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Letter to the Editor

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Axonal Demyelination Versus Wallerian Degeneration in Human Spinal Cord Injuries

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In recent years much attention has been given to demyelination of axons following Spinal Cord Injuries (SCI) as a potential target for curative treatment. Much research has been undertaken in this respect. It is therefore a timely exercise to examine the question of demyelination versus Wallerian degeneration in human SCI. True demyelination is strictly defined as the loss of the myelin sheath and preservation of the axis cylinder. In my experience naked demyelinated axons are not a common component of the human SCI lesion. In a review of 220 post mortem cases of SCI true demyelination was only identified in a small number of acute lesions. Demyelinated axons should not to be confused with the numerous normal unmyelinated nerve fibers in the human spinal cord. In SCI research it is also essential to distinguish demyelinated axons from Wallerian degeneration (Figure 1).

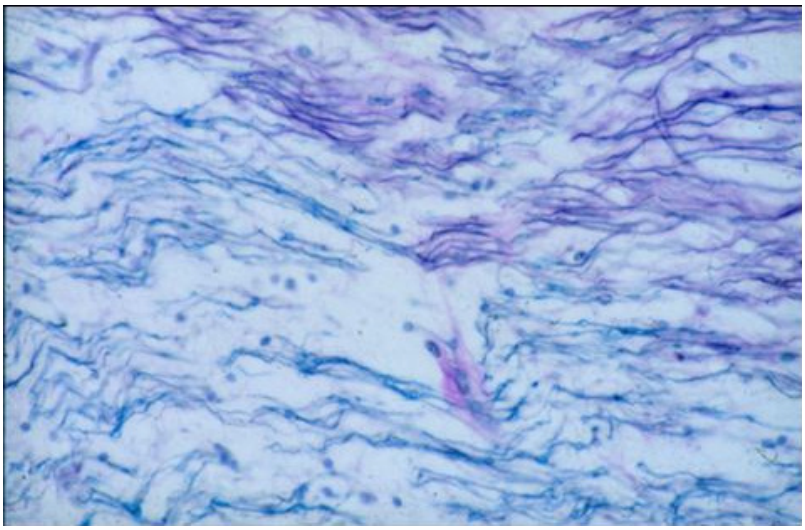

Figure 1: Illustration depicting central remyelinated axons. Longitudinal section at the level of a spinal cord injury stained with Luxol Fast Blue (LFB) for myelin and Periodic Acid Schiff (PAS) for basement membrane. On the top right there are axons remyelinated with peripheral Schwann cell myelin appearing deep blue with the basement membrane stained pink. Bottom left are normal central axons with oligodendrocytic myelin staining light blue. True demyelination is a rare component of the lesion in human SCI.

The question of demyelination as a factor in human SCI was also addressed indirectly by determining the proportion of axons myelinated by Schwan cells in long term survivors of SCI. Of 27 cases investigated in this way, 16 showed central axons coated by peripheral myelin, distinguishable from central oligodendrocytic myelin by the presence of Schwann cells and a basement membrane [1]. Given the power of Schwann cells to promote axonal regeneration a possible interpretation

of this finding is that these peripherally myelinated central axons have regenerated. However, such axonal regeneration is considered a less likely possibility because the observed axons are in linear continuity fully traversing the lesion.

A common and important component of human SCI is Wallerian degeneration of axons, a change which must not be confused with demyelination. Wallerian degeneration is a general reaction which follows disruption of the axon whether it is central or peripheral. When the axon is disrupted its distal portion degenerates and its myelin sheath fragments, the debris being taken up by macrophages. Wallerian degeneration is always present in the spinal cord of survivors of the acute stage of SCI. Wallerian degeneration proceeds distally from the site of injury in the efferent pathways and proximally in the afferent pathways of the injured spinal cord. Wallerian degeneration continues throughout the lifetime of the SCI patient. It is essential for scientists undertaking SCI research to distinguish demyelination from Wallerian degeneration in planning and evaluating experiments using animals.

References

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