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Rona Giffard

Professor of Anesthesiology, Perioperative and Pain Medicine, Emerita

CONTACT INFORMATION

- **Administrative Contact**

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Bio

ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Anesthesiology, Perioperative and Pain Medicine
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

HONORS AND AWARDS

- Ellis Cohen Achievement Award, Stanford Department of Anesthesia (2009)
- AHA/Bugher Award, American Heart Association (2000-2004)
- Frontiers in Anesthesia Research Award, International Anesthesia Research Society (1998-2003)
- Ellen Weaver Award, Association for Women in Science, Northern California Chapters (1997)
- Young Investigator Award, Foundation for Anesthesia Education and Research (1991-1992)
- NIH Clinical Investigator Award, NIH (1990-1995)

PROFESSIONAL EDUCATION

- Ph.D., Stanford University , Structural Biology
- M.D., Stanford University , Medicine

LINKS

- Giffard Lab Web site: http://giffardlab.stanford.edu

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Brain injury from stroke, head trauma, and chronic neurologic degenerative diseases, is a major cause of morbidity and mortality. We are particularly interested in the cellular consequences of brain injury. To study this problem we work with primary cultures of neurons and astrocytes from mice and employ rodent models of stroke. Current work focuses on: 1) the role of miRNAs as a way to regulate groups of proteins important to ischemic outcome; 2) the interaction of neurons and glia during

injury; 3) the role of astrocytes in global ischemia; 4)protection using heat shock proteins and cell death regulatory proteins 4) changes in mitochondrial function and signaling in injury and ways to protect mitochondria; 5) ways to improve neurogenesis after stroke; 6) the interaction of oxidative stress and inflammation in stroke; 7) computational modeling of cell death.

We use gene transfer techniques to express genes and miRNAs of interest in brain cells and intact brain and analyze ways in which these can provide protection. We use fluorescent probes for pH, intracellular calcium, ROS, mitochondrial membrane potential, as well as morphologically evaluate outcome, and quantitate injury. We also use transgenic mice to analyze the effects of overexpression or loss of expression of specific genes on outcome from stroke. Mitochondria are central to energy metabolism, the regulation of inflammation, and the regulation of cell death. We study changes in mitochondria with stress. We are also interested in the interaction of oxidative stress and inflammation in stroke.

Teaching

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Anesthesia (Fellowship Program)
- Molecular and Genetic Medicine (Fellowship Program)
- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **Nursing Markedly Protects Postpartum Mice From Stroke: Associated Central and Peripheral Neuroimmune Changes and a Role for Oxytocin.** *Frontiers in neuroscience*
  Stary, C. M., Xu, L., Volobouеva, L. A., Alcántara-Hernández, M., Arvola, O. J., Idoyaga, J., Giffard, R. G.
  2019; 13: 609

- **Pre-treatment with microRNA-181a Antagomir Prevents Loss of Parvalbumin Expression and Preserves Novel Object Recognition Following Mild Traumatic Brain Injury** *NEUROMOLECULAR MEDICINE*
  Griffiths, B. B., Sahbaie, P., Rao, A., Arvola, O., Xu, L., Liang, D., Ouyang, Y., Clark, D. J., Giffard, R. G., Stary, C. M.
  2019; 21 (2): 170–81

- **Pre-treatment with microRNA-181a Antagomir Prevents Loss of Parvalbumin Expression and Preserves Novel Object Recognition Following Mild Traumatic Brain Injury.** *Neuromolecular medicine*
  Griffiths, B. B., Sahbaie, P., Rao, A., Arvola, O., Xu, L., Liang, D., Ouyang, Y., Clark, D. J., Giffard, R. G., Stary, C. M.
  2019

- **Role of Myeloid Lineage Cell Autophagy in Ischemic Brain Injury** *STROKE*
  Kotoda, M., Furukawa, H., Miyamoto, T., Korai, M., Shikata, F., Kuwabara, A., Xiong, X., Rutledge, C., Giffard, R. G., Hashimoto, T.
  2018; 49 (6): 1488–95

- **MicroRNA Changes in Preconditioning-Induced Neuroprotection** *TRANSLATIONAL STROKE RESEARCH*
  Bell, J. D., Cho, J., Giffard, R. G.
  2017; 8 (6): 585–96

- **Reduction of microRNA-338 protects from ischemic injury in vivo and in vitro, and targets mitochondrial function**
  Li, L., Volobouеva, L., Xu, L., Stary, C., Giffard, R.
  ELSEVIER SCIENCE BV.2017: 508

- **Inhibition of miR-181a protects female mice from transient focal cerebral ischemia by targeting astrocyte estrogen receptor-a.** *Molecular and cellular neurosciences*
  Stary, C. M., Xu, L., Li, L., Sun, X., Ouyang, Y., Xiong, X., Zhao, J., Giffard, R. G.
  2017; 82: 118-125

- **Gpr124 is essential for blood-brain barrier integrity in central nervous system disease** *NATURE MEDICINE*

Chang, J., Mancuso, M. R., Maier, C., Liang, X., Yuki, K., Yang, L., Kwong, J. W., Wang, J., Rao, V., Vallon, M., Kosinski, C., Zhang, J. J., Mah, et al
2017; 23 (4): 450-?

- **High Dose Gamma Radiation Selectively Reduces GABAA-slow Inhibition.** *Cureus*
  Dagne, B. A., Sunay, M. K., Cayla, N. S., Ouyang, Y., Knox, S. J., Giffard, R. G., Adler, J. R., Maciver, B.
  2017; 9 (3)
- **Distinct effects of miR-210 reduction on neurogenesis: increased neuronal survival of inflammation but reduced proliferation associated with mitochondrial enhancement.** *journal of neuroscience*
  Volobоueva, L. A., Sun, X., Xu, L., Ouyang, Y., Giffard, R. G.
  2017
- **High dose gamma radiation selectively reduces GABAA-slow inhibition** *Cureus*
  Dagne, B. A., Sunay, M. K., Cayla, N. S., Ouyang, Y., Knox, S. J., Giffard, R. G., Adler , J. R., MacIver, B.
  2017; 9 (3): e1076
- **Alteration of Interneuron Immunoreactivity and Autophagic Activity in Rat Hippocampus after Single High-Dose Whole-Brain Irradiation.** *Cureus*
  Ouyang, Y. B., Ning, S. n., Adler, J. R., Maciver, B. n., Knox, S. J., Giffard, R. n.
  2017; 9 (6): e1414
- **miR-29a differentially regulates cell survival in astrocytes from cornu ammonis 1 and dentate gyrus by targeting VDAC1.** *Mitochondrion*
  Stary, C. M., Sun, X., Ouyang, Y., Li, L., Giffard, R. G.
  2016; 30: 248-254
- **A Pharmacogenetic Discovery: Cystamine Protects Against Haloperidol-Induced Toxicity and Ischemic Brain Injury** *GENETICS*
  Zhang, H., Zheng, M., Wu, M., Xu, D., Nishimura, T., Nishimura, Y., Giffard, R., Xiong, X., Xu, L. J., Clark, J. D., Sahbaie, P., Dill, D. L., Peltz, et al
  2016; 203 (1): 599-?
- **Physiologically normal 5% O2 supports neuronal differentiation and resistance to inflammatory injury in neural stem cell cultures.** *Journal of neuroscience research*
  Sun, X., Volobоueva, L. A., Stary, C. M., Giffard, R. G.
  2015; 93 (11): 1703-1712
- **Astrocytes Protect against Isoflurane Neurotoxicity by Buffering pro-brain-derived Neurotrophic Factor.** *Anesthesiology*
  Stary, C. M., Sun, X., Giffard, R. G.
  2015; 123 (4): 810-819
- **IL-4 Is Required for Sex Differences in Vulnerability to Focal Ischemia in Mice.** *Stroke; a journal of cerebral circulation*
  Xiong, X., Xu, L., Wei, L., White, R. E., Ouyang, Y., Giffard, R. G.
  2015; 46 (8): 2271-2276
- **Advances in Astrocyte-targeted Approaches for Stroke Therapy: An Emerging Role for Mitochondria and microRNAS.** *Neurochemical research*
  Stary, C. M., Giffard, R. G.
  2015; 40 (2): 301-307
- **MicroRNA-200c contributes to injury from transient focal cerebral ischemia by targeting Reelin.** *Stroke; a journal of cerebral circulation*
  Stary, C. M., Xu, L., Sun, X., Ouyang, Y., White, R. E., Leong, J., Li, J., Xiong, X., Giffard, R. G.
  2015; 46 (2): 551-556
- **Post-stroke treatment with miR-181 antagomir reduces injury and improves long-term behavioral recovery in mice after focal cerebral ischemia.** *Experimental neurology*
  Xu, L., Ouyang, Y., Xiong, X., Stary, C. M., Giffard, R. G.
  2015; 264: 1-7
- **The Use of microRNAs to Modulate Redox and Immune Response to Stroke.** *Antioxidants & redox signaling*
  Ouyang, Y., Stary, C. M., White, R. E., Giffard, R. G.
  2015; 22 (2): 187-202
- **microRNAs affect BCL-2 family proteins in the setting of cerebral ischemia** *NEUROCHEMISTRY INTERNATIONAL*
  Ouyang, Y., Giffard, R. G.
  2014; 77: 2-8

- **MicroRNAs affect BCL-2 family proteins in the setting of cerebral ischemia.** *Neurochemistry international*
  Ouyang, Y. B., Giffard, R. G.
  2014; 77: 2-8
- **Neuroprotection by astrocytes in brain ischemia: Importance of microRNAs** *NEUROSCIENCE LETTERS*
  Ouyang, Y., Xu, L., Yue, S., Liu, S., Giffard, R. G.
  2014; 565: 53-58
- **Overexpression of Heat Shock Protein 72 Attenuates NF-?B Activation Using a Combination of Regulatory Mechanisms in Microglia.** *PLoS computational biology*
  Sheppard, P. W., Sun, X., Khammash, M., Giffard, R. G.
  2014; 10 (2)
- **Role of Astrocytes in Delayed Neuronal Death: GLT-1 and its Novel Regulation by MicroRNAs.** *Advances in neurobiology*
  Ouyang, Y., Xu, L., Liu, S., Giffard, R. G.
  2014; 11: 171-188
- **MicroRNAs Regulate the Chaperone Network in Cerebral Ischemia** *TRANSLATIONAL STROKE RESEARCH*
  Ouyang, Y., Giffard, R. G.
  2013; 4 (6): 693-703
- **Inhibition of microRNA-181 reduces forebrain ischemia-induced neuronal loss** *JOURNAL OF CEREBRAL BLOOD FLOW AND METABOLISM*
  Moon, J., Xu, L., Giffard, R. G.
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- **Astrocyte-enriched miR-29a targets PUMA and reduces neuronal vulnerability to forebrain ischemia.** *Glia*
  Ouyang, Y., Xu, L., Lu, Y., Sun, X., Yue, S., Xiong, X., Giffard, R. G.
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- **Anaesthetic neurotoxicity and neuroplasticity: an expert group report and statement based on the BJA Salzburg Seminar** *BRITISH JOURNAL OF ANAESTHESIA*
  Jevtovic-Todorovic, V., Absalom, A. R., Blomgren, K., Brambrink, A., Crosby, G., Culley, D. J., Fiskum, G., Giffard, R. G., Herold, K. F., Loepke, A. W., Ma, D., Orser, B. A., Planel, et al
  2013; 111 (2): 143-151
- **The future of molecular chaperones and beyond.** *The Journal of clinical investigation*
  Giffard, R. G., Macario, A. J., de Macario, E. C.
  2013; 123 (8): 3206-8
- **Selective activation of protein kinase C? in mitochondria is neuroprotective in vitro and reduces focal ischemic brain injury in mice.** *Journal of neuroscience research*
  Sun, X., Budas, G. R., Xu, L., Barreto, G. E., Mochly-Rosen, D., Giffard, R. G.
  2013; 91 (6): 799-807
- **Inflammatory response of microglial BV-2 cells includes a glycolytic shift and is modulated by mitochondrial glucose-regulated protein 75/mortalin** *FEBS LETTERS*
  Volobоueva, L. A., Emery, J. F., Sun, X., Giffard, R. G.
  2013; 587 (6): 756-762
- **Mitigation of Murine Focal Cerebral Ischemia by the Hypocretin/Orexin System is Associated With Reduced Inflammation** *STROKE*
  Xiong, X., White, R. E., Xu, L., Yang, L., Sun, X., Zou, B., Pascual, C., Sakurai, T., Giffard, R. G., Xie, X. (.
  2013; 44 (3): 764-770
- **microRNAs: Innovative Targets for Cerebral Ischemia and Stroke** *CURRENT DRUG TARGETS*
  Ouyang, Y., Stary, C. M., Yang, G., Giffard, R.
  2013; 14 (1): 90-101
- **Effects of heat shock protein 72 (Hsp72) on evolution of astrocyte activation following stroke in the mouse** *EXPERIMENTAL NEUROLOGY*
  Barreto, G. E., White, R. E., Xu, L., Palm, C. J., Giffard, R. G.
  2012; 238 (2): 284-296

- **Mice lacking the #2 adrenergic receptor have a unique genetic profile before and after focal brain ischaemia.** *ASN neuro*
  White, R. E., Palm, C., Xu, L., Ling, E., Ginsburg, M., Daigle, B. J., Han, R., Patterson, A., Altman, R. B., Giffard, R. G.
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- **MicroRNA-320 induces neurite outgrowth by targeting ARPP-1** *NEUROREPORT*
  White, R. E., Giffard, R. G.
  2012; 23 (10): 590-595
- **Stroke-induced activation of the alpha 7 nicotinic receptor increases Pseudomonas aeruginosa lung injury** *FASEB JOURNAL*
  Lafargue, M., Xu, L., Carles, M., Serve, E., Anjum, N., Iles, K. E., Xiong, X., Giffard, R., Pittet, J.
  2012; 26 (7): 2919-2929
- **Genomic Analysis of Reactive Astrogliosis** *JOURNAL OF NEUROSCIENCE*
  Zamanian, J. L., Xu, L., Foo, L. C., Nouri, N., Zhou, L., Giffard, R. G., Barres, B. A.
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  Adelson, J. D., Barreto, G. E., Xu, L., Kim, T., Brott, B. K., Ouyang, Y., Naserke, T., Djurisic, M., Xiong, X., Shatz, C. J., Giffard, R. G.
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- **miR-181 targets multiple Bcl-2 family members and influences apoptosis and mitochondrial function in astrocytes** *MITOCHONDRION*
  Ouyang, Y., Lu, Y., Yue, S., Giffard, R. G.
  2012; 12 (2): 213-219
- **miR-181 regulates GRP78 and influences outcome from cerebral ischemia in vitro and in vivo** *NEUROBIOLOGY OF DISEASE*
  Ouyang, Y., Lu, Y., Yue, S., Xu, L., Xiong, X., White, R. E., Sun, X., Giffard, R. G.
  2012; 45 (1): 555-563
- **Mice lacking the beta 2 adrenergic receptor have a unique genetic profile before and after focal brain ischaemia** *ASN NEURO*
  White, R. E., Palm, C., Xu, L., Ling, E., Ginsburg, M., Daigle, B. J., Han, R., Patterson, A., Altman, R. B., Giffard, R. G.
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- **ER-Mitochondria Crosstalk during Cerebral Ischemia: Molecular Chaperones and ER-Mitochondrial Calcium Transfer.** *International journal of cell biology*
  Ouyang, Y., Giffard, R. G.
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- **Inflammation, Mitochondria, and the Inhibition of Adult Neurogenesis** *JOURNAL OF NEUROSCIENCE RESEARCH*
  Voloboueva, L. A., Giffard, R. G.
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- **Astrocyte Proliferation Following Stroke in the Mouse Depends on Distance from the Infarct** *PLOS ONE*
  Barreto, G. E., Sun, X., Xu, L., Giffard, R. G.
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- **Significance of Marrow-Derived Nicotinamide Adenine Dinucleotide Phosphate Oxidase in Experimental Ischemic Stroke** *ANNALS OF NEUROLOGY*
  Tang, X. N., Zheng, Z., Giffard, R. G., Yenari, M. A.
  2011; 70 (4): 606-615
- **Quantitative characterization and analysis of the dynamic NF-kappa B response in microglia** *BMC BIOINFORMATICS*
  Sheppard, P. W., Sun, X., Emery, J. F., Giffard, R. G., Khammash, M.
  2011; 12
- **Increased Brain Injury and Worsened Neurological Outcome in Interleukin-4 Knockout Mice After Transient Focal Cerebral Ischemia** *STROKE*
  Xiong, X., Barreto, G. E., Xu, L., Ouyang, Y. B., Xie, X., Giffard, R. G.
  2011; 42 (7): 2026-2032
- **Astrocytes: targets for neuroprotection in stroke.** *Central nervous system agents in medicinal chemistry*
  Barreto, G., White, R. E., Ouyang, Y., Xu, L., Giffard, R. G.
  2011; 11 (2): 164-173

- **Heat Shock Protein 72 Overexpression Prevents Early Postoperative Memory Decline after Orthopedic Surgery under General Anesthesia in Mice** *ANESTHESIOLOGY*
  Vizcaychipi, M. P., Xu, L., Barreto, G. E., Ma, D., Maze, M., Giffard, R. G.
  2011; 114 (4): 891-900
- **Endotoxin-activated microglia injure brain derived endothelial cells via NF-kappa B, JAK-STAT and JNK stress kinase pathways** *JOURNAL OF INFLAMMATION-LONDON*
  Kacimi, R., Giffard, R. G., Yenari, M. A.
  2011; 8
- **Overexpressing GRP78 influences Ca2+ handling and function of mitochondria in astrocytes after ischemia-like stress** *MITOCHONDRION*
  Ouyang, Y., Xu, L., Emery, J. F., Lee, A. S., Giffard, R. G.
  2011; 11 (2): 279-286
- **Glycyrrhizin Protects Against Focal Ischemia and Attenuates Peripheral Immunosuppression in Rats** *International Stroke Conference*
  Xiong, X., Gu, L., Li, L., Lee, J., Li, M., Xu, L., Giffard, R., Krams, S. M., Steinberg, G. K., Zhao, H.
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- **Heat shock protein 72 (Hsp72) improves long term recovery after focal cerebral ischemia in mice** *NEUROSCIENCE LETTERS*
  Xu, L., Xiong, X., Ouyang, Y., Barreto, G., Giffard, R.
  2011; 488 (3): 279-282
- **Direct protection of cultured neurons from ischemia-like injury by minocycline.** *Anatomy & cell biology*
  Huang, W. C., Qiao, Y., Xu, L., Kacimi, R., Sun, X., Giffard, R. G., Yenari, M. A.
  2010; 43 (4): 325-331
- **Mitochondrial Protection Attenuates Inflammation-Induced Impairment of Neurogenesis In Vitro and In Vivo** *JOURNAL OF NEUROSCIENCE*
  Voloboueva, L. A., Lee, S. W., Emery, J. F., Palmer, T. D., Giffard, R. G.
  2010; 30 (37): 12242-12251
- **Automation of neurobehavioral assays for the mouse stroke model assessment at homecage using SmartCage (TM) system** *14th Congress of European-Federation-of-Neurological-Societies*
  Xie, X. S., Xu, L., Xiong, X., Zou, B., Xie, J., Zhang, J., Giffard, R.
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- **Intrathecal injection of an alpha seven nicotinic acetylcholine receptor agonist attenuates gp120-induced mechanical allodynia and spinal pro-inflammatory cytokine profiles in rats** *BRAIN BEHAVIOR AND IMMUNITY*
  Loram, L. C., Harrison, J. A., Chao, L., Taylor, F. R., Reddy, A., Travis, C. L., Giffard, R., Al-Abed, Y., Tracey, K., Maier, S. F., Watkins, L. R.
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- **Astrocyte Targeted Overexpression of Hsp72 or SOD2 Reduces Neuronal Vulnerability to Forebrain Ischemia** *GLIA*
  Xu, L., Emery, J. F., Ouyang, Y., Voloboueva, L. A., Giffard, R. G.
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- **Age-related Defects in Sensorimotor Activity, Spatial Learning, and Memory in C57BL/6 Mice** *JOURNAL OF NEUROSURGICAL ANESTHESIOLOGY*
  Barreto, G., Huang, T., Giffard, R. G.
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- **Protection of astrocytes from ischemia-like injury by endoplasmic reticulum chaperone protein Grp78** *24th International Symposium on Cerebral Blood Flow and Metabolism/9th International Conference on Quantification of Brain Function with PET*
  Giffard, R. G., Emery, J. F., Xu, L., Lee, A. S., Ouyang, Y.
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- **Nadph oxidase from circulating inflammatory cells exacerbates injury in experimental stroke** *24th International Symposium on Cerebral Blood Flow and Metabolism/9th International Conference on Quantification of Brain Function with PET*
  Tang, X., Zheng, Z., Giffard, R., Yenari, M.
  NATURE PUBLISHING GROUP.2009: S83–S83
- **TARGETING ASTROCYTES TO REDUCE LOSS OF CA1 HIPPOCAMPAL NEURONS IN FOREBRAIN ISCHEMIA** *9th European Meeting on Glial Cells in Health and Disease*
  Giffard, R. G., Xu, L., Ouyang, Y. B., Emery, J. F.

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- **Mild Hypothermia Desreases Cerebral Hemorrhage Caused By Tissue Plasminogen Activator Treatment In Experimental Stroke.** *American-Association-International-Stroke Conference 2009*
  Tang, X. N., Liu, L., Koike, M., Giffard, R. G., Yenari, M. A.
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  Xu, L., Volobouеva, L. A., Ouyang, Y., Emery, J. F., Giffard, R. G.
  2009; 29 (2): 365-374
- **Inflammation and NF kappa B activation is decreased by hypothermia following global cerebral ischemia** *NEUROBIOLOGY OF DISEASE*
  Webster, C. M., Kelly, S., Koike, M. A., Chock, V. Y., Giffard, R. G., Yenari, M. A.
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- **Postischemic Brain Injury Is Attenuated in Mice Lacking the beta(2)-Adrenergic Receptor** *ANESTHESIA AND ANALGESIA*
  Han, R., Ouyang, Y., Xu, L., Agrawal, R., Patterson, A. J., Giffard, R. G.
  2009; 108 (1): 280-287
- **Regulation of apoptotic and inflammatory cell signaling in cerebral ischemia - The complex roles of heat shock protein 70** *ANESTHESIOLOGY*
  Giffard, R. G., Han, R., Emery, J. F., Duan, M., Pittet, J. F.
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- **Overexpression of mitochondrial Hsp70/Hsp75 protects astrocytes against ischemic injury in vitro** *JOURNAL OF CEREBRAL BLOOD FLOW AND METABOLISM*
  Volobouеva, L. A., Duan, M., Ouyang, Y., Emery, J. F., Stoy, C., Giffard, R. G.
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  Tang, X. N., Zheng, Z., Cairns, N., Cairns, B., Giffard, R. G., Yenari, M. A.
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  Xu, L., Wang, B., Kaur, K., Kho, M. F., Cooke, J. P., Giffard, R. G.
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- **Selective dysfunction of hippocampal CA1 astrocytes contributes to delayed neuronal damage after transient forebrain ischemia** *JOURNAL OF NEUROSCIENCE*
  Ouyang, Y., Volobouеva, L. A., Xu, L., Giffard, R. G.
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- **Blood-brain barrier disruption is related to NADPH oxidase in experimental stroke** *32nd International Stroke Conference*
  Tang, X. N., Wang, Q., Xu, L., Koike, M., Cairns, N., Cairns, B., Giffard, R. G., Yenari, M. A.
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  Ouyang, Y., Xu, L., Volobouеva, L., Giffard, R. G.
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- **Improved astrocyte function using ceftriaxone to upregulate GLT-1 is associated with decreased CA1 neuronal loss in forebrain ischemia**
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- **Improved astrocyte function using ceftriaxone to upregulate GLT-1 is associated with decreased CA1 neuronal loss in forebrain ischemia** *8th European Meeting on Glial Cells in Health and Disease*

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- **Transplantation of embryonic stem cells-derived endothelial cells in rat stroke model promotes functional recovery** *3rd Annual Symposium of the American-Heart-Association-Council-on-Basic-Cardiovascular-Sciences*
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- **Biphasic role of nuclear factor-kappa B on cell survival and COX-2 expression in SOD1 Tg astrocytes after oxygen glucose deprivation** *JOURNAL OF CEREBRAL BLOOD FLOW AND METABOLISM*
  Lee, Y., Song, Y. S., Giffard, R. G., Chan, P. H.
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- **Transplantation of embryonic stem cell derived endothelial cells promotes functional recovery after transient cerebral ischemia** *28th Congress of the European-Society-of-Cardiology/World Congress of Cardiology*
  Wu, J. E., Li, Z., Xu, L., Giffard, R., Wu, J. O., Cooke, J. O.
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- **The carboxyl-terminal domain of inducible Hsp70 protects from ischemic injury in vivo and in vitro** *JOURNAL OF CEREBRAL BLOOD FLOW AND METABOLISM*
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