Use of Laser in Urology.

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08/02/2018.
Introduction.

- Acronym for “light amplification by stimulated emission of radiation”.

- Characterized by: Wavelength (nm), Energy (j), and Power (Watt).
Types:

- Potassium-titanyl-phosphate (KTP), 532 nm.
- Lithium-triborate (LBO), 532 nm.
- Holmium: yttrium-aluminum-garnet (Ho:YAG), 2140 nm.
- Thulium (Tm: YAG), 2013-nm.
- CO2 laser.
- Diode laser.
Uses:

- Prostate.
- Urolithiasis.
- Urethral and ureteral stenoses.
- Bladder and upper urothelial carcinoma.
- Penile cancer.
Prostate
Lasers used in BPH Treatment:

- Ho: YAG laser.
- Green light laser.
- Diode laser.
- Tm: YAG laser.
HoLEP:
HoLEP:
HoLEP:
Morcellation:

- Video.
Advantages:

- Excision of large prostates without the need of open procedure.

- Risk of hemorrhage is minimal (decrease in transfusion rate) → Could be done on anticoagulants.

- Use of NSS → no TUR Syndrome.

- Lessens hospital stay (1 day catheterization).

- It appears that re-intervention rate after few years is lower.
Complications:

- Bladder and ureteral orifices injury.
- Incomplete evacuation of the adenoma.
**HoLEP vs TURP: (large RCT’s).**

<table>
<thead>
<tr>
<th></th>
<th>HoLEP</th>
<th>TURP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease Hb (g/dl)</td>
<td>1.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Catheterization time (hours).</td>
<td>27.6</td>
<td>43.4</td>
</tr>
<tr>
<td>Hospital stay (hours)</td>
<td>53.3</td>
<td>85.4</td>
</tr>
<tr>
<td>Operative time (min).</td>
<td>94.6</td>
<td>73.8</td>
</tr>
<tr>
<td>Peak flow rates (at 12 months).</td>
<td>4.9 → 23.1</td>
<td>5.9 → 25.5</td>
</tr>
<tr>
<td>Residual volume (ml) at 12 months.</td>
<td>5.3</td>
<td>26.6 (not clinically sig)</td>
</tr>
<tr>
<td>AUASS</td>
<td>2.7</td>
<td>3.3</td>
</tr>
</tbody>
</table>
HoLEP vs Open prostatectomy (OP):

<table>
<thead>
<tr>
<th></th>
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<th>OP</th>
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<tr>
<td>Time to catheter removal (days)</td>
<td>1.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Hospital time (days)</td>
<td>2.7</td>
<td>5.4</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Q max.</td>
<td>7.8 → 26.6</td>
<td>8.3 → 24.4</td>
</tr>
<tr>
<td>AUASS</td>
<td>22.1 → 2.3</td>
<td>21 → 2.3</td>
</tr>
</tbody>
</table>
Disadvantages:

- Difficult and exaggerated learning curve → require experience and relevant endoscopic skills.
- Increase operative time.
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>LE</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holmium laser enucleation and 532-nm laser vaporisation of the prostate are alternatives to transurethral resection of the prostate (TURP) in men with moderate-to-severe LUTS leading to immediate, objective, and subjective improvements comparable with TURP.</td>
<td>1a</td>
<td>A</td>
</tr>
<tr>
<td>The long-term functional results of holmium laser enucleation are comparable with TURP or open prostatectomy.</td>
<td>1b</td>
<td>A</td>
</tr>
</tbody>
</table>
Photoselective Prostate vaporization (PVP):

- Uses Nd:YAG laser, KTP, or LBO.
- Called green light laser.
- Laser energy is absorbed by haemoglobin, but not by water.
- Vaporisation leads to immediate removal of prostatic tissue,
PVP:
• In 2016 the standard Greenlight procedure was the 180-W-XPS laser.

• The majority of evidence is published with the former 80-W (KTP) or 120-W HPS (LBO) laser systems.
A meta-analysis of the nine available RCTs comparing PVP using the 80-W and 120-W lasers with TURP (2012).

- No differences were found in Qmax and IPSS between 80-W-PVP and TURP.

- The 180-W (XPS) laser efficacy is comparable to TURP in terms of IPSS, Qmax, PVR volume, prostate volume reduction, PSA decrease and QoL questionnaires, and re-intervention.
A meta-analysis of the nine available RCTs comparing PVP using the 80-W and 120-W lasers with TURP (2012).

- The XPS laser prostatectomy is superior to TURP in terms of catheterisation time, length of hospital stay and time to stable health status.

- But has a longer operative time.
Advantages:

• Combined vaporization and coagulation.

• Can be done in patients on anticoagulants.
Disadvantages:

- Post-op dysuria and storage symptoms
  TURP or OP.
Practical considerations:

- The 180-W XPS laser should be regarded as the reference for Greenlight laser prostatectomy.
- Studies were done on the former 80 and 120 W.
- Results from the Goliath Study (180-W XPS vs. TURP) are pending.
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<tr>
<td>The short-term and mid-term functional results of 532-nm laser vaporisation of the prostate are comparable with TURP.</td>
<td>1b</td>
<td>A</td>
</tr>
<tr>
<td>With regard to intra-operative safety, 532-nm laser vaporisation is superior to TURP.</td>
<td>1b</td>
<td>A</td>
</tr>
<tr>
<td>532-nm laser vaporisation should be considered in patients receiving anticoagulant medication or with a high cardiovascular risk.</td>
<td>3</td>
<td>B</td>
</tr>
</tbody>
</table>
Thulium:yttrium-aluminium-garnet laser (Tm:YAG).

- Different applications, ranging from vaporisation (ThuVaP), vaporesection (ThuVaRP), and enucleation (ThuVEP/ThuLEP: similar enucleating techniques) are published.

- ThuLEP and HoLEP were compared in one RCT with eighteen months follow-up with comparable outcomes in both arms.
• ThuLEP appeared to be equivalent with regard to clinical efficacy and superior with regard to intra-operative haemostasis.
• The limited number of RCTs and only a few studies with long-term follow-up (up to 48 months) support the efficacy of thulium laser prostatectomy

→ there is a need for ongoing confirmation.
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<tbody>
<tr>
<td>Tm:YAG vapoeresection is an alternative to TURP for small- and medium-size prostates.</td>
<td>1b</td>
<td>A</td>
</tr>
<tr>
<td>With regard to intra-operative safety and haemostatic properties, diode and thulium lasers appear to be safe.</td>
<td>3</td>
<td>C</td>
</tr>
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</table>
Urolithiasis
Urolithiasis.

- The Ho:YAG is one of the newest members of the endoscopic lithotrites.
- It allows segmental resection of all stones regardless of their composition.
- Flexible endoscopes require laser lithotripsy to maintain tip deflection.
- Ho:YAG laser has become the standard.
Advantages:

- Minimal risk of surrounding thermal injury (in water: beam is absorbed within the 1st few mm) ≠ Nd: YAG.

- Minimal fragment migration and retrograde propulsion when low settings are used.

- Able to fragment all stones regardless of their composition, size and location (ex: lower calyx).
Disadvantages:

- Long learning curve.
- Time consuming.
- Easily damaged.
• Video
Other uses.

- The introduction of small flexible ureteroscopes and the holmium laser has made ureteroscopy a valid treatment option for transplant calculi.

- Because of the smaller size of the probes, laser energy is easier to use in smaller instruments and is more useful for pediatric cases.
Urethral stenosis
• With the exception of open urethral reconstruction, all are associated with a high rate of recurrence.

• Nd: YAG, KTP, and Ho: YAG lasers have been used.
• They can yield recurrence rates similar to those of cold knife internal urethrotomy (20-40% success rates). And repeat procedures offer little improvement.

• Recently, hope of using Nd: YAG laser with a crystal tip contact method of vaporization yielded a 93% success rate that durable for a mean over 2 years.
Ureteral stenosis

- Strictures < 3 cm in length may be treated endoscopically either with percutaneous balloon dilation or antegrade flexible ureteroscopy and holmium laser incision.

- In this scenario (laser) the success rate approaches 50%.
Bladder cancer
EAU 2017

- En-bloc resection using monopolar or bipolar current, Thulium-YAG or Holmium-YAG laser is feasible in *selected* exophytic tumors.

- It provides high quality resected specimens with the presence of detrusor muscle in 96-100% of cases.
• Potassium titanyl-phosphate (KTP) laser vaporisation is associated with a low risk of complications.

• Its oncologic outcomes need to be confirmed in a larger patient population.
Upper urothelial carcinoma:

- Endoscopic ablation can be considered in patients with clinically low-risk cancer in the following situations:
- Laser generator and pliers are available for biopsies.

- In case a flexible ureteroscope is available (rather than a rigid ureteroscope).

- The patient is informed of the need for closer, more stringent, surveillance.

- Complete tumor resection can be achieved.
References:

- Pubmed.
Thank You !!