

Neuronal arrangement in cervical enlargement of spinal cord of rabbit

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Abstract

Study was conducted using eight adult rabbits with an aim to see the arrangement of motor neuron somata in ventral grey horn of spinal cord of rabbit 'in the region of cervical enlargement (i.e. C5 - T1 spinal cord segments)' and further to localize the motor neuron somata of various nerves of forelimb. These rabbits were sacrificed and perfusion fixed in 10% buffered formalin. Cervical spinal cord segments (C5 - C8) and thoracic spinal cord segment (T1) were processed for paraffin embedding. 40-micron thick serial transverse sections were obtained and every 5th section stained with thionin. Reconstruction from serial transverse section of different segments was done by Elliot's method and it was found that neurons in the spinal cord are not scattered but they are arranged in vertical columns. Following columns of cells were observed. Ventrolateral column, from 5th cervical to 1st thoracic segment. Dorsolateral column, from 5th cervical to 1st thoracic segment. Retrodorsolateral column, from 8th cervical to 1st thoracic segment. Ventromedial column; from 5th cervical to 1st thoracic segment. Dorsomedial column; from 8th cervical to 1st thoracic segment. Central column; from 5th cervical to 6th cervical segment.

Key words: Spinal cord, neuron somata, ventral grey horn, cell columns and spinal segment.

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Introduction

Most of the workers have found that neuron somata of spinal cord are not scattered, but are organized in more or less definite columns or groups, which may be recognized in transverse sections as separate groups distinguished from one another, e.g. [1-13].

However, some authors [14,15] have questioned the columnar organization of grey matter of spinal cord. Since the time of [16] the motor neuron somata of mammalian spinal cord have generally been considered to lie in longitudinal columns, which extend over many segments or in some cases over entire length of spinal cord. Many workers have focused their attention to the arrangement of nerve cell groups or columns in spinal cord. In spite of this there is some disagreement on the functional significance of various motor cell groups or columns of spinal cord.

The aim of present study is to see the arrangement of neuron somata in ventral grey horn of spinal cord in the region of cervical enlargement and further to localize the motor neuron somata of various nerves of upper limb in ventral grey horn of spinal cord both for rostrocaudal extent as well as their relative positions in ventral grey horn.

Material and Methods

Eight adult rabbits were used in this study. Animals were sacrificed with an overdose of chloroform and were immediately perfused through left ventricle of heart. Before starting the perfusion one of the superficial veins was cut in the neck. During perfusion first 500 ml normal saline was injected followed by injection of 1500 ml of 10 % of formal saline so that animal may be perfusion fixed. Twenty-four hours after perfusion spinal cord and hind-brain were exposed by dorsal approach i.e. by laminectomy and destruction of skull. Cervical and upper thoracic segments of spinal cord were removed along with hind-brain. The 5th, 6th, 7th, & 8th cervical and 1st thoracic spinal segments were identified, separated from each other and embedded in paraffin. Tissue blocks of each segment were prepared.

Serial transverse sections of each embedded segment were cut at 40-micron thickness mounted on slides and stained with thionin.

From the stained sections reconstruction of longitudinal cell columns of ventral Grey horn of spinal cord was done from serial transverse sections at the levels extending from 5th cervical to 1st thoracic segments. The above reconstruction was done by Elliott method, which is described below.

Images of twenty transverse sections in a serial order from the desired level of reconstruction were projected on a sheet of white paper. The periphery of first image of series was drawn on the paper. The outline of the grey matter was also drawn on the same sheet of the paper and the position of each cell image of the ventral Grey horn was marked by a dot. The peripheries of successive images were then made to fit accurately to the pencil outline so that the corresponding portion of all images should successively fall in exactly the same part of drawing. The

cell bodies of neurons from all these images were recorded by dots.

Observations

It was found that neurons in the spinal cord are not scattered but they are arranged in vertical columns. Following columns of neurons were observed by reconstruction from serial transverse sections at different spinal segment levels (Figs.1-2).

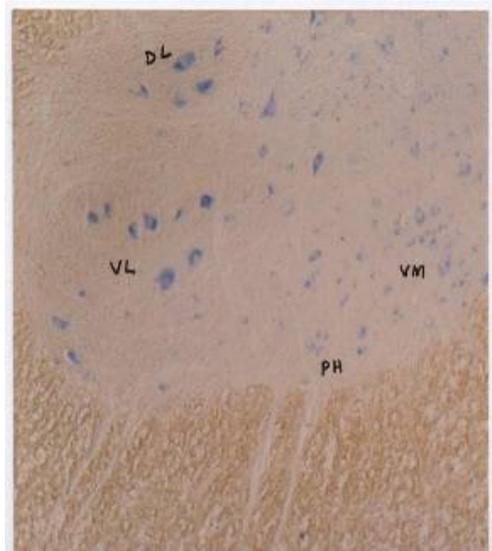
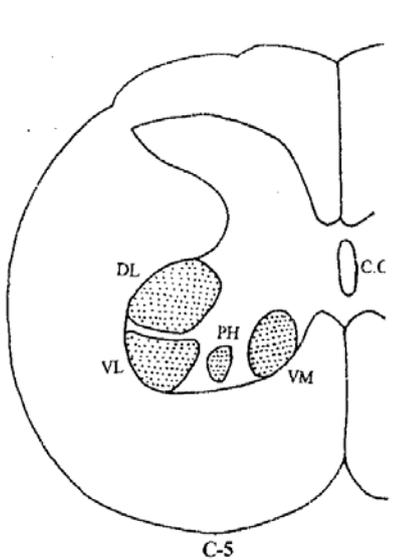


Figure 1.Reconstructed sketch by Elliott's method and photomicrograph of C5 spinal segment showing dorsolateral (DL), ventrolateral(VL), ventromedial(VM) and central(PH) column of motor neuron somata in spinal cord of rabbit

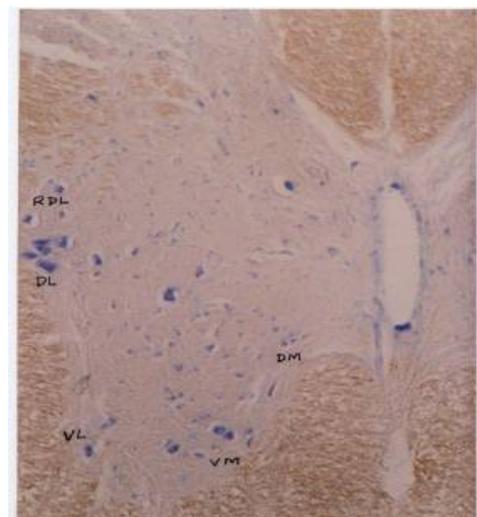
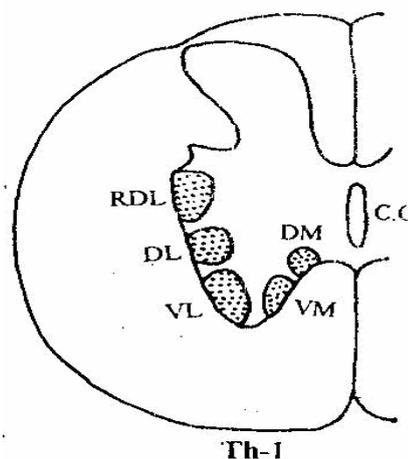


Figure 2 Reconstructed sketch by Elliott's method and photomicrograph of T1 spinal segment showing dorsolateral (DL), ventrolateral (VL), dorsomedial(DM) ventromedial (VM) and retrodorsolateral (RDL) column of motor neuron somata in spinal cord of rabbit.

Ventromedial (VM) column, Dorsomedial (DM) column, Ventrolateral (VL) column, Dorsolateral (DL) column, Retrodorsolateral (RDL) column and Central (PH) column.

Ventromedial column was present in ventral and medial part of ventral grey horn of spinal cord, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Dorsomedial column was present in dorsal and medial part of ventral Grey horn of spinal cord, extending from middle of 8th cervical (C8) to cranial end of 1st thoracic (T1) spinal segment. Ventrolateral column was present in ventral and lateral part of ventral Grey horn of spinal cord, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Dorsolateral column was present in dorsal and lateral part of ventral Grey horn of spinal cord, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Retrodorsolateral column was present dorsal to dorsolateral column, extending from middle of 8th cervical (C8) to cranial end of 1st thoracic (T1) spinal segment. Central column was present between Ventromedial and ventrolateral columns, extending from caudal end 5th cervical (C5) spinal segment to middle of 6th cervical spinal segment.

Discussion

It was found in present study that topographical arrangement of ventral Grey horn neuron somata is columnar. As such the findings of present study are in agreement with many investigators e.g. [1-10,11-13].

The findings of present work are not in agreement with [14,15] etc who have questioned the columnar organization of Grey matter of spinal cord. The findings of present study in rabbit are in agreement with [11] who also found in buffalo the presence of Ventrolateral, dorsolateral and retrodorsolateral columns on the lateral side and Ventromedial and dorsomedial on medial side of ventral Grey horn of cervical and upper thoracic part of spinal cord except that the dorsomedial and retrodorsolateral columns were found to be absent in 5th, 6th, and 7th cervical segments in present study.

The findings of present study are in agreement with [17] who described the presence of Ventromedial and dorsomedial columns on medial side and ventrolateral, dorsolateral and retrodorsolateral columns on lateral side of ventral Grey horn in cervical enlargement of human spinal cord. However the findings of present study are not in total agreement with [17] so far as the longitudinal extent of the cell columns is concerned.

In present study Ventrolateral column extends from caudal end of 5th cervical segment to cranial end of 1st tho-

racic segment, but [17] found that this column was not present in 1st thoracic segment.

In present study dorsomedial column was found from 8th cervical to 1st thoracic spinal segment but [17] found that this column was present only in 1st thoracic spinal segment.

Conclusion

Conclusion drawn from above study is that the neurons in the spinal cord are not scattered but they are arranged in vertical columns. Following columns of neurons were observed at different spinal segment levels (Figs.1-5).

Ventromedial (VM) column, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Dorsomedial (DM) column, extending from middle of 8th cervical (C8) to cranial end of 1st thoracic (T1) spinal segment. Ventrolateral (VL) column, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Dorsolateral (DL) column, extending from caudal end of 5th cervical (C5) to cranial end of 1st thoracic (T1) spinal segment. Retrodorsolateral (RDL) column, extending from middle of 8th cervical (C8) to cranial end of 1st thoracic (T1) spinal segment. Central (PH) column, extending from caudal end 5th cervical (C5) spinal segment to middle of 6th cervical spinal segment.

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