CSF pulsatility and vascular biomarkers in glaucomatous optic neuropathy

Karl Mercieca
MD FRCOphth PGCTLCP
Background

- Normal tension glaucoma (NTG) and primary open angle glaucoma (POAG) may have different aetiologies

- CSF differences have been shown in POAG and OHT
  - Pressure
  - Protein content

The Role of Cerebrospinal Fluid Pressure in Glaucoma
Pathophysiology: The Dark Side of the Optic Disc

William H. Morgan, MBBS, PhD, Dao Yi Yu, MD, PhD, and
Chandrakumar Balaratnasingan, MBBS
Hypothesis

- Increased incidence of stroke and Alzheimer’s in POAG\(^5,6\)
- CSF pulsatility changes and vascular imaging biomarkers have been identified in dementia and CVA\(^7\)


Cardiovascular risk factors

Hardening of arteries

Increased CSF pulse wave energy

? Optic nerve damage

? Glaucomatous change
Cerebrovascular disease (Stroke, Alzheimer’s disease)  
Open Angle Glaucoma (NTG vs POAG)  
CSF Pulse Wave Changes  
Vascular Biomarkers  
Increased CSF pulse wave energy  
Hardening of arteries  
? Optic nerve damage  
Cardiovascular risk factors  
? Glaucomatous change
Methods

**HASTE** — Half-Fourier Acquisition Single-shot Turbospin Echo

**ASL-MRI** — Arterial Spin Labelled perfusion scans
CSF Pulsatibility
Vascular Biomarkers

Dilated Virchow Robin spaces (VRS)
Study Design
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- MRIF funding obtained for pilot study (30 scans)
- Ethics Board approval obtained (10 months)
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8 NTG  8 POAG  8 CONTROLS
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Demographics
Diagnosis
Presenting and current IOP
CCT
Optic disc details
Visual Fields (MD and PSD)
Treatment

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**8 POAG**
- Patient information leaflet
- Consent form
- Clinical data collection

**8 CONTROLS**
- MRI scan – 1 hour

MREH

WMIC
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MREH

WMIC

MRI scan – 1 hour

- Mann Whitney U test used for statistical analysis
Results
## Results

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<th>POAG</th>
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<tbody>
<tr>
<td>Age (mean/range)</td>
<td>61.0/41-86</td>
<td>53.6/50-82</td>
<td>65.5/54-75</td>
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<td>M/F ratio</td>
<td>3/5</td>
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<td>Presenting IOP</td>
<td>Mean 16 (12-18)</td>
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<td>CCT (microns)</td>
<td>524</td>
<td>531</td>
<td>569</td>
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<tr>
<td>CD ratio</td>
<td>Mean 0.7(0.6-0.95)</td>
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**POAG group**

Higher number of centrum semiovale (CSOV) dilated Virchow Robin spaces (VRS) than controls: \( p=0.008 \)

**NTG group**

Higher number of CSOV VRS than controls: \( p=0.021 \)
Increased aqueductal systolic stroke volume: \( p=0.035 \)

- No significant difference between mean age of groups
Conclusions
Conclusions

Open Angle Glaucoma (NTG an POAG)

Cerebrovascular disease

Vascular Biomarkers
Conclusions

Open Angle Glaucoma
(NTG an POAG)

Cerebrovascular disease

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CSF Pulsatility

Normal Tension Glaucoma
Conclusions

Open Angle Glaucoma (NTG an POAG)

Cerebrovascular disease

Vascular Biomarkers

CSF Pulsatility

? CSF Pressure Differences

? Ocular Blood Flow

Normal Tension Glaucoma
The Future?
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Prof David Henson
Amy Watkins
Trainees
Patients
Controls