Changes In Quantitative Pupillary Reactivity During Diagnosis and Treatment Of Symptomatic Intracranial Hypotension

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INTRODUCTION

• Pupillary light response (PLR) evaluates cranial nerves II, III and midbrain function.
• Quantitative infrared pupillometry objectively measures PLR as NPI (neurological pupillary index).
• Increases in ICP decrease NPI.
• We hypothesized that similar changes in NPI could be seen with intracranial hypotension (IH) because of midbrain distortion, despite low intracranial pressures.
• We determined the sequential changes in NPI in IH before and after treatment.

METHODS

• We identified four patients who were monitored with pupillometry for clinical care at the time of IH diagnosis and treatment.
• Quantitative pupillometry was performed with the NPI-200 Pupillometer (Neuroptics, Irvine, CA)
• IH was diagnosed with a compatible history, exam and characteristic neuroimaging findings. (Fig. 1)
• Patients’ NPI at baseline, during symptomatic IH and after treatment were compared using non-parametric statistical methods including related samples Friedman’s two-way ANOVA by ranks test.

CONCLUSIONS

• Impairment of the pupillary light reactivity as measured by NPI occurs early during IH and precedes clinical and ICP worsening with brisk improvement after treatment.
• PLR impairment is attributable to stretching of the 3rd cranial nerve +/- midbrain distortion.
• Management of intracranial hyper- and hypotension differ markedly. Our results emphasize the importance of evaluating the clinical context before attributing pupillary/NPI changes to increased ICP.
• Automated pupillometry provides a non-invasive, bedside tool for monitoring progression and treatment of intracranial hypotension.

RESULTS

Figure 1: Sagittal MRI of patient #3.
Pre-treatment MRI (left) shows flattening of ventral pons and prominent dural venous sinuses. After repair of skull fracture (right), the pons shape is restored and dural sinuses are less prominent.

Figure 2: Pupillometry and ICP during symptomatic IH and after treatment

Figure 3: Mean NPI at baseline, during symptomatic IH, and after treatment

Mean baseline NPI was normal (defined as >3) and declined in one or both eyes concurrent with clinical deterioration in the 24-48 hours preceding definitive diagnosis. All patients underwent treatment for CSF leak with epidural blood patch or fracture repair, with return of NPI > 3 within 5 hours of treatment. The baseline, symptomatic and post treatment NPI’s differed significantly (3.55±0.35 vs 0.80±0.59 vs 3.65±0.24, mean +/- SD, pre-treatment vs nadir vs post-treatment, p=0.05). Both baseline and post treatment NPI’s differed from the NPI nadir (p=0.068) but there was no significant difference between baseline and post-treatment NPI (p = 0.71).

The authors have no disclosures.