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# Associations between serial pupillometer readings and intracranial pressure crises in neurocritical-care patients.

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**Introduction**: Elevated intracranial pressure(ICP) and cerebral edema are common causes of mortality in neurocritical-care patients. Key monitoring techniques for ICP-elevation include neuroimaging and invasive ICP-measurement. Examination of the pupils is routinely performed to determine disturbances within cerebral physiology but shows high inter-rater variability. Portable infrared pupillometry is increasingly used in clinical routine, yet, it`s benefit remains to be established in patients with elevated ICP. Aim of this study was to identify pupillary parameters associated with ICP-crisis in neurocritical-care patients.

**Methods**: We prospectively enrolled 39 critically-ill patients(subarachnoid hemorrhage/intracerebral hemorrhage/stroke) admitted to our neurointensive care unit(07/2016-11/2017) who required placement of external ventricular drains. We recorded serial pupillometer readings [i.e. maximum/minimum apertures(mm), constriction/dilation velocities(mm/sec.), latency period(sec.)] using a portable pupilometer (NeurOptics®) and corresponding ICP values every 3 hours after admission. Neurological Pupil index (NPi), an algorithm that compares various pupillary parameters to a normative model of pupil reaction to light, grades pupil-function on a scale of 0(nonreactive) to 5(normal). Receiver Operating Characteristic(ROC) Curve Analysis was performed to investigate associations between pupillary readings and ICP-crisis(ICP>20mmHg).

**Results:** In 39 patients (median age:58(51-68) years) 2414 serial pupillary assessments were available for analysis. In 14 of our patients 91 ICP-crises were detected. In these patients, median pupillometer readings differed between recordings during ICP-crises and recordings while ICP was <20mmHg for: NPi [3.8(3.6-4.1)C(Crisis)vs.NPi 4.3(3.9-4.6)];P<0.001, latency [0.25(0.22-0.28)(C)vs.0.24(0.22-0.27)];P<0.023, dilation-velocity[0.16(0.12-0.25)(C)vs.0.31(0.19-0.42];P<0.001, maximal constriction-velocity [0.73(0.51-1.21)(C)vs.1.29(0.92-1.67)];P<0.001, constriction-velocity [0.46(0.29-0.83)(C)vs.0.90(0.61-1.14)];P<0.001 and minimum pupil-size [2.1(2.0-2.4)(C)vs.2.0(1.8-2.3)];P<0.003. ROC analyses revealed a negative association between ICP-crisis and NPi ([AUC]0.285), maximal constriction-velocity ([AUC]0.307), constriction-velocity ([AUC]0.309). NPi<4.13 was associated with a 5.4fold higher rate of ICP-crisis compared to NPi>4.13 [NPi<4.13: 69/922(7.5%)vs. NPi>4.13: 22/1492 (1.5%);OR(95%CI):5.4(3.3-8.8); p<0.001].

**Conclusions**: Our data suggest an association between non-invasively detected changes in NPi, constriction-velocity or maximal constriction-velocity and ICP-crisis. However, clinical benefit of these parameters is subject to future studies.