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Studies on the structure and localisation of the avian nervous centres. Motor nucleus of the facial nerve in goose (*Anser anser*)

SUMMARY

Badania nad budową i lokalizacją ptasich ośrodków nerwowych. Jądro ruchowe nerwu twarzowego u gęsi (*Anser anser*)

The aim of this study was morphological analysis of NMF in goose. Medullas taken from geese constituted the study material. The medullas were fixed in formalin, dehydrated in ethyl alcohol and embedded in paraffin. Thus prepared material was cut into 12 μm scrapes that were then placed on glass plates. Histological preparations were stained by Klüver and Barrera's method. The results were documented photographically.

NMF in goose is constituted by a small layer of nerve cells extending in the ventricular part of the medulla near its abdomino-lateral part. The average length of the nucleus is 0.768 ±0.027 mm (mean ±SD).

In its course, the NMF divides into two secondary groups: the bigger abdominal one, constituting 65% of the total and the smaller — dorsal one, constituting the rest. Basing on the analysis of the specific musculature of the face and the neck in goose and on the basis of formerly undertaken developmental investigation, one can say that the abdominal group is responsible for innervating the muscles around and above the eye, and the abdominal group — for neck muscles innervation.

STRESZCZENIE

Celem pracy była analiza morfologiczna jądra ruchowego nerwu twarzowego (NMF) gęsi. Materiał do badań stanowiły rdzenie przedłużone, które utrwalono w formalinie, odwodniono w kolejnych rozcieńczeniach alkoholu etylowego i zatopiono w parafinie. W ten sposób przygotowany materiał pokrojono na mikrotomie na skrawki o grubości 12 μm. Preparaty histologiczne barwiono metodą Klüvera i Barrery (5). Wyniki dokumentowano fotograficznie. NMF gęsi stanowi niewielkie pasmo komórek nerwowych ciągnące się w części komorowej rdzenia przedłużonego

w pobliżu jego brzuszno-bocznej krawędzi. Średnia długość jądra liczona na seryjnych przekrojach poprzecznych wyniosła 0,768 ±0,027 mm (średnia ± odchylenie standardowe). W swoim przebiegu jądro ulega rozczłonkowaniu na dwie grupy wtórne: większą, stanowiącą około 65% całości, grupę brzuszną oraz mniejszą grupę grzbietową. Na podstawie specyficznej budowy muskulatury twarzy i szyi gęsi oraz na podstawie przeprowadzonych wcześniej badań rozwojowych uznano, że grupa brzuszna odpowiada za unerwienie mięśni wokół i powyżej oka, grupa zaś brzuszna NMF stanowi źródło wyjścia włókien unerwiających ruchowo mięśnie szyi.

Key words: facial nerve, medulla oblongata, *Anser anser*

List of abbreviations: NMF — motor nucleus of the facial nerve; IV–IVth ventricle.

INTRODUCTION

The following study is the continuation of the research cycle concerned with the structure and the localisation of the avian nerve centers and mainly the structure and the localisation of XII pairs of the cranial nerves. The facial nerve (VIIth nerve) is a nerve of a mixed type with sensory--motor and parasympathetic character. So far, the research workers dealing with the morphology of nervous system structures have been focusing their interest on mammals and especially on domesticated species. In the recent years, however, we have observed an increased interest in nervous system structures in birds, which has resulted in recognition of most vital structures, which, in turn, allowed conducting comparative studies of avian nerve centers with analogical structures in mammals.

Facial nerve is responsible for the motor innervations of the skin muscles of the head, neck and expression muscles of the face. Its motor nuclei (nucleus motorius nervi facialis — NMF) have already been described in a detailed way in some of the domestic birds (1–4) and flamboyant birds (8). The aim of this study was a morphological analysis of NMF in goose, which would constitute a basis for further physiological and pharmacological studies. Such complex studies should definitely broaden the actual knowledge and add to better understanding of the causes, mechanisms and ways of treatment of clinical cases of facial nerve paralysis.

MATERIAL AND METHODS

The study material were 5 sexually mature geese (*Anser anser*). Their medullas were taken for examination. The material was fixed in 4% formalin and consecutively dehydrated in alcohol and embedded in parrafin. The medullas were cut into 12 μm scrapes and every second scrape was taken for further examination. The scrapes were placed on glass plates covered with albumin solution. The material was stained with cresyl violet according to Klüver and Barrera's method (5). The histological preparations obtained in this way were submitted to morphological analysis using OLYMPUS light microscope. The documentation was illustrated with black and white pictures.

RESULTS

NMF in goose presents itself as a small layer of nerve cells extending in the ventricular part of the medulla closely to its abdomino-lateral edge. As for the more precise localisation of nerve structures in this part of the medulla, the nuclei

of the bottom olive as well as the upper olive appear to be a good reference point. This is why in most studies concerned with NMF, the localization of the nucleus is described in relation to the nuclei of the olive. In goose, the posterior pole begins at the level of the end of the anterior nucleus of the upper olive while the anterior end reaches 1/4 of the anterior length of the nucleus of the upper olive. Only the anterior and posterior pole and the posterior 1/3 of the nucleus are constituted by a uniform group of the nerve cells, the rest being divided into two clearly visible secondary groups. The medium length of the NMF counted on serial transverse cross sections was 0.768 $\pm$0.027 (mean $\pm$SD) (Fig. 1).

Fig 1. NMF length in the studied geese

At the height of its posterior pole, NMF presents itself as a circular (at other sites — vertical-oval) group of dispersed oval or circular nerve cells of 25 to 35 μm size (Photo 4 and 5). In the observed cells, one can spot a clearly visible, centrally placed nucleus with its nucleolus and the dust-like tigroid evenly placed in the cytoplasm. In its further course, NMF is fragmented into two secondary groups: the larger abdominal one, constituting about 65% of the total and the smaller — dorsal group constituting the remaining part. The size of the cells and their shape does not display basic differences, only in individual transverse cross-sections, one can observe the presence of multi-polar medium sized (about 45 μm) cells.

NMF divided into two secondary groups extends to the anterior pole, where it once again turns into one uniform group of nerve cells. Both left and right NMF localised on both sides of the medulla do not point to any substantial differences as far as the course or the structure is concerned. In some transverse cross-sections, a specific ”compensation” of the sizes of NMF secondary groups is observable. In case when in some NMF, there occurs an increase in the

number of cells for one of the groups, in its analogical counterpart the decrease occurs.

DISCUSSION

NMF in goose is localised similarly as in other species of animals, in the front part of the medulla, just at its abdomino-lateral edge. Considering the localisation of NMF in relation to olive nuclei, one should say that it is comparable to the localization of NMF in hen (1) but differs a little as compared to the NMF in parrot (8) and pigeon (2) (Fig 2). Such a localisation of NMF results from the weak development of the bottom olive characteristic of the lower classified animals.

Fig 2. NMF localisation in birds in relation to olive nuclei

That is why, in most mammals (animals qualified higher than birds), one can notice the migration of NMF to the back direction, being effected by the nucleus of the bottom olive that exerts ”pushing” effect on it. The average length of the NMF in goose calculated on serial scrapes, was 0.77 mm, and in relation to the brain size it is comparable with NMF length in other birds studied beforehand (Fig. 3).

The cell structure of NMF in goose does not substantially differ from other bird species. Similarly as in hen, pigeon, and parrot (1–4, 8) in most cases NMF is created by small and medium size cells of circular and oval shape. Taking into account the data available in world literature, one can see that the degree of division of NMF into two secondary groups is directly connected with the degree of the complexity of expression musculature of face and neck. In man

Fig 3. NMF length in domestic birds

(7) the dorsal NMF group is responsible for innervating the muscles around the ear, the indirect group of muscles above and around the ear is supplying the back part of the belly (musculus digastricus). In cat (6), the innervation of the muscles around the eyes and above the eyes is provided by the dorsal group, lateral and abdomino-lateral groups innervate the muscles around the mouth and the medial and direct group innervate the muscles around the ear. The last group (abdomino-medial) innervates the posterior part of musculus digastricus.

The presence of 2, 3 secondary NMF groups has its explanation in the substantial reduction of expression muscles of the face. There are no buccal, nose, circular mouth and external ear muscles. There are, however, more complicated muscles around the eye and the eyelids. Additionally in birds, the main part of the facial nerve is supplying neck muscles. This is why it seems fully justified to say that in goose the dorsal part of NMF is responsible for the innervation of the muscles around and above the eye and the abdominal group of NMF is responsible for the neck muscles. This hypothesis may require verification in experimental anatomical studies using neuron-marking technique, for example.

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