LASERS IN GLAUCOMA MANAGEMENT

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Basic Principles of LASERS

- Light amplification by stimulated emission of radiation

- The emitted light is
  1. Coherent (in phase),
  2. Collimated (rays in same direction),
  3. Monochromatic (one wave length)
  4. High intensity (amplified)
### Specific LASERS & Tissue Interactions

<table>
<thead>
<tr>
<th>Type of Laser</th>
<th>Wavelength</th>
<th>Effect on tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argon laser</td>
<td>514-488 (blue &amp; green light)</td>
<td>Photocoagulation</td>
</tr>
<tr>
<td>Nd:YAG laser (pulsed)</td>
<td>1064 (near infrared)</td>
<td>Photodisruption</td>
</tr>
<tr>
<td>Nd:YAG, freq. doubled</td>
<td>532-nm</td>
<td>Photocoagulation</td>
</tr>
<tr>
<td>Diode laser</td>
<td>800-820-nm (infrared)</td>
<td>Photocoagulation</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>10600 (far infrared)</td>
<td>Photovaporization</td>
</tr>
<tr>
<td>Femto second laser</td>
<td>1053 (near infrared)</td>
<td>Photodisruption</td>
</tr>
<tr>
<td>Krypton laser</td>
<td>670-531 (visible light)</td>
<td>Photocoagulation</td>
</tr>
<tr>
<td>Excimer laser</td>
<td>193 (far ultraviolet)</td>
<td>Phototablation</td>
</tr>
<tr>
<td>Ruby laser</td>
<td>694-nm (visible spectrum)</td>
<td>Photoablation</td>
</tr>
<tr>
<td>Helium-neon laser</td>
<td>(the red wave length)</td>
<td>An aiming beam</td>
</tr>
</tbody>
</table>

### Lasers in Glaucoma

- **Cause**
- **Diagnose**
- **Treat**

**GLAUCOMA**
LASER-INDUCED GLAUCOMA

• Post laser pressure spikes & persistent IOP elevation after ant segment laser Sx: YAG cap, PI, LPI, ALT, pupilloplasty,…

• Experimental open-angle glaucoma (photocoagulation of TM): acute & chronic

• YAG capsulotomy provoking rubeosis irides and neovascular glaucoma in diabetic eyes

• Malignant glaucoma post CPC

LASER APPLICATION FOR GLAUCOMA DIAGNOSIS

• Confocal laser scanning ophthalmoscopy (HRT, TopSS)

• Optical coherence tomography (OCT):
  – Post segment OCT
  – Ant segment OCT

• Laser scanning polarimetry (GDX)

• Retinal ganglion cell imaging
The Confocal Laser Scanning Ophthalmoscope (HRT)

- Uses laser beam to scan the target tissue one point at a time
- A confocal optical system is utilized
- The laser beam scans the ONH horizontally across a given plane then moves down to scan sequential planes

Topography Image & Data Analysis
OPTICAL COHERENCE TOMOGRAPHY (OCT)

- **Optical Principles**: low coherence interferometry
- **Light source**: a broadband superluminescent light emitting diode
- The interferometer measures the *echo delay time* of the sample beam reflected from different microstructures in the retina & combines it with the reflected reference beam producing the phenomenon of interference
- A photodetector detects and measures interference (the echo delay patterns)

OCT Analysis of Optic Disc & RNFL
What We see with Anterior Segment OCT:

AC 15 mm scan

Scanning Laser Polarimetry

• **Birefringence:** A property of a tissue or a material that arises when the tissue is composed of parallel structures, each of which is of smaller diameter than the wavelength of the incident light used to image it.
The GDX VCC Printout
- Disc photos
- TSNIT Parameters
- Thickness map
- Deviation map
- TSNIT Graph

LASER APPLICATION FOR GLAUCOMA DIAGNOSIS
- Investigational tools under study:
  - Longitudinal scanning laser ophthalmoscopy for Retinal ganglion cell imaging

LASER TREATMENT OF GLAUCOMA

- Laser Trabeculoplasty
  - Argon: ALT
  - Argon laser
  - Nd: YAG laser
  - Diode laser: DLT
  - Micropulse Diode: MDL

- Peripheral Iridotomy
  - Argon laser
  - Nd: YAG laser
  - Sequential argon/YAG

- Goniopuncture
  - Nd: YAG
  - Goniophotocoagulation: Argon
  - Closure of cyclodialysis cleft (argon)

- Laser suture lysis for augmenting filtration: Argon/Krypton

- Non-pen Deep Sclerectomy
  - Excimer laser
  - Femtosecond laser

- Femto second laser-assisted cataract surgery (FLAPS)

- Laser Sclerostomy
  - Ab-interno (Nd: YAG)
  - Ab externo (Holmium)

- Transcleral Cyclophotocoagulation: Diode laser, Nd:YAG

- Endoscopic CPC

LASERS: THE SOFT POWER IN GLAUCOMA TREATMENT

- Except for ALT & SLT, all other lasers are substitutes for surgical intervention

- Being
  - Noninvasive
  - Office procedures
  - Maximally tolerated
  - Least adverse effects
  - Targeting tissue of the main pathology
  - Average success rate
  - Average cost compared to drops or surgery

- SLT/ALT overcomes many of the adverse effects of medicinal therapy
  - Compliance to meds
  - Side effects of drug & preservative
  - Declining Persistence & tolerability to drops
  - Cost
  - Poor access to or non availability of drugs
  - Effect on future Sx
  - Quality of life & psychological stress

- make them preferred to surgery with regard to safety, efficacy, cost, and patient’s acceptance
Indications for Laser Treatment for different types of glaucoma

<table>
<thead>
<tr>
<th>Type of Glaucoma</th>
<th>Laser Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>POAG, OH, PIGG, XFG</td>
<td>ALT, SLT, DLT, MDLT</td>
</tr>
<tr>
<td>PACG, PACS, Acute PACG, Plateau iris</td>
<td>PI, Laser iridoplasty, femto laser cat sx</td>
</tr>
<tr>
<td>2ry pupillary block glaucoma: NVG, Uveitic, ...</td>
<td>Multiple laser iridotomies</td>
</tr>
<tr>
<td>Refractory glaucomas</td>
<td>Trans-scleral CPC, Endoscopic CPC</td>
</tr>
<tr>
<td>Malignant glaucoma</td>
<td>YAG capsulotomy-hyaloidotomy</td>
</tr>
<tr>
<td>Postoperative pressure spikes</td>
<td>Laser suture lysis, Goniopuncture</td>
</tr>
<tr>
<td>Neovascular glaucoma</td>
<td>Goniophotocoagulation, Pan retinal photocoagulation</td>
</tr>
<tr>
<td>Cyclodialysis cleft</td>
<td>Argon laser treatment for closure of cleft</td>
</tr>
<tr>
<td>Blocked tube or sclerostomy</td>
<td>YAG laser membranectomy</td>
</tr>
<tr>
<td>Surgical Rx of OAG</td>
<td>Laser sclerostomy, Excimer laser Deep Sclerectomy</td>
</tr>
</tbody>
</table>

ARGON LASER PERIPHERAL IRIDOPLASTY

- **Principle of treatment**
- **Indications**
  - Plateau iris syndrome
  - Pupillary block with appositional angle closure when laser PI cannot be done or failed to open the angle
  - In nanophthalmos to relieve angle crowding
  - To open the angle before trabeculoplasty
- **Contraindications:**
  - Corneal edema, very shallow AC
  - Synechial angle closure
ARGON LASER IRIDOPLASTY

- **Technique:**
  - Laser setting: 300-500 µm spot size, 0.5 sec, 200-400 mW power
  - Site of treatment: extreme iris periphery
  - Number of burns: 20-40 over 360 degrees
  - Treatment of 180 degrees may be advisable
  - End point: visible brisk contraction of iris, no bubble or pigment release
  - The flat surface of a contact lens is preferred to goniolens

- **Complications:**
  - Iritis, endothelial edema, IOP rise, retinal burn, pupil changes

LASER SUTURE LYSIS

- Postop pressure rise due to tight scleral flap
- Sutures are Nylon or Prolene
- Exclude other causes of high IOP
- Used for titration of filtration postoperatively

- **Timing of LSL is very critical:**
  - Not before one week & may extend for 1 months with antimetabolites
  - CTM is done to test flap dislodgement and amount of flow
  - The postop target pressure
  - Intensity of the healing/scarring process
LASER SUTURE LYSIS

• **Technique**
  • Argon, Diode, or Krypton laser (if subconj. hemorrhage):
  • 500 mW, 100 microns spot size, 0.1 sec
  • Hoskins or Ritch lens
  • Local anesthesia
  • Suture compression by the lens with laser cutting under direct visualization
  • Light pressure with lens may help to dislodge tight flap & increase flow


LASER SUTURE LYSIS

• **Precautions:**
  — Only one suture cut at a time
  — IOP must be checked after suture cutting
  — Slitlamp ex for AC, & Seidel test for leak

• **Complications**
  — Failure to locate or cut the suture
  — Failure to increase flow after suture cutting
  — Conjunctival buttonholes
  — Excessive flow & hypotony-related complications: lost AC, choroidal effusion
  — Malignant glaucoma
Multiple laser iridotomies: Nd:YAG or Sequential Argon & YAG laser

LASER MEMBRANECTOMY
For blocked tube or internal ostium

Argon laser Goniophotocoagulation for Open-angle Neovascular Glaucoma

Settings: 200 mW, 100-200 microns spot size, 0.2 sec

YAG laser Capsulotomy/Hyaloidotomy for disruption of anterior vitreous face in Malignant Glaucoma in aphakic or pseudophakic eyes
“Health Literacy” & Laser Glaucoma Treatment

• Poor health literacy is associated with lower compliance, poor glaucoma understanding, and more missed appointments, with subsequent more visual field loss


• ABUSE of the word LASER by the physician & the patient

• The Underestimate & Overestimate impression

• The confusion with other laser applications in the eye (laser in retina, refractive sx, cat sx, plastic sx...etc)

GIVE YOUR PATIENT HOPE, NOT FEAR

• Glaucoma for most patients is
  — Bad disease
  — Incurable
  — Blinding

• And for most eye care providers is
  — Frustrating
  — No cure whatever you do
  — No appreciation whatever you do

• FEAR is key to doctor visit

• Antidote to fear is HOPE

• There is no better feeling than walking out of the doctor’s office with a good report


• No patient should ever leave a visit with a physician without a sense of HOPE

  — Harris JC, DeAngelis CD. The power of hope. JAMA 2008;300(24):2919
Thank U for the kind attention

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