Biocompatibility of reduced graphene oxide nanoscaffolds following acute spinal cord injury in rats

Ali H. Palejwala, B.S.,[1,2] Jared S. Fridley, M.D,[1,2] Javier A. Mata, M.D.,[1,2] Errol L. G. Samuel, M.A.,[3] Thomas G. Luerssen, M.D.,[1,2] Laszlo Perlaky, Ph.D.,[4,5] Thomas A. Kent, M.D.,[6,7,8] James M. Tour, Ph.D.,[3,9] and Andrew Jea, M.D.[1,2]

[1]Department of Neurosurgery, Baylor College of Medicine, Houston, Texas, USA;
[2]Division of Pediatric Neurosurgery, Texas Children's Hospital, Houston, Texas, USA;
[3]Department of Chemistry, Rice University, Houston, Texas, USA;
[4]Department of Pediatrics, Baylor College of Medicine, Houston, Texas, USA;
[5]Research and Tissue Support Services Core Laboratory, Texas Children's Cancer and Hematology Services, Houston, Texas, USA;
[6]Department of Neurology, Baylor College of Medicine, Houston, Texas, USA;
[7]Center for Translational Research in Inflammatory Diseases, Michael E. DeBakey VA Medical Center, Houston, Texas, USA;
[8]Interdepartmental Program in Translational Biology and Molecular Medicine, Baylor College of Medicine, Houston, Texas, USA; and
[9]Smalley Institute for Nanoscale Science and Technology, Rice University, Houston, Texas, USA

Contact@ ali.palejwala@bcm.edu

Abstract (Arial 10)

Graphene has unique electrical, physical, and chemical properties that may offer significant potential as a bioscaffold for neuronal regeneration after spinal cord injury (SCI).

To establish the in vivo biocompatibility of pristine graphene and its mechanical support for cells and axons when implanted into spinal cord tissue.

Graphene nanoscaffolds were prepared by the mild chemical reduction of graphene oxide (GO). Twenty Wistar rats (19 male and 1 female) underwent hemispinal cord transection at approximately the T2 level. To bridge the lesion, graphene nanoscaffolds with a hydrogel were implanted immediately after spinal cord transection. Control animals were treated with hydrogel matrix alone. Histologic evaluation was performed 3 months after the spinal cord transection to assess in vivo biocompatibility of graphene and to measure the ingrowth of tissue elements adjacent to the graphene nanoscaffold.

The graphene nanoscaffolds adhered well to the spinal cord tissue. There was no area of pseudocyst around the scaffolds suggestive of cytotoxicity. Instead, histological evaluation showed an ingrowth of connective tissue elements, blood vessels, neurofilaments, and Schwann cells around the graphene nanoscaffolds.

Graphene is a nanomaterial that is biocompatible with neurons and may have significant biomedical application. It may provide a scaffold for the ingrowth of regenerating axons after SCI.

References

1. Fehlings MG, Vaccaro A, Wilson JR, et al. Early versus delayed decompression for traumatic cervical spinal cord injury: results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). *PLoS One.* 2012;7(2):e32037.
2. Vale FL, Burns J, Jackson AB, Hadley MN. Combined medical and surgical treatment after acute spinal cord injury: results of a prospective pilot study to assess the merits of aggressive medical resuscitation and blood pressure management. *J Neurosurg.* 1997;87(2):239-246.