AWARD NUMBER: W81XWH-22-1-0578

TITLE: Therapeutic Potential of Arginase 1 for Trauma-Induced Vision Loss

PRINCIPAL INVESTIGATOR: Ruth B. Caldwell

CONTRACTING ORGANIZATION: Augusta University Research Institute, Augusta, GA

REPORT DATE: July 2023

TYPE OF REPORT: Annual

PREPARED FOR: U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
July 2023	Annual	01Jul2022 – 30Jun2023

4. TITLE AND SUBTITLE

Therapeutic Potential of Arginase 1 for Trauma-Induced Vision Loss

5a. CONTRACT NUMBER
W81XWH-22-1-0578

5b. GRANT NUMBER
VR210046

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Ruth Caldwell

E-Mail: rcaldwel@augusta.edu

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Augusta University 1120 15th St, Augusta, GA 30912

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Research and Development Command
Fort Detrick, Maryland 21702-5012

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for Public Release; Distribution Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This proposal seeks to develop an effective therapy to limit retinal neurovascular injury and promote repair after potentially blinding traumatic injury to the brain or eye. Ocular injuries are a significant problem for service members and are associated with substantial costs for resources, rehabilitation, and training. So far, there is no effective treatment. The lack of understanding of the mechanisms by which trauma damages retinal neurons represents a critical knowledge gap in developing effective therapies. Our group is studying the role of an enzyme called arginase 1 in this pathological process. We have shown that arginase 1 protects against injury and promotes repair in models of acute glaucoma and optic nerve crush (ONC). Our studies using a stable, long-acting form of human recombinant arginase 1 (PEGArg1) have shown that PEGArg1 protects against retinal neuronal injury by decreasing inflammation and increasing repair functions by resident retinal immune cells. During the first year of DOD support, we have used a mouse model to elucidate the mechanisms of PEGArg1-mediated protection against ONC-induced injury and vision loss. Our data support the hypothesis that PEGArg1 limits neuronal injury by activating its downstream target, the ornithine decarboxylase enzyme that processes the arginase product ornithine, leading to polyamine formation. We have also assessed whether PEGArg1 can limit retinal injury and vision loss in a model of TON. We have reported the results of these studies at national and regional scientific meetings.

15. SUBJECT TERMS

arginase 1, arginine, ornithine decarboxylase, ornithine, polyamine, retinal ganglion cells, traumatic optic neuropathy, optic nerve crush

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			USAMRDC
Unclassified	Unclassified	Unclassified	Unclassified	10	19b. TELEPHONE NUMBER *(include area code)*

TABLE OF CONTENTS

Page

1. **INTRODUCTION:**

This proposal seeks to develop an effective therapy to limit retinal neurovascular injury and promote repair after potentially blinding traumatic injury to the brain or eye. Traumatic optic neuropathy (TON) can occur due to direct ocular injury, trauma to the optic nerve, or as an indirect result of traumatic brain injury (TBI). Such injury is frequently associated with degeneration of retinal ganglion cells (RGC) due to primary damage of their axons or injury-related glaucoma. Additional neuronal loss often occurs secondary to oxidative stress, inflammation, vascular dysfunction, and ischemia. There is no effective treatment to limit such secondary injury and promote repair after acute trauma. The lack of understanding of the mechanisms by which trauma damages retinal neurons represents a critical knowledge gap in developing effective therapies. Our group is studying the role of the arginase 1 enzyme in this pathological process. Arginase 1 processes the semi-essential amino acid arginine to form ornithine which is further metabolized by ornithine decarboxylase to form the polyamine putrescine. We have shown that arginase 1 protects against injury and promotes repair in models of acute glaucoma and optic nerve crush (ONC). Our studies using a stable, long-acting form of human recombinant arginase 1 (PEGArg1) have shown that PEGArg1 protects against retinal neuronal injury by decreasing inflammation and increasing repair functions of retinal immune cells. During the first year of DOD support, we have used mouse models to confirm the protective effects of the PEGArg1 therapy and in models of optic nerve crush (ONC) and TON. We are evaluating the hypothesis that PEGArg1 limits neuronal injury by activating the ornithine/ODC/polyamine pathway. We have reported the results of these studies at national and regional scientific meetings.

2. KEYWORDS: traumatic optic neuropathy, optic nerve crush, glaucoma, arginase 1, arginine, ODC, PEGarg1, inflammation, vision loss, neuroprotection

3. ACCOMPLISHMENTS:

Major goals of the project

Our major goals are to elucidate the mechanisms underlying the PEGArg1-mediated neuroprotection in the ONC model and investigate the therapeutic benefits of PEGArg1 treatment for TON and glaucoma. We hypothesize that Arg1 protects against the progression of retinal inflammation and injury and preserves vision after ONC by activating the ornithine/polyamine pathway. Our objectives are to assess this hypothesis and to determine the effect of PEGArg1 on retinal injury and vision loss in models of ONC, TON, and glaucoma. Our Specific Aims are 1) To assess whether PEGArg1 mediates its protective effects against ONC-induced retinal injury, inflammation, and vision loss through activation of the ornithine/ODC/polyamine pathway and 2) To determine the effects of PEGArg1 on retinal injury and vision loss in models of TON and glaucoma.

Accomplishments under these goals

1) Major activities: We have performed studies using mouse models to determine the effectiveness of PEGArg1 treatment on neuronal injury and visual function in ONC and TON and to assess the role of ODC activity in the PEGArg1-mediated neuroprotection by treating mice with PEGArg1 in combination with the ODC inhibitor difluoromethylornithine (DFMO).

Major Task 1: Test whether PEGArg1 mediates its protective effects against ONC-induced retinal injury, inflammation, and vision loss through activation of the ornithine/ODC/polyamine pathway.

Major Task 2: Employ a mouse model of TON to assess the effect of PEGArg1 in preserving retinal structure and function

2) Specific objectives:

Prepare mouse model of ONC treated with PEGArg1 with or without DFMO and complete in vivo testing of retinal neuronal and vascular structure and function. Collect tissue samples for imaging analysis and perform data analyses.

Prepare mouse model of TON and complete in vivo testing of retinal neuronal and vascular structure and function. Collect tissue samples for imaging analysis and perform data analyses.

3) Significant results/key outcomes

Major Task 1:

Aim 1. Test whether PEGArg1 mediates its protective effects against ONC-induced retinal injury, inflammation, and vision loss through activation of ODC.

We performed studies to assess the effects of PEGArg1 treatment on retinal ganglion cell death and retinal inflammation in the mouse model of ONC and to examine the involvement of ODC activity in this process. Our studies showed that PEGArg1 treatment significantly increases survival of RGC neurons at 7 days after ONC. Further analyses using immunolocalization and quantitative RT-PCR techniques showed that this protective effect of PEGArg1 treatment is associated with inhibition of the ONC-induced activation of microglia/macrophage cells, decreased expression of the inflammatory cytokine IL-1β, and increased expression of the immune-modulating factor IL-6 and pro-survival factors

BDNF and IL-10. Additional studies using PEGArg1 treatment in combination with the ODC inhibitor DFMO (α-difluormethylornithine) showed that inhibiting ODC completely blocks the beneficial actions of PEGArg1 in preserving neuronal survival. These results suggest that PEGArg1 is an effective therapy to limit retinal inflammation and RGC death by a mechanism involving activation of the ornithine/ODC/polyamine pathway.

Major Task 2:

Aim 2. Employ a mouse model of traumatic optic neuropathy (TON) to assess the effect of PEGArg1 in preserving retinal structure and function.

We performed studies to determine the effects of PEG-Arg1 treatment on retinal ganglion cell death and retinal inflammation in a mouse model of indirect TON induced by sonification of the orbital bone. Sonification-induced TON significantly increased expression of inflammatory markers [macrophage colony stimulant factor (MCSF) and tumor necrosis factor (TNF)], increased the retinal injury marker glial fibrillary acidic protein (GFAP), and decreased the number of retinal ganglion cells. PEGArg1 treatment significantly increased retinal ganglion cell survival along with increased expression of the pro-survival factor brain derived neurotrophic factor, decreased expression of MCSF, TNF, and GFAP. These data suggest PEGArg1 is a novel and effective therapy for indirect TON.

4) Other achievements

Nothing to report

Opportunities for training and professional development

Nothing to report

Dissemination of results

Results of this project have been presented at regional and national scientific meetings. Manuscripts are in preparation for submission to high-impact, peer-reviewed journals.

Plans for the next reporting period

We will continue our investigations in models of ONC and TON and extend our studies to the silicone oil-induced model of glaucoma.

4. IMPACT:

The lack of effective therapies to limit neurovascular injury and promote repair after potentially blinding traumatic injury to the brain or eye represents a major clinical problem. Compromised vision can negatively affect healthy behavior, social functioning, and quality of life and has also been linked to increased mortality. Vision loss is a common complication of traumatic injury to the brain or eye. Such injury is frequently associated with degeneration of retinal ganglion cells due to primary damage of their axons or injury-related glaucoma. Further neuronal loss often occurs secondary to oxidative stress, inflammation, vascular dysfunction, and ischemia. So far, there is no effective treatment to limit such secondary injury and promote repair after acute trauma. The lack of understanding of the mechanisms of this progressive damage to retinal neurons represents a critical knowledge gap in developing effective therapies. Our previous work in models of ischemic retinopathy has shown that treatment with a stable form of the arginase 1 enzyme (PEGArg1) can protect against neurovascular injury by a mechanism involving decreased inflammation and upregulation of the reparative microglia/macrophage phenotype. Our current investigations suggest that this therapy is also protective in models of traumatic ocular injury via a mechanism involving activity of the ornithine/ODC/polyamine pathway.

Impact on development of the principal discipline

Nothing to report

Impact on other disciplines

Nothing to report

Impact on technology transfer

Nothing to report

Impact on society beyond science and technology

Nothing to report

5. CHANGES/PROBLEMS

Nothing to report

6. PRODUCTS

Publications, conference papers, and presentations

Authors: Sandow P, Rojas MA, Lemtalsi T, Caldwell RW, Caldwell RB, Peg-Arg1 treatment offers retinal neural protection during indirect traumatic optic nerve injury. Poster Presentation at the Vision Discovery Institute Annual Retreat, March 2023.

Authors: Sandow P, Lemtalsi T, Labasi L, Rojas MA, Caldwell RB, Caldwell RW, PEGylated arginase 1 a novel treatment for traumatic optic neuropathy. Presentation at the Department of Defense Vision Injury Research Forum (VIRF), Poster and Oral Presentation, March 17 – April 14, 2023.

Austin E, Rojas MA, Sandow P, Lemtalsi T, Xu Z, Caldwell RW, Caldwell RB, PEG-Arg1 as a novel anti-inflammatory treatment for optic nerve damage, Presentation at Women in Ophthalmology Conference, August 2023.

Website(s) or other internet site(s)

Nothing to report

Technologies or Techniques

Nothing to report

Inventions, patent application, and/or licenses

Nothing to report

Other products

Nothing to report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

Participants:

Name:	Ruth B. Caldwell, PhD
Project Role:	PI
Researcher Identifier:	0000-0003-0168-0354
Nearest person month worked:	2
Contribution to Project:	Dr. Caldwell supervises the project and provides guidance and direction to the other investigators on all aspects of the studies.
Funding Support:	W81XWH-22-1-0578

Name:	Robert W. Caldwell, PhD
Project Role:	Collaborator
Researcher Identifier:	
Nearest person month worked:	1
Contribution to Project:	Dr. Caldwell collaborates on the project and supervises the work of Ms. Porsche Sandow
Funding Support:	W81XWH-22-1-0578

Name:	Katharine Bolinger, MD
Project Role:	Consultant
Researcher Identifier:	
Nearest person month worked:	1
Contribution to Project:	Dr. Bolinger consults on the project and provides guidance on models of optic nerve and ocular trauma
Funding Support:	W81XWH-22-1-0578

Name:	Modesto A. Rojas, MD
Project Role:	Collaborator
Researcher Identifier:	0000-0002-9441-3302
Nearest person month worked:	1
Contribution to Project:	Dr. Rojas supervises the studies using the model of traumatic optic neuropathy, supervises data analysis, and assists in preparing abstracts, meeting presentations, and manuscripts.
Funding Support:	W81XWH-22-1-0578

Name:	S. Adeel Zaidi, PhD
Project Role:	Collaborator
Researcher Identifier:	0000-0002-9177-0881
Nearest person month worked:	3
Contribution to Project:	Dr. Zaidi supervises the studies of optic nerve crush, performs quantitative PCR experiments, supervises data analysis, assists in preparing abstracts, meeting presentations, and manuscripts.
Funding Support:	W81XWH-22-1-0578

Name:	Porsche Sandow, BS
Project Role:	Research Assistant
Researcher Identifier:	
Nearest person month worked:	3
Contribution to Project:	Ms. Sandow performs studies using the model of traumatic optic neuropathy, prepares retinal samples for analysis, performs imaging studies and morphometric analyses.
Funding Support:	W81XWH-22-1-0578

Name:	Zhimin Xu, MS
Project Role:	Research Associate
Researcher Identifier:	
Nearest person month worked:	1
Contribution to Project:	Ms. Xu manages the animal colony, prepares the optic nerve crush model, and processes retinal samples for analysis.
Funding Support:	W81XWH-22-1-0578

Name:	Tahira Lemtalsi, BA
Project Role:	Lab Manager
Researcher Identifier:	
Nearest person month worked:	1
Contribution to Project:	Ms. Lemtalsi maintains the laboratory, orders supplies, prepares reagents, performs western blots, and assists with morphometric analyses.
Funding Support:	W81XWH-22-1-0578

Funding changes for PI or key personnel

Ruth Caldwell
Grants Ended

5R01EY011766-22 (RB. Caldwell/RW. Caldwell) 09/01/2018 – 07/31/2022 5.16 Calendar Months
NIH/NEI Total Costs Role: Contact PI Cellular Mechanisms of Retinopathy: Role of Arginase
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): We propose studies designed to show that increasing activity of the arginase 1 enzyme in immune cells offers a novel and highly effective strategy for limiting neurovascular injury and promoting retinal tissue repair in the early stages of ischemic retinopathy.

1R21EY032265-01 (Caldwell/Rojas) 03/01/2021 – 02/28/2023 1.44 Calendar Months
NIH/NEI Total Costs Role: Contact PI Role of ACAT1 in Pathological Retinal Neovascularization
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): The proposed studies are designed to use a highly specific ACAT1 inhibitor and ACAT1 deficient mice and cells to investigate the specific role of macrophage ACAT1 in pathological ocular angiogenesis and to define the underlying mechanisms.

New Grants Added

1 R01EY033369 (Caldwell/Huo) 04/01/2022 – 2.4 Calendar Months
NIH/NEI 02/28/2026 Total Costs Role: Contact PI
Myeloid PFKFB3 in Subretinal Fibrosis
Primary Place of Performance: Augusta University, Augusta, GA

Major Goal(s): The proposed studies are designed to use Pfkfb3 deficient cells and mice to investigate the involvement of glycolysis in macrophages in subretinal fibrosis and to define the underlying mechanisms.
Grant Management Specialist: Renee Livshin, National Eye Institute, NIH, 6700B Rockledge Dr., MSC 6914, Bethesda, MD 20892

1R01EY033737 (Huo/Caldwell) 05/01/2022 – 03/31/2027 2.4 Calendar Months
NIH/NEI Total Costs Role: Co-PI Adenosine Receptor 2A in Subretinal Fibrosis
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): The proposed studies are designed to use Adora2a deficient cells and mice to investigate the involvement of different cellular Adora2a in subretinal fibrosis and to define the underlying mechanisms.
Grant Management Specialist: Renee Livshin, National Eye Institute, NIH, 6700B Rockledge Dr., MSC 6914, Bethesda, MD 20892

VR210046 (R.B. Caldwell) 08/01/2022 – 07/31/2024 1.8 Calendar Months
CDMRP/DoD Total Costs Role: PI
Therapeutic Potential of Arginase 1 for Trauma-induced Vision Loss
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: Our objectives are to use mouse and tissue culture models to elucidate the mechanisms of PEGArg1-mediated protection against ONC-induced injury and vision loss and determine the effect of PEGArg1 on retinal injury and vision loss in models of TON and glaucoma.
Grant Management Specialist: Jason D. Kuhns, Grants Officer, CDMRP, 301-682-5507.

Grants Pending

R01 EY035411-01 (Jing Wang) 7/01/2023 – 6/30/2028 0.6 Calendar Months
NIH/NEI Total Costs Role: Co-I
Targeting Sigma 1 receptor as a Novel Therapy for Limiting Neurovascular Injury in ROP
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): The proposed studies are designed to test the hypothesis that Sig1R acts as a novel key modulator of normal retinal vascular development and neurovascular damage in OIR, limits vascular injury by promoting reparative microglia/macrophages via inhibition of proinflammatory and proangiogenic factors, and provides a novel neurovascular therapy for ROP.
Grant Management Specialist: Renee Livshin, National Eye Institute, NIH, 6700B Rockledge Dr., MSC 6914, Bethesda, MD 20892

R01 EY035683-01 (RB Caldwell/MA Rojas) 12/01/2023 – 11/30/2028 1.8 Calendar Months
NIH/NEI Total Costs Role: Contact PI Myeloid ACAT1 in Ischemic Retinopathy
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: The proposed studies are designed to test the hypothesis that Sig1R acts as a novel key modulator of normal retinal vascular development and neurovascular damage in OIR, limits vascular injury by promoting reparative microglia/macrophages via inhibition of proinflammatory and proangiogenic factors, and provides a novel neurovascular therapy for ROP.
Grant Management Specialist: Renee Livshin, National Eye Institute, NIH, 6700B Rockledge Dr., MSC 6914, Bethesda, MD 20892

R01 EY036007 (Shenoy/Narayanan) 04/01/2024 – 03/31/2029 0.24 Calendar Months
NIH/NEI total subaward funds Role: Co-I Modulation of Claudins in Proliferative Retinopathy
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: 1) To provide collaborative support for Drs. Shenoy and Narayanan's proposed studies testing and developing triciribine (a moderate Akt inhibitor, and tricyclic nucleoside adenosine analog) as a novel therapeutic form proliferative retinopathy. 2) To provide suggestions/guidance on general vascular injury and inflammation and specifically on blood-retinal barrier breakdown and leukostasis in the mouse model of oxygen-induced.retinopathy 3) Advise in the use of mouse cells and tissues for experiments using in vitro and ex vivo models of retinal angiogenesis.

There is no scientific overlap between the projects listed.

R. William Caldwell

Grants Ended

5R01EY011766-22 (RB. Caldwell/RW. Caldwell) 09/01/2018 – 07/31/2022 0.12 Calendar Months
NIH/NEI Total Costs Role: Co-PI
Cellular Mechanisms of Retinopathy: Role of Arginase
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): We propose studies designed to show that increasing activity of the arginase 1 enzyme in immune cells offers a novel and highly effective strategy for limiting neurovascular injury and promoting retinal tissue repair in the early stages of ischemic retinopathy.

1R56AG062647-01A1 (S. Fulzele) 09/15/2020 – 08/31/2022 0.6 Calendar Months
NIH/NIA Total Costs Role: Co-I
Arginase 1 in Age-dependent Muscle and Bone Loss
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal(s): 1: Test the hypothesis that inhibition of arginase or lack of expression in muscle and bone can effectively prevent or reduce age dependent muscle and bone loss. 2: Test the hypothesis that age-related increases in arginase activity directly impact key cellular events in muscle and bone anabolism and catabolism. 3: Determine the molecular mechanisms by which ARG1 modulates muscle and bone homeostasis.

New Grant Added

VR210046 (R.B. Caldwell) 08/01/2022 – 07/31/2024 1.8 Calendar Months
CDMRP/DoD Total Costs Role: Co-I Therapeutic
Potential of Arginase 1 for Trauma-induced Vision Loss
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: Our objectives are to use mouse and tissue culture models to elucidate the mechanisms of PEGArg1-mediated protection against ONC-induced injury and vision loss and determine the effect of PEGArg1 on retinal injury and vision loss in models of TON and glaucoma.
Grant Management Specialist: Jason D. Kuhns, Grants Officer, CDMRP, 301-682-5507.

There is no scientific overlap between the projects listed.

Kathryn E. Bollinger

Grants Ended

R01EY029728 (Ashok Sharma) 02/01/2019-01/31/2023 0.24 Calendar Months
NIH/NEI Total Costs Role: Co-I
Proteomic Biomarkers for Glaucomatous Optic Neuropathy.
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: To elucidate aqueous humor proteomic alterations associated with glaucomatous optic neuropathy and to further delineate potential proteomic risk factors for this disease.

5 R01 EY027406-04 (Bollinger) 02/01/2018 - 01/31/2023 3.6 Calendar Months
NIH/National Eye Institute, R01 Grant Total Costs Role: PI
Sigma-1 Receptor Provides Neuroprotection Against Optic Neuropathy
Primary Place of Performance: Augusta University, Augusta, GA
Major Goal: To determine whether agonists of Sigma Receptor-1 are neuroprotective against optic neuropathy.

New Grants Added

1 R01 EY035277 (Yutao Liu) 07/01/2023-06/30/2028 0.36 Calendar Months
NIH/NEI Total Costs Role: Co-I
Estrogen and Its Receptors in Intraocular Pressure Regulation
Major Goals: To determine the role of estrogen and its receptors - estrogen receptor 1 (*ESR1*) and G protein-coupled estrogen receptor (*GPER1*) – in regulating intraocular pressure (IOP) through the trabecular meshwork (TM) and Schlemm's canal (SC) endothelial cells.
Primary Place of Performance: Augusta University, Augusta, GA

VR210046 (R.B. Caldwell) 08/01/2022 – 1.8 Calendar Months
07/31/2024 CDMRP/DoD Total Costs Role: Co-I
Therapeutic Potential of Arginase 1 for Trauma-induced Vision Loss
Primary Place of Performance: Augusta University, Augusta, GA
Major Goals: Our objectives are to use mouse and tissue culture models to elucidate the mechanisms of PEGArg1-mediated protection against ONC-induced injury and vision loss and determine the effect of PEGArg1 on retinal injury and vision loss in models of TON and glaucoma.
Grant Management Specialist: Jason D. Kuhns, Grants Officer, CDMRP, 301-682-5507.

Grants Pending

R01 EY035411-01 (Jing Wang) 7/01/2023 – 6/30/2028 0.6 Calendar Months
NIH/NEI Total Costs Role: Co-I
Targeting Sigma 1 Receptor as a Novel Therapy for Limiting Neurovascular Injury in ROP
Primary Place of Performance: Augusta University, Augusta, GA
Grant Management Specialist: Renee Livshin, National Eye Institute, NIH, 6700B Rockledge Dr., MSC 6914, Bethesda, MD 20892
Major Goal(s): The proposed studies are designed to test the hypothesis that Sig1R acts as a novel key modulator of normal retinal vascular development and neurovascular damage in OIR, limits vascular injury by promoting reparative microglia/macrophages via inhibition of proinflammatory and proangiogenic factors, and provides a novel neurovascular therapy for ROP.

R01EY027406 (Kathryn Bollinger) 05/01/2024-04/28/2029 3.6 Calendar Months
NIH/NEI Role: PI
Mechanism of Sigma 1 Receptor Mediated Neuroprotection in Glaucoma
Major Goals: To determine the mechanism of sigma 1 receptor mediated neuroprotection in glaucoma
Primary Place of Performance: Augusta University, Augusta, GA

There is no scientific overlap between the projects listed.

Other organizations involved as partners

Nothing to report

8. SPECIAL REPORTING REQUIREMENTS

Nothing to report