Normative Data of Pupillary Reading in Neurocritical Care Patients

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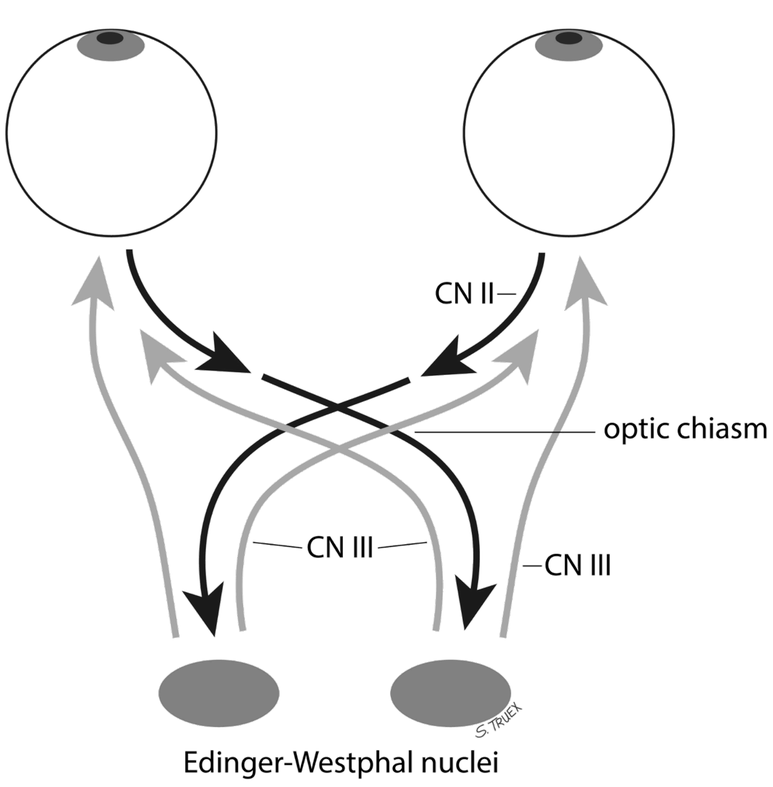
Background

Automated pupillometry provides more precise readings of pupil size and reactivity, these data offer a paradigm shift from the historic method of reporting pupil findings. The intent of this study was to collect a large sample of patient pupil data, using the NeurOptic® Pupillometer, characterize pupil observations and physiological data, and to report the central tendencies of these findings.

Automated pupillometers have gained wide acceptance as a critical care assessment tool to aid practitioners when assessing pupillary function. While pupillometers provide higher precision and reliability than subjective pupil assessments (human observation), there are no data defining what counts as 'normal.' The Neurological Pupil index (NPi®) is a relatively new value describes the size and constriction velocity of pupil reactivity in one value. The normative data (e.g., mean, standard deviation) have not yet been established for the neurocritical care population.



Methods

Prospective, observational study of 987 neurocritical care (NCC) patients. Eligible patients were those admitted to the NCC unit between October 2015 to July 2017 with a medical order for serial neurological exams. Pupil assessments were performed using hand-held pupillometers (NeurOptics®, Inc) by RNs, patient technicians, and members of the research team. Pupillometer readings were downloaded from the Smart Guard® readers directly into MS Excel. Patient demographics and daily hospital record data (vital signs) were abstracted from the electronic medical record into separate MS Excel spreadsheets. All data were uploaded into a single database (SAS Institute) for analysis.

References

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- McNett, M., Moran, C., Janki, C., & Gianakis, A. (2017). Correlations Between Hourly Pupillometer Readings and Intracranial Pressure Values. Journal Neuroscience Nursing, 49(4), 229-234.
- Olson, D. M., Stutzman, S., Saju, C., Wilson, M., Zhao, W., & Aiyagari, V. (2016). Interrater Reliability of Pupillary Assessments. Neurocritical Care, 24(2), 251-257.

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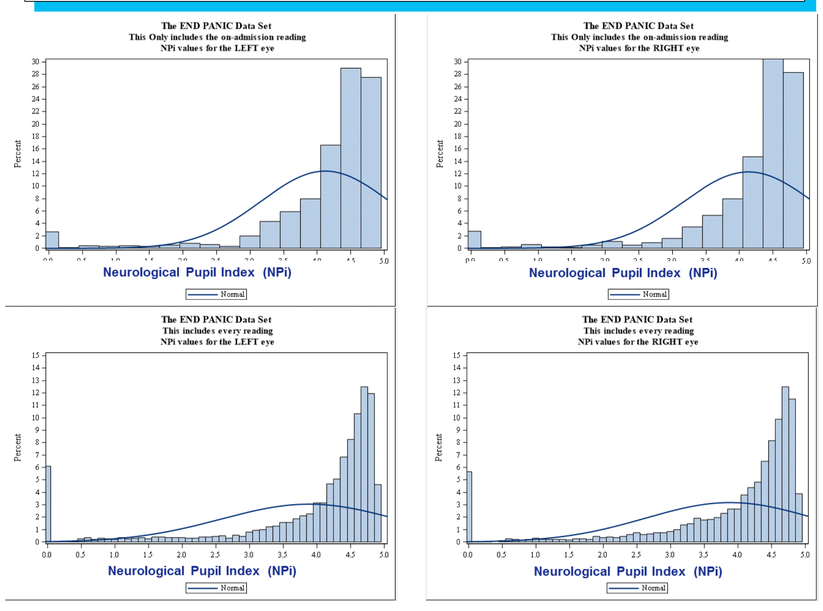
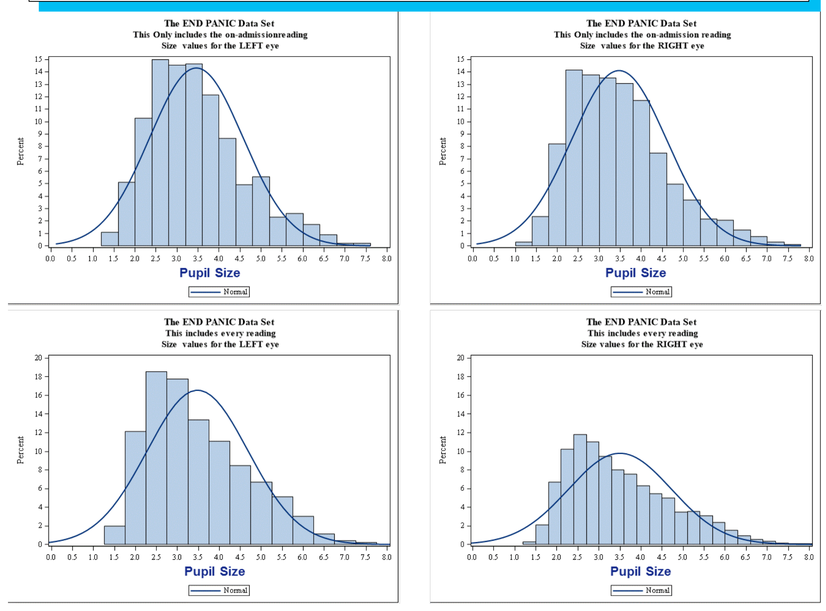
Results

Data were analyzed using SAS v.9.4. In all, 10,318 pupillometer readings [5,127 left eye (OS) and 5,191 right eye (OD)] were obtained from 450 patients. The mean (s.d.) age was 57.79 yrs (17.1); 52.1% were female. The racial distribution was: Caucasian 71.99%, African American 20.33%, Asian 3.23%, and other 4.48%. The group mean pupil reactivity was similar for OS [NPi=3.9(1.3)] and OD [NPi=3.8(1.3)]. Mean (s.d.) pupil size was also similar for OS [size=3.5(1.2) mm] and OD [size=3.5(1.2) mm]. The group mean (s.d.) for constriction velocity was also similar for OS [CV=1.6(0.8)mm/sec] and OD [CV=1.5(0.9)mm/sec]. These data suggest that there are no significant differences between left and right eye for size, NPi, and constriction velocity.

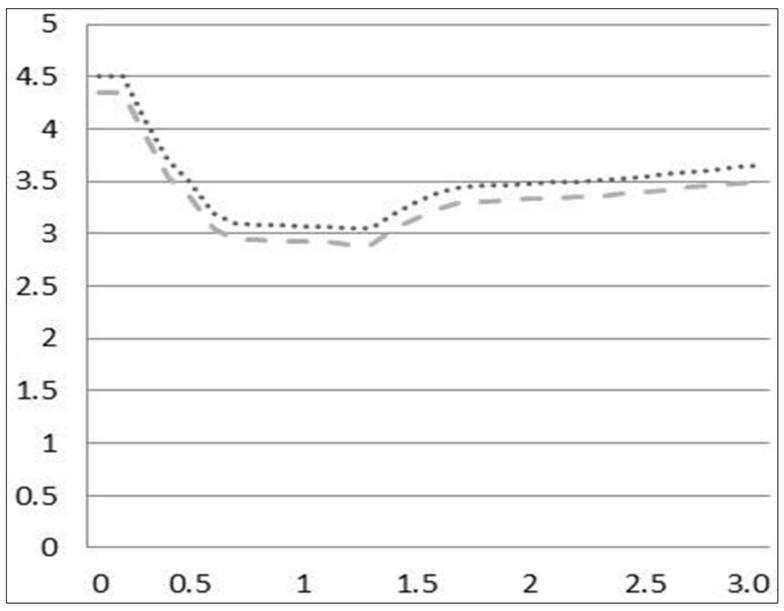
NPi values for left and right eye at baseline and across length of stay



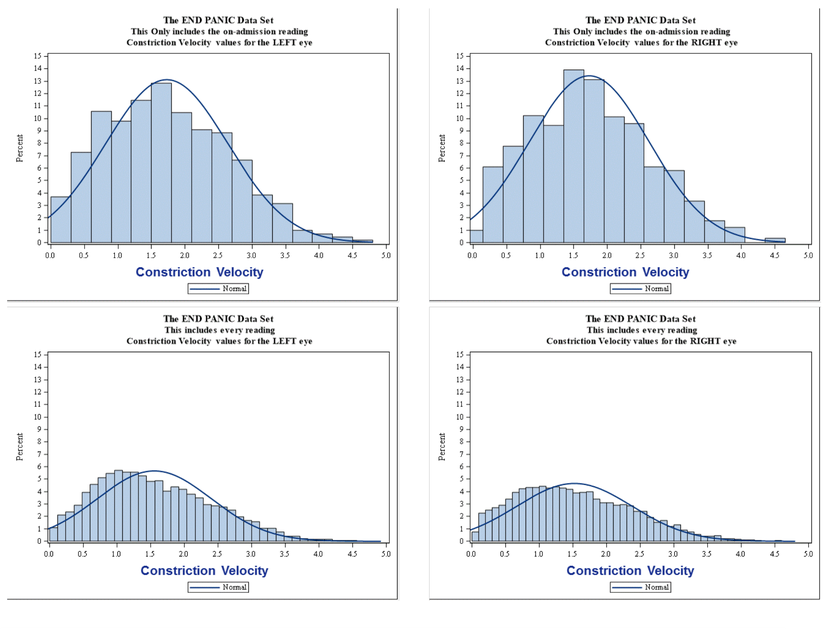
Size values for left and right eye at baseline and across length of stay



Expected Pupillary Light Reflex Curve



Constriction Velocities for left and right eye at baseline and across length of stay



Variables	N	Mean(SD) or %
Age	987	57.79 yrs (17.1)
Sex		
Male	473	47.9 %
Female	514	52.1 %
Race		
Caucasian	690	71.95 %
African American	195	20.33 %
Asian	31	3.23 %
Other	43	4.48 %
Diagnosis		
ICH	89	10.16 %
SAH	72	8.22 %
Ischemic Stroke	177	20.21 %
Tumor	251	28.65 %
Other	398	32.76 %
Eye Color		
Blue	120	27.84 %
Brown	73	16.94 %
Dark Brown	172	39.91 %
Green	48	11.14 %
Gray	6	1.39 %
Other	10	2.32 %
Length of Stay	843	6.5 days (14.4)

Key Points

These data, while observational, provide an insight towards what clinicians may expect to find when conducting pupillary exams with automated pupillometers.

Conclusion

Pupillary assessment is an important aspect of patient care. This study generates interesting data that can assist clinicians in better understanding NPi values. Specifically, knowing the normal values for pupil size and reactivity (NPi) will assist the critical care nurse in determining which assessment findings are not within normal limits and thus require intervention or additional assessment. These data provide a valuable contribution to the literature.

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