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SOME ANATOMICAL STUDIES ON THE OCULOMOTOR AND ABDUCENT NERVES IN THE EGYPTIAN BUFFALO

(With 4 Figures)

By

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بعض الدراسات التشريحية على العصب محرك المقلة والعقدة الهدبية والعصب المبعد في الجاموس المصرى

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أجرى هذا البحث على سبعة عشر من رؤوس الجاموس فى مصر مختلفة الأعمار والجنس منها ثلاثة عشر أستخدمت للدراسة التشريحية والأربعة الأخرى للدراسة الهستولوجية ومن أهم النتائج : أن العصب محرك المقلة خلال خروجه من التجويف القحفى عن طريق الثقب الحجابى المستدير ينقسم إلى فرعين ، فرع ظهرى يمد كل من العضلة المستقيمة الظهرية لمقلة العين ورافعه الجفن العلوية · أما الفرع البطنى فيمد كل من العضلات المستقيمة الأنسية والبطنية والمنحرفة البطنية هذا وقد تم تحديد وجود وكذلك التركيب الهستولوجى للعقدة العصبية الهدبية فى الجاموس · أما العصب المبعد لمقلة العين فقد أشارت النتائج إلى أنه يخرج من التجويف القحفى خلال الثقب الحجابى المستدير وبعد كل من العضلة المستقيمة الوحشية والمرجعة لمقلة العين · هذا وقد تمت مناقشة النتائج مع مثيلاتها فى الحيوانات المتأنسة الأخرى ·

SUMMARY

The oculomotor nerve arises from the ventral aspect of the cerebral crus by three bundles. It pierces the dura mater and passes through the foramen orbitorotundum dividing into R. dorsalis and R. ventralis. The former innervates Mm. rectus dorsalis and levator palpebrae superioris while the latter supplies Mm. rectus medialis and obliquus ventralis. The abducent nerve springs from the rostral portion of the ventral lateral sulcus of the medulla oblongata by two bundles. It emerges via the foramen orbitorotundum then divides into two branches supply Mm. retractor bulbi and rectus lateralis.

INTRODUCTION

The buffalo is an important domestic animal in Egypt. This is greatly due to its economic value concerning the meat and milk production. The available literature on the anatomy of the cranial nerves of the buffalo especially the oculomotor and abducent nerves is very meagre. The present investigation was carried out to obtain a detailed and sufficient anatomical description for these nerves.

MATERIAL and METHODS

The present study was carried out on thirteen heads of Egyptian buffalos of different sex and age. The heads were preserved in 10% formalin solution. To confirm the anatomical finding concerning the position of the ciliary ganglion, another four heads were used. The specimens were taken from the ciliary ganglion, immediately after slaughtering the animals. They were fixed in 10% neutral formalin, dehydrated in ascending grades of alcohol, cleared in xylene and embeded in paraffin wax. Sections of 5-7 U were obtained and stained with haemaloxylin and eosin (DRURY and WALLINGTON, 1980).

The nomenclature used in this investigation was that adopted by N.A.V. (1983).

RESULTS

N. oculomotorius :

The oculomotor nerve (1/1, 2/1) arises from the ventral aspect of the cerebral crus by three bundles, each of them is formed from 3-4 rootlets. It pierces the dura mater and courses in a dural sheath along the dorsal wall of the cavernous sinus and passes through the foramen orbitorotundum with the abducent, trochlear, maxillary and ophthalmic nerves where it divides into R. dorsalis and R. ventralis. In three dissected cases, the oculomotor nerve divided just at its emergence from the foramen orbitorotundum.

R. dorsalis :

The dorsal branch (1/3, 2/5) runs rostrodorsally in a dorsolateral relation to the nasociliary nerve to reach the caudal portion of the M. rectus dorsalis where it divides into 3-5 twigs which innervate the latter muscle. One or two of these twigs penetrate the M. rectus dorsalis to innervate the M. levator palpebrae superioris.

In two dissected specimens, another twigs arose from the oculomotor nerve before its termination and passed along the nasociliary nerve to end in the M. rectus dorsalis.

R. ventralis :

The ventral branch (1/4, 2/6) passes in the orbital cavity ventral to the caudal portion of the M. rectus dorsalis for about 1 cm. where it is related medially to the nasociliary nerve. It continues its course between the M. retractor bulbi laterally and optic nerve medially. It then runs obliquely in a lateral direction on the deep face

of the M. rectus ventralis to gain at first its lateral border then its ventral surface ending in the M. obliquus ventralis. At the middle of the lateral border of the M. rectus ventralis, the R. ventralis of N. oculomotrius receives a communicating branch from N. maxillaris.

In two specimens, the R. ventralis penetrated the deep surface of the M. rectus ventralis continued rostrad to end in M. obliquus ventralis.

Along its course, the R. ventralis gives off the following branches:

A large muscular branch to M. rectus medialis (1/5):

It springs from the R. ventralis at a distance of 2-4 cm. from the foramen orbitorotundum. It pases rostromedially below the optic nerve to distribute by 3-5 twigs in the deep surface of the caudal third of the M. rectus medialis.

Muscular branch to M. rectus ventralis (2/8):

It is given off at about 0.5 cm. after the preceeding one. In one specimen, it arose at the same level of origin of the R. muscularis to M. rectus medialis and in three cases it was detached separately. It runs for about 3 mm. on the deep surface of M. rectus ventralis where it divides into 3-4 twigs that enter the muscle at its middle third innervating it.

Radix oculomotoria of ganglion ciliare :

The motor root of the ciliary ganglion (2/7, 4/6) arises at the same level of origin of R. muscularis to M. rectus ventralis. In three cases, it originated after the last mentioned branch by a distance of 0.5 cm. It extends rostrad to the caudal aspect of the ciliary ganglion.

Ganglion ciliare :

The ciliary ganglion (1/6, 2/9) is a small nodular structure situated between the ventrolateral aspect of the optic nerve and M. retractor bulbi at a level of 4-6 cm. from the foramen orbitorotundum. It receives the R. communicans cum ganglion ciliare (2/11), radix oculomotoria and sympathetic filaments. The former is a branch from the nasociliary nerve which passes along the R. ventralis of N. oculomotorius and enters the caudal aspect of the ganglion.

The sympathetic filaments are given off the internal carotid nerve and pass with the oculomotor nerve during its course on the cavernous sinus. The filaments extend with the radix oculomotoria to the ganglion. From the rostral end of the ganglion, 2-3 short ciliary nerves (2/10) are given off which runs rotrad along the lateral aspect of the optic nerve to pierce the sclera under cover of the M. retractor bulbi dorsolateral to the optic nerve and supply the muscles of the iris, cornea and ciliary body.

The histological sections showed that the ciliary ganglion is covered by connective tissue capsule and presents numerous scattared multipolar nerve cells and unmyelinated

nerve fibers (Fig. 3 & 4). The nerve cells is surrounded by incomplete capsule of satellite cells (Fig. 4).

N. abducens :

The abducent nerve (1/2, 2/2) arises from the rostral portion of the ventral lateral sulcus of the medulla oblongata by two bundles at the level of the trapezoid body and caudal to the pons. Each bundle consists of 3-4 rootlets.

The nerve passes laterally on the trapezoid body for about 0.5 cm. and pierces the dura mater at the caudal border of the pons. It passes through the dorsal portion of the cavernous sinus and rete mirabile epidurale rostrale where it receives sympathetic filaments from the internal carotid nerve. In this course, it is related externally and ventrally to the oculomotor nerve and to the ophthalmic and maxillary divisions of N. trigeminus medially. Then it emerges from the cranium through the foramen orbitorotundum ventral to the R. ventralis of N. oculomotorius and medial to N. ophthalmicus. In the orbit, the abducent nerve passes rostrally for about 1.5 cm. ventral to the nasociliary nerve then it divides into two unequal branches. The smaller branch runs rostrodorsally on the origin of the M. retractor bulbi for 3 cm. where it divides into branches which in turn give off several twigs to the mentioned muscle. The large branch constitutes the continuation of the abducent nerve, extends rostrally along the dorsal border of the M. rectus lateralis for about 3 cm. and curves inward to distribute by 3-4 twigs in the caudal half of the deep surface of the muscle.

In one exceptional case, two small twigs arose from the large branch of N. abducens and supply M. retractor bulbi.

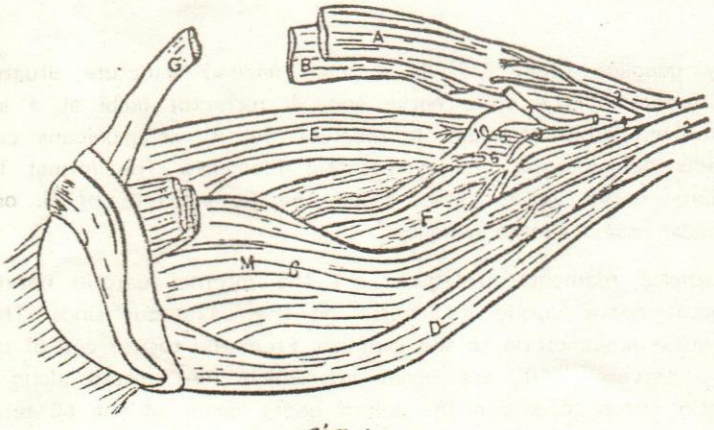
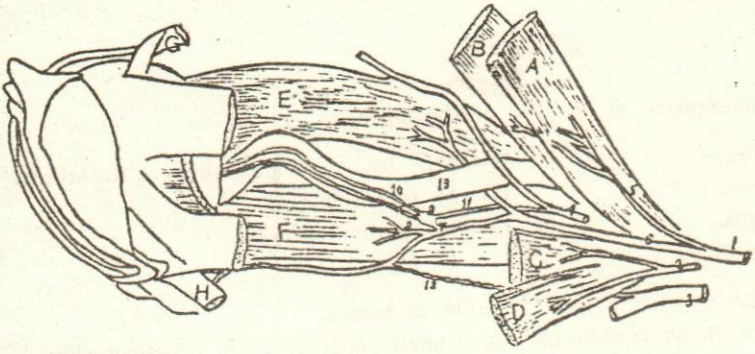


Fig 1

OCULOMOTOR, ABDUCENT NERVES, BUFFALO



Fig(2)

Fig (3)

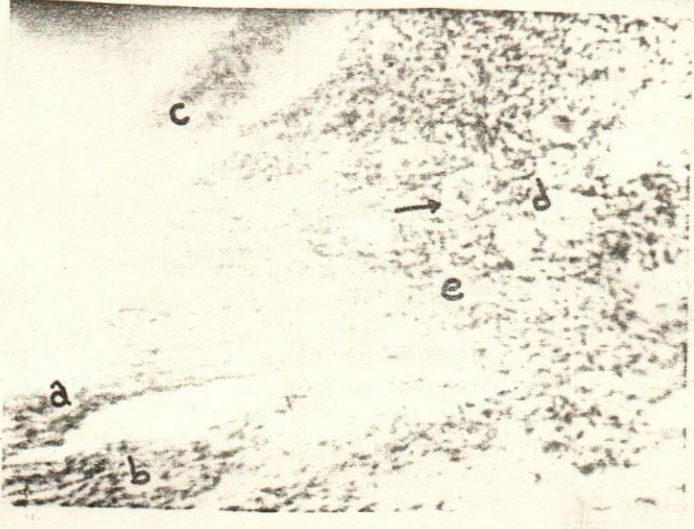


Fig. (4)

LEGNDS

Fig. (1): A diagramatic illustration of the eye of the buffalo:

A- M. rectus dorsalis.
B- M. levator palpebrae superioris.
C- M. retractor bulbi.
D- M. rectus lateralis
E- M. rectus medialis.
F- M. rectus ventralis.
G- M. obliquus dorsalis.

1. N. oculomotorius.
2. N. abducens.
3. Ramus dorsalis of N. oculomotorius.
4. Ramus ventralis of N. oculomotorius.
5. Muscular branch to rectus medialis.
6. Ganglion ciliare.
7. N. nasociliaris.
8. Nn. ciliares breves.
9. Ramus communicans cum ganglion ciliare.
10. N. opticus.

Fig. (2): A diagramatic illustration of the eye of the buffalo.

A- M.rectus dorsalis.
B- M. levator palpebrae superioris.
C- M. retractor bulbi.
D- M. rectus lateralis.
E- M. rectus medialis.
F- M. rectus ventralis.
G- M. obliquus dorsalis.
H- M. obliquus ventralis.

1. N. oculomotorius.
2. N. abducens.
3. N. maxillaris.
4. N. nasociliaris.
5. R. dorsalis of N. oculomotorius.
6. R. ventralis of N. oculomotorius.
7. Radix oculomotoria.
8. Muscular branch to M. rectus ventralis.
9. Ganglion ciliare.
10. Nn. ciliares breves.
11. R. communicans cum ganglion ciliare.
12. Communication between N. maxillaris and R. ventralis of N. oculomotorius.
13. N. opticus.

Fig. (3): Paraffin section in ciliary ganglion of buffalo showing:

A- Connective tissue capsule
B- Multipolar nerve cells.
C- Stromal cells.

H & E stain x 40.

Fig. (4): Paraffin section in ciliary ganglion of buffalo showing:

A- Sensory root of nasociliary nerve.
B- Radix oculomotoria of the ventral branch of oculomotor nerve.
C- Connective tissue capsule.
D- Multipolar nerve clls.
E- Stromal cells.

Note the capsular cells (Satellite cells) arrow H & E stain x-100.

DISCUSSION

The present investigation shows that the origin of the oculomotor nerve from the cerebral crus in Egyptian buffalo is similar to that given by RAGHAVAN and KACHROO (1964) in OX and MAY (1970) in sheep, however GODINHO and GETTY (1975) in ruminants and SOLIMAN (1982) and FATH EL-BAB et al. (1984) in camel rcordec the origin of the nerve to be from the intercrural fossa.

The oculomotor nerve arises by three bundles, each of them is formed of 3-4 fibers. It arises by several rootlets in bovine and ovine (GODINHO and GETTY, 1975) and by 5 roots in camel (ABD EL-MONEIM, 1980 and FATH EL-BAB et al., 1985). The N. oculomotorius in the present work passes in a dural sheath along the dorsal wall of the cavernous sinus simulating that of goat (GODINHO and GETTY, 1975) and camel (SOLIMAN, 1982 and FATH EL-BAB et al., 1984) in contrast, it runs through the cavernous sinus in ox and pig (GODINHO and GETTY, 1975).

The oculomotor nerve in buffalo is found to emerge through the foramen orbitorotundum similar to that observed by PETERSON (1951) and DIESEM (1968) in ox, SISSON and GROSSMAN (1968) in ovine and caprine, EL-SHAIEB et al. (1978) in camel while in horse, it emerges through the orbital fissure (SISSON and GROSSMAN, 1968). The obtained results revealed that the oculomotor nerve divides into R. dorsalis and R. ventralis within the orbitorotundum formen, DIESM (1968) in ox, TAYEB (1957) in camel and SEIFERLE (1984) in different domesticated animals observed this division immediately after the nerve leaves the cranial cavity.

According to GODINHO and GETTY (1975) and SEIFERIE (1984) in domestic animals and SOLIMAN (1982) and FATH EL-BAB et al. (1984) in camel, the R. dorsalis or N. oculomotorius in the present investigation supplies the M. rectus dorsalis and levator palpebrae superioris while the R. ventralis distributes in the Mm. rectus medialis, rectus ventralis and obliquus ventralis and gives off a small motor branch to the ciliary ganglion. The ventral branch of the oculomotor nerve in Egyptian buffalo receives a communicating branch from N. maxillaris, a condition which was also recorded in the rumimants by GODINHO and GETTY (1975).

The ciliary ganglion in the present work is found on the ventrolateral aspect of the optic nerve similar to that described in the camel by ABD EL-MONEIM (1980), FATH EL-BAB et al. (1984) and SOLIMAN (1982). On the other hand, EL-MAHDY (1985) in bufalo and DIESEM (1975) in ox stated that the ciliary ganglion is firmly attached to the R. ventralis of N. oculomotorius. The formation and branches of the ciliary ganglion in the present investigation are in a line with that described in different domesticated animals by GODINHO and GETTY (1975) and SEIFERLE (1984).

The origin of the N. abducens in the Egyptian buffalo resembles that described in ox, pig and horse by SISSON and GROSSMAN (1968). However, MAY (1970) in sheep recorded that the nerve arises from lower border of the pons, while ABD EL-MONEIM (1980) and SOLIMAN (1982) in the camel described its origin from the corpus trapezodium.

In the present work, the abducent nerve courses through the cavernous sinus and rete mirabile epidurale rostrale similar to that given in ruminants by GODINHO and GETTY (1975) and in camel by SOLIMAN (1982) and FATH EL-BAB et al. (1984).

Within the cavernous sinus, the abducent nerve receives a sympathetic filament from the internal carotid plexus a case which was also recorded by GODINHO and GETTY (1975) in ovine, caprine and swine and SEIFERLE (1984) in ruminants.

In agreement with SISSON and GROSSMAN (1968) in ruminants and SOLIMAN (1982) in camel, the N. abducens in the Egyptian bufflo leaves the cranium through the foramen orbitorotundum.

According to SISSON and GROSSMAN (1968) and SEIFERLE (1984) in domestic animals, the N. abducens in the present work supplies the Mm. retractor bulbi and rectus lateralis. However, GODINHO and GETTY (1975) reported in pig that in 5% of the cases, the abducent nerve also supplied M. rectus ventralis.

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