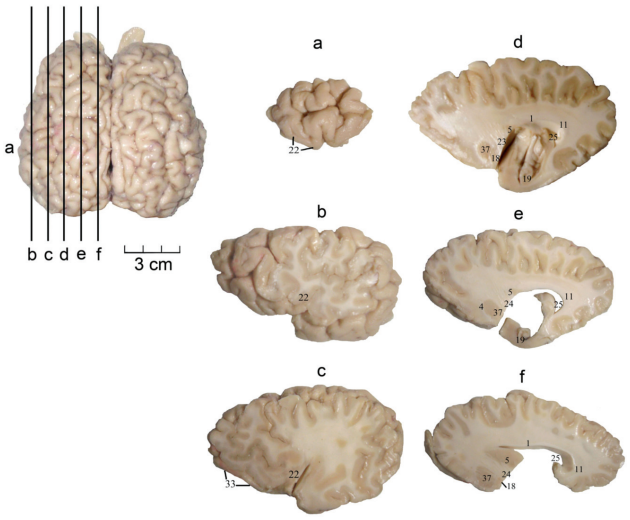


**Fig 2.** Parasagittal slices (a-f) of left cerebral hemisphere of bactrian camel brain. Key as for Fig. 1.

The pallidum was covered externally by putamen like a cap, was surrounded by fibres. The 2 nuclei were often referred to as the lentiform nucleus. The pallidum was the oldest part of the entire corpus striatum and was characterised by a large number of myelinated nerve fibres and diffusely distributed nerve cells.

### *Internal capsule and external capsule*

The internal capsule consisted of a relatively thick plate of fibres which connected the cortex with practically all other cerebral nuclei. After having passed through the corpus striatum or between the caudate nucleus and thalamus medially and the putamen laterally, the fibres of the internal capsule spread out in all directions into the cortex to form, together with the fibres of the corpus callosum is the coronal radiate. Both external and internal surfaces of the internal capsule were concave. It actually formed a laterally opening angle which was occupied by the putamen and pallidum and it separated the internal capsule into 3 distinct segments: the rostral or frontal part, the caudal part or occipital part and the genu of internal capsule.

The external capsule was a very thin lamella of white fibres which separated the claustrum and putamen. It was slightly convex laterally and concave medially and blended dorsally into the internal capsule. Ventrocaudal part of external capsule extended to pyriform lobe and was contained laterally to amygdaloid body.

### *Amygdaloid body*

It was an almond-shaped grey complex of several nuclei. It was situated lateroventrocaudally to lateral ventricle within the caudal part of the piriform lobe. The diameter of this nucleus was about one cm. This slightly curved nucleus was laterally related to the cortex, dorsally to the putamen and ventrally to the caudal part of the putamen and ventrally to the caudal part of the piriform lobe. The 3 main sub-divisions of the amygdaloid complex anterior amygdaloid area, corticomedial complex and basolateral nuclear group were ill-defined to the naked eye.

## Discussion

The basal nuclei are concerned primarily with somatic motor functions and related to the hypothalamus and limbic system as well as to the corpus striatum and cerebral cortex (Parent, 1996). Numerous studies over the last few years have demonstrated that basal nuclei and brain stem nuclei are involved in the pathophysiology of various neurological and neuropsychiatric disorders (Martino *et al*, 2008; Grahn *et al*, 2008). Nieto *et al* (1978) reported the caudate nucleus of different mammals including rat, rabbit, cat, zebra, deer, antelope, bull, horse, dolphin (*Stenella graffmani*) and human. A linear regression coefficient is obtained with its corresponding correlation coefficient. They indicated that there was not a close correlation between the size of the caudate nucleus and the brain weight of the different animals studied. The caudate nucleus of the horse is extremely large in relation to its brain weight. In our study, the caudate nucleus of bactrian camel is also largest nucleus among basal nuclei to the naked eye.

According to Humphrey (1968) and Johnston (1923), the amygdale consists of 2 main nuclear groups: the corticomplex, being phylogenetically older, is partitioned into: the central, medial nuclei, cotical amygdalohippocampal area, nucleus of the lateral olfactory tract, bed nucleus of accessory olfactory tract and amygdalopiriform cortex. On the other hand, the phylogenetically younger basolateral complex is divided into the basal and lateral nuclei. There are other amygdaloid areas such as the anterior amygdaloid area and intercalated masses. The morphology and subdivision of the amygdaloid complex in many species have been studied e.g. the rat, mouse (Turner, 1981), aquirrel, guinea pig (Uchida, 1950a), hamster (Unchida, 1950b), cat, rabbit (Hanna *et al*, 2001), dog, monkey (Unchida, 1950b) and human (Humphrey, 1972; Millhouse and DeOlmos, 1983). Seiya (2008) considered that the amygdaloid complex of Ungulata is not so well developed in comparison with that of Carnivora, but a more or less high degree of differentiation than in rodents. This study revealed the amygdaloid body that contour is slender and ill-defined and needs further study.

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