

Reinnervation events in long term denervated rat muscles

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Abstract

In spite of the surgical approaches utilized to prevent reinnervation from the sciatic proximal stump, some reinnervation of the distal leg muscles occurs, resulting in minimal or substantial recovery of muscle mass and function. These reinnervation events are recognizable at the light microscopy level by size and morphology of the reinnervated myofibers and by the recovery of the fascicle muscle structure. A clear type grouping (clustering of muscle fibers with the same contractile and metabolic profile) is the golden standard of muscle reinnervation. The fascicles are made of well packed fibers positive for either fast or slow ATPase. Mitochondrial activity is demonstrated by succinic acid dehydrogenase staining. While in normal soleus muscles a low percentage of type II fibers are sparsely distributed among type I fibers, in some area of the sciactomized-reinnervated muscles type II and Type I fibers are grouped. The innervated fibers neither express embryonic myosin nor NCAM (outside the synapse). The lack of expression of N-CAM confirms the re-innervation of the type-grouped fibers.

Key Words: rat muscle, long term denervation, N-CAM, muscle re-innervation.

Basic Appl Myol 16 (3&4): 115-116, 2006

In spite of the surgical approaches utilized to prevent reinnervation from the sciatic proximal stump, some reinnervation of the distal leg muscles occurs, resulting in minimal or substantial recovery of muscle mass and function. These reinnervation events are recognizable at the light microscopy level by size and morphology of the reinnervated myofibers and by the recovery of the fascicle muscle structure. The “type grouping” (clustering of muscle fibers with the same contractile and metabolic profile) is the golden standard of muscle reinnervation [1]. The fascicles are made of well packed large fibers (Figure 1, A), that are positive for either fast or slow ATPase. In the sciactomized-reinnervated muscles type II and Type I fibers are grouped (Figure 1, B), while in normal soleus a low percentage of type II fibers are sparsely distributed among type I fibers (not shown). Mitochondrial activity, demonstrated by succinic acid dehydrogenase staining shows clusters of either high or low stained large myofibers (Figure 1, C).

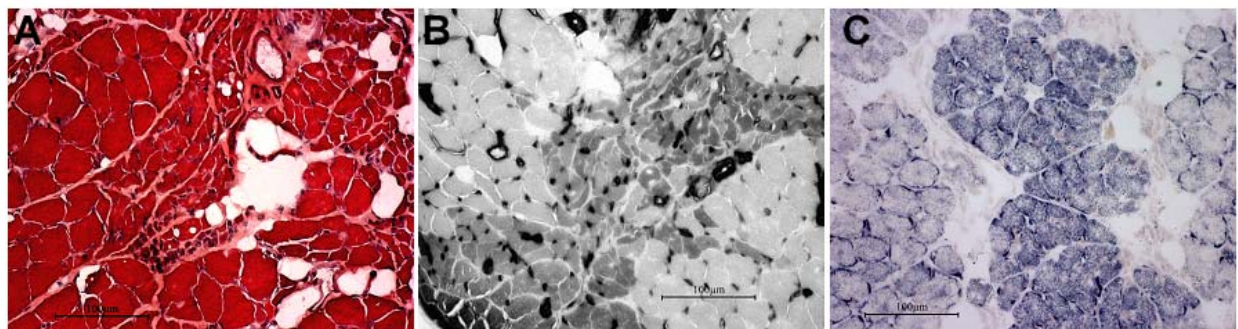


Figure 1. Reinnervation events of denervated soleus from 4 months. A, Hematoxylin and eosin stain; B, ATPase pH 10.4 stain; C, SDH activity.

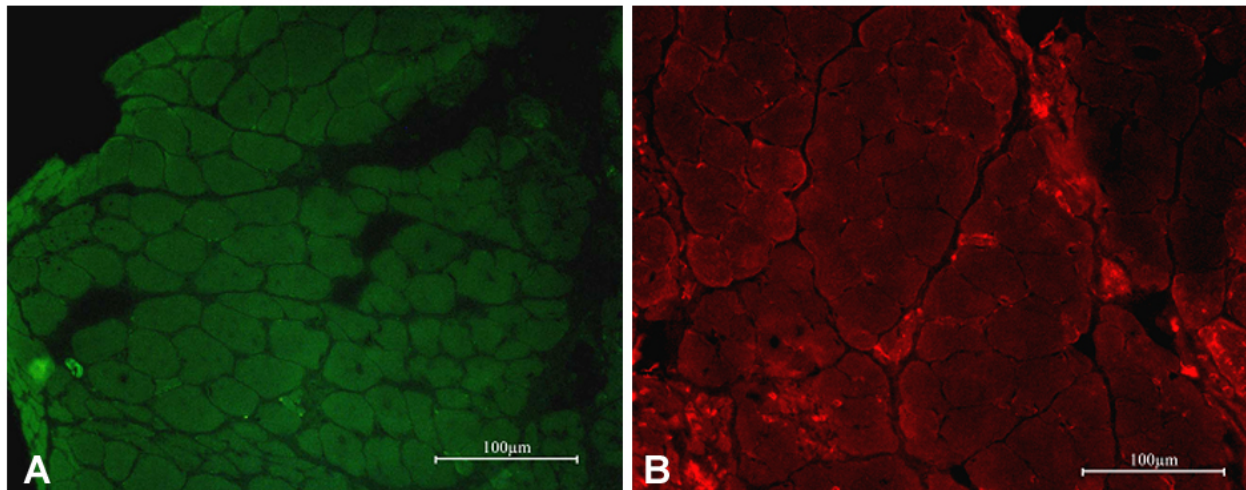


Figure 2. *A., After long term reinnervation in the soleus muscle the embryonic myosin positive fibers (green) are seldom present. B, NCAM is not expressed in reinnervated large fibers, while sparse reactivity (red) is seen in small fibers.*

The innervated fibers neither express embryonic myosin nor NCAM (outside the synapse). Indeed in muscle the levels of the neural cell adhesion molecule NCAM are regulated in parallel with the susceptibility of muscle to innervation [2]. In fact, it is expressed on the surface of early embryonic myotubes (until the nerve endings contact the myofibers), declines in level as development proceeds (i. e., it is restricted to the synaptic region), reappears when adult muscles are denervated and it is lost after reinnervation. So the lack of the expression of NCAM confirms the state of innervation of the type-grouped fibers. How long rat or human myofibers re-express NCAM during permanent denervation remains to be analyzed in details.

Acknowledgements

This research was undertaken with the financial support of ex60% MURST funds to Prof. Ugo Carraro.

References

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