

# Nervous System in Two Species of *Cotylophoron*, a Rumen Parasite of Cattle

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## Introduction

The localization of non-specific esterase activity in trematodes has helped in revealing the complete nerve arrangement of many digenetic trematodes including some paramphistomes [1]. In continuation of our studies on the nervous system in the members of the latter group, another bovine paramphistome, *Cotylophoron* has been put to similar investigations and the complete nerve pattern and distribution is traced in two species of the genus, namely *C. cotylophorum* (Fischoeder, 1901; Näsmark, 1937) and *C. chauhani* (Gupta and Gupta, 1972).

## Materials and Methods

Live specimens of *Cotylophoron* spp. recovered from the rumen of freshly slaughtered cow at the local abattoirs in Shillong were fixed and processed for localizing the non-specific esterases as mentioned elsewhere [2].

## Observations

The nervous system in both the species studied herein comprises a pair of cerebral ganglia and three pairs each of anterior and posterior nerves emerging from them. The cerebral ganglia are situated dorsally to and at the postero-lateral margins of the pharynx connected with each other by a thick band like cerebral commissure (Figures 1, 5).

In *C. cotylophorum* the anterior longitudinal nerves include a pair each of the antero-dorsals, antero-inner ventrals and antero-outer ventrals (Figure 2). The antero-dorsals are the innermost pair emerging from the dorso-middle facet of the cerebral ganglia and take a course dorsal to the pharynx and finally terminate near the oral tip where a circum-oral ring is formed by the merging together of all the anterior nerves. The antero-inner ventrals originate from the ventro-lateral facet of the cerebral ganglia and proceed anteriorly lateral to the pharynx. The antero-outer

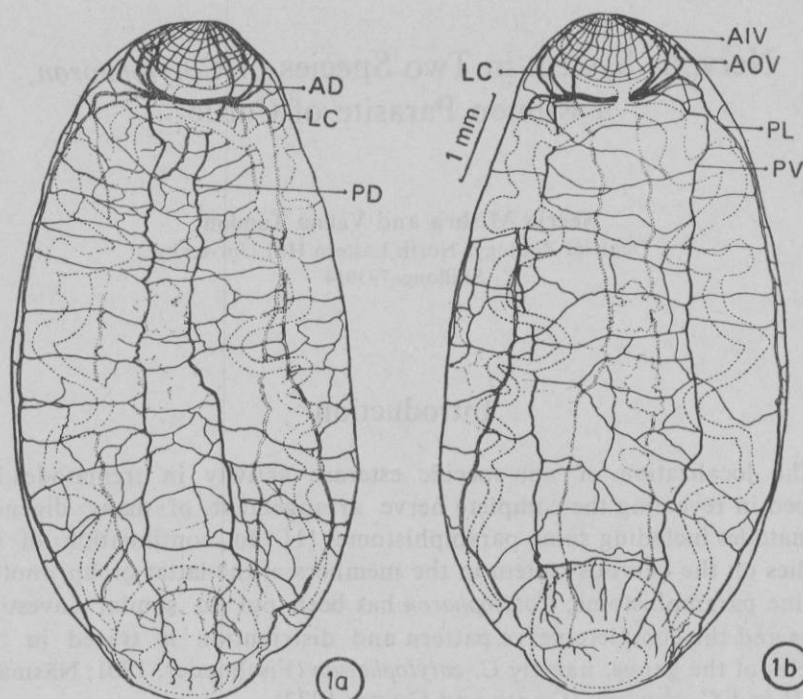
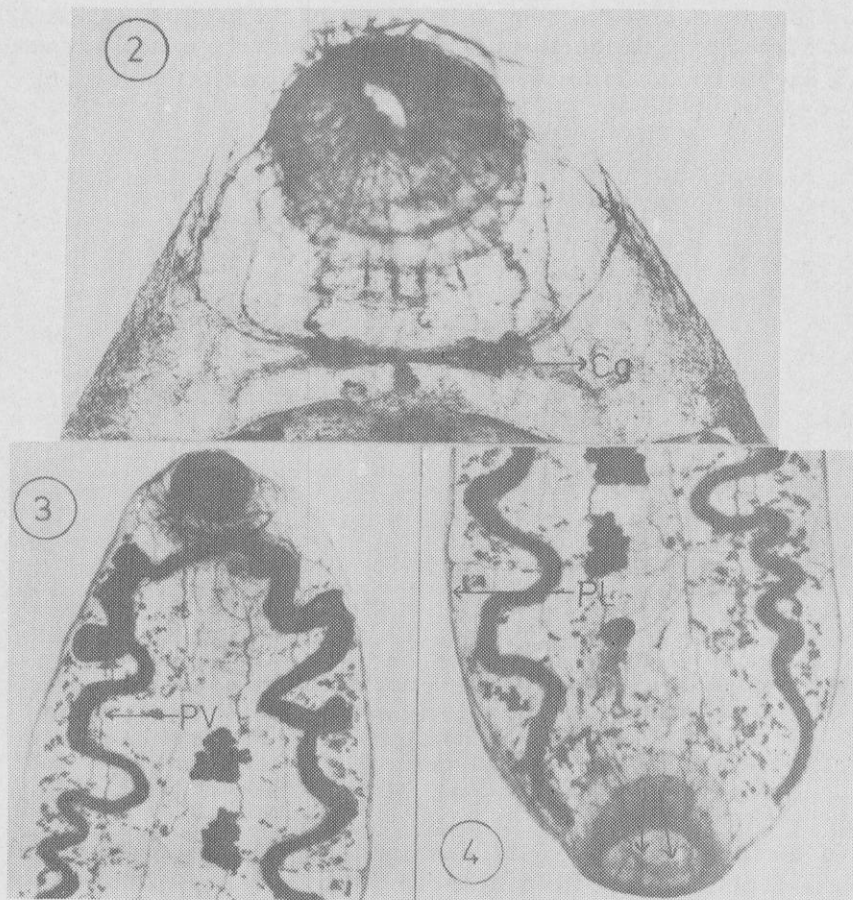


Fig. 1 *Cotylophoron cotylophorum*: 1. Camera lucida sketch of the nervous system in whole mount of the worm. (a) Dorsal view, (b) Ventral view. [AD—antero dorsal, AOV—antero-outer ventral, AIV—antero-inner ventral, Cg—cerebral ganglia, LC—longitudinal connective, PD—postero dorsal, PL—postero lateral, PV—postero ventral, POV—postero-outer ventral, PIV—postero-inner ventral]

ventrals originate from the lateral facet of the cerebral ganglia and run anteriad parallel to the lateral body wall. All the anterior longitudinal nerves are interconnected with one another by means of thin ring like transverse connectives encircling the pharynx. The latter are further joined with one another by still thinner longitudinal connectives thus constituting a closely knitted nerve basket (Figure 2). The anterior nerves are superficially lodged and innervate the dorsal, ventral and lateral aspects of the anterior region including the pharynx.

Of the posterior nerves, the inner most pair is of postero-dorsals which proceed medially (nearing the median axis) (Figure 3). These nerves innervate the alimentary canal, excretory duct and bladder and reproductive system. In the acetabular region both the postero-dorsals also join medially and their branches supply the floor and the lateral aspects of the sucker (Figure 4). The postero-ventrals arising from the postero-lateral facet of the cerebral ganglia proceed caudad and outer to the postero-dorsals. They also innervate the productive system, excretory system and vitellaria. The outermost nerve pair is of the postero-laterals that emerge from the postero-lateral facet of the cerebral ganglia. These nerves after

taking a short oblique course soon run parallel to the lateral edges of the body (Figure 3, 4). On their way to acetabulum they innervate the reproductive system, excretory system and lateral body wall. In the immediate preacetabular region, all the postero-ventrals and lateral nerves are joined by a common transverse connective; from the latter many branches emerge and supply the whole ventral surface of the sucker. The postero-ventrals of either side further proceed beyond the connective and several branches from them innervate the acetabulum. The two postero-laterals also extend beyond the connective up to the posterior extremity of the body. Several thin transverse connectives interconnect all the posterior nerves with one another. Still thinner and irregularly



**Fig. 2-4** *Cotylophoron cotylophorum*: 2. Brain mass and nerve net of anterior nerves ( $\times 30$ ), 3. All the posterior nerves in the postcerebral region ( $\times 12.3$ ), 4. Postero-dorsals joining medially (arrow) in the acetabular region ( $\times 12.3$ ). [AD—antero dorsal, AOV—antero-outer ventral, AIV—antero-inner ventral, Cg—cerebral ganglia, LC—longitudinal connective, PD—postero dorsal, PL—postero lateral, PV—postero ventral, POV—postero-outer ventral, PIV—postero-inner ventral]

distributed longitudinal and oblique connectives joining all the transverse connectives constitute a five nerve net on the dorsal and ventral surface of the body (Figure 1a, b).

A pair of transverse genital nerves derived from the postero-ventrals innervate the genital pore region.

The Postero-ventrals and postero-laterals of two sides are connected at their proximal ends with the antero-inner and antero-outer ventrals, respectively, of their respective side by way of a thin longitudinal connective.

Among the posterior nerves only the postero-dorsals are deeply seated in the parenchyma.

In *C. chauhani* the general nerve pattern closely resembles that of *C. cotylophorum*, however, a few differences from the latter are exhibited:

In *C. chauhani* the connectives of the anterior nerves are not arranged in a way to form a conspicuous circumpharyngeal basket (Figures 5, 6).

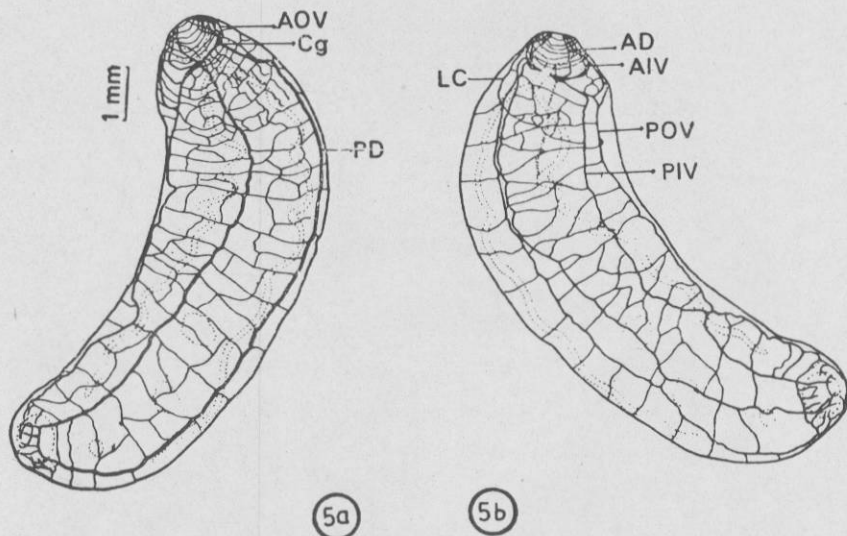


Fig. 5 *Cotylophoron chauhani*: 5. Camera lucida sketch of the nervous system in whole mount of the worm. (a) Dorsal view, (b) Ventral view. [AD—antero-dorsal, AOV—antero-outer ventral, AIV—antero-inner ventral, Cg—cerebral ganglia, LC—longitudinal connective, PD—postero-dorsal, PL—postero-lateral, PV—postero-ventral, POV—postero-outer ventral, PIV—postero-inner ventral]

Of the posterior nerves, the outermost nerve pair is not lateral but ventral in position termed as postero-outer ventrals (Figure 7); these nerves emerge from the ventro-lateral aspects of the cerebral ganglia. Inner to these are the postero-inner ventrals that emerge from the postero-ventral side of the cerebral ganglia (Figures 6, 7), these nerves correspond to the postero-ventrals of *C. cotylophorum*. Fine branches given off from the postero-ventrals extend towards the median axis and by their further ramification and anastomosis, medially form the ventral nerve net (Figure 5b).

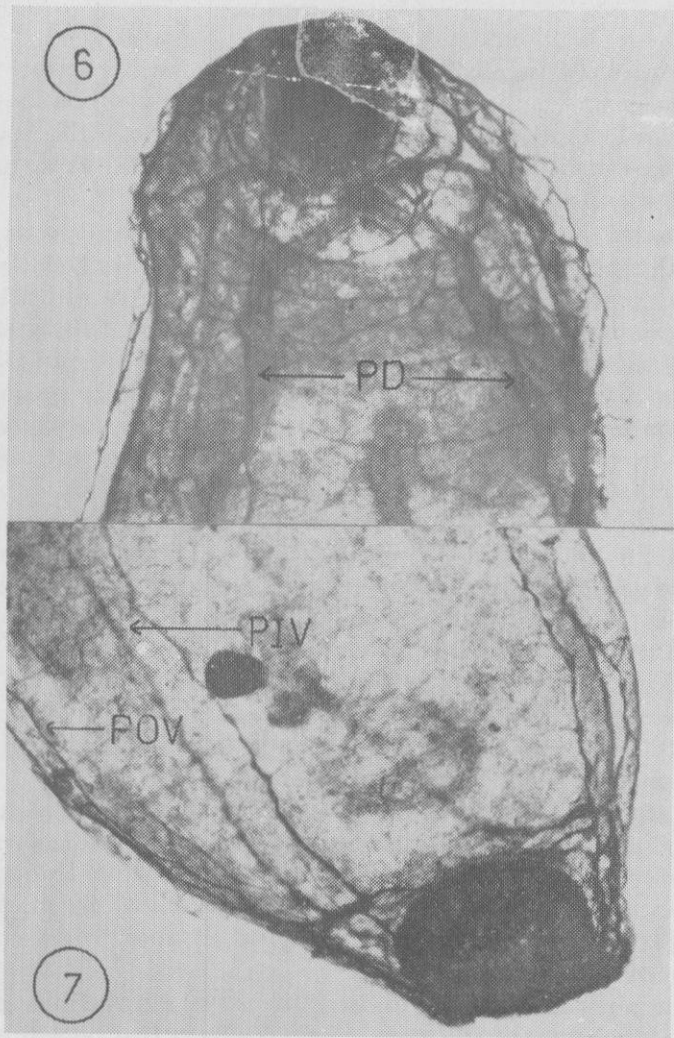


Fig. 6-7 *Cotylophoron chauhani*: 6. Brain mass and the main anterior and posterior nerves ( $\times 30$ ), 7. Termination of the postero-ventrals in the acetabular region ( $\times 30$ ). [AD—anterodorsal, AOV—antero-outer ventral, AIV—antero-inner ventral, Cg—cerebral ganglia, LC—longitudinal connective, PD—postero-dorsal, PL—postero-lateral, PV—postero-ventral, POV—postero-outer ventral, PIV—postero-inner ventral]

The genital pore region is innervated by the tributaries of the ventral nerve net.

Only one pair of longitudinal connectives joining the antero- and postero-outer ventral nerves of either side is present.

## Discussion

NSE of carboxylesterase group hydrolyse the indoxyl acetate (Pearse, 1972). The components of nervous system are clearly visible using this substrate for localizing the non specific esterases in both the species of *Cotylophorum* studied herein. However no NSE activity was reported in the nervous system of *Ceylonocotyle scolioceelium* [3].

With regard to the neuroanatomical pattern both the species closely agree with each other. This similarity is not surprising as both belong to the same genus. A comparison of the nerve pattern with other non-pouched paramphistome species investigated so far viz. *Olyeria indica* [4] and *Parorientodiscus magnus* and *Paramphistomum calicophorum* [5] brings out several differences although revealing some general resemblances. The circum-pharyngeal nerve basket observed in *C. cotylophorum* is not reported in these species. Also, neither an extra pair of anterior nerves i.e. pharyngeal nerves, reported to be occurring in *O. indica*, *P. magnus* and *P. calicophorum* nor the oesophageal nerves in the last two mentioned spp. [5] are not present in *Cotylophoron* spp. . . The presence of a pair of transverse genital nerves as observed in *C. cotylophorum* has also been reported in the above mentioned paramphistomine [4] and cladorchiine [5] species. The longitudinal ventro-lateral connectives observed in *Cotylophoron* spp. correspond to the accessory nerves of *P. magnus* [5]. A conspicuous acetabular nerve described for other species [4, 5] is absent in the species studied herein, instead all the posterior nerves innervate the acetabulum.

A few features of the nerve topography of the non pouched paramphistomes are also shared by pouched species like *Gastrothylax* and *crumenifer* and *Fischoederius* spp. [1, 2]. The feature of a circumpharyngeal nerve basket as occurring in *C. cotylophorum* is also shared by *Fischoederius cobboldi* [2] and like *C. chauhani*, the pouched species lack a separate genital nerve.

Though no group-specific patterns of nerve distribution seem to be emerging, in comparison to the paramphistomes that possess a ventral pouch, the non-pouched species are found to have a coarser and less complicated nerve net.

## Summary

Based on the indigogenic technique of esterase localization the nerve arrangement is studied in two species of *Cotylophoron*, *C. cotylophorum* and *C. chauhani*, the non pouched bovine paramphistomes. With regard to neuroanatomical pattern, both the worms closely agree with each other in having two cerebral ganglia situated postero dorsally to pharynx and three pairs each of anterior and posterior nerves and their course and distribution in various organs. However, they differ from each other in

the respect that *C. cotylophorum* possess a fine nerve basket in pharyngeal region contributed by anterior pairs of nerves. In this species the genital pore region is innervated by a pair of transverse genital nerves but in *C. chauhani* the tributaries from the nerve not formed by postero inner and outer ventrals supply the genital pore area. In *C. chauhani* the dorsal and ventral surface nerve net is highly complicated and dense. The nerve arrangement is described in detail in two species and compared with other paramphistomes.

## References

1. Mishra, N. and Tandon, V.: Proc. Indian Acad. Sci. (Anim. Sci.), 94: (2), 129-138, 1985.
2. Mishra, N. and Tandon, V.: Indian J. Parasitol., 8: (1), 33-39, 1984.
3. Roy, T. K.: Indian J. Exp. Biol., 18: 872-876, 1980.
4. Mishra, N. and Tandon, V.: J. Helminthol., 1986 (in press).
5. Lee, S. K.: Zool. Anz. Leipzig., 187: 1-25, 1971.