ACTA THERIOLOGICA
Vol. 33, 10: 115—120, 1988

Parasympathetic Ganglia in the Head of Western Hedgehog (Erinaceus europaeus). I. Otic ganglion

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Gienc J., Kuder T. & Szczurkowski A., 1988: Parasympathetic ganglia in the head of western hedgehog (*Erinaceus europaeus*). I. Otic ganglion. Acta theriol., 33, 10: 115—120. [With Plates V—VI]

Using the thiocholine method of Koelle and Friedenwald and histological techniques the otic ganglion of the western hedgehog, *Erinaceus europaeus* Linnaeus, 1758 from the Province of Wrocław was studied. The ganglion was found to be a single oval cluster of neurons of ganglionic type, 2.4 mm long and 0.9 mm broad. The otic ganglion is situated at the medial side of the mandibular nerve closely below the maxillary artery. The ganglion is composed of typical ganglionic neurons in compact arrangement, and is surrounded by a thick connective-tissue capsule.

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1. INTRODUCTION

The parasympathetic cephalic ganglia have been studied in many species of birds and mammals, and among the latter the rodents have been given most attention (Gienc & Kuder, 1980; Kuder, 1980, 1983a, 1983b, 1985). On the other hand, no similar data are available on the *Insectivora*. Earlier studies suggested certain correlations between the morphological features and the topography of the parasympathetic ganglia and the taxonomic position of animal species.

In view of this, a study was untertaken on the cephalic parasympathetic ganglia in the hedgehog, since this might be of interest from the standpoint of phylogenetic development. The present study is the first part of this work.

2. MATERIAL AND METHODS

The reported investigations were carried out on eight adult western hedgehogs *Erinaceus europaeus* Linnaeus, 1758 of either sex. The animals were killed by decapitation under ether anaesthesia. For histochemical examinations five animals were used exposing carefully by dissection the area of the trigominal nerve, oculomotor nerve and the efferent ducts of the salivary glands. The material prepared in this way was studied *in situ* by the thiocholine method of Koelle-Friedenwald (1948), modified by Gienc (1976, 1977) for use in macromorphological specimens. The procedure was described in detail elsewhere (Gienc, 1976, 1977).

From the remaining three animals tissue were taken for histological examina-

tions. The sections were embedded in paraffin and cut serially at 10 μm thickness in a microtome. Staining was done by Nissl's method.

3. RESULTS

The otic ganglion in the hedgehog is a single oval cluster of neurons, 2.4 mm long and 0.9 mm broad. It is situated at the medial aspect of the mandibular nerve, about 2 mm below the oval foramen and is visible as a bulging structure lying closely below the maxillary artery (Plate V—VI, Fig. 1, 2). This artery runs along the posterior aspect of the mandibular nerve, and closely above the otic ganglion it bends crossing the nerve over its medial side. The otic ganglion is thus related more closely to the mandibular nerve than to the maxillary artery. As demonstrated by histochemical examinations the delicate fascicles of postganglionic nerve fibres enter into connections with the branches of the mandibular nerve, mainly with the buccal nerve and auriculotemporal nerve. On the fascicles minute additional clusters of ganglionic neurons were observed (Fig. 1). Running upwards the fascicles of postganglionic fibres become closely associated with maxillary artery, and pass then to the ipsilateral maxillary nerve.

Histological examinations demonstrated a very thick connective-tissue capsule of the ganglion (about 500 μm) at the periphery, while the most bulging middle part of the ganglion is coverd with only a thin (about 100 μm) layer of connective tissue (Plate VI, Fig. 3). It was demonstrated, moreover, that in the hedgehog the otic ganglion is a compact cluster of cells fused to the medial aspect of the mandibular nerve and, in part, to the maxillary artery (Fig. 3). The ganglionic neurons, usually 40 μm in diameter, had a large clear nucleus with a well outlined nucleolus. The neurons were seen in a compact arrangement over the whole area of the cross-section. Satellite cells and few fibres were present between them. In succesive microtome sections pterygoid nerves were found, which branched off from the mandibular nerve and passed through the main mass of the ganglion (Plate VI, Fig. 4).

4. DISCUSSION

The otic ganglion may be associated with the mandibular nerve as well as with the maxillary artery. A comparative analysis of the topographic conditions in many animal species (Gienc & Kuder, 1985) demonstrated that the location of the otic ganglion is determined, in the first place, by a different position of the maxillary artery in relation to the mandibular nerve. When the artery lies laterally the ganglion is situated at the mandibular nerve (Čirkova, 1958, 1959; Godinho, 1968

Kovšikova, 1958; Petela, 1974, 1979). On the other hand, in many animals (mouse, rat, golden hamster, midday gerbil *Meriones meridianus*, rabbit, dog), in which the maxillary artery runs along the medial side of the mandibular nerve (Fischbach & Dudzińska, 1970; Gienc & Kuder, 1983; Kuder, 1983a, 1983b, 1985) the otic ganglion is associated, in the first place, with this artery at the site where it crosses the mandibular nerve. In such cases, the maxillary artery separates the main mass of the ganglion from this nerve. As stated by Gienc & Kuder (1985) the course of the maxillary artery is, however, not a determinant of the topography of the otic ganglion. In the guinea pig the maxillary artery, which runs medially to the mandibular nerve, is not crossing the nerve near the oval foramen but runs along its anterior aspect (Gienc & Kuder, 1980). In that species the otic ganglion encloses the trunk of the mandibular nerve on its medial, posterior and partly lateral sides. In the hedgehog also the maxillary artery crosses the mandibular nerve on its medial aspect but in such a way that the main mass of the ganglion lies below this artery on the medial aspect of the nerve, while only the upper border of the ganglion touches the maxillary artery, and numerous fascicles of the postganglionic fibres leave the ganglion at its upper border.

The morphologic features of the otic ganglion show a species-dependent variability. A single compact cluster of ganglionic neurons is present in the guinea pig (Gienc & Kuder, 1980), mouse, rat, and hamster (Kuder, 1980, 1983a, 1983b), rabbit (Fischbach & Dudzińska, 1970), cattle (Petela, 1971) and man (Žabotynski, 1953). The otic ganglion may have also the form of several cell clusters interconnected each with others, as it is observed in the wild pig (Petela, 1979), sheep, and goat (Čirkova, 1958, 1959), and dog (Gienc & Kuder, 1980). The otic ganglion of the hedgehog, despite presence of additional cell clusters at it, should be included into the former group. However, the presence of a thick capsule of connective tissue makes impossibile an accurate determination of the shape of the ganglion by the histochemical method. Only the middle, most bulging, part of the ganglion covered by only a thin connective tissue layer shows acetylocholinesterase activity.

The otic ganglion of the hedgehog is relatively large in relation to these ganglia in other species (Gienc & Kuder, 1980, 1983; Kuder, 1983b, 1985).

As shown in the observations of Petela (1979) in the wild pig the nasomedial part of the otic ganglion covers the initial part of the medial pterygoid nerve. Similary as in cattle (Petela, 1974) since in that species the otic ganglion lies along the medial pterygoid nerve. In the rabbit this gangion is closely associated with the medial pterygoid nerve (Fischbach & Dudzińska, 1970). The topographic association of these two stru-

ctures is even more pronounced in the hedgehog, since in this species the nerve passes through the main mass of the ganglion.

The fascicles of postganglionic fibres leave the otic ganglion in various directions. In the guinea pig they form a characteristic plexus surrounding the trunk of the mandibular nerve on its medial and lateral aspects, and then join the main branches of this nerve (Gienc & Kuder, 1980). On the other hand, in the dog these fascicles of cholinergic fibres lie on the superiorposterior side of the maxillary artery and join the auriculotemporal nerve and the buccal nerve (Gienc & Kuder, 1983). A similar course of the postganglionic fibres was reported by Kuder (1983b) in the mouse, rat, and golden hamster. The present study confirms this course of the postganglionic fibres in the hedgehog as well, these fibres lie on the wall of the maxillary artery and form parts mainly of the buccal nerve and auriculotemporal nerve.

In the hedgehog the neurons in the otic ganglion show a compact arrangement, with only a small number of fibres between them. A similar arrangement of the ganglionic neurons was observed also in man (Žabotynski, 1953), dog (Gienc & Kuder, 1983), golden hamster, and midday gerbil *Meriones meridianus* (Kuder, 1983b, 1985). This suggests that the morphology and topography of the otic ganglion are species-specific and not related to the taxonomic position of the species.

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Received 9 April 1987, Accepted 14 July 1987.

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PRZYWSPÓŁCZULNE ZWOJE GŁOWOWE JEŻA ZACHODNIEGO (*ERINACEUS EUROPAEUS*). I. ZWÓJ USZNY

Streszczenie

Przy użyciu tiocholinowej metody Koellego-Friedenwalda i techniki histologicznej opracowano zwój uszny jeża zachodniego, *Erinaceus europaeus* Linnaeus, 1758. Stwierdzono, że jest on pojedynczym, owalnym skupiskiem neurocytów zwojowych o długości 2,4 mm i szerokości 0,9 mm. Zlokalizowany jest na przyśrodkowej stronie nerwu żuchwowego, tuż poniżej tętnicy szczękowej (Tablica V, Ryc. 1, 2). Zwój uszny jeża utworzony jest z typowych neurocytów zwojowych, o zwartym układzie. Otoczony jest grubą torebką łącznotkankową (Ryc. 3). Wychodzące ze zwoju wiązki włókien zazwojowych nawiązują łączność z głównymi odgałęzieniami nerwu żuchwowego oraz z tętnicą szczękową. Środkowa część zwoju przebita jest nerwami skrzydłowymi (Ryc. 4).

Zwój uszny jeża zachodniego, zarówno pod względem kształtu jak i położenia, pomimo ogólnych podobieństw do innych zwierząt, wykazuje wiele cech charakterystycznych dla tego gatunku. Są to: duże rozmiary zwoju, gruba torebka łącznotkankowa oraz ścisłe zespolenie zwoju z nerwami żuchwowym i skrzydłowymi.

EXPLANATION OF PLATES V—VI

Plate V

Fig. 1. Schematic drawing showing the shape and site of the otic ganglion in the hedgehog. 1 — trigeminal nerve, 2 — lesser petrosal nerve, 3 — tympanic chorda, 4 — auriculotemporal nerve, 5 — mylohyoid nerve, 6 — inferior alveolar nerve, 7 — lingual nerve, 8 — masseteric nerve, 9 — buccal nerve, 10 — pterygoid nerves, 11 — maxillary artery. The arrow shows the direction of the cross-section presented in Fig. 3.

Plate VI

Fig. 2. Otic ganglion (left) in a hedgehog. Thiocholine method. Magnif. about 20×. 1 — trigeminal nerve, 2 — site of severing of the ophthalmic and maxillary rami, 3 — mandibular nerve, 4 — maxillary artery, 5 — middle most bulging part of otic ganglion showing acetylcholinesterase activity, 5' — additional cluster of otic ganglion neurons.

Fig. 3. Cross-section trough the otic ganglion in a hedgehog on the left side. Nissl's metod. Magn. about 60×. 1 — mandibular nerve, 2 — buccal nerve, 3 — pterygoid nerves, 4 — maxillary artery, 5 — connective — tissue capsule of the ganglion.

Fig. 4. Cross-section through the otic ganglion of a hedgehog. Pterygoid nerves passing through the main mass of the ganglion are visible. Nissl's stain. Magnif. about 90×. 1 — mandibular nerve, 2 — pterygoid nerve, 3 — maxillary artery.