Nanowired Delivery of Growth Hormone Attenuates Pathophysiology of Spinal Cord Injury and Enhances Insulin-Like Growth Factor-1 Concentration in the Plasma and the Spinal Cord

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Previous studies from our laboratory showed that topical application of growth hormone (GH) induced neuroprotection 5 h after spinal cord injury (SCI) in a rat model. Since nanodelivery of drugs exerts superior neuroprotective effects, a possibility exists that nanodelivery of GH will induce long-term neuroprotection after a focal SCI. SCI induces GH deficiency that is coupled with insulin-like growth factor-1 (IGF-1) reduction in the plasma. Thus, an exogenous supplement of GH in SCI may enhance the IGF-1 levels in the cord and induce neuroprotection. In the present investigation, we delivered TiO2-nanowired growth hormone (NWGH) after a longitudinal incision of the right dorsal horn at the T10?11 segments in anesthetized rats and compared the results with normal GH therapy on IGF-1 and GH contents in the plasma and in the cord in relation to blood-spinal cord barrier (BSCB) disruption, edema formation, and neuronal injuries. Our results showed a progressive decline in IGF-1 and GH contents in the plasma and the T9 and T12 segments of the cord 12 and 24 h after SCI. Marked increase in the BSCB breakdown, as revealed by extravasation of Evans blue and radioiodine, was seen at these time points after SCI in association with edema and neuronal injuries. Administration of NWGH markedly enhanced the IGF-1 levels and GH contents in plasma and cord after SCI, whereas normal GH was unable to enhance IGF-1 or GH levels 12 or 24 h after SCI. Interestingly, NWGH was also able to reduce

BSCB disruption, edema formation, and neuronal injuries after trauma. On the other hand, normal GH was ineffective on these parameters at all time points examined. Taken together, our results are the first to demonstrate that NWGH is quite effective in enhancing IGF-1 and GH levels in the cord and plasma that may be crucial in reducing pathophysiology of SCI.

Blood-spinal cord barrier

Edema

Growth hormone

Insulin-like growth factor-1

Spinal cord injury

Evans blue

growth hormone

nanowire

radioactive iodine

somatomedin C

titanium dioxide

drug implant

Evans blue

growth hormone

insulin-like growth factor-1, rat

neuroprotective agent

radioactive iodine

recombinant protein

somatomedin C

animal experiment

animal tissue

Article

continuous infusion

controlled study

drug delivery system

edema

extravasation

growth hormone deficiency

hormone blood level

incision

male

nerve cell lesion

neuroprotection

nonhuman

pathophysiology

permeability barrier

rat

spinal cord dorsal horn

spinal cord injury

thoracic spinal cord

animal

blood

chemistry

complication

drug delivery system

drug implant

edema

infusion pump

intraspinal drug administration

nerve cell

pathology

permeability

spinal cord

Spinal Cord Injuries

Sprague Dawley rat

thoracic vertebra

topical drug administration

vascularization

Administration, Topical

Animals

Drug Delivery Systems

Drug Implants

Edema

Evans Blue

Growth Hormone

Infusion Pumps

Infusions, Spinal

Insulin-Like Growth Factor I

Iodine Radioisotopes

Male

Nanowires

Neurons

Neuroprotective Agents

Permeability

Rats

Rats, Sprague-Dawley

Recombinant Proteins

Spinal Cord

Spinal Cord Injuries

Thoracic Vertebrae