On the fasciculus longitudinalis medialis in the brain of *Mugil cephalus**

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With 10 figures

I. Introduction

In the piscian brain, the fasciculus longitudinalis medialis is a complicated system of fibers, chiefly descending, connecting the deeper areas of gray between the mesencephalon and the spinal cord. Furthermore, the fibers from the brachium conjunctivum, the several tegmental fascicles, the tractus cerebello-et octavo-motorius anterior adjoin to this fasciculus (Goldstein, '05, Sheldon, '12, Burr, '28, Ariëns Kappers, '21, '36 and others). Some of the descending fibers which originate in the telencephalon may come into the synaptic relation with cells of origin of the medial longitudinal fasciculus (Sheldon, '12), through which bundle impulses from the olfactory centres of the telencephalon are transmitted to the efferent centres of the medulla oblongata and the spinal cord (Ariëns Kappers, '36). The nucleus of the fasciculus longitudinalis medialis which lies in the ventricular eminence of the peduncle comes into synaptic relation with cells of the oculomotor nucleus (Beccari, '12, '31), the giant fibers of Mauthner's cell (Bartelmez, '15) and also with large cells in the region ventral and ventrolateral to the medial longitudinal fasciculus (Franz, '12, Holmgren, '20, Burr, '28).

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Nevertheless, the relation of the nucleus of the fasciculus longitudinalis medialis with other efferent centres of the medulla oblongata and the synopsis of the fiber constitution of this fasciculus require further investigation.

II. Material and Methods

For this purpose, the adult brains of *Mugil cephalus* were employed. After completely fixed with 20% neutral formalin, they are cut transversally, sagittally and horizontally (ca. 15μ in thickness). These serial preparations were treated with Pal-carmin deying, Sugamo's method, Bielschowsky's pyridin silver impregnation.

III. Findings

In horizontal series, the nucleus of the medial longitudinal fasciculus¹⁾ is present rostral to the nucleus oculomotorius along the ventricular eminence and the latter nucleus receives collaterals and terminal fibers from the medial longitudinal fasciculus (Fig. 1). A few of fibers from this fasciculus run ventromedially to decussate at the midline, while the majority of its fibers pass through the oculomotor nucleus to elongate caudalward.

Tracing more ventrally, the fibers from the commissura posterior adjoin to this fasciculus. The reticular cells near the oculomotor nucleus which has been termed the nucleus interstitialis may have a synaptic relation with this fasciculus (Fig. 2). Burr ('28) did find a midline cell group extending from the medial longitudinal fasciculus to the ventral surface of the brain. In this section, numerous fine fibers from the tuber posterior enter this fasciculus. Tracing more ventrally, the well-myelinated fibers of the tractus praetecto-spinalis elongate spinalward to join this fasciculus after crossed at the midline (Fig. 3).

Tracing more ventrally, the fasciculus longitudinalis medialis receives numerous neuraxes of the reticular cells which suggested by Burr ('28) as a "generalized ancestor of the olive". The region of termination of the neuraxes of the small cells of the more frontal

1) The nucleus of the medial longitudinal fasciculus may be homogenous to the nucleus of Darkschewitsch, after called the nucleus of the posterior commissure in the mammalian brain (cf. Ranson, '49, p. 185).

reticular groups is not definitely ascertained as indicated by Ariëns Kappers ('36). It has been said that the nucleus reticularis mesencephali¹⁾ contributes fibers to the posterior commissure. This matter, however, requires further investigation.

In sagittal series, cells of the nucleus of fasciculus longitudinalis medialis lies in front of the oculomotor nucleus and are densely arranged being surrounded with fiber neuropil (Fig. 4). In this section, a few of fibers derived from the commissura posterior stream into the neuropil of this commissure. Tracing more medially, the majority of this fasciculus extend caudally along the ventricular margin passing through the oculomotor nucleus and the fibers of the latter nucleus adjoin to this fasciculus. The oculomotor nucleus²⁾ especially the dorsolateral nucleus of oculomotor also receives collaterals and terminal fibers from the medial longitudinal fasciculus, apparently arising from nuclei of the vestibular nerves, as indicated by Beccari ('31) (Fig. 5). A few of fibers from the nucleus trochlearis also run into this fasciculus (Fig. 6).

The ascending fibers arose from the ventricular nuclei terminate in the dorsolateral part of the oculomotor nucleus (Fig. 7), the abducens nucleus (Fig. 8) and feebly in the trochlear nucleus (Fig. 9). The latter nucleus is situated further caudal to the oculomotor nucleus in the ventricular eminence, having an indirect relation with this fasciculus (Fig. 10), contrary to the description of Ariëns Kappers, Huber and Crosby ('36)³⁾ in cyclostomes.

In the entire length of the fasciculus longitudinalis medialis, the synaptic relation with this fasciculus and the nucleus reticularis mesencephali and the large and small reticular cells of the brain stem and the medulla oblongata can be estimated. In this specimens, however, the Mauthner's cells are ill-developed, so that it is scarcely

1) Jansen ('30) found that in *Myxine* the laterodorsal neurons of the nucleus reticularis mesencephali send large dendrites in a dorsal direction to intermingle with the posterior commissure fibers (cf. Ariëns Kappers, Huber and Crosby '36, p. 648).

2) Cf. Ariëns Kappers, Huber and Crosby ('36, p. 526): The oculomotor nuclear gray may be divided into three nuclear groups (Tretjakoff, '09) in *Ammocoetes* a ventral nucleus giving rise to crossed fibers, a dorsal and lateral nucleus sending homolateral fibers.

3) Cf. Ariëns Kappers, Huber and Crosby ('36, p. 627): Both the trochlear and the oculomotor nuclei lie in very close relation to the medial longitudinal fasciculus, through which they are interrelated with other efferent nuclei of the brain stem (particularly with the nucleus of the abducens nerve) and with the vestibular centres.

distinguished from large reticular cells of the medulla oblongata.

IV. Concluding remarks

In general, the fasciculus longitudinalis medialis in the piscian brain is a remarkable compact bundle of fibers extending from a point near the rostral border of the mesencephalon to the rostral segments of the spinal cord, where it is continuous with the anterior fasciculus proprius as shown in mammalian brains and physiologically, this fasciculus is especially concerned with the reflex control of the movement of the body and eye musculatures. In its entire course, this fasciculus has respectively a synaptic relation with the oculomotor, trochlear and the abducens nuclei. Furthermore, a large proportion of its fibers are derived from the vestibular nuclei. In cephalad course of this fasciculus, the tractus praetecto-spinalis, the commissura posterior and the tractus vestibulo-cerebellaris stream into this fasciculus.

Furthermore, the fibers derived from the tegmental fascicles loosely join to the medial longitudinal fasciculus. The tractus cerebello-tegmentalis or brachium conjunctivum anterius which is regarded as a special derivative of the cerebello-motorius system partly terminate in the oculomotor nucleus, but the relation with this fasciculus is not well accomplished. The synaptic relation with the fasciculus longitudinalis medialis and the descending fibers originated in the telencephalon can scarcely be ascertained. The neuraxes of the nucleus interstitialis, the large and small cells of the nucleus reticularis respectively have a synaptic relation with this fasciculus. But it is uncertain whether the neuraxes of the rudiment sense and bipolar cells of the pineal gland terminate in the nucleus of origin of the medial longitudinal fasciculus or not as shown by Ariëns Kappers, Huber and Crosby ('36).

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VI. Abbreviation for all figures

ascend. f.....	ascending fibers
cb.....	cerebellum
com. ans.....	commissura ansulata
com. p.....	commissura posterior
fasc. long. l.....	fasciculus longitudinalis lateralis
fasc. long. m.....	fasciculus longitudinalis medialis
fasc. retrofl.....	fasciculus retroflexus
interped.....	interpeduncle
nuc. d. l. nuc. III.....	nucleus dorso-lateralis of nucleus oculomotorius
nuc. fasc. long. m.....	nucleus of fasciculus longitudinalis medialis
nuc. interst.....	nucleus interstitialis
nuc. III.....	nucleus oculomotorius
nuc. IV.....	nucleus trochlearis
nuc. VI.....	nucleus abducens
r. IV.....	root of trochlear nerve
reticl. c.....	reticular cells
tr. cb. teg.....	tractus cerebello-tegmentalis
tr. t. cb.....	tractus tecto-cerebellaris
tr. praet. sp.....	tractus praetecto-spinalis
valv. cb.....	valvula cerebelli
vel. m. a.....	velum medullare anterius
ventr.....	ventriculum
vest. lob.....	vestibular lobe

Fig. 1. Horizontal section passing through the nucleus of fasciculus longitudinalis medialis (Pal-carmin stained).

Fig. 2. Horizontal section passing through the commissura posterior (Sugamo's method).

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Fig. 3. Horizontal section passing through the decussation of fibers of the tractus praetecto-spinalis (Sugamo's method).

Fig. 4. Sagittal section passing through the nucleus of fasciculus longitudinalis medialis and the nucleus oculomotorius (Bielschowsky's pyridin silver method).

Fig. 5. Sagittal section passing through the nucleus oculomotorius (Bielschowsky's pyridin silver method).

Fig. 6. Sagittal section passing through the nucleus trochlearis (Bielschowsky's pyridin silver method).

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Fig. 7. Sagittal section passing through the nucleus oculomotorius (Bielschowsky's pyridin silver method).

Fig. 8. Sagittal section passing through the nucleus abducens (Bielschowsky's pyridin silver method).

Fig. 9. Sagittal section passing through the nucleus trochlearis
(Bielschowsky's pyridin silver method)

Fig. 10. Transverse section passing through the nucleus trochlearis
(Pal-carmin stained).

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