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RESEARCH ARTICLE

PRENATAL STUDIES ON INTERMEDIATE HORN OF SPINAL CORD IN GOAT

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ABSTRACT

Prenatal development of intermediate horn of gray matter in goat was studied using 52 foetuses of various ages. By 48 days of gestation, outer white matter and inner gray matter became distinguishable; the latter with dorsal and ventral horns. In thoracic, anterior lumbar and middle sacral levels the intermediate horn appeared as lateral projections of gray matter. It contained lamina VII of the intermediate zone and presented intermediolateral and intermediomedial nuclei. Intermediolateral nucleus appeared by 48 days as a clear cell column at the lateral aspect of intermediate horn, became better organized by 54 days and well differentiated by 124 days. By 81 days, cells were spindle-shaped with acidophilic, scanty cytoplasm and condensed nucleus. Typical spindle-shaped neurons with vesicular nucleus and size upto 36 µm were seen towards end of gestation. Intermediomedial nucleus appeared by third month in thoracic and lumbar regions, consisting of small-sized neurons located lateral to central canal and ventral to Clarke's column in the medial aspect of intermediate horn. By fifth month, these nuclei became better developed with fine and uniformly distributed Nissl bodies indicating a better differentiation towards the end of gestation.

INTRODUCTION

Gray matter of the spinal cord is arranged in columns, which extend the entire length of the cord. The 'H' shaped gray matter in cross-section presents dorsal and ventral horns on either side. Intermediate (lateral) horn projects laterally from the lateral intermediate substance between dorsal and ventral horns and is prominent in the thoracolumbar parts of the spinal cord (Dellmann and Mc Clure, 1975). As the data on the developmental aspect of intermediate horn in goats are very limited, a study was undertaken to elucidate the normal structure and development of the same at different stages of prenatal growth in this species.

MATERIALS AND METHODS

The study was conducted on 52 goat foetuses of different ages. The age was calculated using the formula derived by Singh *et al.* (1979), for goat foetuses, $W^{1/3} = 0.096$ (t - 30), where, 'W' is the body weight of the foetus in grams and 't' is the age of the foetus in days. The foetuses were grouped into five age groups corresponding to five months of gestation. The fixative used was 10 per cent neutral buffered formalin. Embryos and small foetuses upto 50 days were fixed as such. In foetuses from 50 days to 90 days, the spinal cord within the vertebral column was processed after cutting into region-wise pieces and serial sections were made. In foetuses above 90 days of gestational age, the spinal cord was exposed by laminectomy, dissected out from the vertebral canal and cut into several pieces of two to three segments each and processed. The specimens were washed, dehydrated, embedded in high melting paraffin (MP 58-60^{o}C), serial sections of 5µm thickness were cut and stained for central nervous system tissues. The data collected were analysed statistically following Snedecor and Cochran (1994).

RESULTS

In the present study, the tubular form of the primordium (neural tube) was with inner ependymal, middle mantle and outer marginal layers upto middle of the second month of gestation. By 48 days, in foetuses of CRL 40 mm, the inner gray matter and outer white matter became distinguishable from the mantle and marginal layers respectively. The mantle layer got differentiated into the dorsal and ventral horns of gray matter. Central intermediate substance surrounded the central canal with dorsal and ventral gray commissures and was continuous with the lateral intermediate substance located between dorsal and ventral horns. The intermediate horn projected laterally from the lateral intermediate substance from this age onwards (Fig. 1).

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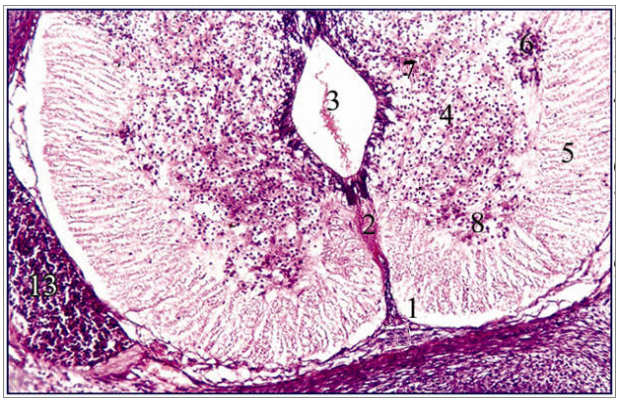

Fig.1 C.S. of thoracic region of spinal cord (48 days) H&E x 100
1. Ventral median fissure2. Ventral commissure 3. Central canal
4. Gray matter5. White matter 6. Intermediate Horn
7. Clarke's column 8. Ventral horn

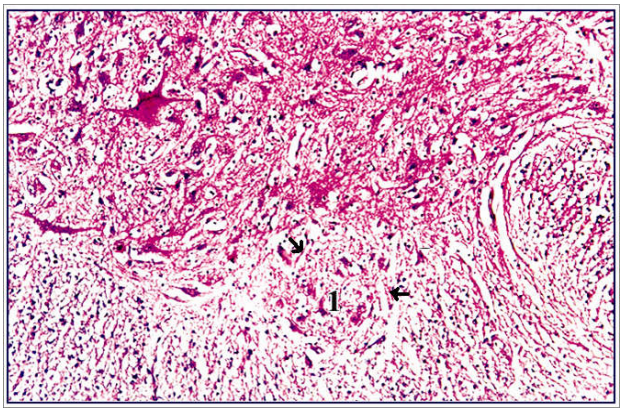

Fig. 2 C.S. of fourth lumbar segment at 102 days. H&E x 100
1. Intermediolateral nucleus with encircling fibres (arrows)

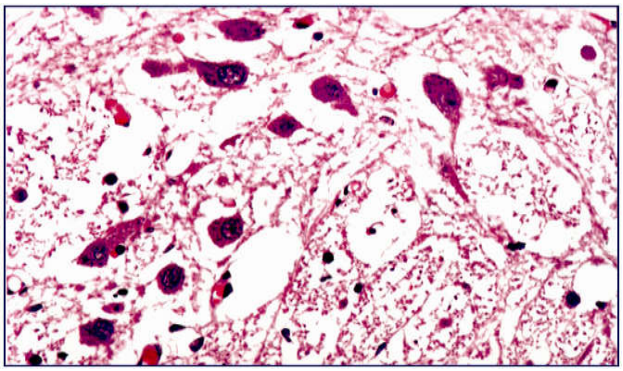

Fig. 3 Cells of intermediolateral nucleus at second lumbar segment (142 days) showing spindle shape and uniform distribution of Nissl bodies. H & E x 400

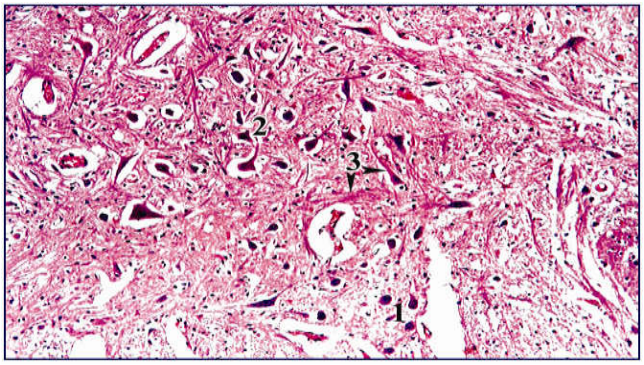

Fig. 4 Intermediate zone of gray matter at tenth thoracic segment (142 days). H&E x 100.
1.Intermediolateral nucleus 2. Intermediomedial nucleus
3.Processes extending between the two nuclei

The intermediate horn extended from C8 or T1 to L2 segments. It was also seen at the middle sacral region. This horn contained intermediolateral and intermediomedial nuclei, which belonged to the lamina VII of the spinal cord gray matter. By the middle of second month, the intermediolateral nucleus appeared as a clear cell column in the lateral aspect of the intermediate horn. This nucleus was better organized towards the end of second month by 54 days. It became surrounded by fibres in the fourth month (Fig. 2). The neurons in this nucleus were not as differentiated as those of the ventral horn upto fourth month, but became prominent towards the end of gestation. By 62 days, the cells had approximately 5.4 µm size with indistinguishable cell boundaries. Towards the end of third month, by 81 days, this nucleus was better differentiated, and measured 75 µm size with spindle-shaped cells of 7.6 to 11.4 µm in size with acidophilic and scanty cytoplasm and condensed nucleus.

The intermediolateral nucleus became well developed in the beginning of fifth month by 124 days. Towards the end of this month, the nucleus presented a size of 87.5 to 125 µm in width. Typically spindle-shaped neurons (Fig. 3) with vesicular nucleus, 36 µm length and 7.2 µm width could be seen. The processes extended from these neurons at the intermediolateral nucleus towards the neurons of intermediomedial nuclei (Fig. 4).The intermediomedial nucleus appeared for the first time towards the end of third month in the thoracic and lumbar regions, consisting of small-sized neurons located lateral to central canal and ventral to Clarke's column. Towards the end of fifth month, the intermediomedial nucleus was better developed (Fig. 4) and had an average size of 275 µm in anterior and middle thoracic region. But this nucleus was small with a size of 50 µm at caudal thoracic and anterior lumbar segments. Towards the fifth month, this nucleus was small at T1 and had 87.5 µm size with neurons of 14.4 µm width and 25.2 µm length with an average nuclear size of 10.8 µm.The neurons in the intermediate horn were always smaller than those of the ventral horn. The latter measured upto 75µm towards the end of gestation. The Nissl bodies were finer and uniformly distributed in the neurons of intermediomedial and intermediolateral nuclei.

DISCUSSION

By 48 days, the central intermediate substance surrounded the central canal with dorsal and ventral gray commissures and was continuous with the lateral intermediate substance. The intermediate horn projected laterally from the lateral intermediate substance in accordance with the reports of Rao (1970) in buffalo calf and Zargar *et al.* (1975) in albino rat, who found the presence of substantia intermedia lateralis and centralis in the intermediate gray matter. The intermediate horn extended from C8 or T1 to L2 segments and was also seen at the middle sacral region in this study. The location of this horn agreed with the reports by Jenkins (1978) in mammals, who identified the intermediate horn as the nucleus of origin for the general visceral efferent neurons of the autonomic nervous system. Intermediate horn presented intermediolateral and intermediomedial nuclei in accordance with the findings of Papez (1967), who described the cells of the intermediate horn as contributing preganglionic fibres, which pass through the white rami communicans and

terminate on cells of sympathetic ganglia. By the middle of second month, the intermediolateral nucleus appeared in this study. The presence of this nucleus was also reported in buffalo calf (Rao, 1970), and albino rat (Zargar *et al.*, 1975) in the lateral aspect of intermediate horn. Intermediolateral nucleus was surrounded by fibres in the fourth month, in accordance with the findings of Rethelyi (1976), who revealed a regular orientation of dendrites in the intermediate region forming a circular or elliptical gray matter in cats. The neurons in the intermediolateral nucleus were not as differentiated as those of the ventral horn initially. By the end of third month, the nucleus was better differentiated with spindle-shaped cells. The cells were always smaller than the alpha neurons in the ventral horn, agreeing with the reports of Truex and Carpenter (1969), who described these visceral efferent neurons as smaller than the somatic motor cells.

Intermediomedial nucleus appeared for the first time in the present study by the end of third month in the thoracic and lumbar regions ventral to Clark's column. Its presence was also reported in buffalo calf (Rao, 1970) and albino rat (Zargar *et al.*, 1975) in the medial aspect of intermediate horn. Even towards the end of gestation, this nucleus was small similar to the reports of Arciszewski *et al.* (1999) who also described this nucleus as an interrupted band of cells extending from C1 to S5 during the prenatal period in horses. In the present study, the processes extended from the neurons of intermediolateral nucleus towards those of intermediomedial nucleus. This was in accordance with the findings of Grottel and Teresa (1979), who observed that such dendrites reach lamina II of the spinal cord gray matter. The intermediate horn was absent in the anterior cervical region, prominent in the thoracic region and reappeared in the middle sacral region. Papez (1967) reported that it gives rise to the cervical sympathetic chain, the cardiac plexus, white rami communicans of the intercostal nerves and the splanchnic nerves; and in the lower sacral segments also to the hypogastric plexus. Towards the end of gestation, these nuclei became better developed with fine and uniformly distributed Nissl bodies indicating a better differentiation of the autonomic nervous system by birth.

REFERENCES

Arciszewski, M.B., Fleiger, S. and Zacharko, A. 1999. Nucleus intermediomedialis in the spinal cord of the horse in the prenatal period. *Medna. vet.* 54:1-9.

Dellmann, H.D. and Mc Clure, R.C. 1975. Central nervous system. *Sisson and Grossman's The Anatomy of the Domestic Animals, Volume I.* Fifth edition. (ed. Getty, R.). W.B. Saunder's Company, Philadelphia, pp. 1065-1080.

Grottel, K. and Teresa, H. 1979. Topography of dendrites of neurons of thoracic lateral horns in cat spinal cord. *Folia morph.* 37: 327-334.

Jenkins,T.W. 1978. *Functional Mammalian Neuroanatomy*. Second edition. Lea and Febiger, Philadelphia, p. 480

Papez, J.W. 1967. *Comparative Neurology- A manual and Text for the Study of the Nervous System of Vertebrates*. Hafner Publishing Company, New York. p. 518.

Rao, G.S. 1970. Nuclear pattern of spinal gray matter in the buffalo. *J. anat. Soc. India*. 19: 5-11.

Rethelyi, M. 1976. Central core cells in the spinal grey matter. *Acta morph. hung.* 24: 63-70.

Singh,Y., Sharma, D.N. and Dhingra, L.D. 1979. Morphogenesis of testis in goat. *Indian J.Anim.Sci.* 49: 925-931.

Snedecor, G.W. and Cochran, W.G. 1994. *Statistical Methods*. Eighth edition. Oxford and IBM Publishing Company, New Delhi, pp. 313.

Truex, R.C. and Carpenter, M.B. 1969. *Human Neuroanatomy*. Sixth edition. The Williams and Wilkins Company, Baltimore, pp.673.

Zargar, R.K., Mehrotra, T.N. and Shinde, V.A. 1975. Nuclear pattern and extend of anterior horn cells in spinal cord of albino rats. *J. anat. Soc. India.* 24: 49.

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