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Roots of the Lateral Cord of the Brachial Plexus in Man

Korzenie pęczka bocznego splotu ramiennego u człowieka

The lateral cord is usually formed by the union of two roots, superior and inferior. The origin of the roots has been known for a long time, but those investigations did not concern their internal structure. The purpose of this work was to determine both the thickness of the roots of the lateral cord and the number of fascicles, the size and the index of their cross-section area.

MATERIAL AND METHODS

The studies were carried out on material obtained bilaterally from the cadavers of 33 males (♂) and 33 females (♀) who died between the age of 11 days and 86 years. They were free of any neurological diseases. The cadavers were divided into six age groups, as described in the previous paper (9). Group I included 5 ♂ and 5 ♀, group II — 5 ♂ and ♀, group III — 5 ♂ and 7 ♀, group IV — 5 ♂ and 6 ♀, group V — 8 ♂ and 5 ♀, group VI — 5 ♂ and 5 ♀. The methods used to obtain the samples, stain the slides and to determine the thickness of different parts of the peripheral nervous system and their fascicles, the number of fascicles and the index of the fascicles area, were described in the previous papers (9, 10).

RESULTS

The lateral cord of the brachial plexus was formed by the union of two roots — superior and inferior. The superior root has been made in all the cases by the anterior division of the superior trunk. The inferior root has been made by the anterior division of the middle trunk in 87.9%, by its lateral branch in 7.6% and by the anterior lateral part of the middle trunk in 4.5% of the cases.

Thickness of the roots of the lateral cord

The dimension of the cross-section area of both roots showed the following range of values: the superior root 0.789—11.022 sq mm, the inferior root 0.471—14.120 sq mm. The thickness of the superior root was the same on both sides of a single body in 3%, and of the inferior root in 3% too. It was greater on the right side, respectively, in 60.6 and 51.5%, and it was greater on the left side in 36.4 and 45.5% of the cases. The thickness of both roots was the same in 13.6%, the thickness of the superior root was greater in 33.4%, and the thickness of the inferior root was greater in 53.0% of the cases.

The average thickness of the superior root equalled (in sq mm) 4.918 [on the right side (r) 5.042, on the left side (l) 4.794, in males (♂) 4.992, in females (♀) 4.844], and of the inferior root 5.304 (r — 5.409, l — 5.200, ♂ — 5.468, ♀ — 5.140). The values mentioned above in the age groups came out to be: in group I 1.919 and 1.980 respectively, in group II — 4.282 and 3.442, in group III — 5.865 and 6.820, in group IV — 5.544 and 6.175, in group V — 6.262 and 6.663., in group VI — 6.042 and 5.897.

Number of fascicles

The superior root was composed of 1 to 14 fascicles and the inferior root was composed of 1 to 20 fascicles. There were 1 to 5 fascicles in the superior root in 64.4%, and in the inferior root in 38.6%, from 6 to 10 fascicles were found respectively in 30.3 and in 47.7%, and more than 10 fascicles in 5.3 and 13.7% of cases. The same number of fascicles on both sides of one body was found in 18.2% in the superior root and in 4.6% in the inferior root. The number of fascicles was greater on the right side of the body in 51.5 and in 42.4%, and it was greater on the left side in 30.3 and 53.0% of cases respectively. The number of fascicles was the same in both roots in 7.6%, the greater number in the superior root in 30.3%, and in the inferior root in 62.1% of cases.

The mean number of fascicles equalled in the superior root 4.9 and in the inferior root 6.8, while on the right side it was 5.1 and 6.7, respectively, on the left side 4.7 and 7.0, in males 4.3 and 6.6, in females 5.5 and 7.1. In the age groups it was: in group I — 4.0 and 7.0, in group II — 5.3 and 7.0, in group III — 4.6 and 6.7, in group IV — 4.9 and 7.2, in group V — 5.3 and 6.5, in group VI — 5.2 and 6.8 respectively.

Dimension of the cross-section area of fascicles

The thickness of the individual fascicles showed the following range of values: 0.002—9.899 sq mm in the superior root, and 0.001—5.247 sq mm in the inferior root. Five groups of the fascicles were distinguished, which were described in the

previous paper (10). They appeared with different frequency in the superior and inferior root. Very thin fascicles (vtn) made 18.3% in the superior root and 24.5% in the inferior root, thin fascicles (tn) made 20.7 and 28.9% respectively, medium-thick fascicles (mtk) 18.6 and 16.8%, thick fascicles (tk) 20.5 and 16.7%, very thick fascicles (vtk) 21.9 and 13.1%.

The frequency of occurrence of differently thick fascicles in the examined roots was unequal in the age groups. The participation of fascicles in the structure of the superior root was as follows: in group I — vtn 38.7%, tn — 21.2%, mtk — 21.2%, tk — 11.3% and vtk — 7.5%, in group II it was 19.8%, 26.4%, 19.8%, 26.4% and 7.5% respectively, in group III — 6.4, 19.1, 12.7, 31.8 and 30.0%, in group IV — 11.2, 24.3, 21.5, 16.8 and 26.2%, in group V — 16.8, 16.8, 18.2, 21.2 and 27.0%, in group VI — 23.1, 17.3, 19.2, 12.5 and 27.9%.

In the inferior root in age group I vtn made 44.7%, tn 39.7%, mtk 8.5%, tk 5.7% and vtk 1.4%, in group II respectively 23.6, 40.7, 21.4, 12.1 and 2.2%, in group III — 20.6, 23.0, 16.4, 20.0 and 20.0%, in group IV — 20.6, 23.8, 18.7, 21.9 and 15.0%, in group V — 20.1, 21.9, 17.3, 21.3 and 18.9, in group VI — 19.1, 27.3, 17.6, 17.6 and 18.4%.

The cross-section area of all the fascicles forming the superior root ranged between 0.455 and 9.899 sq mm, and in the inferior root ranged between 0.204 and 7.175 sq mm. It showed similar values on both sides of one body in 6.1% in the superior root, and in 1.5% in the inferior root, greater on the right side respectively in 56.1 and in 59.1%, greater on the left side in 37.8 and in 39.4% of the cases. The sum of the thicknesses of fascicles of the superior root compared with the respective sum of the inferior root was similar in 12.1%, greater in 42.4%, and it was less in 45.5% of the cases.

The average value of the cross-section area of the fascicles of the superior root equalled (in sq mm) 3.272 (r — 3.313, l — 3.231, δ — 3.293, η — 3.251), and of the inferior root 3.287 (r — 3.356, l — 3.217, δ — 3.385, η — 3.188). It was different in the age groups; in group I the average value was: in the superior root 1.238, and in the inferior root 1.195, in group II respectively — 2.141 and 2.123, in group III — 3.919 and 4.287, in group IV — 3.675 and 3.787, in group V — 4.141 and 4.234, in group VI — 4.086 and 3.559.

Index of the cross-section area of fascicles (IAF)

The magnitude of the index of the fascicle's area was similar on both sides of a single body in 12.1% in the superior root and in 15.2% in the inferior root, greater on the right side in 36.4 and 43.9% respectively, greater on the left side in 51.5 and 40.9% of the cases. It was similar in both roots in 7.6%, greater in the superior root in 57.6%, greater in the inferior root in 34.8% of the cases. The

average value of IAF equalled in the superior root 66.5 (r — 65.7, l — 67.4, ♂ — 66.0, ♀ — 67.1) and in the inferior root 62.0 (r — 62.0, l — 61.9, ♂ — 61.9, ♀ — 62.0). The value mentioned above in the age groups ranged as follows: in group I in the superior root it was 66.6 and in the inferior root it was 60.4, in group II respectively 65.2 and 61.7, in group III — 66.8 and 62.9, in group IV — 66.3 and 61.3, in group V — 66.1 and 63.5, in group VI — 67.6 and 60.4.

DISCUSSION

The lateral cord was usually formed by the junction of roots originating from two trunks — the superior one and the middle one. The certain variants of its beginning in man and in some primates were described (3, 4, 6, 11, 12), but they appeared very rarely. In the examined material the lateral cord was formed by the junction of two roots — the superior one and the inferior one. The first has been made in all the cases by the anterior division of the superior trunk, the second originated from the anterior division of the middle trunk. We were unable to find any papers concerning the internal structure of the roots of the lateral cord in the literature. The presented investigations showed great individual variability and asymmetry of some features of internal structure of both roots, like other parts of the peripheral nervous system (1, 2, 5, 7—10). The discussed roots differed between each other in thickness, in the number of fascicles, in the size of their cross-section area and the index of the fascicle's area.

The examined features were similar in both roots in a single person: the thickness in 13.6%, the size of the cross-section area of fascicles in 12.1%, the number of fascicles in 7.6% and the index of the fascicle's area in 7.6% of the cases, they were greater in the superior root respectively in 33.3, 42.4, 30.3 and 57.6%, and they were greater in the inferior root in 53.0, 45.5, 62.1 and 34.8% of the cases.

The mean values of the features mentioned above were greater in the inferior root: the thickness by 7.8% and the number of fascicles by 38.8%, on the contrary, the mean value of the index of the fascicle's area was greater in the superior root. The size of the cross-section area of fascicles showed similar values in both roots.

The participation of fascicles of various thickness in the structure of the lateral cord roots was unequal. The tk and vtk were observed more often in the superior root than in the inferior one, but vtn and tn were found in the superior root rather rarely. The vtn occurred more often on the right side in the superior root, and were present equally on both sides of the body in the inferior root. The tn were observed more often on the left side in the inferior root, and were present equally on both sides of the body in the superior root. The mtk occurred more often on the left side in the superior root, and on the right side in the inferior root.

There were certain differences in the fascicular structure in relation to the sex: mtk occurred more often in females in the superior root, and in males in the inferior root, but vtk appeared more often in males in the superior root, and were present equally in the persons of both sexes in the inferior root.

The examined features of the roots of the lateral cord, apart from the number of fascicles and the index of the fascicle's area, underwent big changes in postnatal life, especially in the age up to 22nd year of life. The thickness of the superior root increased 3.3 times, and of the inferior root 3.4 times, the size of the cross-section area of fascicles increased respectively 3.3 times and 3.5 times. The participation of fascicles of different thickness in the structure in the discussed roots changed, too. The fascicles of a cross-section area up to 0.3 sq mm dominated in the structure of both roots in children up to the 1st year of age. At the ages between the 1st and the 22nd year of life their participation in the structure of roots of the lateral cord decreased, while the ratio of fascicles with a cross-section area greater than 0.5 sq mm increased considerably.

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STRESZCZENIE

Pęczek boczny tworzyły 2 korzenie: górny, stanowiący we wszystkich przypadkach część przednią pnia górnego, i dolny, wywodzący się z części przedniej pnia środkowego. Ich wewnętrzna struktura, badana obustronnie na 66 zwłokach ludzi, wykazywała dużą osobniczą zmienność i asymetrię. Korzeń dolny w porównaniu z korzeniem górnym był grubszy o 7,8% i miał liczbę pęczków większą o 38,8%, natomiast wskaźnik powierzchni pęczków mniejszy o 6,8%. Wielkość powierzchni poprzecznego przekroju pęczków miała podobne wartości w obu korzeniach. Udział pęczków o różnej grubości w budowie korzeni był niejednakowy. W korzeniu górnym obserwowano częściej niż w korzeniu dolnym pęczki bardzo grube i grube, a rzadziej pęczki cienkie i bardzo cienkie.