Brain is the most vulnerable organ in the body and even the slightest interference in its circulation can produce profound disturbances. Occlusion of the cerebral vessels due to embolism may result from fragments of blood clots, fat, and air bubbles. Haemorrhage in the brain or meninges may result from pathological changes in cerebral vessels. The topographic anatomy of the blood vessels of brain is also essential for surgeons, clinicians, pathologists and radiologists to locate the occlusions of the blood vessels due to traumatic injuries and any disease conditions like tumors, blood clot or embolism. Keeping in view the significance of the vascular architecture of the brain in goat, the present study was planned.

MATERIALS AND METHODS

The study was conducted on five adult goat heads based on the radiological observations followed by gross and sub-gross dissections. The blood supply to the brain of goat was carried by rete mirabile cerebrale which was formed by the three or four anterior meningeal arteries, two or three middle meningeal arteries, posterior meningeal artery and cerebro-spinal artery. The branches from middle part of the rete gave rose to a single trunk on either side, which emerged from the rete as emergent artery, which divided into cranial and caudal primary branches. The cranial primary branch gave origin to the middle cerebral artery and continued as cranial cerebral artery. The two cranial cerebral arteries communicated with each other by means of a small communicating branch. The caudal primary branch traversed backward gave rise to the caudal cerebral artery and cranial cerebellar artery. Then it continued inward and at the median line joined the corresponding branch of the opposite side to form the basilar artery. This union of cranial primary branches and caudal primary branches of opposite side formed a complete circle termed as "circle of Willis". The basilar artery supplied blood to pons and medulla oblongata and then continued as ventral spinal artery in the ventral median fissure of the spinal cord.

Key words: Brain, Circle of Willis, Goat, Rete mirabile cerebrale

RESULTS AND DISCUSSION

The blood supply to the brain in goat was carried through a specialized structure, the rete mirabile cerebrale. The Present study revealed that three or four cranial meningeal arteries which arose from the internal maxillary artery about one cm. anterior to the ophthalmic artery and entered the cranial cavity through the foramen orbito-rotundum. The middle meningeal artery also arose from the internal maxillary artery and entered the cranial cavity through the foramen ovale. The posterior meningeal artery arose from the occipital artery and entered the cranial cavity through the foramen lacerum. The
The cranial cerebral arteries of the other side were connected with each other and inward and in front of the optic chiasma, the two cranial hemisphere. The cranial cerebral artery coursed forward and divided into branches on the lateral aspect of cerebral hemisphere. The middle cerebral artery curved outward and backward, crossed the trigeminal nerve and then detached the cranial cerebellar artery which supplied the cranial part of cerebellum (Figs. 3, 5, 6). The caudal primary branches of opposite sides then continued further inward and anastomosed with each other just in front of pons to form the basilar artery (Figs. 3, 4, 5, 6). This arterial circle which was formed on the ventral aspect of the brain was termed "circle of Willis". The formation of circle of Willis has been reported earlier in goat, sheep and pig (Ashwini et al., 2008), ox (Raghavan, 1964). This arterial circle has been named as "circulus arteriosus" or "polygon of Willis". The circulus arteriosus cerebri in camel received blood supply from the cerebral carotid artery and the basilar artery (Ocal et al., 1999) and in yak circulus arteriosus cerebri was formed by the internal carotid, maxillary, occipital and vertebral arteries (Ding et al., 2007).

The basilar artery which resulted from the anastomoses of the two caudal primary branches of the corresponding sides coursed backward in the central depression of pons and during this course, it detached five or six fine lateral branches on either side of pons which supplied blood to the pons. It then traversed backward in the ventral longitudinal fissure of medulla oblongata and continued along the ventral median fissure of the spinal cord as ventral spinal artery (Figs. 3, 5, 6). The basilar artery before passing into the ventral median fissure of the medulla oblongata gave off a pair of caudal cerebellar arteries close to the origin of seventh and eighth cranial nerves (Figs. 3, 5, 6). As the basilar artery coursed backward in the ventral median fissure of medulla oblongata it detached five or six medullary branches on either side to supply blood to the medulla oblongata (Figs. 3, 5, 6) and then continued in the ventral median fissure of spinal cord as ventral spinal artery. Similar finding has been reported in ox (Raghavan, 1964). However in camel, the basilar artery was formed by the vertebral and spinal arteries of each side (Ocal et al., 1999).
1. Photograph of ventral view of brain of goat showing the rete mirabile cerebrale (a), vessels of duramen (b), olfactory bulb (c), optic chiasma (d), pituitary gland (e), pons (f), medulla oblongata (g); 2. Photo-arteriograph of ventro-dorsal view of brain showing rete mirabile cerebrale (a); 3. Photograph of ventral view of brain showing the "Circle of Willis" and its branches. Note: internal carotid artery (a), middle cerebral artery (b), posterior cerebral artery (c), cranial cerebral artery (e), middle cerebral artery (f), basilar artery (j), pontine branches (k), medullary branches (l).

4. Photo-arteriograph of ventro-dorsal view of brain showing the "Circle of Willis". Note internal carotid artery (a), middle cerebral artery (b), cranial cerebral artery (c), posterior cerebral artery (d), pontine branches (h), medullary branches (i); 5. Line-diagram showing the "Circle of Willis". Note internal carotid artery (a), anterior cerebral artery (b), middle cerebral artery (c), posterior cerebral artery (d), basilar artery (d), pontine branches (f), medullary branches (g); 6. Line-diagram showing branching pattern of the "Circle of Willis". Note internal carotid artery (a), anterior cerebral artery (b), middle cerebral artery (c), posterior cerebral artery (d), pontine branches (e), medullary branches (f), basilar artery (g).

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