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# Regeneration of the radial nerve cord in a holothurian: A promising new model system for studying post-traumatic recovery in the adult nervous system

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**Abstract**

After a complete transection, the radial nerve cord (RNC) of the adult sea cucumber *Eupentacta fraudatrix* quickly regrows and reconnects. The description of the major cellular events that accompany this regeneration is derived from light and transmission electron microscopy. Shortly after lesioning, the extensive nerve fiber degeneration and neuronal apoptosis occur. The gap in the cord created by the transection is rapidly bridged, at first by connective tissue and subsequently by regenerating nerve tissue. On either side of the wound, the ectoneural and hyponeural components of the injured RNC form separate tubular rudiments, whose epithelial walls are composed mostly of dedifferentiated glial cells, capable of mitotic division, but also contain some nerve fibers and occasional neuronal perikarya. It is suggested that the glial cells play a crucial role in regeneration not only by providing the supporting guiding scaffold for regrowing nerve fibers, but also by producing new neurons. Other mechanisms of post-traumatic neurogenesis may involve proliferation and/or migration of existing perikarya. The anterior and posterior regenerates grow towards one another and eventually fuse to restore the anatomical continuity of the RNC. Re-differentiation of gliocytes and accumulation of nerve cells in the newly formed regions of the nervous tissue make histological organization of the fully regenerated RNC indistinguishable from that of the intact cord. The authors suggest that the holothurian RNC provides a valuable experimental model, which opens new possibilities for exploring the fundamental mechanisms underlying regeneration of the nervous system in deuterostomes.


*Keywords:* Nervous system; Regeneration; Echinoderms; Neurogenesis

## 1. Introduction

The long-standing dogma that the adult nervous system has no ability to recover from injury has been recently challenged by new experimental data (for review, see Will et al., 1998; Horner and Gage, 2000; Ferretti et al., 2003; Caser and Tessier-Lavigner, 2005). However, injury to the adult central nervous system (CNS) of higher vertebrates, including human, is often devastating because of the inability of the nervous tissue to regenerate correct axonal and dendritic connections and/or to replace damaged neurons with new ones (Fawcett and Asher, 1999; Horner and Gage, 2000; Caser and Tessier-Lavigner, 2005). In an effort to define what goes wrong after injury, numerous comparative studies have been carried out. In particular, it has been shown that adult lower vertebrates, including fish, urodele amphibians, and reptiles, do regenerate significant portions of their central nervous system (Clarke and Ferretti, 1998; Font et al., 2001; Chernoff et al., 2002, 2003; Ferretti et al., 2003). Moreover, developing chick and mammalian embryos are also capable of substantial CNS repair (Ferretti et al., 2003; Caser and Tessier-Lavigner, 2005). Although these studies have contributed greatly to our knowledge of the mechanisms underlying regeneration of the nervous tissue, much research needs to be done, because the fundamental principles of neural repair can only be addressed by using outgroups.

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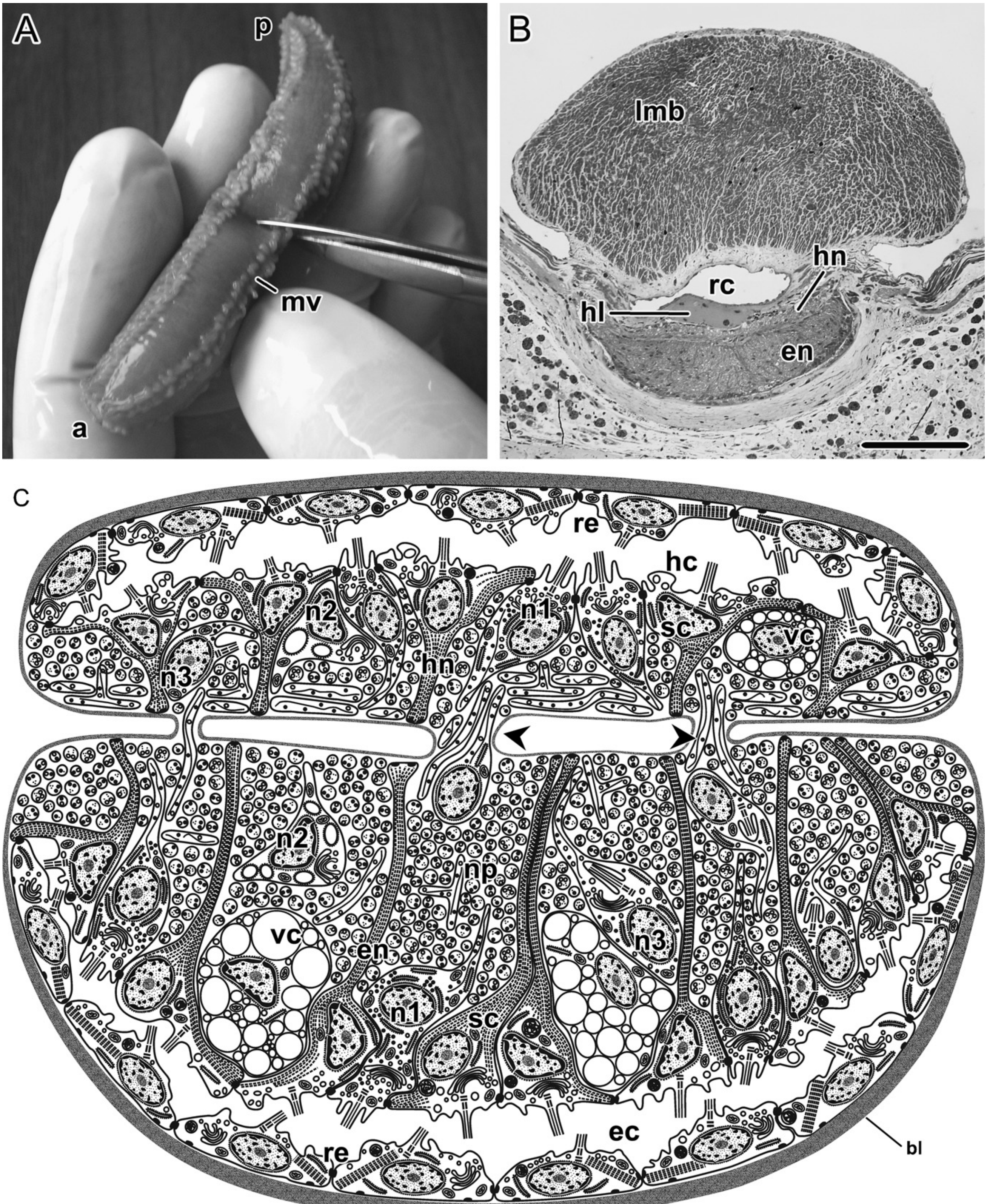
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