Title: Neurogenesis Associated with Neurological Recovery

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Abstract:

Scientists long have believed that the neurons we were born with are the neurons we die with. In other words, that after birth, the brain cannot make new neurons. However, in the last three decades, many scientists have shown that neural stem cells present in adult brains can make new neurons that incorporate into brain circuitry and contribute to functional recovery. Clinicians have known for many years that the brain can recover from even severe damage.

For decades, scientists have attributed such neurological recovery to redundancy and a poorly defined phenomenon called "plasticity". However, recent studies suggest that neurogenesis is an important and probably a critical mechanism for function recovery after genetic or neonatal hypoxic-ischemic neuronal loss. We recently found that in utero lithium-induced neurogenesis can reverse neuronal loss in mice fetuses with Down Syndrome (DS).

Likewise, rat neonates that suffer hypoxia-ischemia during birth lose as much as 20-25% of neurons in the brain dying, but recover both neuronal number and behavior within 3 months. However, if we did not ensure good reperfusion in hypoxia-ischemia encephalopathy models, the rats showed greater neuronal loss and prolonged behavioral deficits. Treatments that stimulate neurogenesis can reverse the neuronal loss and behavioral deficits.

Developing human and rodents show peaks of neurogenesis. In human, birth peak neurogenesis occurs at birth but neonatal rats do not show their peak of neurogenesis until a week after birth. Most DS rats in utero die and DS rats with more brain growth are selected for survival and birth. Between 1 week and 1 month, and between 1 and 3 months, the rats nearly double their brain size.

If care is not taken to prevent damage to the carotid arteries, they may reocclude and the behavioral rats will continue to show behavioral deficits. However, if care is taken to ensure that the brain is well-perfused, we see little or no difference in the number of cortical and hippocampal neurons between HIE and uninjured wild-type animals. Growth and development can compensate for hypoxic-ischemic damage to the brain of rats.

Treatments of hypoxia-ischemia and injury may generate greater than normal numbers of neurons. If confirmed, this finding suggests that neonatal animals not only may compensate for the genetic or imposed loss but may achieve better than normal neuronal numbers and behavior. If confirmed, our findings suggest that treatments that increase neurogenesis may not only reverse mental retardation but may increase mental functions.