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The Effect of Ambient Light Conditions on Quantitative Pupillometry Measurements in Healthy Subjects

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Introduction

Automated devices collecting quantitative measurements of pupil size and reactivity are increasingly used for critically ill patients with neurologic disease. However, there is limited data on the effect of ambient light conditions on pupil metrics. To address this issue, we we tested the range of pupil reactivity in healthy volunteers in both light and dark conditions.

Methods

We measured quantitative pupil size and reactivity in seven healthy volunteers with the Neuroptics-200 pupillometer in both bright and dark ambient lighting conditions. Bright conditions were created by overhead LED lighting in a room with ample natural light. Dark conditions consisted of a windowless room with no overhead light source. The primary outcome was the Neurologic Pupil Index (NPi), a composite metric ranging from 0-5 in which >3 is considered normal. Secondary outcomes included resting and constricted pupil size, change in pupil size, constriction velocity, dilation velocity and latency. Results were analyzed with multi-level linear regression to account for both inter and intra-subject variability.

Results

Seven subjects underwent ten pupil-readings in bright and dark conditions, yielding 140 total measurements. Mean resting pupil sizes were 3.56 v. 6.19 mm in bright and dark conditions respectively, (Difference 2.48 mm, CI [2.36-2.60], $p<0.001$). The mean NPi was 4.19 v. 4.33 (Difference 0.14, CI [0.08-0.19], $p<0.001$), and average change in pupil size was 24.6% v. 39.7% (Difference 15.1%, CI [13.8-16.4], $p<0.001$). All additional secondary outcomes except latency were also significantly different between conditions.

Conclusions

We found that ambient light levels impact pupil parameters in healthy subjects. However, changes in NPi are small and more consistent in varying lighting conditions than other metrics. Further testing of patients with poor pupil reactivity is necessary to determine if ambient light conditions could influence clinical assessment in the critically ill. Practitioners should standardize lighting conditions to maximize the reliability of their measurements.