



Signature

## CAROLYN A HARRIS, PhD

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### EDUCATION

PhD, Bioengineering 2006 - 2011  
University of Utah, Salt Lake City, UT

BS, Engineering, Biomedical Engineering, Biology 2002 - 2006  
Purdue University, West Lafayette, IN

### POSTGRADUATE TRAINING

Senior Postdoctoral Fellow, Shunt Design in Hydrocephalus, Neural Prosthetics 2011 - present  
Seattle Children's Hospital  
Advisor: William Shain, PhD

Consultant, Shunt Design in Hydrocephalus 2011 - present  
Aqueduct Neurosciences, Seattle, WA  
CEO: Tom Clement

Postdoctoral Fellow, Shunt Design in Hydrocephalus 2011  
University of Utah  
Advisor: James P. McAllister II, PhD

Consultant, Shunt Design in Hydrocephalus 2011  
Agile Sciences, Raleigh, NC  
CEO: Eva Garland, MD

### FACULTY APPOINTMENTS

Assistant Professor, Neurosurgery 2014 - present  
Wayne State University, Detroit, Michigan

Part-time Adjunct Faculty, Anatomy and Physiology 2009  
Salt Lake Community College, Salt Lake City, UT

### HOSPITAL AND OTHER PROFESSIONAL APPOINTMENTS

USA Representative, Executive Board 2015 - 2019  
Society for Research in Hydrocephalus and Spina Bifida

Scientific Advisory Board, Microbot Medical 2014 - present  
Invited Ad Hoc Reviewer: *Computers in Biology and Medicine* 2012  
Invited Ad Hoc Reviewer: *Journal of Pediatric Epilepsy* 2012

## MAJOR PROFESSIONAL SOCIETIES

- Society for Research into Hydrocephalus and Spina Bifida (2008-2011, 2014 - present)
- Biomedical Engineering Society (2002-present)
- Hydrocephalus Association (2006-present)
- Society for Neuroscience (2004, 2012-present)
- International Society for Hydrocephalus and Cerebrospinal Fluid Disorders (2011)
- Society of Women Engineers (2002-2006)

## CERTIFICATIONS

### Office of Environmental Health and Safety, Wayne State University

- OSHA Laboratory Standard
- Biosafety and OSHA Bloodborne Pathogens
- Hazardous Waste / Emergency Procedures
- HIPAA Compliance

### Division of Laboratory Animal Resources, Wayne State University

- Investigating the Mouse and Rat
- Investigating the Feline
- Rodent Surgery Training

## HONORS AND AWARDS

Best Scientific Presentation Award, Society for Research in Hydrocephalus and Spina Bifida, Sweden	2014
Recipient of NIH NINDS Loan Repayment Program in Pediatric Research	2013
Top 10 Ranked Abstract, Hydrocephalus International Conference (ISHCSF), Baltimore MD	2009
Heilbrun Lectureship's Best Overall Presentation, Salt Lake City UT	2009
AIChE Materials Science and Engineering Poster Session, 3 <sup>rd</sup> Place, Salt Lake City UT	2007
William P. Corcoran Award, Outstanding leadership in Engineering Service, Purdue University	2006
NSF Fellowship Trainee: International School on Biocomplexity from System to Gene, Dartmouth College	2004

## **TEACHING**

### General Coursework Taught

Part-time Adjunct Faculty, Anatomy Lab Instructor, Salt Lake Community College	2009
Hands on Neuroanatomy Course Instructor, Hydrocephalus Association's 10 <sup>th</sup> National Conference	2008
SfN Brain Bee Competition Judge	2006
Engineering Seminar Teaching Assistant, Purdue University	2004

### Mentorship

- Brian Hanak, 4<sup>th</sup> year Neurosurgical Resident (2013-present)
- Kelsie Pearson, Hydrocephalus Scientist
- Cale Crowder, Undergraduate Center for Sensorimotor Neural Engineering Student (2012)
- Ramin Eskandari, 4<sup>th</sup> year Neurosurgical Resident (2010)
- Candice (Leishman) Moon, Undergraduate Bioengineering Student (2008-2010)
- Myron Lance, Undergraduate Bioengineering Student (2010)
- Jonathon (Phillip) Smith, BSE, Electrical Engineering Trainee (2009-2010)
- Andrew Black, Undergraduate Biology Student (2009)
- Melissa Mason, Undergraduate Biology Student (2008 - 2010)
- Shawna Wright, Undergraduate Biology Student (2007)
- Jeffery Gloss, High School Student (2006)

## **COURSE AND CURRICULUM DEVELOPMENT**

Undergraduate Gross Anatomy Laboratory Course, Salt Lake Community College	2009
Engineering Projects in Community Service, Purdue University	2002

## **GRANTS, CONTRACTS, AND OTHER FUNDING**

### Current funding

Examining SOPHYSA Anti-Block Catheters, Industrial Contract with SOPHYSA,  
12/1/13-12/1/14, \$25,000 (PI)

Investigating the cellular mechanisms of shunt obstruction in pediatric hydrocephalus, NIH NINDS  
Loan Repayment Program in Pediatric Research (L40), 08/1/13 – 08/1/15, \$70,000 toward  
student loans (PI)

### Previously funded

Novel Methods to Reduce Catheter Obstruction in Treating Hydrocephalus, Seeking Techniques  
Advancing Research in Shunts (STARS-kids), 10/01/2008 - 09/30/2010, \$37,500 (Co-PI)

### Previously submitted, not funded

Linking the Foreign Body Response and Hydrocephalus Etiology using Patient Data,  
NIH R03, October 2013, Scored 36, \$50,000 (PI)

Advanced Tools and Technologies for Cerebrospinal Fluid Shunts NIH Phase II STTR (R41/R42), April 2013, Scored 28, \$3,000,000 (Col)

Modeling Tissue Obstruction in CSF-drainage Catheters, NIH Exploratory Developmental Research Grant Program (Parent R21), June 2010, Scored 34, \$250,000 (Co-PI)

## PATENTS

1. "Systems and Methods for Simulating Flow of Cerebrospinal Fluid".  
Carolyn A. Harris and James P. McAllister, II. Publication number US20120060622 A1, Priority Date 9/10/10, Filing Date 9/9/11, Publication Date 3/15/12
2. The Hydrocephalus Shunt Catheter Bioreactor;  
Submitted 8/4/10; Invention Disclosure Designation Number U-4918
3. Disulfide Sensitive Methods in Reducing Adhesion on Ventricular Catheters: N-Acetyl-L-Cysteine; Submitted 8/20/08; Invention Disclosure Designation Number U-4509

## PUBLICATIONS

1. Megjhani M, Mukherjee A, Rey N, Merouane A, Lu Y, Trett K, Chong P, **Harris C**, Shain W, Roysam B. IEEE Biomaterials (in press). Harris Role: Animal Work, Confocal Microscopy, and Manuscript Editing.
2. **Harris C**, McAllister JP II: What We Should Know About the Cellular and Tissue Response Causing Catheter Obstruction in the Treatment of Hydrocephalus (Review). Neurosurgery. 70(6): 1589-601, discussion 1601-2.
3. Eskandari R, **Harris CA**, McAllister JP II: Reactive astrocytosis in feline neonatal hydrocephalus: acute, chronic, and shunt-induced changes. Child's Nervous System. 27(12): 2067-76, 2011. Harris Role: All Statistical Analysis, Manuscript Editing.
4. **Harris C**, Resau J, Hudson E, West R, Moon C, Black AD, McAllister JP II: Reduction of Protein Adsorption and Macrophage and Astrocyte Adhesion on Ventricular Catheters by Polyethylene Glycol and N-Acetyl-L-Cysteine. Journal of Biomedical Materials Research Part A. 98(3):425-33, 2011.
5. **Harris C**, McAllister JP II: Does drainage hole size influence adhesion on ventricular catheters? Child's Nervous System. 27(8):1221-32, 2011.
6. **Harris C**, Resau J, Hudson E, West R, Moon C, Black AD, McAllister JP II: Effects of surface wettability, flow, and protein concentration on macrophage and astrocyte adhesion in an in vitro model of central nervous system catheter obstruction. Journal of Biomedical Materials Research Part A. 97(4): 443-440, 2011.
7. **Harris C**, Resau J, Hudson E, West R, Moon C, McAllister JP II: Mechanical contributions to astrocyte adhesion using a novel in vitro model of catheter obstruction. Experimental Neurology. 222(2):204-210, 2010.
8. **Black C**, Resau J, West R, Grever W, McAllister JP II: Are We Implanting Shunt Catheters that Facilitate Shunt Failure? Fluids and Barriers of the CNS. 6 (Suppl 1):S42. (published abstract)
9. Wang A, Liang X, McAllister JP, Li J, **Black C**, Finlayson P, Cao T, Tang C, Salley S, Auner G, Ng KYS. 2007. Stability of and inflammatory response to silicon coated with a fluoroalkyl self-assembled monolayer in the central nervous system. Journal of Biomedical Materials Research Part A 81(2): 363-372, 2007. Harris Role: Coating Devices, Animal Work, Data Analysis.

10. Wang A, McAllister JP II, Finlayson PG, Li J, Brabant KE, Tang H, **Black CE**, Cao T, Liang X, Salley SO, Auner GW, Ng KYS: Short- and long-term neural biocompatibility of heparin coated sapphire implants. *Materials Science & Engineering C-Biomimetic and Supramolecular Systems*. 27(2):237-243, 2007. Harris Role: Coating Devices, Animal Work, Data Analysis.
11. Wang A, Cao T, Tang H, Liang X, **Black C**, Salley SO, McAllister JP II, Auner GW, Ng KYS. 2006. Immobilization of polysaccharides on a fluorinated silicon surface. *Colloids and Surfaces B Biointerfaces* 47(1): 57-63, 2006. Harris Role: Coating Devices, Animal Work, Data Analysis.

### INVITED PRESENTATIONS

1. What we don't know (but should) about Shunt Obstruction. 13<sup>th</sup> National Conference on Hydrocephalus for Patient Support. Portland, OR.
2. Investigating shunt obstruction in hydrocephalus using human explants. Society for Research into Hydrocephalus and Spina Bifida International Conference pre-meeting on Experimental Hydrocephalus, Uppsala, Sweden.
3. Three-dimensional high throughput quantitative data analysis of brain-device interactions. Seattle Children's Research Institute, Seattle, WA. Joint center initiative to instigate translational research.
4. Bioengineering Tools to Advance Hydrocephalus Treatment. University of Washington, Department of Neurosurgery Grand Rounds, Seattle, WA.
5. Addressing Patients and Families: We Will Improve Shunts! Hydrocephalus Walk, Seattle, WA.
6. Brain-device interactions – identifying biological events that will enable improved device performance. NSF Engineering Research Center for Sensorimotor Neural Engineering, Seattle, WA.
7. Analysis of Shunt Obstruction in Hydrocephalus. Discovery Board Center for Integrative Brain Research, Seattle, WA.
8. Bioengineering Advances for Shunt Catheters. Heilbrun Lectureship, Salt Lake City, UT.

### SELECTED ABSTRACTS (from 37, first/presenting author on 20)

1. **Harris C**, Pearson K, Trett K, Zhu S, Taskin N, Chong P, Roysam B, Browd S, Shain. Investigation of treatment failure in hydrocephalus using human shunt explants. SfN, San Diego, CA, 2013.
2. Zhu S, **Harris C**, Xu Y, Lv Y, Trett K, Mkulkarni P, Taskin N, Chong P, Merouane A, Somasundar V, Cai X, Butts K, Lu J, Stoetzner C, Kipke D, Roysam B, Padmanabhan R, Carin L, Shain W. Revealing 3D neural-glia networks around implanted neuroprosthetic device. San Diego, CA, 2013.
3. **Harris C**, Trett K, Shain W, Kipke DR, Stotetzner C, Roysam B, Xu Y, Padmanabhan R, Carin L: Correlation of Microglia Distribution and Complex Impedance Spectra Around Implanted Neuroprostheses. BMES, Seattle, WA, 2013.
4. **Harris C**, Pearson K, Shain W, Trett K, Browd S, Clement T, Lutz B, Relethford J: Shear-Induced Prevention of Shunt Occlusion in a 3D Astrocyte Culture Model. BMES, Seattle, WA, 2013.
5. Roysam B, Padmanabhan R, Xu Y, Lu Y, Luisi J, Savelonas M, Busse B, somasundar V, Rey-Villamizar N, Kulkarni P, Cheung H, Cheong A, Carin L, Tsai CL, Trett K, **Harris C**, Chong P, Kipke D, Stoetzner C, Vetter R, Shain W: Quantitative 3D Cellular-scale Profiling of Brain Tissue Surrounding Implanted Devices, Neural Interfaces Conference, Salt Lake City, 2012
6. Shain W, Stoetzner C, Kipke DR, Trett K, Chong P, **Harris C**, Busse B, Padmanabhan R, Xu Y, Lu Y, Luisi J, Savelonas M, Somasundar V, Rey-Villamirar N, Kulkarni P, Cheung H, Cheong A, Roysam B, Williams JC, Carin L: Changes in complex impedance spectra associated with cell-electrode interactions, Neural Interfaces Conference, Salt Lake City, 2012

7. **Harris C**, McAllister JP II: Larger drainage holes reduce inflammatory cell adhesion on ventricular catheters. Hydrocephalus, 2011, Copenhagen, Denmark, 2011.
8. **Harris C**, Resau J, Hudson E, West R, Moon C, McAllister JP II: Polyethylene Glycol and N-Acetyl-L-Cysteine Attenuate Macrophage adhesion on Ventricular Catheters. 14th International Conference on Intracranial Pressure and Brain Monitoring, Tubingen, Germany, 2010.
9. **Harris C**, Moon C, McAllister JP II: The Hydrocephalus Shunt Catheter Bioreactor: In vitro Modeling of Catheter Obstruction in Hydrocephalus. Hydrocephalus 2009, Baltimore, MD, 2009.
10. **Black C**, McAllister JP II: Disulfide sensitive methods in reducing adhesion on ventricular catheters. Biomedical Engineering Society, St. Louis, MO, 2008.
11. **Black C**, Grever W, Ng KYS, McAllister JP II: The Effect of Pulsatile Flow on Astrocytic Growth. 3<sup>rd</sup> Annual Mountain West Biomedical Engineering Conference, Park City, Utah, 2007.
12. McAllister JP II, Brabant K, **Black C**, Tang H, Liang X, Wang A, Xiang J, Keep R, Grever W, Salley SO, Ng KYS: Astrocyte and choroid plexus growth on silicone coated with polymers and self-assembled monolayers. Hydrocephalus 2006, Goteburg, Sweden, 2006.
13. K Patel, JP McAllister, W Grever, H Tang, J Xiang, R Keep, K Brabant, **C Black**, KYS Ng. Astrocyte and Choroid Plexus Growth on Silicone Coated with Polymers and Self-Assembled Monolayers. Association of Neurological Surgeons Conference, Alabama, 2005.
14. Liang X, McAllister JP II, Wang A, Tang H, Cao T, Salley SO, Brabant K, **Black C**, Li J, Ng KYS: Development of a long-lasting silicone catheter impregnated with rifampicin. AANS/CNS Section on Pediatric Neurological Surgery Annual Meeting, Orlando, FL, 2005.
15. Wang A, Finlayson PG, Li J, Brabant K, **Black CA**, McAllister JP II, Cao T, Tang H, Liang X, Salley SO, Auner GW, Ng KYS: Is Silicon suitable for making implantable biomedical devices? American Institute of Chemical Engineering Annual Meeting, Cincinnati, OH, 2005.
16. Wang A, Finlayson PG, Li J, Brabant K, **Black CA**, McAllister JP II, Cao T, Tang H, Liang X, Salley SO, Auner GW, Ng KYS: Surface Modification of Sapphire to Enhance Its Neural Biocompatibility. American Institute of Chemical Engineering Annual Meeting, Cincinnati, OH, 2005.
17. McAllister JP II, Finlayson PG, Li J, Deren K, Jaboro C, McCullen E, **Black C**, Baird R, Ng S, Auner GA. Chronic In Vivo Neurocompatibility and Biostability of Sapphire. Society for Neuroscience Annual Meeting, San Diego, CA, 2004.