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The arterial supply of the eye of the yak (*Bos Grunniens*)

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Abstract

The heads and necks of 10 yaks were dissected to study the arterial supply to the eye of the yak in the Qinghai-Tibetan Plateau. The supply came from the internal ophthalmic, external eight ophthalmic, superficial temporal and malar arteries. The internal ophthalmic was one of sources of the posterior long ciliary artery. The external ophthalmic artery gave rise to branches to supply the dorsal oblique muscle and otherwise, and to take part in the formation of the ophthalmic rete mirabile. The ophthalmic rete mirabile gave off many branches to supply the rectus muscles of the eye and otherwise. The malar artery was one of the branches derived from the infraorbital artery, and its branches supplied the inferior, superior and third eyelids and otherwise. The superficial temporal artery detached off some branches to supply the lateral angle of the eye and otherwise, and anastomosed with the lacrimal artery of the ophthalmic rete mirabile.

Keywords: Yak; Eye; Arterial supply; Qinghai-Tibetan Plateau; Ophthalmic rete mirabile

1. Introduction

The yak (*Bos grunniens*) is an important domestic animal in some of the higher altitude areas of the world. It was firstly domesticated about 4000 years ago in China where there are now more than 13 million yaks, making up >90% of the world yak population. In the Qinghai-Tibetan Plateau, which is located about 3000–4700 m above sea level, the yaks provide a critical source of animal products such as meat, milk and hides, etc.

It is important to know the details of the arterial supply of the eye of the yak to explore the morphological characteristics of the plateau animal. The eye is the visual organ of the vertebrate, the visual system is the most important sensory path, and approximately 80% of the outer information enters brain through visual system. The yak can exist in the Qinghai-Tibetan Plateau there is higher altitude and less oxygen, the arterial supply of the eye plays an important role. So in studying the adaptability of the plateau animal, it is necessary to define the arterial supply to its eyes. Hideki et al. (2003) studied the blood supply to the retina and the lens in the gerbil of both sexes from infancy to maturity. Wang (2002) studied the arterial supply to the eye of the Bactrian camel. Kanan (1972) observed the distribution of the external and internal ophthalmic arteries in dromedary camel. Smuts and Bezuidenhout (1987) described some arteries that supply the eye of the dromedary camel. Godinho and Getty (1975) described some arteries that supply to the eye of the oxen.

No reports describing the arterial supply to the eye in the yak have been published. The aim of the present study was to describe the origin, course and branches of the arteries that supply to the eye in the yak and to provide a morphological basis for further research on the adaptability of the plateau animal, the comparative anatomy of the vertebrate and the related clinical surgery of this domestic animal.

2. Materials and methods

Ten heads (cut above the second cervical vertebra) from adult yaks were collected from the Second Yak Slaughterhouse, Datong, Qinghai, China, after the animals had been

Abbreviation: A, arteria.

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killed by exsanguination for food. The specimens were fixed within 24 h of death by infusing them with 10% formalin through the common carotid artery. After the specimens had been fixed for five to seven days, the specimens were then colored by injecting a solution of the red oils in ether (15:1) into the common carotid artery. All the animals were adults, but the sex and weight were not recorded. After again the specimens had been stored for one week, both sides of each specimen were carefully dissected to observe the origin, course, situations arrangements and branches of the arteries supply to the eye, following the procedures described by Xie (1987), Li (1995) and Godinho and Getty (1975).

3. Results

The arterial supply of the eye of the yak came from the internal ophthalmic, external ophthalmic, superficial temporal and malar arteries.

3.1. Internal ophthalmic artery

The internal ophthalmic artery (Fig. 1) arose as a branch of the rete chiasmaticum. The artery left the rostral epidural rete mirabile near the optic foramen and accompanied the optic nerve ventrally in the orbital fossa, where it joined with the branches of the external ophthalmic artery. The communicating branch was as a source of the posterior long ciliary artery (*A. ciliaris longus posterioris lateralis*).

3.2. External ophthalmic artery (*A. ophthalmica externa*)

The external ophthalmic artery (Figs. 1–3) arose from the dorsal wall of the maxillary artery following the origin of the buccal artery, at the level of the foramen orbitorotundun (Fig. 1). It crossed the maxillary nerve laterally

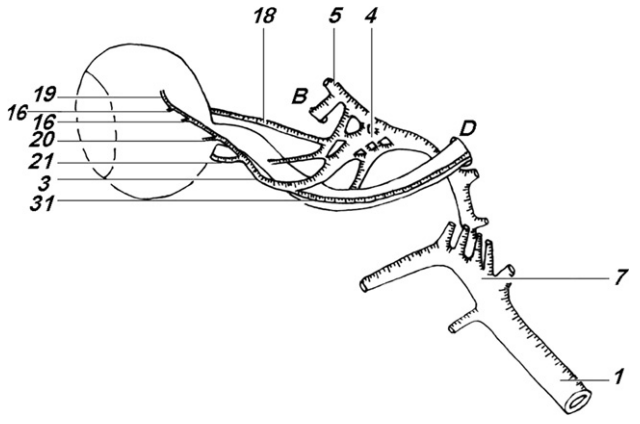

Fig. 1. Arterial blood supply to the right eye of the yak: medial view. D. Orbito-round foramen: (1) Carotid artery; (3) External ophthalmic artery; (4) Ophthalmic rete mirabile; (5) Supraorbital artery; (7) Maxillary artery; (16) Posterior short ciliary artery; (18) Lacrimal artery; (19) Medial posterior long ciliary artery; (20) Central retinal artery; (21) Lateral posterior long ciliary artery; (31) Internal ophthalmic artery.

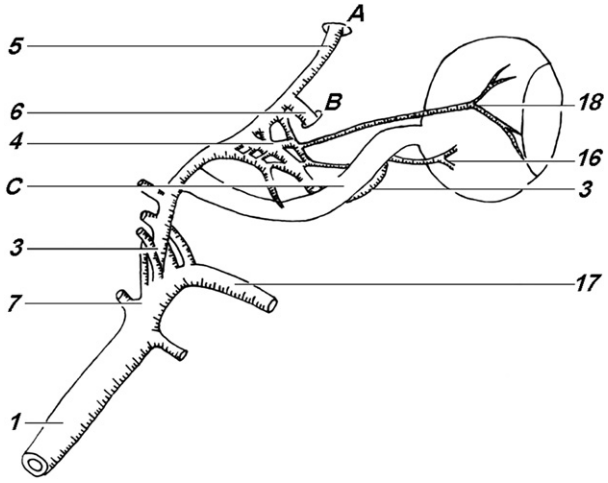

Fig. 2. Arterial blood supply to the right eye of the yak; lateral view. A. Supraorbital canal; B. Ethmoidal foramen and C. Optic nerve: (1) Carotid artery; (3) External ophthalmic artery; (4) Ophthalmic rete mirabile; (5) Supraorbital artery; (6) External ethmoidal artery; (7) Maxillary artery; (16) Posterior short ciliary artery; (17) Buccal artery; (18) Lacrimal artery.

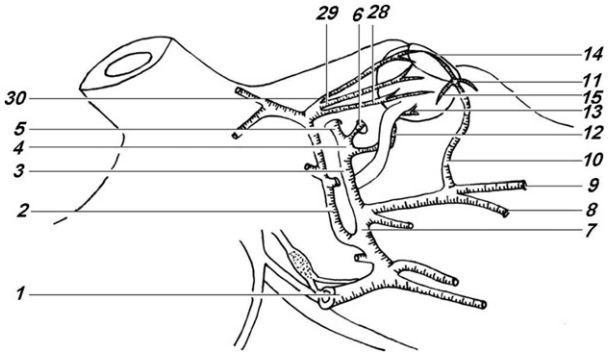

Fig. 3. The deep arterial blood supply to the right eye of the yak; lateral view: (1) Carotid artery; (2) Superficial temporal artery; (3) External ophthalmic artery; (4) Ophthalmic rete mirabile; (5) Supraorbital artery; (6) External ethmoidal artery; (7) Maxillary artery; (8) Descending palatine artery; (9) Infraorbital artery; (10) Malar artery; (11) Third palpebral artery; (12) External ophthalmic artery; (13) Medial posterior long ciliary artery; (14) Medial superior palpebral artery; (15) Medial inferior palpebral artery; (28) Lateral inferior palpebral artery; (29) Lacrimal branch; (30) Lateral superior palpebral artery.

and entered the apex of the periorbita, where it gave off three branches, one entered the orbit with the ophthalmic nerve to form the ophthalmic rete mirabile, and the others took part in the formation of the rostral epidural rete (Figs. 1 and 2). From the ophthalmic rete mirabile arose to a common trunk for the supraorbital and external ethmoidal arteries (Figs. 1–3). After traversed the supraorbital canal, the supraorbital artery (*A. supraorbitalis*) do not gave off any branches in the orbit, and supplied the mucous membrane of the frontal sinus and the musculature and skin lied on the surface of the frontal bone directly (Figs. 1 and 2). The external ethmoidal artery (*A. ethmoidalis externa*) was the continuation of the external ophthalmic, which left the orbit through the ethmoidal foramen and entered the