MULTIFACTORIAL APPROACH TO IMPROVING PERFORMANCE OF THE NOVICE VITREORETINAL SURGEON: IMPLICATIONS IN SURGICAL PRACTICE

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MULTIFACTORIAL APPROACH TO IMPROVING PERFORMANCE OF THE NOVICE VITREORETINAL SURGEON: IMPLICATIONS IN SURGICAL PRACTICE

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Purpose. To quantitatively analyze the surgical performance of in-training vitreoretinal surgeons following exposure to propranolol, alcohol, physical activity, or polysomnographic recorded sleep interruption.

Methods. We conducted a cross-sectional study with 15 vitreoretinal fellows with less than 2 years of surgical experience. Surgical performance using the Eyesi simulator (VRmagic, Mannheim, Germany) was quantitatively assessed after each exposure on 4 nonsequential days, as follows: day 1: placebo, 0.2 mg/kg propranolol, and 0.4 mg/kg propranolol (total=0.6 mg/kg). Day 2: baseline simulation, wine consumption with breathalyzer reading of 0.06-0.10% of blood alcohol concentration (BAC), followed by 0.11-0.15% BAC. Day 3: baseline simulation, 4 series of push-ups with 50% of maximum repetition (RM) training load, followed by 4 series of push-ups with 85% RM. Day 4: sleep restriction of 3 hours of total time in bed. The Eyesi surgical simulator was used to obtain total surgical score, task completion time (minutes), tooltip intraocular trajectory (mm), and tremor-specific task score. The data was analyzed using the Friedman test with the Bonferroni’s adjustment for multiple comparison and the Wilcoxon test for paired comparison and p-value was set at 0.05.

Results. The simulated surgical performance worsened with increasing alcohol exposure, as measured by total score (X^2 =7, df=2, p=0.03) and intraocular trajectory (X^2 =6.86, df=2, p=0.03). BAC of 0.06-0.10% and 0.11-0.15% worsened performance compared to improvement after 0.6 mg/kg and 0.2 mg/kg propranolol, respectively, in terms of total score (delta= -22 vs. delta= +13, p=0.02; delta= -43 vs. delta= +23, p=0.01); anti-tremor task score (delta= -7.5 vs. delta= +5, p=0.008; delta= -15 vs. delta= +8, p=0.009), and task completion time (delta= -0.05 min vs. delta= -1.35 min, p=0.008; delta= +0.46 min vs. delta= -0.83 min, p=0.009). Intraocular trajectory was negatively impacted by 0.11-0.15% BAC compared to 0.2 mg/kg propranolol (delta= +204.84 mm vs. delta= -221.7 mm, p=0.006). No changes were observed in surgical performance after 4 series of push-ups with 85% RM or following sleep restriction of 3 hours in bed.

Conclusions. Alcohol exposure worsened overall surgical performance in a dose dependent manner. Propranolol 0.2 mg/kg positively affected surgical dexterity compared to alcohol levels of 0.06-0.10% BAC.
This study suggested that young vitreoretinal surgeons who ingest caffeine before performing a surgical procedure may benefit from receiving a partially neutralizing dose of propranolol.
PURPOSE

PROPRANOLOL

ALCOHOL

EXERCISE

SLEEP
METHODS

Eyesi (VRmagic GmbH, Mannheim, Germany)
INCLUSION CRITERIA

- < 2 yrs real surgical experience
- > 2hrs experience with Eyesi

EXCLUSION CRITERIA

- Having any previous systemic disease
- Alcohol intake > 3 standard drinks/day

Before the study: ECG + 0.6 mg/kg propranolol
TOTAL SCORE (0-700)

TIME INSIDE THE EYE

TREMOR SPECIFIC SCORE (0-100)

INTRAOCULAR PATHWAY

Methods
STUDY PROTOCOL

BAC: Blood Alcohol Concentration
RM: Repetition Maximum
PSG: Polysomnography

**DAY 1**
- **PROPRANOLOL**
  - Placebo
  - 30 min.
  - Simulation 1

**DAY 2**
- **ALCOHOL**
  - 0.06-0.10% BAC
  - 40 min.
  - Simulation 1
  - 0.11-0.15% BAC
  - 40 min.
  - Simulation 2

**DAY 3**
- **EXERCISE**
  - 50% RM
  - Simulation 1
  - 85% RM
  - Simulation 2

**DAY 4**
- **SLEEP DEPRIVATION**
  - Sleep Deprivation (PSG)
  - 3 hours
  - Simulation 1

**SIMULATION**
- Simulation 1
- Simulation 2
- Simulation 3
- Simulation 4

**Time**
- Sleep Deprivation (PSG) for 3 hours

15 VR fellows (60% men)
29.6 ± 1.4 years
MEDIAN COMPARISON OF PERFORMANCE DATA BETWEEN DIFFERENT LEVELS OF THE SAME EXPOSURE

<table>
<thead>
<tr>
<th>ALCOHOL</th>
<th>Baseline</th>
<th>Post-exposure</th>
<th>p *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SCORE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline vs. 0.11-0.15% BAC</td>
<td>596.5 (562.0, 617.2)</td>
<td>537.5 (459.5, 585.7)</td>
<td>0.02</td>
</tr>
<tr>
<td>TREMOR-SPECIFIC SCORE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline vs. 0.06-0.10% BAC</td>
<td>68.5 (46.0, 80.7)</td>
<td>54.0 (42.00, 63.2)</td>
<td>0.04</td>
</tr>
<tr>
<td>Baseline vs. 0.11-0.15% BAC</td>
<td>68.5 (46.0, 80.7)</td>
<td>52.5 (36.50, 63.2)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

BAC: Blood Alcohol Concentration
## RESULTS

### COMPARISON OF THE MEDIAN DELTA OF PERFORMANCE DATA BETWEEN DIFFERENT EXPOSURES

<table>
<thead>
<tr>
<th>ALCOHOL vs. PROPRANOLOL</th>
<th>Δ Exposure 1</th>
<th>Δ Exposure 2</th>
<th>p *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCORE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.11-0.15% BAC vs. Propranolol 0.2 mg/kg</td>
<td>-43.0 (-120.5, -5.7)</td>
<td>+23.0 (-29.0, +54.0)</td>
<td>0.01</td>
</tr>
<tr>
<td>0.06-0.10% BAC vs. Propranolol 0.6 mg/kg</td>
<td>-22.0 (-62.0, +16.5)</td>
<td>+13.0 (-12.0, +49.0)</td>
<td>0.02</td>
</tr>
<tr>
<td>0.11-0.15% BAC vs. Propranolol 0.6 mg/kg</td>
<td>-43.0 (-120.5, -5.7)</td>
<td>+13.0 (-12.0, +49.0)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

| TREMOR-SPECIFIC SCORE                     |                                  |                                  |      |
| 0.11-0.15% BAC vs. Propranolol 0.2 mg/kg| -15.0 (-26.2, +1.25)             | +8.0 (-11.0, +25.0)              | 0.009|
| 0.06-0.10% BAC vs. Propranolol 0.6 mg/kg| -7.5 (-19.0, +2.7)               | +5.0 (-14.0, +20.0)              | 0.008|

| TIME (minutes)                            |                                  |                                  |      |
| 0.11-0.15% BAC vs. Propranolol 0.2mg/kg   | +0.46 (-0.52, +2.91)             | -0.83 (-2.76, +0.94)             | 0.009|
| 0.06-0.10% BAC vs. Propranolol 0.6 mg/kg  | -0.05 (-0.78, +0.84)             | -1.35 (-2.94, -0.51)             | 0.005|
| 0.11-0.15% BAC vs. Propranolol 0.6 mg/kg  | +0.46 (-0.52, 2.91)              | -1.35 (-2.94, -0.51)             | 0.01 |

| INTRAOCULAR TRAJECTORY (mm)               |                                  |                                  |      |
| 0.11-0.15% BAC vs. Propranolol 0.2 mg/kg  | +204.8 (-25.5, +338.8)           | -221.7 (-374.9, +93.1)           | 0.006|

*BAC: Blood Alcohol Concentration*
RESULTS
ALCOHOL
- worsened surgical performance in a dose dependent manner

PROPRANOLOL
- Improved performance compared alcohol intake

PHYSICAL EXERCISE
- No change in performance

SLEEP DEPRIVATION
- No change in performance
THANK YOU FOR YOUR ATTENTION!

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