BrightFocus® Foundation | National Glaucoma Research

Current National Glaucoma Research Projects

Glaucoma is the second leading cause of blindness worldwide, according to the World Health Organization, affecting 60.5 million in 2010. As people live longer, this number may increase to almost 80 million by 2020. More than three million Americans are living with glaucoma, 2.7 million of whom—aged 40 and older—are affected by its most common type, open-angle glaucoma. In the United States, glaucoma is a leading cause of blindness among African Americans and Hispanics.

Since inception, National Glaucoma Research (NGR), a BrightFocus Foundation program, has awarded more than $35 million to support research projects on the causes and potential prevention and treatment of this disease.

NGR funds investigator-initiated research topics, allowing us to invest in a wide range of scientific approaches to ending glaucoma. There are 30 research projects currently supported by NGR that fall into these broad categories:

- **New Knowledge about What Causes Glaucoma**
- **Imaging and Exploring the Eye-Brain Connection**
- **Controlling Eye Pressure in New Ways**
- **Protecting and Regenerating the Optic Nerve**
- **New Ways to Predict Progression and Treating Glaucoma**

Note: *The funding statistics and inclusion of research grants in this yearbook are based upon award offers and grants that were active as of July 1, 2019. Excerpts are from research profiles available at BrightFocus.org and may have been edited for clarity and space constraints. This information is accurate as of Sept 5, 2019.*

New Knowledge about What Causes Glaucoma

Glaucoma is a group of eye diseases united under one name. Ultimately, glaucoma threatens sight by damaging the optic nerve, at the back of the eye which carries light signals from the eye to the brain. However, our knowledge of how and when glaucoma damages nerve cells remains imprecise. It's mostly linked to chronic pressure increases inside the eye, referred to as elevated intraocular pressure (IOP), which may be caused by the eye's inability to drain properly. There may be other factors besides IOP increases that lead to glaucoma. National Glaucoma Research is funding studies on genetics, more sensitive methods to study onset of glaucoma, as well as projects to develop new research models to further understand glaucoma. New understanding will lead to new therapies.

Rouzbeh Amini, PhD (7/1/18 - 6/30/20)
The University of Akron, OH
Co-Principal Investigator: Syril K. Dorairaj, MD

Detecting Iris Stiffening and its Significance in Certain Types of Glaucoma

The main goal of this project is to examine if, why, and how the iris becomes stiffer and consequently becomes abnormally deformed in the eyes of certain groups of patients who suffer from angle-closure glaucoma.

www.brightfocus.org/grant/G2018177

Jessica Cooke Bailey, PhD (7/1/18 - 6/30/20)
Case Western Reserve University, Cleveland, OH
Co-Principal Investigator: Jonathan L. Haines, PhD

Amish Study to Understand Glaucoma Genetics

With the Genetics of Glaucoma Evaluation in the Amish pilot study (GGLEAM), researchers will study an Amish population concentrated in Holmes County, Ohio, wherein primary open-angle glaucoma is present, with the goal of identifying a novel genetic contributor to this disease.

www.brightfocus.org/grant/G2018042

F. Kent Hamra, PhD (7/1/18 - 6/30/20)
University of Texas Southwestern Medical Center, Dallas

Genetically Engineering a New Animal Model to Find Cures for Glaucoma

Our project will generate novel visual systems for inventing new glaucoma medicines by genetically engineering an animal model so that their eyes express clinically relevant, heritable human glaucoma-causing genes.

www.brightfocus.org/grant/G2018080

Monica Jablonski, PhD (7/1/18 - 6/30/20)

The University of Tennessee Health Science Center, Memphis

New Glaucoma Models

This study will identify and characterize new glaucoma models that mimic the human disease more closely. These models will be a very useful resource for all vision scientists.

www.brightfocus.org/grant/G2018116

Robert Johnston, PhD (7/1/19 - 6/30/21)

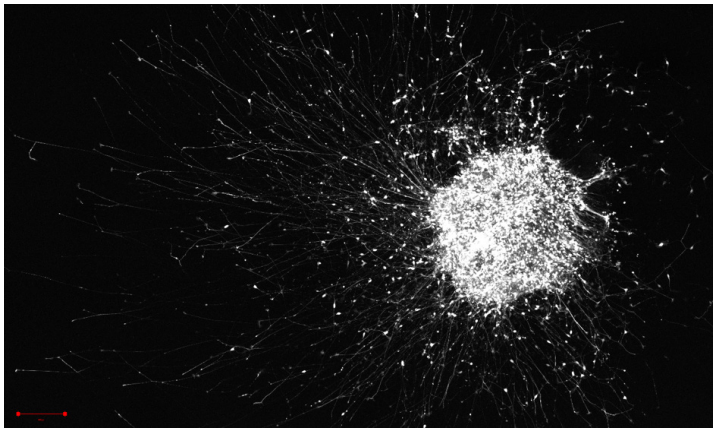
Johns Hopkins University, Baltimore, MD

Growing Human Retina in a Dish to Model Glaucoma

In this study, researchers propose to grow human retinas in a dish from adult stem cells to (1) determine what genes are on or off in these neurons, (2) develop treatments to increase the number of these neurons, and (3) study how these neurons die and develop ways to prevent their death.

www.brightfocus.org/grant/G2019300

Courtesy of Dr. Robert Johnston's Lab
Human retina in a dish



Benjamin Sivyer, PhD (7/1/18 - 6/30/20)

Oregon Health and Science University, Portland

More Sensitive Methods for Studying the Onset of Glaucoma

This study aims to identify early changes in response to injury in an animal model of glaucoma. The researchers hope that this will lead to earlier detection of glaucoma, but more importantly, they aim to uncover retinal mechanisms that will slow or stop the progression of retinal ganglion cell degeneration following injury.

www.brightfocus.org/grant/G2018011

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research.

Linda Zangwill, PhD (7/1/17 - 6/30/20)
University of California, San Diego

The Role of Vascular Factors in Glaucoma

The goal is to investigate whether changes in the retinal blood supply (microvasculature) precede or follow the death of cells in a layer in the optic nerve head.
www.brightfocus.org/grant/G2017122

Imaging and Exploring the Eye-Brain Connection

Eye changes associated with glaucoma contribute to tiny blind spots, known as "visual field defects," which, if they worsen, might advance to vision loss and blindness. The chance of that, and the speed at which it happens, varies greatly from person to person. Early diagnosis is key, and much progress has been made in imaging the eye to detect the tiniest changes that may precede glaucoma. National Glaucoma Research grantees use these new technologies to look at individual cells and nerve fibers (retinal ganglion cells are nearly transparent and very difficult to image); and changes to synapses, or connections between cells, and in the way the eye responds to light; as well as changes in blood vessels feeding the optic nerve. In addition, changes to the brain structures are being explored to understand the eye-brain connection that may offer new perspective for development of novel therapies for glaucoma.

Kevin Chan, PhD (7/1/19 - 6/30/21)
New York University, NY

The Role of Brain Waste Clearance Pathway in Glaucoma

This study will determine the cerebrospinal fluid dynamics along the optic nerve, and the corresponding visual system impairments, using advanced, multi-parametric magnetic resonance imaging in animal models.
www.brightfocus.org/grant/G2019103
Recipient of the Thomas R. Lee Award for Glaucoma Research.

Esther G. Gonzalez, PhD (7/1/17 - 12/31/19)
Krembil Research Institute, Toronto, Canada

Testing the Brain Structure Connecting Two Hemispheres in Glaucoma

This project plans to study the function of this brain structure in humans with glaucoma using a series of non-invasive tests.
www.brightfocus.org/grant/G2017093

Xiangrun Huang, PhD (7/1/18 - 6/30/20)

University of Miami, FL

Developing a New Imaging Method for Sensitive Detection of Early Glaucoma Damage

The proposed research will develop a new optical imaging method that detects abnormities of the light reflected by the nerve fibers. If successful, it can provide clinicians with a new means to sensitively detect early glaucomatous damage, opening an early therapeutic window for the prevention of vision loss.

www.brightfocus.org/grant/G2018148

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research.

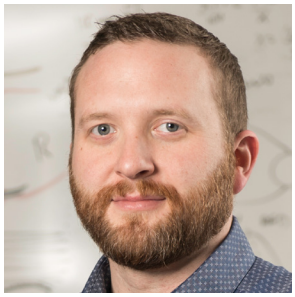
Jason Porter, PhD (7/1/18 - 6/30/20)

University of Houston, TX

A New Method to Detect Glaucoma by Examining Changes in Blood Vessels in the Eye

This project proposes to use high-resolution in vivo imaging to better clarify changes in the capillaries and optic nerve head in relation to neuronal damage in eyes of animal models with experimental glaucoma. The results of the proposed work may aid in earlier diagnosis and management of this disease.

www.brightfocus.org/grant/G2018061



Ethan Rossi, PhD (7/1/17 - 12/31/19)

University of Pittsburgh, PA

Imaging Individual Cells Affected by Glaucoma

The goal is to understand the earliest changes to the individual cells that form the optic nerve, the retinal ganglion cells, in patients with glaucoma.

www.brightfocus.org/grant/G2017082

Gareth Thomas, PhD (7/1/19 - 6/30/21)

Temple University, Philadelphia, PA

Protecting Eye-Brain Connections in Glaucoma

In glaucoma, there is damage to the eye-brain connection caused by activation of "executioner" proteins that cause the connections to degenerate, and loss of "survival" proteins that normally protect the connections. There is evidence that important executioner and survival proteins are modified with a sticky, fatty tag and this study will determine the importance of this "tagging" process for the damage seen in glaucoma

www.brightfocus.org/grant/G2019267

Controlling Eye Pressure in New Ways

Elevated eye pressure, or intraocular pressure (IOP), is present in most forms of glaucoma. This can happen when the fluid that constantly bathes the front of the eye, called aqueous humor, gets backed up. Normally it drains through a spongy tissue known as the trabecular meshwork which is the eye's main drainage channel. The trabecular meshwork offers a certain resistance to the outflow of aqueous humor that is needed to maintain a steady-state eye pressure. In addition, eye pressure can be affected by fluid volume, and by other factors such as trabecular meshwork stiffness, which is reported to be 20 times higher in individuals with glaucoma than in normal eyes. National Glaucoma Research funded grantees are unraveling novel mechanisms that regulate eye pressure, including cellular signaling through microRNAs (very small genetic sequences that can regulate gene expression), and are looking for new ways to decrease stiffness and control eye pressure.

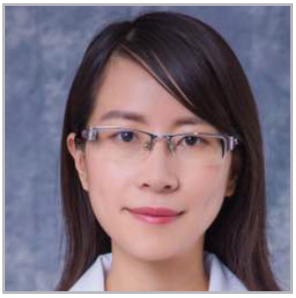
Haiyan Gong, MD, PhD (7/1/19 - 6/30/21)

Boston University, MA

The Role of Thrombospondin-1 in Regulating Eye Pressure

The proposed research will investigate the mechanisms responsible for regulating the drainage of aqueous humor, by specifically studying an important targeting site along the drainage pathway, the trabecular meshwork. The findings may lead to novel treatments or preventative measures for glaucoma.

www.brightfocus.org/grant/G2019295



Yuan Lei, PhD (7/1/18 - 6/30/20)

Eye and ENT Hospital of Fudan University, Shanghai, China

A Key MicroRNA that Controls Eye Pressure

The aim of this project is to understand the role of a very important microRNA in regulating eye pressure. This may be a very effective new way to treat elevated eye pressure in glaucoma.

www.brightfocus.org/grant/G2018112

Chan Young Park, PhD (7/1/19 - 6/30/21)

Harvard T.H. Chan School of Public Health, Boston, MA

Small Molecular Compounds for Glaucoma Therapy

The fluid in glaucoma patients' eyes has a higher concentration of a chemical than the fluid in healthy eyes. This chemical, a growth factor, transforms tissues to be stiffer which is known to increase the chance of glaucoma. This study proposes to test a new drug (called "remodilins") to see if it can make those stiffened tissues go back to a softer state.

www.brightfocus.org/grant/G2019179

Protecting and Regenerating the Optic Nerve

Unlike most cells in the body, which repair themselves, the nerve cells providing our vision don't regrow once damaged. National Glaucoma Research is supporting research into ways of protecting cells threatened by advancing glaucoma and regenerating those cells after vision loss. The biggest focus of these efforts is to replace and reconnect retinal ganglion cells (RGCs), nerve cells which make up the optic nerve and carry visual signals over long tails (axons) extending from the eye to the brain. This is a sophisticated undertaking, given how RGCs are wired into the brain.

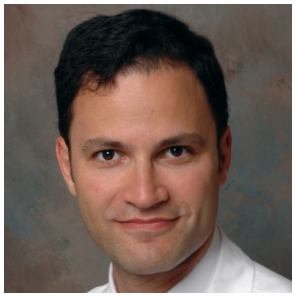
Eldon Geisert, PhD (7/1/19 - 6/30/21)

Emory University, Atlanta, GA

Making Optic Nerve Regeneration Faster

The goal of this study is to use a mouse model developed by this group that will make it possible to identify genes that increase the number of regenerating axons by at least four times and the distance the axons grow by at least three times.

www.brightfocus.org/grant/G2019111



Jeffrey Goldberg, MD, PhD (7/1/15 - 12/31/19)

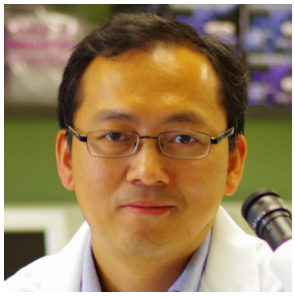
Stanford University, CA

Neuroregenerative Strategies in Glaucoma

Dr. Goldberg is conducting a phase 2 clinical trial where he will implant into the eye a tiny device, called NT-501 encapsulated cell therapy (NT-501 ECT). The NT-501 ECT contains cells designed to deliver a steady stream of a growth factor, called ciliary neurotrophic factor (CNTF), to test whether it can protect against damage to the optic nerve, and, possibly, enhance visual function in patients with glaucoma.

www.brightfocus.org/grant/C2015201

This clinical trial is made possible in part by support from The Barry Friedberg and Charlotte Moss Family Foundation.



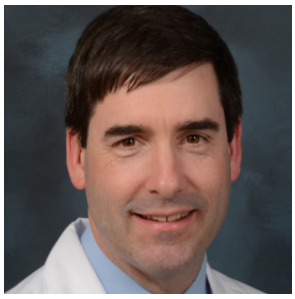
Yang Hu, MD, PhD (7/1/18 - 6/30/20)

Stanford University, CA

Studying Gene Regulation Networks in Retinal Ganglion Cells for Novel Neuroprotective Targets

This study takes advantage of newly developed genetic tools to survey gene expression and epigenetic regulatory elements (heritable genetic changes that turn genes on or off) that are associated with RGCs at normal function, under disease, or after treatment.

www.brightfocus.org/grant/G2018183



András Komáromy, DVM, PhD (7/1/17 - 6/30/19)

Michigan State University, East Lansing

Co-Principal Investigator: Bruce R. Ksander, PhD

A Gene Therapy Approach to Neuroprotection in Glaucoma

This research project will test a new form of treatment for glaucoma that uses gene therapy to protect retinal neurons and stop glaucoma from developing, even in the presence of elevated eye pressure.

www.brightfocus.org/grant/G2017185

Robert W. Nickells, PhD (7/1/18 - 6/30/20)

University of Wisconsin-Madison

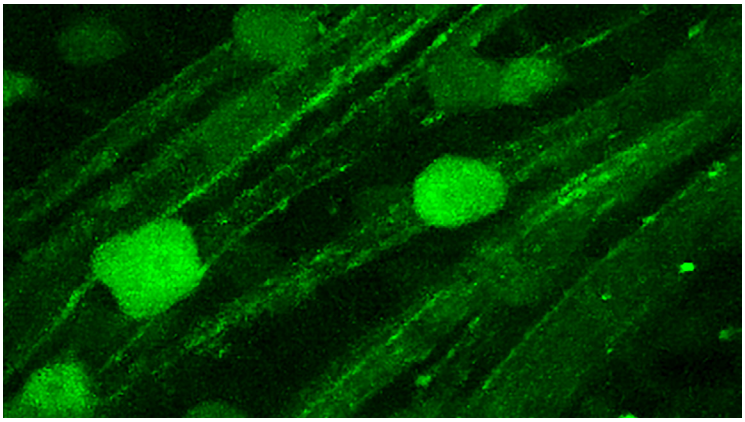
A Study to Define the Link between Cell Adhesion and Retinal Ganglion Cell Death

Cells living in a complex tissue are most healthy when they make and retain contacts with other cells, and to the extracellular environment. The goal of this research is to determine if loss of cell-to-cell, and/or cell-to-surface, contacts by RGCs stimulates the biological pathway leading to their death after damage to the optic nerve.

www.brightfocus.org/grant/G2018166

Courtesy of Dr. Robert W. Nickells' Lab
Retinal ganglion cells from a mouse model expressing a protein called BAX fused to a green fluorescent protein for visualization.

When the nerve is damaged, such as in glaucoma, the BAX protein aggregates on the surfaces of mitochondria and stimulate biochemical changes that lead to ganglion cell death.



Trent Watkins, PhD (7/1/19 - 6/30/21)

Baylor College of Medicine, Houston, TX

Stimulating the Natural Repair Programs of Ganglion Cells for the Preservation of Restoration of Vision

This proposal aims to understand how the natural repair processes in the eye switch from providing hope for recovery to further contributing to the permanent loss of vision. Appropriate modulation of these processes may protect against neuronal loss and even contribute to the restoration of vision.

www.brightfocus.org/grant/G2019332

Derek Welsbie, MD, PhD (7/1/17 - 6/30/20)

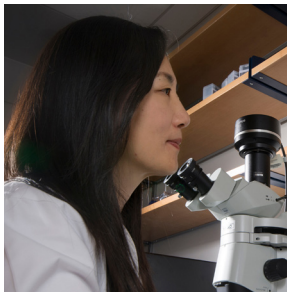
University of California, San Diego

Genome Editing to Inhibit Optic Nerve Cell Death in Glaucoma

This project will develop a novel neuroprotective strategy that directly interferes with the cell death process in retinal ganglion cells that is triggered in glaucoma.

www.brightfocus.org/grant/G2017212

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research



Sarah Zhang, MD (7/1/19 - 6/30/21)

SUNY Buffalo, NY

Targeting Inflammatory Cells to Treat Glaucoma

The proposed research studies a novel protein that was recently identified as a key regulator of macrophages, a type of immune cell that are activated during glaucoma. Using genetic tools and animal models, the study will explore how this protein regulates macrophage activation and inflammation in the retina of glaucoma eyes.

www.brightfocus.org/grant/G2019302

New Ways to Predict Progression and Treating Glaucoma

The only current treatment available is for glaucoma is to lower eye pressure. Numerous therapies exist to lower eye pressure effectively; however, the bulk of them (eyedrops and surgeries) require skill and consistency to achieve results. Easier methods are needed, as well as new therapies to address other underlying causes of glaucoma besides intraocular pressure (IOP). National Glaucoma Reasearch grantees are working to develop drugs that will lower eye pressure and protect against nerve cell injury and death, and genome editing approaches to restore the function of trabecular meshwork (a spongy tissue that drains fluids from the eye). In addition, computerized algorithms are being designed by some groups to analyze an assortment of biometric data to better predict and track a patient's risk of progression to vision loss.

Suchismita Acharya, PhD (7/1/18 - 6/30/20)

University of North Texas Health Science Center, Fort Worth

A Novel Dual-Active Compound to Treat Glaucoma

This study focuses on discovering multi-functional small molecules that may be used for glaucoma treatment to decrease eye pressure and protect retinal ganglion cells from death.

www.brightfocus.org/grant/G2018056

Alejandra Bosco, PhD (7/1/19 - 6/30/21)

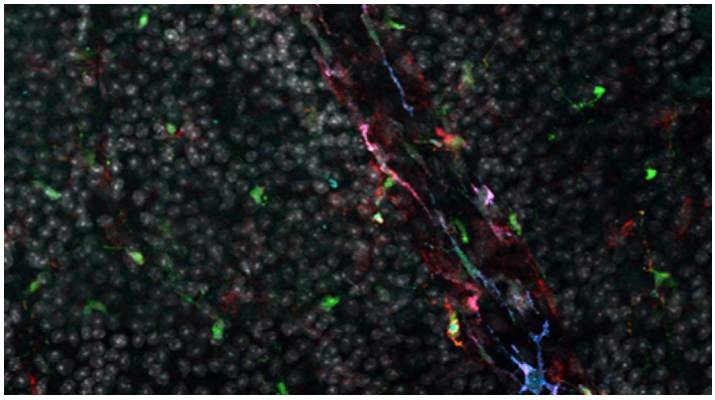
University of Utah, Salt Lake City

Complement-Targeted Therapy to Prevent Glaucoma Progression

Researchers in this study have developed a new potential treatment that rebalances immune responses and controls glaucoma in old mice, and the goal of this study is to define if it may cure patients by testing it in several experimental models. Furthermore, the interaction between the dying or surviving neurons and the complement signaling will be studied.

www.brightfocus.org/grant/G2019219

Recipient of the Thomas R. Lee Award for Glaucoma Research.



Courtesy of Dr. Alejandra Bosco's Lab Confocal microscopy image of the retina in an animal model, showing a blood vessel traversing the parenchyma where neurons (white nuclei) and microglia (green cells) reside.

Meredith Gregory-Ksander, PhD (7/1/19 - 6/30/21)

Massachusetts Eye and Ear, and Harvard Medical School, Boston

Co-Principal Investigator: Kip M. Connor, PhD

Targeting the Immune System to Prevent Glaucoma

The researchers in this study have identified an important component of the immune system that becomes dysregulated early in glaucoma and, in this project, they will determine the efficacy of targeting this pathway as a novel treatment approach in glaucoma.

www.brightfocus.org/grant/G2019340

Recipient of the Dr. Douglas H. Johnson Award for Glaucoma Research.

John Hetling, PhD (7/1/19 - 6/30/21)

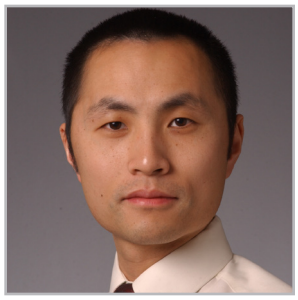
University of Illinois at Chicago

Co-Principal Investigators: Thasarat Vajaranant, MD and Jason McAnany, PhD

A New Method for Diagnosing Glaucoma in the Peripheral Retina

Early glaucoma can affect central vision or peripheral vision, so both areas of vision should be tested. Currently, the best objective test for glaucoma evaluates only central vision and researchers in this study have developed a test to evaluate also the peripheral vision. The goal of this project is to perform the central vision and peripheral vision tests to a group of glaucoma patients, to show that the new peripheral vision test helps in the early diagnosis of the disease.

www.brightfocus.org/grant/G2019356



Weiming Mao, PhD (7/1/17 - 6/30/20)

Indiana University, Indianapolis

CRISPR Interference for Glaucoma

Our study aims to use a novel technology called CRISPR interference to correct abnormal protein modifications, with the hope of thus restoring function to the trabecular meshwork tissue.

www.brightfocus.org/grant/G2017151

Biji Mathew, PhD (7/1/18- 6/30/20)

University of Illinois at Chicago

Novel Cell-Free Treatment of Glaucoma

The objective is to study the use of extracellular vesicles, tiny particles secreted by adult stem cells, as a treatment for glaucoma-induced retinal cell death.

www.brightfocus.org/grant/G2018168

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