Changes in Pupillary Examination Values as Predictors of Clinical Outcomes in Subarachnoid Hemorrhage

Stefany Ortega-Perez, RN, MSc, PhD(c)
Department of Nursing, Universidad del Norte, Barranquilla, Colombia

Purpose: Bedside nursing assessment of the pupil is a key component of the neurological examination in neurocritical care patients. A change in the pupillary light reflex (PLR) is a sensitive indicator for detecting expanding intracranial lesions. Changes in PLR may be a prognostic marker for patients with intracranial lesions. The purpose of this analysis was to explore how PLR readings, size, constriction velocity (CV), dilation velocity (DV), Neurologic Pupil Index (NPI) and latency predict clinical outcome in patients with subarachnoid hemorrhage (SAH).

Methods: This is a secondary analysis of a prospective multicenter END-PANIC registry. The pupillometer used for this registry was the NPi-200 (Neuroptics, Inc). Data was collected from three neurocritical care units (NCU) in the United States that use pupillometers as standard of care. Patients are included in the registry if they are older than 18 years and were admitted to the NCU with SAH [including aneurysmal subarachnoid hemorrhage (aSAH)]. Descriptive statistics included measures of central tendency (means, standard deviations, medians, and ranges) for continuous variables and frequencies and percent for categorical variables. The within-subject standard deviation ($W_{sd}$) of PLR values, NPI, size, CV, DV, and latency were explored as predictors of discharge modified Rankin Scale (mRS) in subarachnoid hemorrhagic patients. The $W_{sd}$ of PLR readings were derived to provide an estimate of the spread of data for each individual patient. The $W_{sd}$ values were then used as the predictors of the mRS at discharge. Correlation and regression analysis for normally distribution data was performed using SAS v9.4.

Results: Eighty-two patients with a SAH were included in the data analysis, with a total of 4,403 pupillary readings (range of readings 2-384 per patient). There was a mean age of 57.7 years, the admission Glasgow Coma Scale (GCS) median score was 14 (eye=4, verbal= 4, motor= 6), the mRS median was 0 on admission and 4 at discharge, a Wilcoxon test indicates a statistical significance difference among the mRS on admission and at discharge (Sign test= 28; $p<0.0001$). The bivariate analysis showed a moderate negative correlation with the dependent variable, mRS at discharge, and the standard deviation for PLR values in both eyes ($r= -0.3$ to $-0.47; p<0.01$). A regression after controlling for admission GCS indicated that SD for NPI, size, CV and DV for both eyes are predictors of mRS at discharge ($\beta= -1.21$ to $-10.21, p<0.05$), suggesting that higher variation in pupillometer readings is associated with lower scores in mRS at discharge. Latency was a non-significant predictor ($p=0.076, 0.134$).

Conclusion: Findings from this study support the statement that the variation of pupillometer values may predict outcome measures at discharge. This suggest that patients whose visual pathways have more adaptation to change and response to the treatment, showed in this study as a wider $W_{sd}$ PLR values, will be more likely to have better clinical outcomes (low scores in mRS at discharge) as evidenced by the negative correlation between $W_{sd}$ PLR values and mRS at discharge. The association between PLR and mRS may reflect dynamic changes in intracranial pressure unresponsive to therapy. These results have high clinical relevance for nurses and physicians to consider using PLR examination as an assessment of rapid interventions and to understand that changes in pupillary parameters reflect intracerebral dynamics and may predict clinical outcomes.
Changes in Pupillary Examination Values as Predictors of Clinical Outcomes in Subarachnoid Hemorrhage

Keywords:
Neuroscience nursing, Pupillary light reflex and modified Rankin Scale

References:


Abstract Summary:
Neurocritical patients with wider changes in pupillary examination values had better discharge modified Rankin Score, suggesting that patients unable to respond to changes in intracranial dynamics are at higher risk for poor outcomes.

Content Outline:
I. Introduction
A. Nursing pupillary examination in neurocritical care patients.

II. Body

A. Main Point #1: Objective way to perform pupillary examination.

1. Supporting point #1

a) Using the automated pupillometer to obtain more reliable results.

2. Supporting point #2

a) Modern pupil technology

B. Main Point #2: Association between pupillary light reflex (PLR) values and neurological deterioration

1. Supporting point #1

a) PLR values as predictors of poor clinical outcomes.

2. Supporting point #2

a) Variation of pupillometer values are associated with modified Rankin Scale at

C. Main Point #3: This is a secondary analysis of a prospective multicenter END-PANIC registry.

1. Supporting point #1: Data analysis

a) Descriptive statistics included measures of central tendency for continuous variables and frequencies and percent for categorical variables.

b) The within-subject standard deviation of PLR readings were first derived to provide an estimate of the spread of data for each individual patient.

2. Supporting point #2: Results

a) The bivariate analysis showed a moderate negative correlation with the dependent variable, mRS at discharge, and the standard deviation for PLR values in both eyes.

b) A regression indicated that PLR readings for both eyes are predictors of mRS at discharge.

III. Conclusion

A. Findings from this study support the statement that the variation of pupillometer values may predict outcome measures at discharge. This suggest that patients whose visual pathways have more adaptation to change and response to the treatment, will be more likely to have better clinical outcomes.

First Primary Presenting Author

**Primary Presenting Author**

Stefany Ortega-Perez, RN, MSc, PhD(c)
Universidad del Norte
Department of Nursing
Assistant Professor
Barranquilla
Colombia

Author Summary: Nurse specialist in adult intensive care at Universidad del Norte. Master in clinical research at the Universidad of Barcelona. Candidate for a PhD in Nursing from the Universidad Nacional de Colombia.