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An ultrastructural study of the myelination of the trigeminal ganglion in human foetuses aged 10 to 23 weeks

Małgorzata Bruska

Department of Anatomy, University of Medical Sciences, Poznań, Poland

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An ultrastructural study was performed on trigeminal ganglia removed from foetuses aged 10 to 23 weeks. The first turns of lemmocyte processes around the axons were observed in the trigeminal ganglion in the 12th week of development. During the period between the 15th and the 18th weeks the myelin sheath increases in thickness and becomes a compact, laminated structure. In foetuses of 23 weeks the compact myelin sheath has up to 24 myelin lamellae.

key words: human neuroembryology, trigeminal ganglion, myelination, ultrastructure

INTRODUCTION

The trigeminal ganglion is mainly formed by a group of nerve cells, glial cells and bundles of nerve fibres. At early phases of development, migrating lemmocytes (Schwann cells) are observed on the periphery of the nerve.

The development of the Schwann cell lineage can be considered in two parts: 1) the generation of differentiated embryonic Schwann cells from neural crest cells, and 2) the transformation of these cells to form two distinct Schwann cell variants, myelin and non-myelin forming cells as seen in adult nerves [2, 5]. The relationships between lemmocytes and axons change during development. Prestige and Wilson [7] recognise transitional and promyelin stages during early myelinogenesis. During the transitional stage the lemmocyte process surrounds more than one axon. At the promyelin stage the 1:1 relationship is established between lemmocyte and axon. The aim of the present investigations is to trace the stages in the development of the trigeminal nerve.

MATERIAL AND METHODS

The study was performed on trigeminal ganglia removed from 20 foetuses aged 10 to 23 weeks (C-R length 67 to 220 mm). Pieces of the trigeminal ganglion were removed in 1.2% glutaraldehyde and stained with this fixative for 1 hour. The pieces were then placed in 2% glutaraldehyde for 2 hours. The fixatives were buffered to pH 7.4 with cacodylate. The material was postfixed in 1% osmium tetroxide for 1 hour. Thin and semi-thin sections were made on Reichert ultramicrotome. The semi-thin sections were stained with toluidyne blue and the thin sections were contrasted with uranyl acetate and lead citrate. The thin sections were viewed with JEM 7A and Philips electron microscopes.

RESULTS

During the 10th and 11th week of development bundles of nerve processes were observed between groups of neuroblasts in the trigeminal ganglion. The processes were ensheathed by an elongated cytoplasm of lemmocytes. In the 12th week the spaces

Address for correspondence: Prof. Małgorzata Bruska, Department of Anatomy, University of Medical Sciences, ul. Święcickiego 6, 60–781 Poznań, Poland, tel: +48 61 869 91 81 ext. 564, fax: +48 61 865 89 85, e-mail: mbruska@usoms.poznan.pl

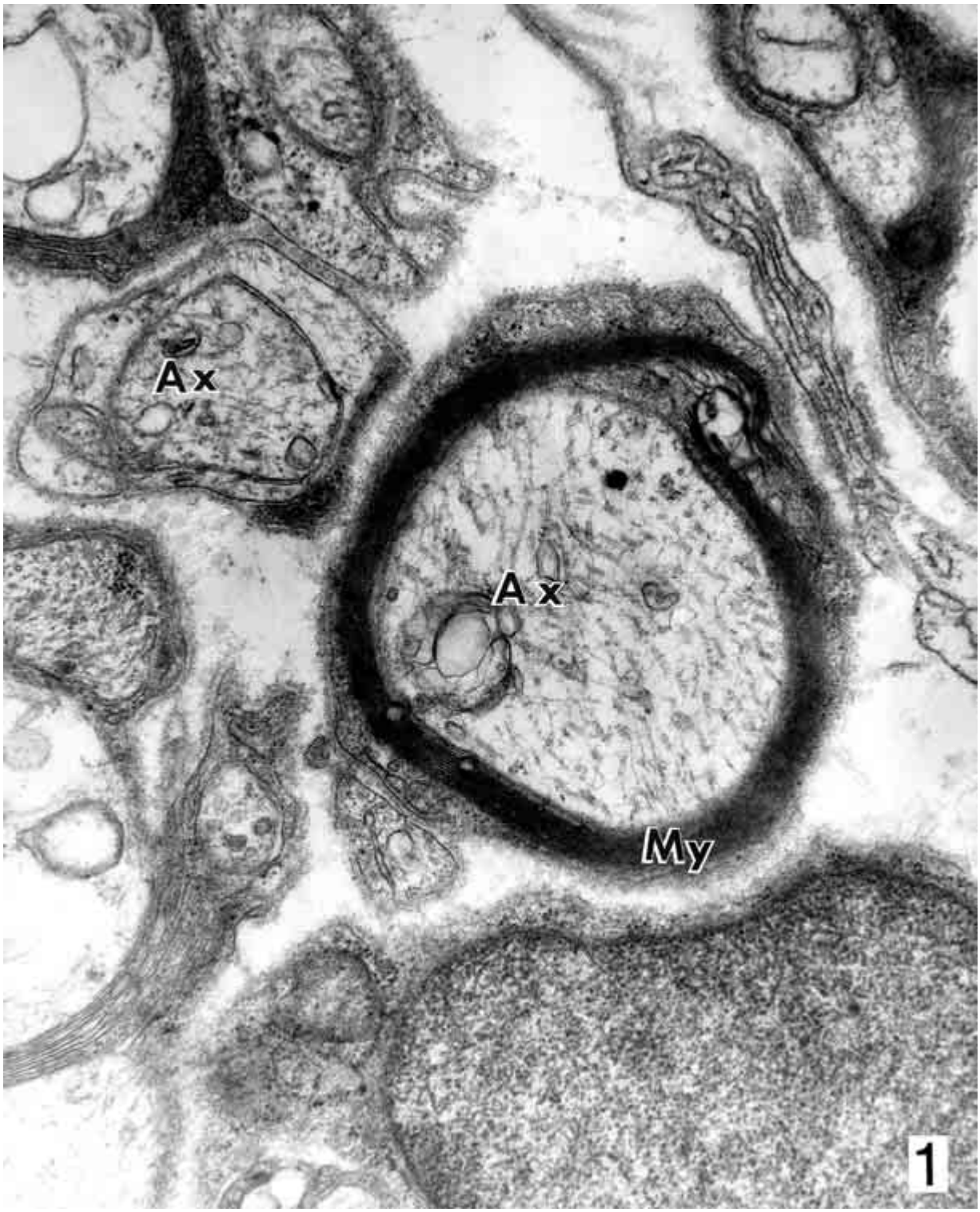

Figure 1. Various phases of myelination in the trigeminal ganglion of human foetuses aged 23 weeks; Ax — axon, My — myelin sheath. Magn. × 45500.

between nerve bundles in the trigeminal ganglion were wider. In this period of development the single axons surrounded by single Schwann cell were observed. This was evidence that the myelination had already started. In the 13th week Schwann cells surrounded regular bundles of axons. Single axons ensheathed by one lemmocyte were observed. At this stage of development the processes of lemmocytes formed one or two thick myelin lamellae. The early phases of myelination observed at this stage of development were found in axons of different diameter. During the period between the 15th and 18th weeks the nerve processes were observed in different phases of myelination. The myelin lamellae in the first phases of myelination were irregular and of differing thicknesses. In this period of development the highest number of myelin lamellae was 15.

In the 23rd week the number of Schwann cells between nerve processes increased. The dark Schwann cells between the nerve processes were observed. In this week of development unmyelinated nerve processes and processes in different phases of myelination were observed (Fig. 1). During 23rd week the highest number of myelin lamellae was 24.

DISCUSSION

The early stage of myelination in the trigeminal ganglion was already observed during the 12th week of development and it starts earlier than in the vagus nerve [8]. The promyelin phase is preceded by a multiplication of lemmocytes, which was also observed in a previous study on the human hypoglossal nerve [1] and phrenic nerve [9] and by Woźniak and O'Rahilly in the vagus nerve [8].

The decrease in the number of axons within lemmocyte/axon complexes with the advancing maturation of the trigeminal ganglion has been recordered by earlier investigators in various human and animal nerves [3, 4, 6, 8, 9].

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