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The impact of reduced left ventricular contractility on retinal perfusion

Michael Chang; Alon Harris; Mohamed Zaid; Lorenzo Sala; Marcela Szopos; Sergey Lapin; Jeffrey Kuvin; Thomas A Ciulla; Louis R Pasquale; Barbara M Wirostko; Alice Chandra Verticchio Vercellin; Gal Antman; Brent A Siesky; Giovanna Guidoboni

— Author Affiliations & Notes

Michael Chang
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States

Alon Harris
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States

Mohamed Zaid
Electrical Engineering and Computer Science, University of Missouri, Columbia, Missouri, United States

Lorenzo Sala
INRAE, MaIAGE, Universite Paris-Saclay, Jouy-en-Josas, Île-de-France, France

Marcela Szopos
Université Paris Cité, CNRS, MAP5, F-75006, Paris, France

Sergey Lapin

Department of Mathematics and Statistics, Washington State University, Pullman, Washington, United States

Jeffrey Kuvin
Department of Cardiology, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Hempstead, New York, United States

Thomas A Ciulla
Clearside Biomedical Inc, Alpharetta, Georgia, United States
Indiana University School of Medicine, Indianapolis, Indiana, United States

Louis R Pasquale
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States

Barbara M Wirostko
University of Utah Health John A Moran Eye Center, Salt Lake City, Utah, United States
Qlaris Bio Inc., Dedham, Massachusetts, United States

Alice Chandra Verticchio Vercellin
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States

Gal Antman
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States
Ophthalmology, Rabin Medical Center, Petah Tikva, Central, Israel

Brent A Siesky
Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, New York, United States

Giovanna Guidoboni
Electrical Engineering and Computer Science, University of Missouri, Columbia, Missouri, United States

Mathematics, University of Missouri System, Columbia, Missouri, United States

Footnotes

Commercial Relationships **Michael Chang** None; **Alon Harris** AdOM, Qlaris, Luseed, Cipla , Code C (Consultant/Contractor), AdOM, Luseed, Oxymap, Qlaris, Phileas Pharma, SlitLed, QuLent , Code I (Personal Financial Interest), AdOM, Qlaris, Phileas Pharma , Code S (non-remunerative); **Mohamed Zaid** None; **Lorenzo Sala** None; **Marcela Szopos** None; **Sergey Lapin** None; **Jeffrey Kuvin** None; **Thomas Ciulla** Clearside Biomedical, Code E (Employment), Clearside Biomedical, Code I (Personal Financial Interest); **Louis Pasquale** Eyenovia, Twenty Twenty, Skye Biosciences, Code C (Consultant/Contractor); **Barbara Wirostko** None; **Alice Chandra Verticchio Vercellin** None; **Gal Antman** None; **Brent Siesky** None; **Giovanna Guidoboni** Foresite Healthcare LLC, Qlaris , Code C (Consultant/Contractor), Gspace LLC, Code I (Personal Financial Interest)

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Abstract

Purpose : To show the relationship between left ventricular contractility (LVc) and retinal blood flow (Q), including the influence of intraocular pressure (IOP).

Methods : A mathematical model of retinal circulation was developed to predict alterations in total Q associated with reductions in LVc and categorized levels of IOP. The model simulates blood flow in the retinal circulation as an electric circuit where the current flows through a network of capacitance and resistances. Variable resistances represent passive diameter changes due to the level of IOP. Q is driven by systemic pressures computed using a mathematical model of cardiovascular physiology that simulates reductions in LVc, as previously validated in a preclinical model of myocardial infarction. Alterations of LVc by 10%, 30%, and 50% for IOP levels of 15, 20, 25, and 30 mmHg were considered.

Results : Model simulations indicate that Q decreased as LVc is reduced for all IOP levels (Table1). At IOP 15mmHg, reducing LVc by 50% from baseline induced a change in Q from 6.57 to 5.45 10^{-4} cm^3/s (17%). At IOP 25mmHg, LVc reduction of 50% induced a 30%

decrease in Q (Figure B). Simulations indicate that the LVc-induced reduction of blood supply to the retina is more pronounced at higher IOP levels. The effect of LVc reduction on blood flow can be comparable to that expected in ocular hypertensive eyes with normal LVc (Figure A). For IOP 15mmHg and LVc reduced by 50%, Q is predicted to be 5.45 10^{-4} cm^3/s, lower than the value predicted for IOP 25mmHg and baseline LVc.

Conclusions : Model simulations suggest that LVc reductions decrease blood flow to the retina and pose a risk to retinal perfusion similar to ocular hypertension. In addition, these changes are more pronounced for elevated levels of IOP, suggesting a strong relationship between systolic cardiac function and retinal blood flow. This finding is likely to be of clinical importance as it may allow for ongoing monitoring of cardiac function.

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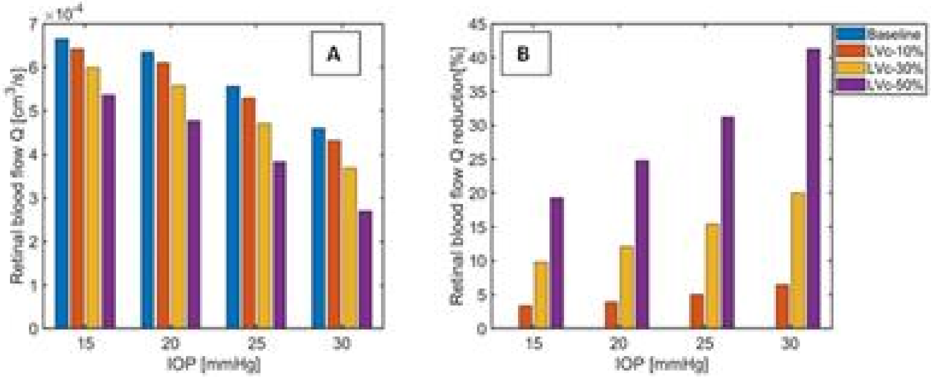

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$Q\ [10^{-4} cm^3/s]$				
	IOP = 15 mmHg	IOP = 20 mmHg	IOP = 25 mmHg	IOP = 30 mmHg
LVc-Baseline	6.75	6.45	5.70	4.74
LVc-10%	6.52	6.20	5.41	4.45
LVc-30%	6.09	5.69	4.83	3.82
LVc-50%	5.45	4.88	3.94	2.83

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