

DISTRIBUTION OF NEUROSECRETORY MATERIAL IN THE NEUROSECRETORY SYSTEM OF *ODONTOPUS VARICORNIS* (DIST.) (HETEROPTERA: PYRRHOCORIDAE)

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ABSTRACT

In the brain of *Odontopus varicornis* two groups of neurosecretory cells are found in pars intercerebralis region. Four types of cells, designated as A, B, C and D, are recognized based on tinctorial affinities. The axonal pathway of A-cell neurosecretory material is traced. This material is transported to aorta wall where it accumulates. The corpora cardiaca and corpus allatum are devoid of this cerebral neurosecretory material. It is concluded, therefore, that aorta wall serves as the neurohemal structure. It is also suggested that aorta should be considered as an integral part of the neurosecretory system of Heteroptera.

INTRODUCTION

SCHARRER and Scharrer¹, while studying the neurosecretory cells of brain in *Leucophaea maderae*, discovered that the neurosecretory material (NSM) is transported through the axons of these cells to the corpora cardiaca which are situated behind the brain. Since then, investigations carried out in different species of insects have established that the corpora cardiaca function as neurohemal organs for the cerebral NSM²⁻⁹. But, Nayar¹⁰ found that in *Iphita limbata* the NSM is distributed not only in the corpora cardiaca but also in the aorta. Similar observation has been reported for *Adelphocoris lineolatus*¹¹. Contrary to these findings, recent studies on certain heteropterans have shown that the cerebral NSM is distributed only in the aorta wall and corpora cardiaca are devoid of it¹²⁻¹⁶. Further, while the NSM is localized in corpora allata of several species^{1, 10, 11, 17, 18}, it could not be traced in these glands in others^{5, 19, 20}. Bearing in mind this diversity offered by insects, the distribution of NSM is investigated in a heteropteran, *Odontopus varicornis*.

MATERIALS AND METHODS

The brain and retrocerebral complex of adult specimens of *Odontopus varicornis* were fixed in Bouin's fluid. The retrocerebral complex consists of a pair of corpora cardiaca, a single corpus allatum and cephalic portion of aorta. Paraffin sections of the material were stained with aldehyde fuchsin (AF)²¹ or with chrome alum hematoxylin-phloxin (CAHP)²². Paraffin sections of the material fixed in formal-saline were also treated according to performic acid-Victoria blue (PAVB) technique²³. Of these, the sections stained with AF were found to be most useful for the present investigation.

OBSERVATIONS

The neurosecretory cells appear as bluish white spots in the pars intercerebralis of brain. The corpora cardiaca are found as tiny milky white bodies situated behind the brain and attached firmly to the ventrolateral aspects of aorta. Two short nerves arise posteriorly, one from each corpus cardiacum, and unite to form a single nerve called nervus corporis allatum which innervates the corpus allatum. The latter is a median, unpaired, dorsoventrally flattened, ovoid gland sandwiched between the aorta and oesophagus.

Two groups of median neurosecretory cells each consisting of about 15 cells are present. Based on their tinctorial affinity four types are recognized and are designated as A, B, C and D (figure 1) following the terminology used by Johansson¹⁹. The A-cells are very conspicuous since they are loaded with NSM staining dark purple with AF, blue-black with CAHP and blue with PAVB. The other three types of cells conform to the description given for those of *Serinettha augur*²⁴.

In *Odontopus varicornis*, the axons of A-cells of each group converge to form a distinct neurosecretory pathway, the course of which can be traced easily because of the presence of stainable material in them. The axonal bundles of the two groups cross each other and run towards the ventral side close to the midline of the brain. Then they curve towards the posterior direction and emerge as distinct nerves called nervi corporis cardiaci (NCC) (figure 2). Each nervus corporis cardiacum passes closely over the corpus cardiacum of its side (figure 3) and terminates in the lateral wall of the aorta near the site of attachment of the corpus cardiacum with the aorta. The NSM is observed in the NCC and aorta wall (figures 3 and 4). The corpora cardiaca and corpus allatum are devoid of this material. The axonal pathways of the NSM of other cell types are indistinct and not traceable.

DISCUSSION

In *Odontopus varicornis*, the NSM of A-cells is transported through NCC, which corresponds to NCC I of other insects in which NCC II and III have been reported^{13,19,25}. The NCC pass over the corpora cardiaca and terminate in the aorta wall where the NSM accumulates. Therefore, aorta is considered as the neurohaemal organ for this heteropteran bug. In the majority of heteropterans so far investigated aorta serves as the neurohaemal organ for the cerebral NSM¹²⁻¹⁶. Apparent exceptions among Heteroptera are *Iphita limbata*¹⁰ and *Adelphocoris lineolatus*¹¹. Nayar¹⁰ observed the NSM both in corpora cardiaca and aorta wall of the former species. However, he

maintained that the corpora cardiaca are the neurohaemal organs and the NSM observed in the aorta wall is the released material. But after reinvestigation of the neurosecretory system of the same species, Seshan and Ittycheriah¹² conclude that NCC carrying the NSM terminate in the aorta wall where it accumulates and the material seen in the corpus cardiacum is a different component of the cerebral NSM. Ewen¹¹ explains the presence of the cerebral NSM in the corpora cardiaca as well as aorta wall of *Adelphocoris lineolatus* as due to the extension of some of the branches of NCC to the aorta wall. Dogra²⁵ also has observed AF-positive material in corpora cardiaca and aorta of *Belostoma indica*. But, he has shown that the former is AF-positive but PAVB-negative, while

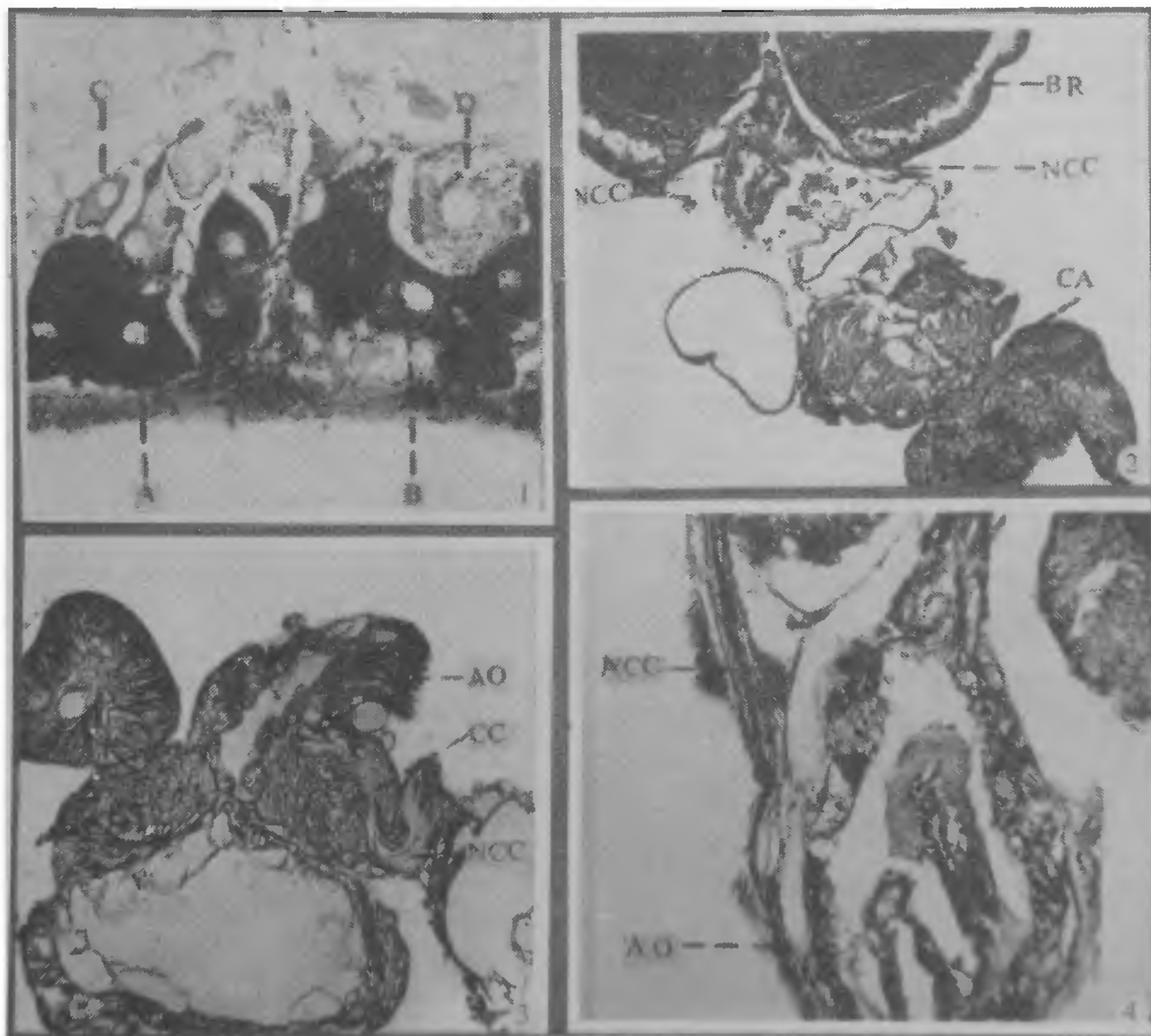


Figure 1. Four types of neurosecretory cells (A, B, C and D) in the brain. $\times 500$. 2. Nervus corporis cardiaci (NCC) emerging from the posteroventral region of brain (BR). $\times 80$ CA - Corpus allatum. 3. Nervus corporis cardiacum (NCC) passes over the corpus cardiacum (CC) and joins the aorta (AO). $\times 125$. 4. Nervus corporis cardiacum (NCC) carrying neurosecretory material joins the aorta (AO) where the material accumulates. $\times 320$.

the material found in aorta wall, NCC and neurosecretory cells of brain is positive to both AF and PAVB. He argues in the light of this finding that the AF-positive material found in the corpora cardiaca of *B. indica* is the intrinsic secretion of the glands and not the stored material received from cerebral neurosecretory cells. If this argument is extended to *I. limbata* and *A. lineolatus*, then probably there is no exception among the investigated heteropterans where corpora cardiaca would serve as the neurohaemal organs. For *Liocoris unctuosus*, it is reported that NCC innervate corpora cardiaca and are free from any attachment to the aorta²⁷. But the distribution of NSM in this heteropteran is not traced. Thus, on the basis of the present investigation in *O. varicornis* and from reports on other heteropterans discussed above, it is suggested that aorta should be considered as an integral part of the neurosecretory system of Heteroptera.

Johansson¹⁹ found the NSM in the aorta wall of *Oncopeltus fasciatus*, but could not trace it in the aortic lumen. He considered that the material undergoes transformation in the process of release and loses its stainability. The absence of NSM in the aortic lumen is also recorded for *O. varicornis*. But this anomaly may be explained if it is assumed that the material is released into the hemocoel and not into the aortic lumen.

Since it appears that in the Heteroptera including *O. varicornis* the NCC innervate the aorta and not corpora cardiaca, it is suggested that the name 'nervi corporis cardiaci' should be changed appropriately for Heteroptera. 'Nervi aorta' may be an apt term.

It is observed that the corpus allatum of *O. varicornis* is completely devoid of NSM. This is in congruence with the observation reported for *Oncopeltus fasciatus*¹⁹, *Schistocerca gregaria*⁵ and *S. paranensis*²⁰. On the other hand, the transportation of the cerebral NSM to this gland has been recorded for many other insects^{1,10,11,17,18,28}. In *Cryllodes sigillatus*²⁹ and *Belostoma indica*²⁵ the NSM has been traced to the surface of the corpus allatum and not within the gland, because the axons carrying the material are distributed only on its surface.

ACKNOWLEDGEMENT

The work was carried out at Annamalai University under the guidance of Prof. P. Govindan and with the

financial assistance from U.G.C. and the University. The author is grateful for the same. Thanks are also due to Dr. Vijayam Sriramulu of the Annamalai University for his help in photography.

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