Laser pointer phototoxicity

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Handheld Green Laser-Pointer Maculopathy (HLPM)

Laser pointer class 3 B can cause permanent eye damage with exposures of 1/100 th of a second or less depending on the strength of the laser.
Male, 12 y.o.

- Mild myopia
- 6 months ago OO reduction VA
- Familiar history: suspected retinitis pigmentosa (aunt)

VA 6/10 -3.5-0.5/85 pp l c
VA 9-10/10 -3-0.5/100t pp l c
Female, 10 y.o.

Central scotoma in her LE, VO 9/10
Male, 14 y.o.

- Visual defect in his RE, VA 1/10
- CNV type II, intravitreal injection of Bevacizumab
IR-OCT
Phototoxicity: is it really an issue?
ILM-BLUE

Chandeliers

Twin Lights
75 year old woman with MH, VA 20/400
The surgery consisted of the standard 3 port 25 G pars plana vitrectomy, air-fluid exchange injection of 0.2 ml of BBG (ILM Blue). The BBG was left to stain the ILM for 2 minutes.

## CONCLUSIONS

These 2 patients presented with outer retinal phototoxic damage after uncomplicated macular surgery. We think that our technique for staining the ILM caused an excessive concentration of BBG in the ILM which was responsible of the phototoxic damage. Since then we have changed our staining technique, we inject 0.2 ml of BBG in a fluid-filled eye and we remove it after 30 seconds. We have not noted anymore phototoxic damage.
55 yo man regmatogenous nasal RD, macula on.
General anesthesia
55 yo woman
regmatogenous nasal RD, macula on.
General anesthesia
Retinal Phototoxicity: Possible Association with Chandelier Endoillumination

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Introduction

- Retinal phototoxicity is a well known complication of anterior segment surgery from operating microscope-induced injury and vitrectomy from endoillumination1.
- Phototoxicity has not been reported with chandelier endoillumination for vitrectomy.
- Thermal melting of chandelier probe tips has been reported2; a change in probe tip shape may focus intense light on the retina.
- Phototoxicity is mediated primarily by UV and short-wavelength light 1.
- Natural protective mechanisms of the cornea and crystalline lens, which help absorb UV-spectrum light, are bypassed during endoillumination.

Methods

- Retrospective chart review.
- Two clinical cases consistent with presumed phototoxicity after vitrectomy are presented.
- Laboratory experimentation using surgical equipment similar to involved cases was performed to study mechanism of toxicity.
- Ultrastructure of probe tips was examined after exposure to air, porcine uvea, and human blood.

Results

<table>
<thead>
<tr>
<th>SURGICAL DETAILS</th>
<th>PRESUMED PHOTOTOXICITY 10 DAYS</th>
<th>OUTCOME</th>
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<tr>
<td><strong>Case 1:</strong> PPV w/ endolaser 23 G Alcon Accurus Illumination: Chandelier at 50% power Perfluoron was used Air-gas exchange: SF6 No intraocular drugs or dyes</td>
<td>10 days: Vision hand motions Long-Term BCVA: 20/400</td>
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<tr>
<td><strong>Case 2:</strong> PPV w/ endolaser 23 G Alcon Accurus Illumination: Chandelier at 50% power Perfluoron was used Air-gas exchange: SF6 No intraocular drugs or dyes</td>
<td>10 days: Vision hand motions Long-Term BCVA: 20/400</td>
<td></td>
</tr>
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Figure 1: Melted (left) and unmelted (right) probe tips after 10 minutes of exposure to porcine uvea (left) and air (right)

Discussion

- Retinal findings consistent with phototoxicity were observed in two vitrectomy cases.
- It is hypothesized that melting of the endoilluminator probe tip may alter the nature and intensity of focused light on the retina, which may lead to phototoxicity.
- Melting of the chandelier fiber probe tips was induced experimentally in the laboratory with exposure to porcine uveal tissue and human blood.
- Uveal tissue and blood may become attached to the probe tip during insertion of the light fiber through the sclera.
- Visual outcomes from phototoxicity after vitrectomy may be worse than injury caused by the operating microscope during anterior segment surgery because the light source bypasses the lens and cornea3.
- Further research is needed to characterize the mechanisms that induce thermal melting of chandelier fiber probe tips.

References


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**Editorial**

**Illumination and Phototoxicity Issues in Vitreoretinal Surgery**

Chandeliers such as the Tornambe Torpedo and dual-mode infusion cannulas have large divergence angles which spreads the light out over a larger area reducing power per unit area but they are immobile, eliminating the opportunity for retinal recovery when the light source is repositioned as is the case with conventional endoilluminators.

Steve Charles
Phototoxicity Mechanisms:

• Photomechanical damage: intense pulsed laser radiation produces vaporization, fragmentation or disruption of retinal tissue.

• Thermal injury: the tissue temperature is raised more than 10 °C above usual → protein denaturation

• Photochemical harm: high photon energies break molecular chemical bonds → free radical formation and increasing oxidative stress
Importance of Light Filters in Modern Vitreoretinal Surgery: An Update of the Literature

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Light Filters in Modern Vitreoretinal Surgery

• Prospective observational clinical study:
  – 359 consecutive vitrectomy cases
  – 6 different illumination modes were compared consecutively: mercury vapor, mercury vapor/xenon, and xenon followed by xenon combined with an amber, green, or yellow spectral filter.
  – Head-to-head comparison showed a significant advantage for the amber over the green and yellow filters with respect to elimination of short wavelengths and contrast generation.

Chow D: The effect of light source filters on tissue visualization: a multicenter trial. Euretina 13th Congress; September 2013; Hamburg
Conclusions

• Distance of the light probe from the macula
  – modifying the working distance of the light probe from 4 to 8 mm from the retina increases the retinal threshold time more than 3-fold

• Surgical time
• Chromovitrectomy (no staining under air, short time)
• Chandelier light
• Pass filters (yellow, green, amber)
• New technology
  – 3D heads-up surgery
  – LED (light-emitting diode) light sources
  – Mercury vapor illuminator
Thank You