Stanford

Paul George, MD, PhD

Associate Professor of Neurology and Neurological Sciences (Adult Neurology) and, by courtesy, of Neurosurgery

CLINICAL OFFICE (PRIMARY)

- **Stanford Neuroscience Health Center**

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Bio

BIO

How can we help the brain heal after injury and maintain brain health throughout the lifetime? The George lab works to identify and leverage key recovery mechanisms to improve the nervous system's ability to repair after injury. Our lab's primary focus is applying novel bioengineering techniques to understand the mechanisms of neural recovery (primarily in stroke) and discovering methods to improve patient recovery after neural injury. We use translational models of stroke combined with biomaterial techniques, stem cell transplants, and microfabrication to achieve these aims and evaluate our methods with behavior testing and various imaging techniques. Our ultimate goal is to translate these findings into clinical trials to help patients with neurological injury

CLINICAL FOCUS

- Vascular Neurology

ACADEMIC APPOINTMENTS

- Associate Professor - University Medical Line, Adult Neurology
- Associate Professor - University Medical Line (By courtesy), Neurosurgery
- Member, Bio-X
- Member, Cardiovascular Institute
- Member, SPARK at Stanford
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Co-Director, Neurology Faculty Mentorship & Sponsorship Program, Department of Neurology, (2023- present)
- Member, Neuroscience Graduate IDP Faculty Program Committee, (2023- present)
- Member, Neuroscience PhD Program DEIB Committee, (2022-2024)
- Neuroscience PhD Program Representative, Committee on Graduate Admissions and Policy, (2017- present)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Chair, Science Committee, American Academy of Neurology (2023 - present)
- Ex-Officio Director, Board of Directors, American Academy of Neurology Institute (2023 - present)
- Science Committee, American Academy of Neurology (2013 - present)

PROFESSIONAL EDUCATION

- Residency: Stanford University Dept of Neurology (2012) CA
- Internship: Stanford University Internal Medicine Residency (2009) CA
- Fellowship: Stanford University Vascular Neurology Fellowship (2013) CA
- Board Certification: Vascular Neurology, American Board of Psychiatry and Neurology (2014)
- Board Certification: Neurology, American Board of Psychiatry and Neurology (2012)
- Medical Education: Harvard Medical School (2008) MA
- PhD, Massachussetts Institute of Technology , Electrical and Medical Engineering (2005)
- BSE, Tulane University of Louisiana (1999)

LINKS

- George Lab Site: http://med.stanford.edu/george-lab.html
- Get a Second Opinion: https://stanfordhealthcare.org/second-opinion/overview.html

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

DEVELOPMENT OF STROKE RECOVERY THERAPEUTICS:

Stroke is devastating to patients and their caregivers. We currently are investigating 3 neural repair approaches. The first focuses on developing a stroke recovery therapeutic based on an essential repair pathway and how it alters the immune response following stroke. The second utilizes implantable, conductive polymer devices to electrically manipulate the recovering nervous system to improve recovery and identify novel therapeutic targets. The final approach works to optimize stem cell therapeutics to enhance their ability to treat patients who have suffered from neural injury.

CONDUCTIVE BIOPOLYMER SYSTEMS FOR NEURAL RECOVERY AND STEM CELL MODULATION:

The George lab develops biomaterials to improve neural recovery in the peripheral and central nervous systems. By controlled release of drugs and molecules through biomaterials we can study the temporal effect of these neurotrophic factors on neural recovery and engineer drug delivery systems to enhance regenerative effects. By identifying the critical mechanisms for neural recovery, we are able to develop polymeric technologies for clinical translation in nerve regeneration. Recent work utilizes these novel conductive polymers to differentiate stem cells for therapeutic and drug discovery applications.

APPLYING ENGINEERING TECHNIQUES TO DETERMINE BIOMARKERS FOR STROKE DIAGNOSTICS:

The ability to create diagnostic assays and techniques enables us to understand biological systems more completely and improve clinical management. Previous work utilized mass spectroscopy proteomics to find a simple serum biomarker for TIAs (a warning sign of stroke). Our study discovered a novel candidate marker, platelet basic protein. Current studies are underway to identify further candidate biomarkers using transcriptome analysis. More accurate diagnosis will allow for aggressive therapies to prevent subsequent strokes.

Teaching

COURSES

2025-26

- Responsible Conduct of Neuroscience Research: NEPR 212 (Aut)

2024-25

- Responsible Conduct of Neuroscience Research: NEPR 212 (Aut)

2023-24

- Responsible Conduct of Neuroscience Research: NEPR 212 (Aut)

2022-23

- Responsible Conduct of Neuroscience Research: NEPR 212 (Aut)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Sepideh Kiani Shabestari

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Neurosciences (Phd Program)
- Vascular Neurology (Fellowship Program)

Publications

PUBLICATIONS

- **Direct and capacitive electrical stimulation shapes neural progenitor cell survival and orientation on conductive scaffolds.** *Scientific reports*
  McConnell, K. W., Thompson, K. J., Spaid, M., Paukshto, M., Dai, H., Shaik, Z. F., Jiang, G., Bakdounes, H., Shabestari, S. K., George, P. M.
  2026
- **Therapeutic Post Stroke TIM1 Blockade Reduces Neuroinflammation and Improves Functional Recovery**
  Kiani Shabestari, S., Iliopoulou, B., Azadian, M., Thompson, K., Meyer, E., George, P.
  LIPPINCOTT WILLIAMS & WILKINS.2026
- **Clearance of intracranial debris by ultrasound reduces inflammation and improves outcomes in hemorrhagic stroke models.** *Nature biotechnology*
  Azadian, M. M., Kiani Shabestari, S., Rajan, A., Martinez, P. J., Macedo, N., Markarian, E., Xiang, Y., Yu, B. J., George, P. M., Fame, R. M., Airan, R. D.
  2025
- **Preclinical Evidence of Nogo-A Inhibition in Stroke Recovery: A Scoping Review.** *Stroke*
  Lima, J. E., Rengarajan, S., Wahl, A. S., Srivatsan, A., Strittmatter, S. M., Carmichael, S. T., George, P. M., Sheth, K. N., Schwab, M. E., Lansberg, M. G.
  2025
- **Changing genes, cells and networks to reprogram the brain after stroke.** *Nature neuroscience*
  Li, W., George, P., Azadian, M. M., Ning, M., Dhand, A., Cramer, S. C., Carmichael, S. T., Lo, E. H.
  2025
- **Eye Toward Stroke Prevention: Central Retinal Artery Occlusion and Tandem Internal Carotid Artery Occlusion.** *Stroke*
  Cheronis, C., Silverman, A., George, P. M.
  2024
- **Conductive gradient hydrogels allow spatial control of adult stem cell fate.** *Journal of materials chemistry. B*

Song, S., McConnell, K. W., Shan, D., Chen, C., Oh, B., Sun, J., Poon, A. S., George, P. M.
2024

- **Intravenous Tenecteplase and Carotid Artery Stenting in a Young Adult With Fibromuscular Dysplasia and Carotid Dissection.** *Stroke*
  Alfandy, F., Dugue, R., Pulli, B., George, P. M.
  2023
- **Wirelessly Powered-Electrically Conductive Polymer System for Stem Cell Enhanced Stroke Recovery.** *Advanced electronic materials*
  Santhanam, S., Chen, C., Oh, B., McConnell, K. W., Azadian, M. M., Patel, J. J., Gardner, E. E., Tanabe, Y., Poon, A. S., George, P. M.
  2023; 9 (10)
- **Clinical Problem Solving: A 38-year-Old Woman With Systemic Lupus Erythematosus Presenting With Headache, Nausea, and Vomiting.** *The Neurohospitalist*
  Silverman, A., Dugue, R., George, P. M.
  2023; 13 (4): 394-398
- **Controlling the Stem Cell Environment Via Conducting Polymer Hydrogels to Enhance Therapeutic Potential** *ADVANCED MATERIALS TECHNOLOGIES*
  Santhanam, S., Feig, V. R. R., McConnell, K. W. W., Song, S., Gardner, E. E. E., Patel, J. J. J., Shan, D., Bao, Z., George, P. M. M.
  2023
- **Strategic Planning at NINDS: Translating Plans into Action and Outcomes.** *Neurology*
  Jones, L. K., George, P.
  2022
- **Electrical modulation of transplanted stem cells improves functional recovery in a rodent model of stroke.** *Nature communications*
  Oh, B., Santhanam, S., Azadian, M., Swaminathan, V., Lee, A. G., McConnell, K. W., Levinson, A., Song, S., Patel, J. J., Gardner, E. E., George, P. M.
  2022; 13 (1): 1366
- **Elastin-like Proteins to Support Peripheral Nerve Regeneration in Guidance Conduits.** *ACS biomaterials science & engineering*
  Suhar, R. A., Marquardt, L. M., Song, S., Buabbas, H., Doulames, V. M., Johansson, P. K., Klett, K. C., Dewi, R. E., Enejder, A. M., Plant, G. W., George, P. M., Heilshorn, S. C.
  2021; 7 (9): 4209-4220
- **Electrical stimulation of human neural stem cells via conductive polymer nerve guides enhances peripheral nerve recovery.** *Biomaterials*
  Song, S., McConnell, K. W., Amores, D., Levinson, A., Vogel, H., Quarta, M., Rando, T. A., George, P. M.
  2021; 275: 120982
- **Conducting polymer-based granular hydrogels for injectable 3D cell scaffolds.** *Advanced materials technologies*
  Feig, V. R., Santhanam, S., McConnell, K. W., Liu, K., Azadian, M., Brunel, L. G., Huang, Z., Tran, H., George, P. M., Bao, Z.
  2021; 6 (6)
- **Modulating the Electrical and Mechanical Microenvironment to Guide Neuronal Stem Cell Differentiation.** *Advanced science (Weinheim, Baden-Wurttemberg, Germany)*
  Oh, B., Wu, Y. W., Swaminathan, V., Lam, V., Ding, J., George, P. M.
  2021; 8 (7): 2002112
- **Morphing electronics enable neuromodulation in growing tissue.** *Nature biotechnology*
  Liu, Y. n., Li, J. n., Song, S. n., Kang, J. n., Tsao, Y. n., Chen, S. n., Mottni, V. n., McConnell, K. n., Xu, W. n., Zheng, Y. Q., Tok, J. B., George, P. M., Bao, et al
  2020
- **Single-Cell Encapsulation via Click-Chemistry Alters Production of Paracrine Factors from Neural Progenitor Cells.** *Advanced science (Weinheim, Baden-Wurttemberg, Germany)*
  Oh, B. n., Swaminathan, V. n., Malkovskiy, A. n., Santhanam, S. n., McConnell, K. n., George, P. M.
  2020; 7 (8): 1902573
- **Controlling properties of human neural progenitor cells using 2D and 3D conductive polymer scaffolds.** *Scientific reports*
  Song, S., Amores, D., Chen, C., McConnell, K., Oh, B., Poon, A., George, P. M.
  2019; 9 (1): 19565

- **Regulating Stem Cell Function with Electrical Stimulation**
  Oh, B., Song, S., Lam, V., George, P.
  WILEY.2019: S277–S278
- **Conductive polymers to modulate the post-stroke neural environment** *BRAIN RESEARCH BULLETIN*
  Oh, B., George, P.
  2019; 148: 10–17
- **Utilizing Single Cell Immune Profiling to Identify Serum-based Biomarkers for Transient Ischemic Attacks**
  Therkelsen, K., Tsai, A., Mlynash, M., Oh, B., Eyngorn, I., Gaudilliere, B., George, P.
  LIPPINCOTT WILLIAMS & WILKINS.2019
- **Identification of New Therapeutic Pathways by Transcriptome Analysis of Electrically Stimulated-Neural Progenitor Cells After Stroke.**
  Oh, B., Swaminathan, V., Lam, V., Levinson, A., George, P.
  LIPPINCOTT WILLIAMS & WILKINS.2019
- **Engineered stem cell mimics to enhance stroke recovery** *BIOMATERIALS*
  George, P. M., Oh, B., Dewi, R., Hua, T., Cai, L., Levinson, A., Liang, X., Krajina, B. A., Bliss, T. M., Heilshorn, S. C., Steinberg, G. K.
  2018; 178: 63–72
- **In vivo Electrical Stimulation of Neural Stem Cells via Conductive Polymer Scaffold Improves Endogenous Repair Mechanisms of Stroke Recovery**
  Oh, B., Song, S., Lam, V., Levinson, A., George, P.
  LIPPINCOTT WILLIAMS & WILKINS.2018
- **Electrically Conductive Scaffold to Modulate and Deliver Stem Cells** *JOVE-JOURNAL OF VISUALIZED EXPERIMENTS*
  Oh, B., Levinson, A., Lam, V., Song, S., George, P.
  2018
- **Electrically Conductive Scaffold to Modulate and Deliver Stem Cells.** *Journal of visualized experiments : JoVE*
  Oh, B., Levinson, A., Lam, V., Song, S., George, P.
  2018
- **Electrical preconditioning of stem cells with a conductive polymer scaffold enhances stroke recovery.** *Biomaterials*
  George, P. M., Bliss, T. M., Hua, T. n., Lee, A. n., Oh, B. n., Levinson, A. n., Mehta, S. n., Sun, G. n., Steinberg, G. K.
  2017; 142: 31–40
- **Conductive polymer scaffolds to improve neural recovery.** *Neural regeneration research*
  Song, S. n., George, P. M.
  2017; 12 (12): 1976–78
- **Validation and comparison of imaging-based scores for prediction of early stroke risk after transient ischaemic attack: a pooled analysis of individual-patient data from cohort studies** *LANCET NEUROLOGY*
  Kelly, P. J., Albers, G. W., Chatzikonstantinou, A., De Marchis, G. M., Ferrari, J., George, P., Katan, M., Knoflach, M., Kim, J. S., Li, L., Lee, E., Olivot, J., Purroy, et al
  2016; 15 (12): 1236-1245
- **Inter-rater agreement analysis of the Precise Diagnostic Score for suspected transient ischemic attack.** *International journal of stroke*
  Cereda, C. W., George, P. M., Inoue, M., Vora, N., Olivot, J., Schwartz, N., Lansberg, M. G., Kemp, S., Mlynash, M., Albers, G. W.
  2016; 11 (1): 85-92
- **Novel TIA biomarkers identified by mass spectrometry-based proteomics** *INTERNATIONAL JOURNAL OF STROKE*
  George, P. M., Mlynash, M., Adams, C. M., Kuo, C. J., Albers, G. W., Olivot, J.
  2015; 10 (8): 1204-1211
- **Novel TIA biomarkers identified by mass spectrometry-based proteomics.** *International journal of stroke : official journal of the International Stroke Society*
  George, P. M., Mlynash, M., Adams, C. M., Kuo, C. J., Albers, G. W., Olivot, J. M.
  2015; 10 (8): 1204-11

- **Novel Stroke Therapeutics: Unraveling Stroke Pathophysiology and Its Impact on Clinical Treatments.** *Neuron*
  George, P. M., Steinberg, G. K.
  2015; 87 (2): 297-309
- **Beneficial effects of a semi-intensive stroke unit are beyond the monitor.** *Cerebrovascular diseases*
  Cereda, C. W., George, P. M., Pelloni, L. S., Gandolfi-Decristophoris, P., Mlynash, M., Biancon Montaperto, L., Limoni, C., Stojanova, V., Malacrida, R., Städler, C., Bassetti, C. L.
  2015; 39 (2): 102-109
- **Aortic arch atheroma: a plaque of a different color or more of the same?** *Stroke; a journal of cerebral circulation*
  George, P. M., Albers, G. W.
  2014; 45 (5): 1239-1240
- **Three-dimensional conductive constructs for nerve regeneration.** *Journal of biomedical materials research. Part A*
  George, P. M., Saigal, R., Lawlor, M. W., Moore, M. J., LaVan, D. A., Marini, R. P., Selig, M., Makhni, M., Burdick, J. A., Langer, R., Kohane, D. S.
  2009; 91 (2): 519-527
- **Electrically controlled drug delivery from biotin-doped conductive polypyrrole** *ADVANCED MATERIALS*
  George, P. M., LaVan, D. A., Burdick, J. A., Chen, C. Y., Liang, E., Langer, R.
  2006; 18 (5): 577-+
- **Electrically Controlled Drug Delivery from Biotin-Doped Conductive Polymer** *Advanced Materials*
  George, P. M., LaVan, D., Burdick, J., Chen, C. Y., Liang, E., Langer, R.
  2006; 18 (5)
- **Fabrication and biocompatibility of polypyrrole implants suitable for neural prosthetics** *BIOMATERIALS*
  George, P. M., Lyckman, A. W., LaVan, D. A., Hegde, A., Leung, Y., Avasare, R., Testa, C., Alexander, P. M., Langer, R., Sur, M.
  2005; 26 (17): 3511-3519
- **Simple, three-dimensional microfabrication of electrodeposited structures** *ANGEWANDTE CHEMIE-INTERNATIONAL EDITION*
  LaVan, D. A., George, P. M., Langer, R.
  2003; 42 (11): 1262-1265
- **Fabrication of Screen-Printed Carbon Electrode Arrays for Sensing Neuronal Messengers** *BIOMEDICAL MICRODEVICES*
  George, P. M., Muthuswamy, J., Currie, J., Thakor, N. V., Paranjape, M.
  2001; 3 (4): 307-313