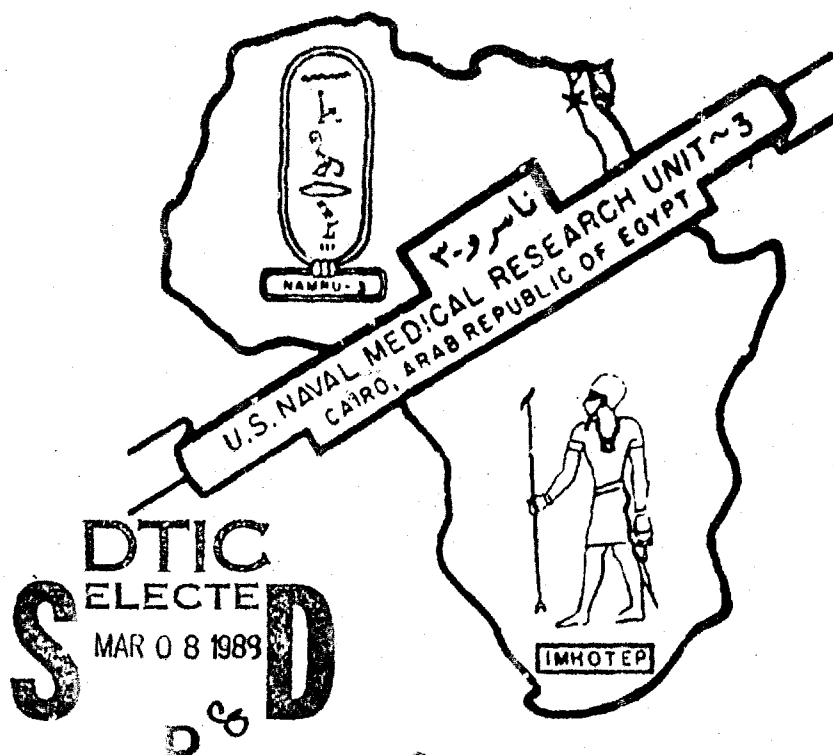


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(ACARI:IXODOIDEA:IXODIDAE)

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SYNGANGLION HISTOLOGY OF THE CAMEL TICK *HYALOMMA DROMEDARI*

(Acari: Ixodidae: Ixodidae) *+

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ABSTRACT

The synganglion histology in female *H. dromedarii* is described and compared with other ticks. The synganglion, lying in a periganglionic blood sinus, is formed by a fused supra-oesophageal part (protocerebrum, cheliceral ganglia, pedipalpal ganglia and stomodaeal pons) and a suboesophageal part (4 pairs of pedal ganglia and the complex opisthosomatic ganglion). The synganglion is enclosed within a connective tissue sheath, the neurilemma. The perineurium underlies the neurilemma and is followed by the cortical region, which is separated from the neuropile by the subperineurium. Association, motor and neurosecretory cell types are the neurons which together with 4 of 5 glial cell types, compose the cortical zone of the synganglion. The fifth glial cell type is only distributed in the perineurium. Five levels of fibrous horizontal connectives and vertical commissures occur in the neuropile.

tick-pathogen associations and of being the center of neuroendocrine activity, the structural and functional organization of the nervous tissue of this highly specialized arthropod group need to be studied to understand its bearing on the physiological activities of the tick.

The basic structural components of the fused ganglionic mass, the synganglion, has been studied histologically in the ixodids *Boophilus* (*Uroboophilus*) *calcaratus* Birula (Tsvileneva, 1965), *B. (U.) microplus* Canestrini (Binnington and Tatchell, 1973), *Dermacentor* (*D.*) *andersoni* Stiles (Douglas, 1943), *D. (D.) pictus* Hermann (Ioffe, 1963), *D. (D.) variabilis* Say (Obenchain, 1974), *Hemaphysalis* (*H.*) *flava* Neumann (Saito, 1960), *Hyalomma* (*H.*) *detritum* Schulze, *H. (H.) anatolicum* Koch (Tsvileneva, 1965), *H. (Hyalommastus)* *egyptium* Sharif and *Rhipicephalus* (*R.*) *marginatus* Latreille (Satja et al., 1971) and the argasids *Argas* (*Pardacarus*) *arabicus* Kaiser, Hoogstraal and Kohls (Roshdy and Marzouk, 1984), *A. (P.) parvus* Oken (Robinson and Davidson, 1914; Satja et al., 1971; Eisen et al., 1973), *Ornithodoros* (*Alectorobius*) *kellyi* Cooley & Kohls (Sonenshine, 1970), *O. (O.) moubata* Murray (Eichenberger, 1970), *O. (Pavlovskyella)* *parkeri* (Pound and Oliver, 1982) and *O. (O.) savignyi* (Christophers, 1906; Evans and Solomon, 1977).

INTRODUCTION

The tick central nervous system is one of the suitable sites for multiplication of pathogenic microorganisms such as spirochetes, rickettsiae and viruses (Burgdorfer, 1951; Aeschlimann, 1958; Roshdy, 1962; Reinhardt et al., 1972; Diab et al., 1977; Zaher et al., 1977).

Because of the vital importance of this system in the

Recent investigations on *Hyalomma* (*H.*)

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- + Dedicated to late Dr. Harry Hoogstraal who initiated and supported this work before he passed away on 24 February 1986.

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dromedarii Koch have revealed that this tick is responsible for the transmission of several arboviruses (Hoogstraal, 1975; Wood et al., 1982).

Herein, we describe the synganglion histology of the female *H. dromedarii* to provide essential information for further investigations on neurosecretory cell distribution, and their possible involvement in hormone-mediated events controlling the various physiological activities of the tick.

MATERIAL and METHODS

Engorged female *H. dromedarii* collected from camels in the Imbaba market, Giza Governorate, Egypt, were used to start a colony in the NAMRU-3 Medical Zoology laboratory. The ticks were fed on the rabbit *Oryctolagus cuniculus* using the method of Berger et al., (1971) at $28 \pm 1^\circ\text{C}$ and 75% relative humidity. All animal care and manipulations were in accordance with the Animal Welfare Act Amendment of 1976 (PLP 14-279 with subsequent amendments).

For histological observations, the dorsal and sometimes the ventral integument were removed and the synganglion was quickly fixed in modified Bouin's fluid (Humason, 1962) for 24 hours. The synganglion was then washed in 70% ethanol, dehydrated in an ascending series of ethyl alcohol and double embedded in celloidin-paraffin. Serial sections, 5-7 μm thick, were stained by Mallory triple stain (MT) (Pantin, 1959), aldehydefuchsin (AF) (Ewen, 1962) and the chrome-haematoxylin phloxine (CHP) techniques (Gomori, 1941).

RESULTS

The synganglion of female *H. dromedarii*, lying in a periganglionic blood sinus, consists of a supraesophageal part and subesophageal part, and is enclosed within a well-defined connective tissue sheath, the neurilemma (Figs. 1-6). The perineurium underlies the neurilemma and is followed by the cortical region, formed mainly of neuronal and non-neuronal cells which is separated from the inner fibrous core or neuropile by the subperineurium.

The neurilemma. This sheath, 3-3.3 μm , is also reflected into the esophageal canal inside the synganglion to surround the esophagus as well (Fig. 7). In MT-stained preparation, it stains blue suggesting a collagenous nature. The perineurium.

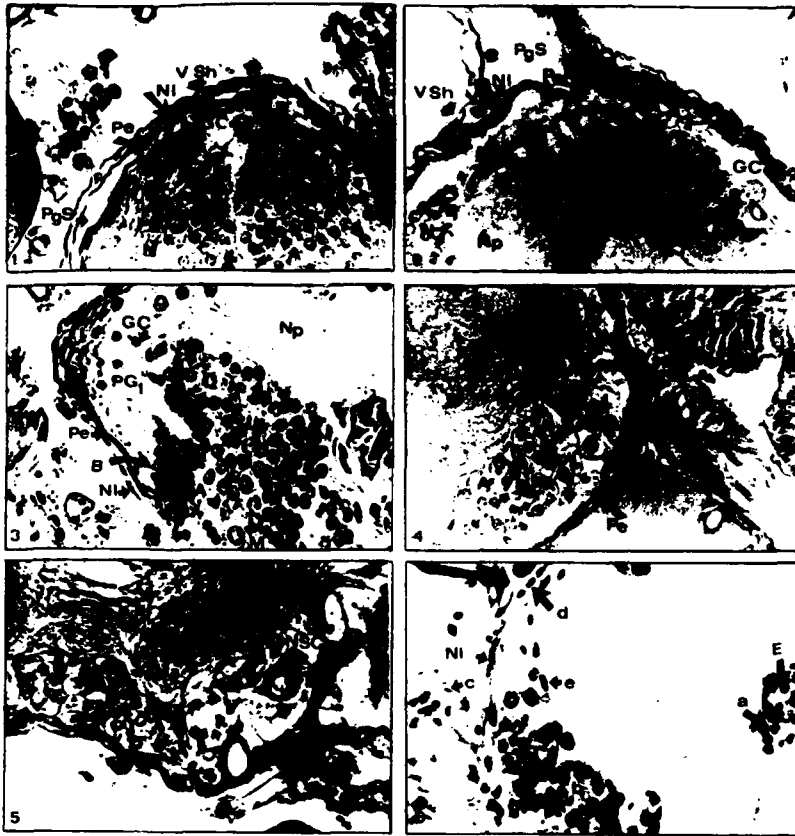
This is an irregular layer of scattered glial cells which lies beneath the neurilemma. The cells, 2.1-2.5 μm thick, have elongated nuclei, and ill-defined boundaries (Figs. 1-4). The subperineurium. This layer of irregularly arranged glial cells, ca. 3-3.5 μm thick (Fig. 2), separates the cortex from the neuropile.

The cortex. The cortex is composed primarily of neuronal cells or perikarya, and a few scattered glial cells (Fig. 1-6). Three major types of neuronal cells are observed: the association, motor and neurosecretory cell types. These cells are classified according to shape, size, cytoplasm staining properties and distribution. Association neurons. Two cell types, A and B are included in this category. Type A cells form the bulk of the cortical layer. They are oval or rounded in shape, measuring 8.8-10 μm in diameter, each with a central rounded nucleus, measuring 5.5-6 μm in diameter (Figs. 1, 3, 4). The cell and nuclear boundaries are very distinct, the cytoplasm is finely to coarsely granular, and the nuclear chromatin is in the form of granular inclusions. Type B cells, known as the globuli cells, occur in large numbers associated with the first pedal ganglia and are the smallest neuronal cells (Fig. 3). They are rounded in shape, measuring 6.0 μm in diameter, with rounded relatively large nuclei, measuring ca. 4.5 μm in diameter. Cell and nuclear boundaries are distinct; the cytoplasm is coarsely granular and the nucleus is chromatin-rich.

Motor cells. These are only few cells which are easily recognized by their relatively large size (Figs. 3, 4). They are rounded to oval in shape, measuring ca. 16.5 μm in diameter. The cytoplasm is finely granular and vacuolated and the nucleus is rounded in shape, 7-7.5 μm in diameter, and contains loose thread-like chromatin and one or two nucleoli.

Neurosecretory cells. These cells are distributed in several mostly bilaterally symmetrical groups in the cortex (Fig. 5). The cells are oval, rounded or irregular in shape and vary greatly in size, ranging from 10×11.5 to $55 \times 23.5 \mu\text{m}$. Their nuclei are oval or spherical in shape, measuring ca. $7.7 \times 5.5 \mu\text{m}$ to $13.2 \times 6.7 \mu\text{m}$.

These cells contain neurosecretory material (NSM) in the form of flocculent, very fine or coarse granules. The staining affinity of this material differs according to the stain used. The NSM may accumulate at the periphery of the cell or around the nucleus and are sometimes distributed throughout the cytoplasm.



(Fig. 1-3)

Transverse sections of the synganglion of semified *H. dromedarii* showing the vascular sheath (V Sh) enclosing the perigastric sinus (Pg S). A, type A association cells; E, oesophagus; GC, glial cells; N, neuronal cells; NL, neurilemma; Np, neuropile; Pe, perineurium; Spe, subperineurium (X 400)

(Fig. 3)

Transverse section of the synganglion of unfed female *H. dromedarii* in the region of the first pedal ganglia (PG₁) showing type B association cells (B) and motor cells (M). Lettering as in Figs. 1, 2. (X 725)

(Fig. 4)

Transverse section of the synganglion of semified

female *H. dromedarii* showing a motor cell (M) among type A association cells (A). c, d, glial cells types c and d; NL, neurilemma; Pe, perineurium (X 400)

(Fig. 5)

Frontal section of the synganglion of unfed female *H. dromedarii* showing a neurosecretory cell (NSC) (X 725)

(Fig. 6)

Transverse section of the synganglion of unfed female *H. dromedarii* showing different types of glial cells (a, b, c, d, e). E, oesophagus; NL, neurilemma (X 400)

Giant cells. These cells include 5 types differing in location, shape, and size. Type "a": These cells are irregularly distributed in the neuropile and many of them accumulate in the area adjacent to the esophageal crossing (Fig. 6). They are oval, measuring ca. 7×3.5 μm , and their oval nuclei measure ca. 5.5×2.2 μm . Type "b": These cells occur among the different neuronal cells (Fig. 6). They are more or less rounded in shape, measuring 6-6.6 μm in diameter, and the large nucleus occupies the majority of the cell body. Type "c": These cells are scattered in the peripheral nerves among the nerve fibers (Figs. 4-6). They are densely packed and best observed where the nerves communicate with the corresponding neuropile regions. They are rounded or oval in shape, measuring 4.5-6 μm in diameter. Type "d": These cells form the perineurium just beneath the neurilemma (Figs. 1, 2, 6). They measure ca. $6.6 \mu\text{m} \times 2.1 \mu\text{m}$. Type "e": These cells form the subperineurial layer (Fig. 6). They are spindle to oval in shape, measuring ca. $9.9 \mu\text{m} \times 3.5 \mu\text{m}$.

Ganglionic structure of the synganglion

The supraesophageal part. This part is formed as a result of the fusion of the protocerebrum, the cheliceral ganglia, the pedipalpal ganglia and the stomodeal pons (Figs. 7-12). The protocerebrum. The protocerebrum appears as a single, median mass which extends in the dorsoventral direction between the bases of the cheliceral and pedipalpal neuropiles and dorsal to the stomodeal pons (Figs. 8-12). The protocerebrum contains the optic ganglia, discrete bilaterally-arranged glomeruli of higher neuropilar density and a number of interconnecting tracts (Figs. 7, 9-12). The glomeruli include the anterodorsal, posterodorsal and ventral glomeruli (Figs. 9-12). **Optic ganglia.** This pair of ganglia occurs in the most anterodorsal part of the protocerebrum (Fig. 7) as small, rounded neuropiles with their bases coinciding with the anterior boarder of the cheliceral ganglia. The ocular cortex surrounds the lateral and ventral aspects of this ganglia. **Anterodorsal glomeruli.** These are two glomerular pairs in the middorsal region of the protocerebral neuropile (Fig. 10). They are spherical in shape, the outer pair (ca. 20.9 μm and ca. 14.3 μm in diameter, respectively) is larger than the inner one. A very thin dorsal cortical layer separates these glomeruli from the perineurium. **Posterodorsal glomeruli.** This pair of glomeruli, measuring 17.6 μm in diameter, is situated posterolateral to the anterodorsal glomeruli (Fig. 11).

Ventral glomeruli. These two glomerular pairs are ventromedial to the protocerebral neuropile (Figs. 9, 12) and lateral to the stomodeal pons, and are bordered laterally by the bases of the cheliceral and pedipalpal neuropiles. The outer pair is larger (ca. 18.7 μm in diameter) than the inner one (ca. 13.2 μm in diameter). Both pairs are closely associated with the esophageal canal and stain darker than the protocerebral neuropile, indicating a higher neuropilar density.

The cheliceral ganglia. This pair of ganglia occupies the dorsolateral part of the supraesophageal part (Figs. 8-10). Anteriorly, the neuropile appears as 2 spherical structures connected ventrolaterally with the anterior boarder of the pedipalpal ganglia (Fig. 8). Ventrally, the cheliceral neuropiles are interrupted across the midline by the protocerebrum.

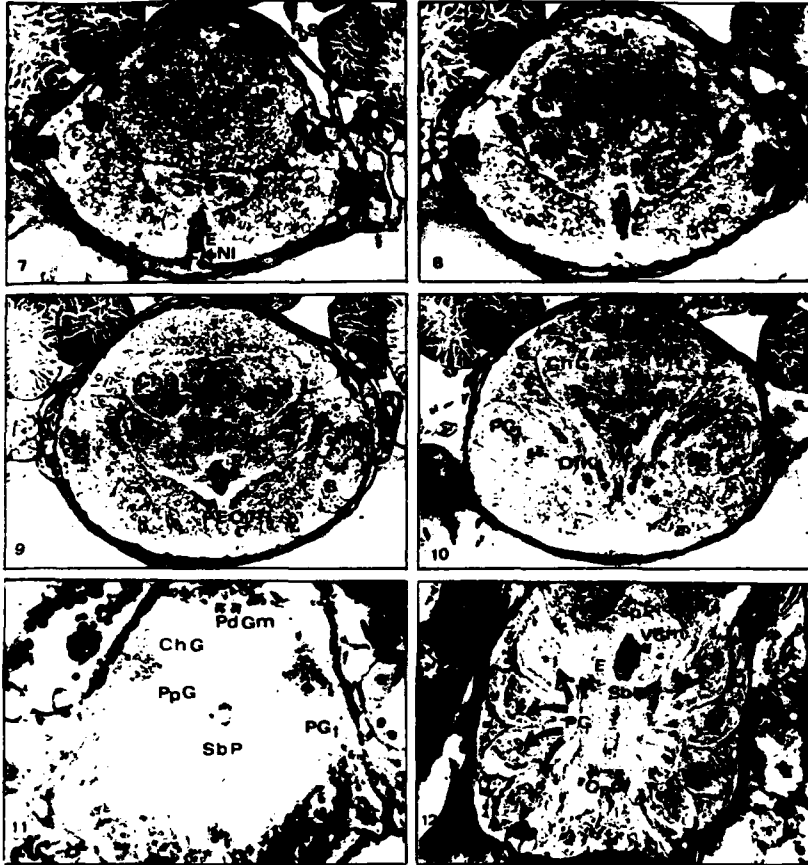
The pedipalpal ganglia. This pair of ganglia is posterior to the cheliceral ganglia. Anteriorly, they extend obliquely upwards (Figs. 8, 9) and are connected together posteriorly by a postesophageal commissure (Fig. 9). The posterior aspect of both pedipalpal ganglia are adjacent to the anterior margin of the first pair of pedal ganglia (Figs. 10-12).

The stomodeal pons. This is the most ventral region of the supraesophageal part (Figs. 7-9). Anterodorsally and anteroventrally, the stomodeal pons neuropile is bordered by a cortex formed mainly of type A association cells and neurosecretory cells (Fig. 7). Posteriorly, the stomodeal pons is bordered laterally by the pedipalpal neuropiles (Figs. 8, 9).

The subesophageal part. This part includes the neuropiles of the four pairs of pedal ganglia and the complex opisthosomatic ganglion (Figs. 12, 13).

The pedal ganglia. These 4 pairs of ganglia are metamERICALLY arranged, the first being anterolateral, the second and third occupying the midlateral region and the fourth oriented posterolateral in a dorsal direction (Fig. 12).

The anterolateral margin of the first pedal ganglia coincides with the posterior aspect of the pedipalpal ganglia (Figs. 10-12), while the anterolateral margins of the second, third and fourth pedal ganglia coincide with the posterior aspect of the preceding pedal ganglia (Fig. 12). The posterior margin of the first three pedal ganglia coincides with the anterior aspect



(Fig. 7-11)

Transverse sections of the synganglion of semised *H. dromedarii* showing the ganglionic structure of the supraoesophageal part (Sp P) and suboesophageal part (Sb P). Ad Gm, anterodorsal glomeruli; B, type B association cells; Ch G, cheliceral ganglia; E, oesophagus; NI, neurilemma; Of K, olfactory knots; Op G, optic ganglia; P E C, postoesophageal commissure; P G₁, first pedal ganglia; Pd Gm, posterodorsal glomeruli; Pg S, periganglionic sinus; Pp G, pedipalpal ganglia; Pr, protocerebrum; St P, stomodaeal pons; V Gm, ventral glomeruli (*X* 250).

(Fig. 12)

Frontal section of the synganglion of unfed female *H. dromedarii* showing the arrangement of the four pedal ganglia (P G₁₋₄) and the opisthosomatic ganglion (Ops. G). E, oesophagus; Sb P, suboesophageal part; Sp P, supraoesophageal part; V Gm, ventral glomeruli (*X* 100).

of the following pedal ganglia and the posteromedial aspect of the fourth pedal ganglion coincides with the anterolateral margin of the opisthosomatic ganglion (Fig. 12). Small dense glomerular lobes, the olfactory knots, and anterior subspherical masses formed of type B association cells are associated with the first pedal ganglia (Figs. 9, 10).

The complex opisthosomatic ganglion. This complex ganglion is located between the posteromedial borders of the fourth pedal ganglia in the most posterior region of subesophageal part (Fig. 12). The complex nature of this ganglion is indicated by multiple dorsal and ventral neuropile projections. The cortical layer surrounding the neuropile is relatively thick in the ventral region and is invaginated into the neuropile dorsally giving it a trilobed appearance (Fig. 13).

Connectives and commissures. The horizontal connectives and vertical commissures of the neuropile occur in five levels. The first level is the most dorsal one at which 7 distinguished commissures occur (Fig. 14). The anteriormost, arc-shaped commissure occurs in the supraesophageal part and surrounds the esophagus anteriorly. The other six commissures are present in the subesophageal part. The second arc-

shaped commissure occurs directly posterior to the esophagus and extends between the pedipalpal ganglia. The third, fourth and fifth commissures are straight and connect the second, third and fourth pedal ganglia, respectively. The extremities of the sixth commissure are directed slightly toward the posterior region of the synganglion. The seventh commissure surrounds the opisthosomatic ganglion anteriorly.

The second level consists of 2 moderately-dense, bilaterally symmetrical connectives which extend from the region behind the esophagus to terminate anterior to the opisthosomatic ganglion (Fig. 15). These connectives give off fibers to the pedal ganglia and are connected anteriorly by a postesophageal commissure which gives off fibers anterolaterally to the pedipalpal ganglia.

The third level includes a dense, fibrous, median ring from which radiate one pair of connectives to the pedipalpal ganglia and one pair to each of the four pairs of pedal ganglia (Fig. 16).

The fourth level consists of 2 pairs of connectives in the center of the synganglion (Fig. 17). One pair is dorsal, medial and straight, and the other pair is more

(Fig. 13)

Transverse section of the opisthosomatic ganglion (Ops G) in semifed female *H. dromedarii* (X 250)

(Fig. 14)

Frontal section of the synganglion of semifed *H. dromedarii* at the first level of connectives and commissures showing seven commissures (Mr 1-7). Ops G, opisthosomatic ganglion; Pg₁₋₄, first to fourth pedal ganglia; Sp P, supraesophageal part (X 100)

(Fig. 15)

Frontal section of the synganglion of unfed *H. dromedarii* at the second level of connectives and commissures showing two connectives (V) and one commissure (Mr). Ops G, opisthosomatic ganglion; Pg₁₋₄, first to fourth pedal ganglia; Sb P, subesophageal part; Sp P, supraesophageal part (X 100)

(Fig. 16)

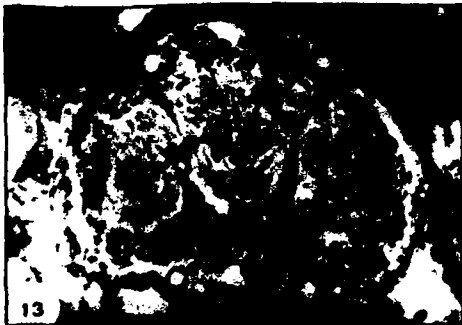
Frontal section of the synganglion of unfed *H. dromedarii* at the third level of connectives and commissures showing a median ring (I) from which radiates connectives (V₁) to the pedipalpal ganglia and to each of the four pedal ganglia (V₂) (X 100)

(Fig. 17)

Frontal section of the synganglion of unfed female *H. dromedarii* at the fourth level of connectives and commissures showing two pairs of connectives (V₁, V₂) (X 100)

(Fig. 18)

Frontal section of the synganglion of unfed female *H. dromedarii* at the fifth level of connectives and commissures showing three pairs of connectives (V 1-3) and three commissures (Mr 1-3). Ol K, olfactory knots (X 100)



ventral and is formed of widely separated connectives which gives off dorsoventral fibers to each of the four pairs of pedal ganglia.

The fifth level consists of three pairs of connectives and 3 commissures (Fig. 18). The median pair of connectives extends between the olfactory knots and the opisthosomatic ganglion. The other two are laterally situated, adjacent to each other and join the second, third and fourth pedal ganglia of each side. The 3 commissures extend between second, third and fourth pedal ganglia, respectively.

DISCUSSION

The synganglion structure in female *H. dromedarii* shows the main evolutionary characteristics of the nervous system in the other acarines and in the chelicerata in general (Ioffe, 1963, 1964; Tsvileneva, 1964, 1965; Satija et al., 1971; Binnington and Tatchell, 1973; Obenchain, 1974). The cheliceral and pedipalpal ganglia location laterad to the protocerebrum in the anterior region of the supraesophageal part and the anteroventral position of the stomodeal pons in this part are common features in the topography of the tick synganglion (Ioffe, 1963, 1964; Tsvileneva, 1965; Eichenberger, 1970; Obenchain, 1974; Pound and Oliver, 1982; Roshdy and Marzouk, 1984). As in other ticks, the optic centers in *H. dromedarii* protocerebrum are represented by small glomerular formations, and the corpora pedunculata is represented by anterodorsal and posterodorsal glomeruli, lacking glomerular cells (Hänström, 1928; Ioffe, 1963; Tsvileneva, 1964; Obenchain, 1974; Roshdy and Marzouk, 1984).

The subesophageal part of *H. dromedarii* synganglion is formed as a result of the consolidation of four pairs of pedal ganglia and the complex opisthosomatic ganglion. The first pedal ganglia are situated along the sides of the esophagus, due to the forward movement of the pedipalpal ganglia into the supraesophageal part (Ioffe, 1963). Olfactory knots, associated with the first pedal neuropile, may have a possible sensory relation to Haller's organ (Tsvileneva, 1964; Obenchain, 1974).

Histological examination of the female *H. dromedarii* synganglion revealed basic structural components similar to those previously described in the ixodida, *B. calcaratus* (Tsvileneva, 1965), *B.*

microplus (Binnington and Tatchell, 1973), *D. andersoni* (Douglas, 1943), *D. pictus* (Ioffe, 1963), *D. variabilis* (Obenchain, 1974), *Haemaphysalis flava* (Saito, 1960), *Hyalomma detritum*, *H. anatolicum* (Tsvileneva, 1965), *H. aegyptium*, *R. sanguineus* (Satija et al., 1971) and the argasids *A. arboreus* (Roshdy and Marzouk, 1984), *A. persicus* (Robinson and Davidson, 1914; Satija et al., 1971; Eisen et al., 1973), *O. kelleyi* (Sonenshine, 1970), *O. moubata* (Eichenberger, 1970), *O. parkeri* (Pound and Oliver, 1982) and *O. naviyayi* (Christophers, 1906; Evans and Solomon, 1977).

The peripheral nerve trunks and esophagus in *H. dromedarii* synganglion are surrounded by a periganglionic blood sinus, thus simulating other ixodid and argasid ticks and most arachnids (Bullock and Horridge, 1965; Babu, 1965; Marzouk, 1974; Roshdy and Marzouk, 1984; Marzouk et al., unpublished data). However, this sinus is lacking in the mesostigmatid mite, *Macrocheles muscadomestica* (Coons and Axtell, 1971) and the prostigmatid mite, *Blankaartia acuscutellaris* (Mitchell, 1964).

The neurilemma in *H. dromedarii* is a well-defined, collagenous, connective tissue sheath closely ensheathing the nervous tissue and extending into the esophageal canal inside the synganglion to surround the esophagus. Transmission electron microscopy of the neural lamella in *D. variabilis*, *Amblyomma americanum* and *Argas arboreus* (Coons et al., 1974) has demonstrated repeated layers of homogeneous, finely granular, disorganized material, showing axons which contain neurosecretory vesicles. A feltwork of collagenous fibrils showing periodic cross-banding and embedded in an amorphous matrix is found between these layers. This composite structure of the tick neurilemma is structurally similar to insect neural lamellar sheath, which allows relative permeability to nutrients and ionic exchange (Hess, 1958; Gray, 1956; Baccetti, 1961; Ashurst and Chapman, 1961; Smith and Treherne, 1963; Ashurst, 1965, 1968; Ashurst and Costin, 1971; Treherne and Pichon, 1972). The tick neurilemma acts primarily as a protective sheath providing structural support for the neural architecture, and may have a functional similarity to that of insects.

The perineurium in *H. dromedarii* is a relatively thin layer of glial cells that lies below the neurilemma, thus resembling other ticks (Eichenberger, 1970;

Obenchain, 1974). However, in *A. arboreus*, the perineurium forms a complex series of extensive, tortuous, membranous extensions of glial cells which contain large intracellular vacuoles with narrow intercellular spaces between adjacent cell boundaries (Coons et al., 1974). A notable difference between ixodids and argasids occurs in the structural organization of the perineurial glial cells (Coons et al., 1974). In the ixodids *Amblyomma americanum*, *B. microplus* and *D. variabilis* (Coons et al., 1974, Binnington and Lane, 1980) these cells lack intracellular spaces and contain large glycogen deposits. The intracellular spaces are thought by those authors to reflect a difference in the trophic requirements in the two families of ticks. Binnington and Lane (1980) suggested that the increase in the glycogen level in *B. microplus* perineurial cells may provide an important store of energy for the central nervous system as in the cockroach, *Periplaneta americana* (Wigglesworth, 1960). The subperineurium layer of glial cells separating the cortical zone from the neuropile in *H. dromedarii* synganglion is similar to that described in the mite, *Macrocheles muscadomestica* (Coons and Axtell, 1971), and the ixodid tick *D. variabilis* (Obenchain, 1974). It is not found in other ticks (Tavileneva, 1964; Eichenberger, 1970).

The distribution of the neuronal cell types in the cortical zone of *H. dromedarii* synganglion resembles that described in other ticks (Eichenberger, 1970; Coons et al., 1974; Obenchain, 1974; Obenchain and Oliver, 1975; Roshdy and Marzouk, 1984). Association, motor and neurosecretory neurons in *H. dromedarii* usually occur in bilaterally symmetrical groups. As in other ticks, the first pedal ganglia in *H. dromedarii* contain small compact masses of type B association neurons forming globuli cells.

Four of five types of glial cells occurring in the cortex and neuropile of *H. dromedarii* synganglion are similar to those described in *A. arboreus* (Roshdy and Marzouk, 1984), *D. pictus* (Ioffe, 1963), *H. aegyptium* and *R. sanguineus* (Satiya et al., 1971) and *O. moubata* (Eichenberger, 1970). However, the fifth type ("e" cells) is only distributed in the subperineurial layer of *H. dromedarii* and also in *D. variabilis* (Obenchain, 1974; Obenchain and Oliver, 1975).

The basic organization of connectives and commissures in a five-level system of nerve fiber

tracts in the subesophageal part of *H. dromedarii* synganglion is similar to that described in *D. pictus* (Ioffe, 1963), *H. detritum* and *H. anatolicum* (Obenchain, 1974) and *A. arboreus* (Roshdy and Marzouk, 1984). Pound and Oliver (1982) suggest that this system not only provides linkage of ganglial elements occurring within each of the two major ganglial parts, but also integrates passage of impulses between them.

The present anatomical data on the cellular organization of the synganglion cortex provides base line data to clarify the mechanism of neurosecretion and hormone production in *H. dromedarii*. Work in this direction is underway.

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التركيب المستولوجي للجهاز العصبي المركزي فى القراد من نوع هيالوما (هيالوما) دروميدرياي

عليه مرزوقى - جليلة خليل - فاطمة محمد - سهر عبد القوى

(من أقسام علم الحيوان - بكليات العلوم بجامعة عين شمس ، وقطر ، والأهر ، ومن قسم علم الحيوان الطبى
بوحدة البحوث الطبية للبحرية الأمر يكية بالقاهرة « نامرو ٣ »

يخترق المرىء الكتلة العصبية المركزية فيميزها إلى جزء علوى صغير وآخر سفلى كبير، وهى محاطة بجيب
دموى .

يتكون الجزء العلوى من عقدة المخ الأمامى وزوج من العقد الكلاية والعقد الملماسية ومركز الاتصال
بالقناة المضمية . أما الجزء السفلى فقد وجد أن الجزء الأكبر منه يحتوى على أربعة أزواج من العقد العصبية
الخاصة بالأرجل والعقد الجسمية المركبة .

من الناحية المستولوجية وجد أن العقدة العصبية المركزية محاطة بغلاف عصبى رقيق يتكون من نسيج
ضام يليه طبقة من خلايا غير عصبية ثم منطقة مكونة من خلايا عصبية وغرائية تحيط بالجزء المركزى اللبغى
الذى يتميز بدوره إلى خمس مستويات أفقية ورأسية من الموصلات الليفية .

الأنواع المختلفة من الخلايا العصبية والغرائية فى الكتلة العصبية المركزية أمكن تمييزها إلى خلايا موصلة
تشمل نوعين أ ، ب ، وخلايا محركة وخلايا إفرازية كذلك أمكن التعرف على خمسة أنواع من الخلايا الغرائية .

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19 ABSTRACT (Continue on reverse if necessary and identify by block number) The synganglion histology in female <u>H. dromedarii</u> is described and compared with other ticks. The synganglion, lying in a periganglionic blood sinus, is formed by a fused supraesophageal part (protocerebrum, cheliceral ganglia, pedipalpal ganglia and stomodeal pons) and a subesophageal part (4 pairs of pedal ganglia and the complex opisthosomatic ganglion). The synganglion is enclosed within a connective tissue sheath, the neurilemma. The perineurium underlies the neurilemma and is followed by the cortical region, which is separated from the neuropile by the subperineurium. Association, motor and neurosecretory cell types are the neurons which together with 4 of 5 glial cell types, compose the cortical zone of the synganglion. The fifth glial cell type is only distributed in the perineurium. Five levels of fibrous horizontal connectives and vertical commissures occur in the neuropile. *Zoology Department, Faculty of Science, Ain Shams University, Cairo, Egypt. +Zoology Department, Faculty of Science, Qatar University, Qatar.					
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