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White communicating rami in human embryos at the end of the fifth week

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White communicating rami were traced in 8 human embryos of developmental stages 14 and 15 (aged 33 and 36 postovulatory days, respectively). In embryos at stage 14 the white communicating rami were found in the spinal nerves T1 to T9. In embryos at stage 15 the white communicating rami were present at the spinal cord levels T1 to L3. (Folia Morphol 2010; 69, 2: 75–77)

Key words: human neuroembryology, white communicating rami

INTRODUCTION

The final stage of sympathetic development is the establishment of synaptic connections, which, for sympathetic neurons, can include alternations in neurotransmitter phenotypes [5].

The neurotransmitter features in sympathetic neurons are subject to change during ontogenesis [2]. Studies of sympathetic ontogeny suggested that catecholaminergic neural crest derivatives, adrenal chromaffin cells, and sympathetic neurons derive from a common sympathoadrenal progenitor [1]. In the studied human embryos, aggregation of cells representing the primordia of the future ganglia of the sympathetic trunk is described at different levels by several investigators. According to Mitchell [9], such clusters of cells are first evident in the lower thoracic and upper lumbar regions. The same location of the first sympathetic ganglia was described by Kuntz [6, 7]. According to Larsen [8], the sympathetic ganglia first form in the cervical region in embryos aged 33 days. In our previous paper [18] we described the first appearance of the sympathetic trunk in human embryos at stage 13. They were found in the thoracic levels T4 to T9. The primordia of the sympathetic ganglia develop before the rami communicantes appear. These rami communicantes are connections between the autonomic centres in the spinal cord and the paravertebral or prevertebral ganglia.

The development of such rami was presented by Pearson and Eckhardt [11]. The authors, however, specify embryonic age based on crown-rump length.

The aim of the present study was to describe the white communicating rami in staged human embryos at the end of the 5th week.

MATERIAL AND METHODS

Serially sectioned human embryos at stages 14 and 15 from the Collection of the Department of Anatomy at Poznań University of Medical Sciences were investigated (Table 1).

Horizontal sections of 4 embryos at stage 14 and 4 at stage 15 were stained with haematoxylin and eosin, according to the Mallory method, and impregnated with protargol (Bodian method) and silver gelatin using the method of Pearson and O'Neil.

Serial sections of each embryo were examined microscopically and the positions of the rami communicantes on both sides were evaluated.

RESULTS

In embryos of stage 14 the white communicating rami were found at the thoracic level. The upper limit of these branches was the thoracic level of the

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Table 1. Crown-rump length (CRL) in mm, developmental stages, age in postovulatory days, and plane of section of investigated embryos

Catalogue number of embryo	CRL [mm]	Stage	Age (days)	Plane of section
P-41	5.0	14	33	Horizontal
B-207	6.0	14	33	Horizontal
A-19	7.0	14	33	Coronal
A-17	7.0	14	33	Horizontal
B-175	9.0	15	36	Horizontal
PJK-20	9.0	15	36	Horizontal
A-16	9.0	15	36	Horizontal
B-115	8.5	15	36	Horizontal

Figure 1. Horizontal section of embryo at stage 14. Haematoxylin and eosin staining; a — spinal ganglion, b — anterior horn of spinal cord, c — spinal nerve, d — white ramus communicans, e — sympathetic ganglion, f — celiac trunk.

Figure 3. Horizontal section of embryo at stage 15. Impregnation with Bodian's protargol; a — spinal ganglion, b — anterior horn of spinal cord, c — spinal nerve, d — white ramus communicans, e — sympathetic ganglion, f — greater thoracic splanchnic nerve, g — mesonephros, h — aorta.

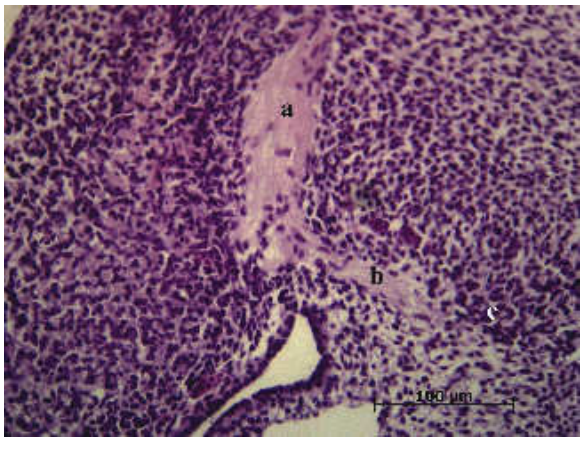

Figure 2. Horizontal section of embryo at stage 15. Hematoxylin and eosin staining; a — anterior ramus of spinal nerve, b — white ramus communicans, c — sympathetic ganglion.

Figure 4. Horizontal section of embryo at stage 15. Impregnation with Bodian's protargol; a — anterior ramus of spinal nerve, b — white ramus communicans, c – greater thoracic splanchnic nerve, d — mesonephros, e — superior mesenteric artery.

first thoracic nerve, and the lower level was the ninth thoracic nerve (Fig. 1). These branches pass ventrally and medially and enter the sympathetic ganglia.

In embryos at stage 15 the white communicating rami are present between spinal nerves thoracic one and lumbar two (Figs. 2–4).

In the middle and lower thoracic regions the white communicating branches split into two bundles. One bundle enters the sympathetic trunk ganglion and a descending bundle runs into the splanchnic nerves (Figs. 3, 4).

DISCUSSION

Sympathetic preganglionic neurons occupy the intermediolateral nucleus of the spinal cord, and in humans these cells are found between the first thoracic spinal segment and the third lumbar segment [12, 16].

The cells within the intermediolateral column form several subnuclei [3] and show a tendency towards segmental aggregation [15]. Experiments in which retrograde tracers have been injected into different target organs or ganglia have established that the aggregations represent a viscerotopy [4, 17]. There is a rostrocaudal viscerotopic organization to the distribution [13, 14]. Differentiation of neurons in the spinal cord proceeds in rostrocaudal and ventrodorsal gradients [10]. Neurons involved in autonomic function show late neurochemical maturation. Axons of preganglionic neurons leave the spinal cord as white communicating rami.

Pearson and Eckhardt [11] described white rami in embryos of 6 and 6.5 mm crown-rump length, and this observation is in agreement with Kuntz. These rami were present in spinal nerves thoracic 3 through thoracic 8. Two embryos investigated by Pearson and Eckhardt [11] of 7 mm and 8 mm crown-rump length did not posses any white rami.

In our investigations the white communicating rami were observed at the levels T1 to T9 in all embryos at stage 14. During stage 15 such rami were found at the levels between the first thoracic and third lumbar. In these embryos the sympathetic trunks extend from the upper cervical to the sacral level. Some of the fibres of the white rami pass onward to the prevertebral ganglia.

Our investigations showed that the white rami communicantes, which are connections between the somatic and autonomic nervous system, develop early in the embryonic period.

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