Ultrasound Cycloplasty – UCP
a new paradigm in glaucoma management?

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Hospital Santa Maria, Lisbon, PT

FINANCIAL DISCLOSURE: C

INTRODUCTION

• 
  #1 cause of irreversible blindness worldwide ➔ over 8 million people

• Main modifiable risk factor ➔ Intraocular Pressure (IOP)

• Medical therapy vs. Surgery

Cochrane Database Syst Rev. 2012 Sep 12;(9):CD004399
INTRODUCTION

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CONCLUSIONS

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Ultrasound Cycloplasty – a new paradigm in glaucoma management?

Use of Ocular Hypotensive Medications in Portugal: PEM Study: A Cross-sectional Nationwide Analysis

David Cordeiro Sousa, MD,† Inês Leal, MD,*,† Nilton Nascimento, BSc,‡ Carlos Marques-Neves, MD, PhD,*,† Anja Tuulonen, MD, PhD,§ and Luís Abegão Pinto, MD, PhD**

• 231,634 patients under Glaucoma drops: ~2.3% prevalence
• Around 15-20% of the patients can be under 3/+ topical drugs!
• Surgical ?!

<table>
<thead>
<tr>
<th></th>
<th>1 Class</th>
<th>2 Classes</th>
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<td>Patients (%)</td>
<td>54.4</td>
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• Around 15-20% of the patients can be under 3/+ topical drugs

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Egypt

95 M population
300,000 Patients

• Filtering surgery:
  o Steep learning curve
  o Surgeon-dependent
  o Intra & post-operative complications
  o High number of visits/re-interventions
  o Quality of life

Cochrane Database Syst Rev. 2012 Sep 12;(9):CD004399
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

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Increase Aqueous Humor Drainage

Decrease Aqueous Humour Production

Creating a fistula to the subconjunctival space

Ciliary body procedures

Trabeculectomy

AH Drainage device

Cryoapplication

UCP

Focused Ultrasound:
The technology behind the scene

High Frequency Focused Ultrasound enables:
- **Precision** through ultra-small spot size
- **Controlled** temperature-time curve
  - → **Targeting** accurately
  - → **Sparing** surrounding tissues
Concept and technology

High intensity focused ultrasound (HIFU)

HIFU & TSCPC temperature evolution

Transducer → Focal Zone

Temperature → Distance

Advantage of HIFU: selective heating

Focal zone

Before and after the focal zone: no heating, no damage
At the focus: fast, elevated titratable (60-85°C), and very localized heating
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

### INTRODUCTION

**Aim:**

- **Oncological:**
  - Bone metastases
  - Prostate cancer
  - Breast cancer
  - Liver cancer
  - Pancreatic cancer
  - Soft tissue cancer
  - Bone cancer
  - Brain cancer
  - Head & neck cancer
  - Melanoma
  - Thyroid cancer
  - Cervical cancer
  - Lung metastases
  - Neuroblastoma, pediatric
  - Bladder cancer
  - Cancer pain
  - Colorectal cancer
  - Esophageal cancer
  - Lung cancer
  - ovarian cancer

- **Urological:**
  - Retroperitoneal hyperplasia
  - Prostate cancer
  - Kidney cancer
  - Renal stones
  - Acute kidney injury
  - Acute tubular necrosis
  - Bladder cancer
  - Ureteroscopy

- **Women’s Health:**
  - Uterine fibroids
  - Breast cancer
  - Breast carcinomas
  - Uterine adenomyosis
  - Tired pregnancy
  - Cervical cancer
  - Pelvic surgery
  - Bilateral renal artery stenosis
  - Ovarian cancer
  - Polycystic ovary syndrome

**Musculoskeletal:**

- Bone metastases
- Back pain, facet joints
- Osteoid osteoma
- Back pain, sacroiliac
- Bone cancer
- Bone tumors, benign
- Osteoarthritis
- Disc degeneration
- Muscle atrophy
- Spinal cord injury

**Development stage**

- Conceptual
- Pre-clinical
- Abodental
- Pilot Trials
- Phase I Trials
- Phase II Trials
- Phase III Trials
- US Harmonisation

**Device Characteristics (EyeOp1®)**

- Frequency: 21 MHz
- Treatment Duration: 8 seconds per sector
- 6 sectors – 160°
- Acoustic Power: 2 – 3 W
- Temperature at the ciliary body: ± 80°C

Creation of six precise circumferential thermal lesions in the ciliary body.
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**Ultrasound Cycloplasty – a new paradigm in glaucoma management?**

The concept: *Ultrasound beams are focused on ciliary body.* Good positioning is critical to ensure good targeting of the ciliary body.

![Image of ciliary body](image1.jpg)

*Creation of six precise circumferential thermal lesions in the ciliary body.*

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**Ultrasound Cycloplasty – a new paradigm in glaucoma management?**

![Image of ultrasound effects](image2.jpg)

*Image showing ultrasound effects on the ciliary body.*
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

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**Diode laser**

**UCP**

Lim KJ. European Ophthalmic Review. 2017;11(1):35-9

<table>
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<tr>
<th>Key Procedure Steps</th>
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12

13
Additional mechanism of action… **Increased Outflow**

Linear or oval-shaped hyporeflective spaces are evident in the middle stromal layers.
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

**INTRODUCTION**

Additional mechanism of action… *Increased Outflow*

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Mastropasqua R et al., BJO 2016;100:1668-75

Microcysts in the conjunctiva

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Widened uveo-scleral pathway in the treated area
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

To analyze safety and efficacy of HIFU cycloplasty using EyeOP-1® device
**Ultrasonic Cycloplasty – a new paradigm in glaucoma management?**

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- Glaucoma patients with uncontrolled IOP despite optimal medication were consecutively scheduled for HIFU treatment and followed up regularly

- Primary efficacy outcome: **IOP reduction**

- Safety outcome: **adverse events**

- Statistical analyses: STATA v14.1

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**Ultrasonic Cycloplasty – a new paradigm in glaucoma management?**

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- **Surgical protocol:**
  - Certified physician
  - Retro/peribulbar anesthesia (5cc lidocaine+ropivacaine)
  - Post-operative dexamethasone 4x/day 4 weeks

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*2'28'”*
Overview

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Patients, n</td>
<td>41</td>
</tr>
<tr>
<td>Age, years (mean ± SD)</td>
<td>69 ± 15</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>22 (54)</td>
</tr>
<tr>
<td>Right eyes, n (%)</td>
<td>23 (56)</td>
</tr>
<tr>
<td>Baseline visual acuity, logMAR (mean ± SD)</td>
<td>0.51 ± 0.66</td>
</tr>
<tr>
<td>Pseudophakic, n (%)</td>
<td>26 (65)</td>
</tr>
<tr>
<td>Follow-up, months (mean ± SD)</td>
<td>13.2 ± 3.8</td>
</tr>
</tbody>
</table>

Glaucoma etiology

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Primary open-angle, n (%)</td>
<td>20 (49)</td>
</tr>
<tr>
<td>Secondary, n (%)</td>
<td>11 (27)</td>
</tr>
<tr>
<td>Neovascular, n (%)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Primary angle closure, n (%)</td>
<td>3 (7)</td>
</tr>
<tr>
<td>Secondary angle closure, n (%)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Juvenile, n (%)</td>
<td>1 (2)</td>
</tr>
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</table>
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

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<tr>
<th></th>
<th>Baseline</th>
<th>D1</th>
<th>M1</th>
<th>M3</th>
<th>M6</th>
<th>M12</th>
<th>M18</th>
</tr>
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<tbody>
<tr>
<td>N</td>
<td>41</td>
<td>40</td>
<td>37</td>
<td>25</td>
<td>19</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Drops (n)</td>
<td>2.8</td>
<td>2.7</td>
<td>2.7</td>
<td>2.4</td>
<td>2.2</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Diamox® (n)</td>
<td>0.3</td>
<td>0.03</td>
<td>0.05</td>
<td>0.04</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Intraocular pressure (mmHg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.2 ± 7.9 mmHg</td>
<td>-39%</td>
<td>-38%</td>
<td>-38%</td>
<td>-34%</td>
<td>-36%</td>
<td>-41%</td>
<td></td>
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</tbody>
</table>

**CONCLUSIONS**

**ACKNOWLEDGMENTS**

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Five (12%) failures

- Off-target IOP → need for filtering surgery (Trab or Tube)

**Adverse Events**

- Minor (e.g. mild anysocoria, hyporeactive iris, hyperemia, foreign body sensation, scleral marks, ...)
- Major → 1 case of severe hypotonia (uveitis patient)
INTRODUCTION

Ultrasound Cycloplasty – a new paradigm in glaucoma management?

Other studies

<table>
<thead>
<tr>
<th>Study</th>
<th># Pts</th>
<th>Glaucoma type</th>
<th>Follow-up</th>
<th>Method</th>
<th>Efficacy Results</th>
</tr>
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<tr>
<td>Denis et al. (2015)</td>
<td>12</td>
<td>Refract.</td>
<td>12</td>
<td>Prosp. Multic.</td>
<td>IOP Baseline: 29.0 ± 7.4 mmHg; IOP M12: 18.5 ± 6.4 mmHg; Meds 3.5 ± 3.4 at M12</td>
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<td>Maftei et al. (2019)</td>
<td>20</td>
<td>Refract.</td>
<td>12</td>
<td>Prosp. single centre</td>
<td>IOP Baseline: 36.4 ± 5.7 mmHg; IOP M12: 22.5 ± 10.6 mmHg; Meds 4.5 ± 4.0 at M12</td>
</tr>
<tr>
<td>Auff et al. (2014)</td>
<td>28</td>
<td>Refract.</td>
<td>12</td>
<td>Prosp. Multic.</td>
<td>IOP Baseline: 29.0 ± 7.2 mmHg; IOP M12: 21.6 ± 6.8 mmHg; Meds 3.5 ± 3.5 at M12</td>
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<td>Auff et al. (2014)</td>
<td>30</td>
<td>Non-refract.</td>
<td>12</td>
<td>Prosp. Multic.</td>
<td>IOP Baseline: 28.2 ± 7.2 mmHg; IOP M12: 19.6 ± 5.7 mmHg; Meds 2.6 ± 3.1 at M12</td>
</tr>
<tr>
<td>Bouanani et al. (2015)</td>
<td>30</td>
<td>Refract. + non-refract.</td>
<td>12</td>
<td>Prosp. Multic.</td>
<td>IOP Baseline: 28.6 ± 5.3 mmHg; IOP M12: 18.4 ± 5.5 mmHg; Meds 3.0 ± 2.9 at M12</td>
</tr>
<tr>
<td>Buonacore et al. (2014)</td>
<td>30</td>
<td>Refract. + non-refract.</td>
<td>9</td>
<td>Prosp. single centre</td>
<td>IOP Baseline: 29.3 ± 9.6 mmHg; IOP M12: 21.6 ± 5.9 mmHg; Meds 2.6 ± 2.9 at M12</td>
</tr>
<tr>
<td>Buonacore et al. (2014)</td>
<td>60</td>
<td>Refract. + non-refract.</td>
<td>6 Prosp. single centre</td>
<td>IOP Baseline: 21.6 ± 4.7 mmHg; IOP M12: 13.8 ± 3.9 mmHg; Meds 2.6 ± 2.2 at M12</td>
<td>75%</td>
</tr>
<tr>
<td>Denis (2016)</td>
<td>12</td>
<td>Refract. + non-refract.</td>
<td>6 Prosp. Multic.</td>
<td>IOP Baseline: 24.8 ± 6.9 mmHg; IOP M12: 15.9 ± 5.9 mmHg; Meds 1.3 ± 1.2 at M12</td>
<td>65%</td>
</tr>
</tbody>
</table>

AIM

Key Results

- Mean IOP-lowering efficiency > 30% (12 months)
- Satisfactory response rate
- High Safety Profile
  - Most common adverse effect: impaired iris mobility
  - No impact on later surgeries (if needed)
- Glaucoma Clinic Management
  - Only two post-op visits during first month (D1, D30)
  - Fast, easy to learn, automated procedure (< 15’)
  - Potential to avoid filtering surgery

Conclusions

Acknowledgments
Ultrasound Cycloplasty – a new paradigm in glaucoma management?

Shift in *status quo* for ciliary body procedures?

- Use in surgery-naïve patients
- Delay the need for filtering procedures
- Allow for IOP-lowering drugs reduction

What question moves you?

Obrigado

شكرا