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Some features of the internal structure of terminal divisions of the brachial plexus medial cord

Niektóre cechy wewnętrznej budowy końcowych części pęczka przyśrodkowego splotu ramiennego

The medial cord gives three thin nerves – one motor nerve and two sensory nerves – and then splits into two comparatively thick parts, the medial and the lateral, making the ulnar nerve and the medial root of the median nerve, respectively. The comparison of some features of the internal structure of the medial cord terminal parts seems interesting. Due to this fact, the present work was performed.

The thickness of both terminal parts of the medial cord, size of cross–section area of their fascicles, number of fascicles and the size of index of fascicle's area have been examined on material obtained bilaterally from cadavers of 84 subjects – 42 males (♂) and 42 females (♀) – who died at the age between 1st day and 87th year of life. Six age groups were distinguished. Group I contained 8 ♂ and 8 ♀ up to 1 year of age, group II – 8 ♂ and 8 ♀ between 1st and 14th year, group III – 6 ♂ and 5 ♀ between 15th and 22nd year, group IV – 7 ♂ and 7 ♀ between 23rd and 40th year, group V – 7 ♂ and 8 ♀ between 41st and 60th year and group VI – 6 ♂ and 6 ♀ above 60th year of life. The methods used to obtain and fix the material, to stain the slides and to determine the thickness of different parts of peripheral nervous system, the size of cross–section area of fascicles, the number of fascicles and the index of the fascicle's area were described in the previous papers (10, 11).

RESULTS

The medial cord has split into two terminal parts, lateral and medial, in all the cases. The lateral part made the medial root of the median nerve (rmm), the medial part made the ulnar nerve (ul).

THICKNESS OF TERMINAL PARTS OF THE MEDIAL CORD

The dimension of the cross–section area of the lateral part ranged between 0.502 and 9.799 sq mm, and of medial part between 0.718 and 9.722 sq mm. It was similar on both sides of the single body in 8.3% in the lateral part, and in 11.9% in the medial part, greater on the right side in 46.4 and 48.8% and greater on the left side in 45.3 and 39.3%, respectively. The thickness of both parts showed similar values in 7.7%. The lateral part was greater in 31.6%, and the medial part was greater in 60.7% of the cases.

The average thickness of rmm equalled (in sq mm) 4.107 on the right side (r) 4.102, on the left side (l) 4.111, in males (♂) 4.273, in females (♀) 3.941, and of ul – 4.468 (r – 4.515, l – 4.421, ♂ – 4.503, ♀ – 4.434). The values mentioned above in the age group came out to be: in group I – 1.428 and 1.564, respectively, in group II – 3.069 and 3.462, in group III – 5.510 and 6.107, in group IV – 5.846 and 6.114, in group V – 4.630, and 5.232, and in group VI – 5.098 and 5.304.

NUMBER OF FASCICLES

In the studied material there were 1 to 19 fascicles observed in the lateral part and 1 to 22 fascicles in the medial part. There were 1 to 5 fascicles in 33.9% in the lateral part and in 47.0% in the medial part, from 6 to 10 fascicles were found respectively, in 44.8 and 42.3%, from 11 to 15 fascicles in 19.0 and 9.5% and more than 15 fascicles in 2.4 and 1.2% of the cases. The same number of fascicles on both sides of one body was found in 11.9% in the lateral part and in 20.2% in the medial part. The number of fascicles was greater on the right side in 44.0% and 41.7%, and it was greater on the left side in 44.1% and 38.1% of the cases, respectively. The number of fascicles was the same in both parts in 8.3%, the greater number in the lateral part in 59.6%, and in the medial part in 32.1% of the cases.

The mean number of fascicles in rmm equalled 7.7 (r – 7.8, l – 7.6, ♂ – 7.4, ♀ – 8.0), and in ul – 6.1 (r – 6.0, l – 6.2, ♂ – 5.4, ♀ – 6.8). In the age groups it was: 5.4 and 5.6 in group I, 6.5 and 5.1 in group II, 8.9 and 7.9 in group III, 7.9 and 7.2 in group IV, 9.0 and 5.6 in group V, 9.5 and 5.7 in group VI.

SIZE OF THE CROSS–SECTION AREA OF FASCICLES

The thickness of the individual fascicle showed the following range of values: 0.001 to 4.066 sq mm in the lateral part, and 0.001 to 4.938 sq mm in the medial part. Five groups of the fascicles were differentiated on the basis of their cross–section area. There were: very thin fascicles with cross–section area up to 0.1 sq mm, thin fascicles (0.101–0.3 sq mm), medium–thick fascicles (0.301–

0.5 sq mm), thick fascicles (0.501–1 sq mm) and very thick fascicles (over 1 sq mm). Very thin fascicles (vtn) created 23.3% in the lateral part and 19.4% in the medial part, thin fascicles (tn) made 43.3% and 33.4%, respectively, medium–thick fascicles (mtk) – 16.7 and 18.6%, thick fascicles (tk) – 14.1 and 17.6% very thick fascicles (vtk) – 2.6 and 11.0%.

The frequency of occurrence of differently thick fascicles in the described parts of the medial cord was unequal in the age groups. In group I vtn constituted 32.7% in rmm and 43.3% in ul, tn – 53.1 and 43.8%, mtk – 8.6 and 7.3%, tk – 5.6 and 3.4%, and vtk – 0% and 2.2%, respectively. In group II vtn composed 21.9% and 20.0%, tn – 42.8 and 36.6%, mtk – 16.7 and 19.4%, tk – 16.2 and 15.4%, and vth – 2.4 and 9.1%, respectively. In group III vtn made 15.7% and 10.3%, tn – 37.4 and 32.8%, mtk – 22.7 and 28.2%, tk – 20.7 and 18.4%, and vtk – 3.5 and 10.3%, respectively. In group IV vtn reached 21.0% and 13.4%, tn – 41.6 and 31.2%, mtk – 14.1 and 19.8%, tk – 19.2 and 25.2%, and vtk – 4.1 and 10.4%, respectively. In group V vtn formed 24.5% and 13.7%, tn – 41.3 and 26.9%, mtk – 16.0 and 17.4%, tk – 15.6 and 24.0%, and vtk – 2.6 and 18.0%, respectively. In group VI vtn made 25.1% and 14.6%, tn – 45.8 and 27.7%, mtk – 20.7 and 20.4% tk – 5.8 and 19.0%, and vtk – 2.6 and 18.3%, respectively.

The size of the cross–section area of all the fascicles of rmm ranged between 0.370 and 5.131 sq mm, and of ul ranged between 0.386 and 5.879 sq mm. It showed similar values on both sides of the single body in 10.7% in rmm, and in 25.0% in ul, greater on the right side, respectively, in 46.4% and 41.7%, greater on the left side in 42.9 and 33.3%. The sum of the thicknesses of fascicles of rmm compared with the respective sum of ul was similar in 8.3%, greater in 19.7% and smaller in 72.0% of the cases.

The average value of the cross–section area of the fascieles of rmm equalled (in sq mm) 2.207 (r – 2.247, l – 2.167, ♂ – 2.343, ♀ – 2.072), and of ul – 2.804 (r – 2.864, l – 2.745, ♂ – 2.855, ♀ – 2.752). It was different in the age groups. In group I the average value was: 0.889 in rmm and 1.034 in ul, in group II – 1.872 and 2.249, in group III – 3.014 and 3.710, in group IV – 2.984 and 3.762, in group V – 2.591 and 3.360, in group VI – 2.287 and 3.258, respectively.

INDEX OF THE CROSS–SECTION AREA OF FASCICLES (IAF)

The size of the index of the fascicle's area of rmm ranged between 24.8 and 79.7, and of ul ranged between 35.3 and 83.8. It was similar on both sides of one body in 2.4% in the lateral part and in 8.3% in the medial part, greater on the right side in 52.4% and 52.4%, greater on the left side in 45.2% and 39.3% of the cases, respectively. IAF showed similar values in both terminal parts of the medial cord in 7.7%, greater in the lateral part in 23.3%, greater in the medial part in 69.9% of the cases.

The average value of index equalled in rmm 53.7 (r – 54.8, l – 52.7, ♂ – 54.8, ♀ – 52.6) and in ul – 62.8 (r – 63.4, l – 62.1, ♂ – 63.4, ♀ – 62.1). The discussed value in the age groups was: in group I – 62.3 and 66.1, in group II – 61.0 and 65.0, in group III – 54.7 and 60.7, in group IV – 51,0 and 61.5, in group V – 56.0 and 62.3, in group VI – 44.9 and 61.4, respectively.

DISCUSSION

The division of the medial cord into two terminal parts making ulnar nerve and medial root of the median nerve has been known for a long time (3, 4, 12). The same division was observed in all the cases in the presented material. The internal structure of the ulnar nerve and of the medial root of the median nerve is characterized by great variability and asymmetry, in contradistinction to the absence of variants of division of the medial cord and of external structure of its terminal parts. These observations are confirmed by the reports of authors who discussed the morphology of peripheral nervous system (1, 2, 5–11, 13). The presented studies showed that thickness of terminal parts of the medial cord, number of fascicles, size of their cross–section area and index of the fascicle's area are usually different even in the same person on both sides of one's body. The similar values on both sides of one body for 4 features were found only in ul in 1.2%, for 3 features – also only in ul in 3.6%, and for 2 features – in ul in 8.3 and in rmm in 2.4%. Similar values of a single feature were observed also rarely on both sides of one body: the thickness of ul in 4.8% and of rmm in 7.1% the size of cross–section area of fascicles in 15.5 and 9.5%, the number of fascicles – in 11.9 and 9.5%, and the IAF – in 1.2% and 2.4% of the cases, respectively.

Out of the examined features the following were greater on the right than on the left side: the thickness of ul in 48.8% and of rmm in 46.4%, the size of cross–section area of fascicles in 41.7% and 46.4%, the number of fascicles – in 41.7 and 44.0%, and IAF – in 52.4 and 52.4%, respectively. The features in a single person which had greater values on the left than on the right side were: the thickness of ul in 39.3% and the thickness of rmm in 45.3%, the size of cross–section area of fascicles – in 33.3 and 42.9%, the number of fascicles – in 38.1 and 44.1%, and IAF – in 39.3 and 45.2% of the cases, respectively.

The mean values of the examined features were different on both sides of one body. They were greater on the right side with the exception of the thickness of rmm which showed similar values on both sides of one body, and the number of fascicles in ul which was greater on the left side. They showed the differences related to the sex, too. In both examined parts the size of cross–section area of fascicles and IAF were greater in males than in females, on the contrary, the number of fascicles was greater in females than in males.

The ulnar nerve compared with the medial root of the median nerve was thicker by 8.8% (r – 10.1%, l – 7.5%, ♂ – 5,4%, ♀ – 12.5%), it had the size of cross–section area of fascicles greater by 27.1% (r – 27.4%, l – 26.7%, ♂ – 21.9%, ♀ – 32.8%), and it had the index of fascicle's area greater by 16.9% (r – 15.7%, l – 17.8%, ♂ – 15.7%, ♀ – 18.1%), on the contrary, the medial root of the median

nerve had the number of fascicles greater than the ulnar nerve by 26.2%, (r – 30.0%, l – 22.6%, ♂ – 37.0%, ♀ – 17.6%).

The participation of fascicles of various thickness in the structure of both terminal parts of the medial cord was unequal. Very thin and thin fascicles were observed more often in rmm, but medium–thick, thick and very thick fascicles were found more often in ul. Very thin and medium thick fascicles occurred more often on the right side in ul, and more often on the left side in rmm, but thin fascicles appeared more often on the right side in rmm, and more often on the left side in ul. Certain differences in the fascicular structure were found in relation to sex: vtn were observed by about 60% more often in females than in males in ul and by 15% in rmm, but mtk, tk and vtk occurred by 14 and 22%, 33 and 65%, and 45 and 52% more often in males than in females, respectively.

The examined features, apart from the number of fascicles in ul, underwent big changes in postnatal life, especially up to the 22nd year of life. The following increased: the thickness of ul 3.9 times and the thickness of rmm – 4.1 times, the size of the cross–section area of fascicles – 3.6 and 3.4 times, but the index of fascicle's area decreased by 7.0% and 18.1%, respectively. The number of fascicles of rmm in adults was greater by 76% than in children up to 1st year of life. The participation of fascicles of different thickness in the structure of the discussed parts changed in postnatal life, too. In children up to 1st year of life very thin and thin fascicles dominated in the structure of both terminal parts. In adults their participation in the structure of ul and of rmm decreased, while the share of fascicles with the cross–section area greater than 0.3 sq mm increased considerably.

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STRESZCZENIE

Końcowe części pęczka przyśrodkowego – n. łokciowy i korzeń przyśrodkowy n. pośrodkowego – badano obustronnie na materiale pobranym obustronnie ze zwłok 84 osób obojga płci. Nerw łokciowy w stosunku do korzenia przyśrodkowego n. pośrodkowego jest grubszy o 8,8%, ma powierzchnię poprzecznego przekroju pęczków większą o 27,1% i wskaźnik powierzchni pęczków większy o 16,9%, natomiast korzeń przyśrodkowy n. pośrodkowego ma większą niż n. łokciowy liczbę pęczków o 26,2%. W korzeniu przyśrodkowym n. pośrodkowego występują częściej niż w n. łokciowym pęczki o powierzchni poprzecznego przekroju do 0,3 mm^2, a rzadziej pęczki o powierzchni poprzecznego przekroju powyżej 0,3 mm^2.