

Anticipating intracranial hypertension before it can harm: Optic nerve sonography to monitor intracranial pressure after stroke

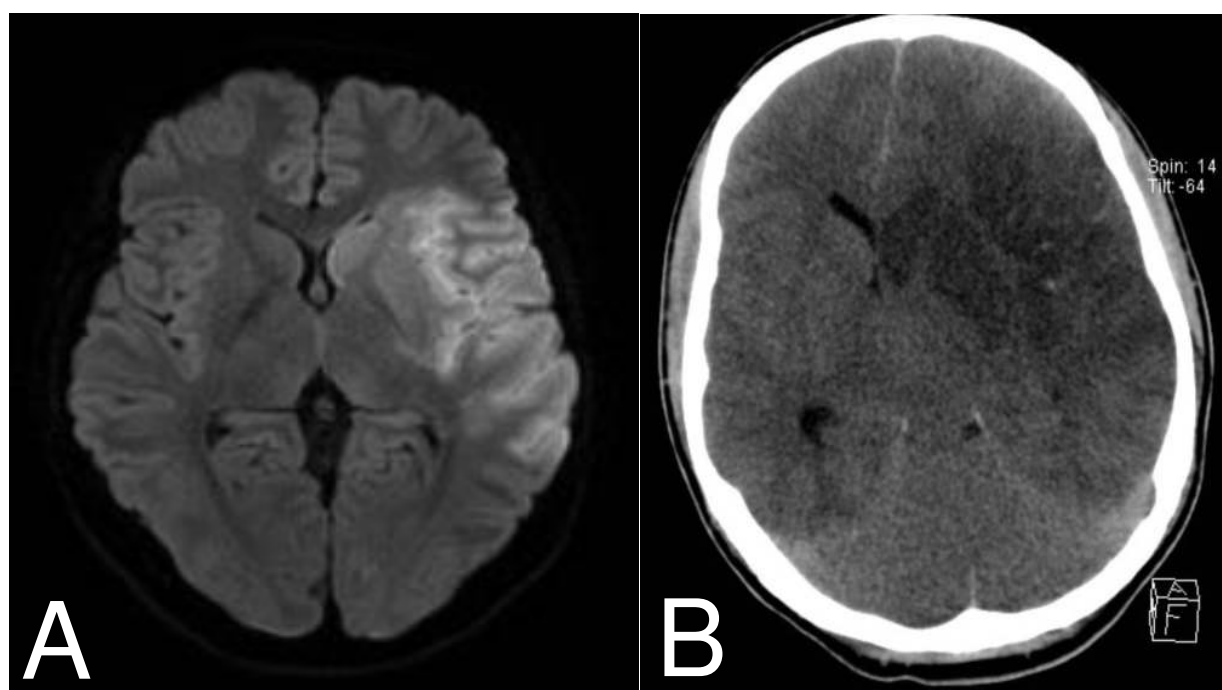
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Background and Aims

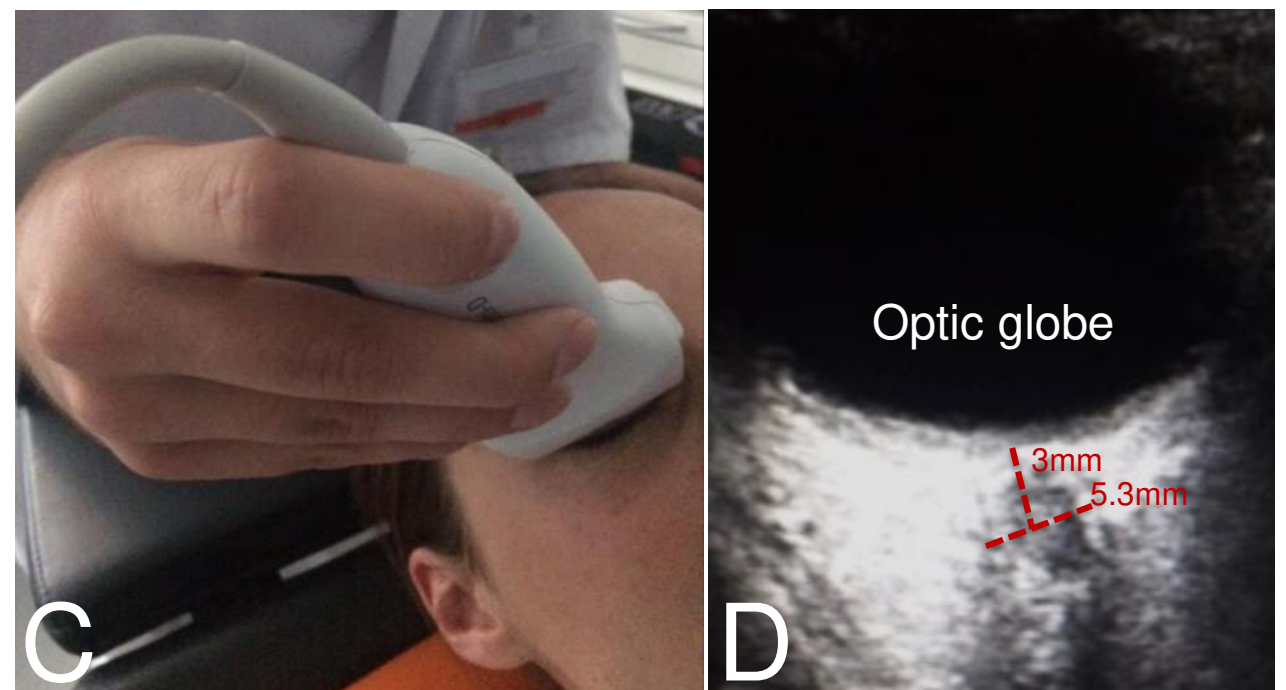
Intracranial Hypertension (IH) is a life-threatening complication in large vessel ischemic stroke (A/B). Mortality in this condition is up to 80% if treated conservatively, thus fast diagnosis of IH and surgical referral for hemicraniectomy is imperative. Since invasive intracranial pressure (ICP) monitoring devices are not always feasible, patients are usually followed based on the clinical symptoms. However, medications or comorbidities of stroke complicate clinical IH assessment. Therefore, readily available, non-invasive methods to early detect IH in stroke patients are needed.

Methods

The goal of this study is to implement optic nerve sonography (ONS) as an easy, non-invasive method to measure ICP and detect IH after stroke. ONS utilizes the fact that the optic nerve sheath, which is readily visualized by transorbital ultrasound, is filled with spinal fluid and grows in diameter according to ICP. To perform ONS, the patient is placed in a position 20° supine to horizontal. The ultrasound probe is then placed on the closed eyelid without pressure to avoid any damage to the eye (C). ONSD is then measured 3 mm behind the globe (D).



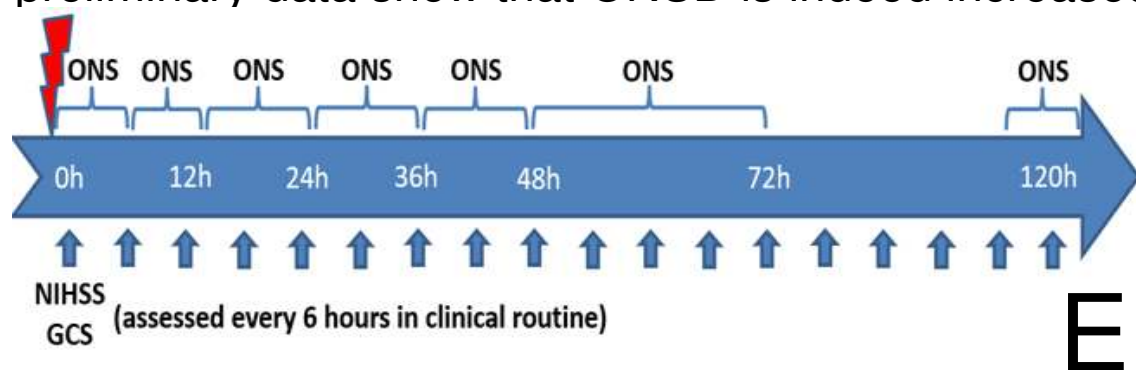
(A) Diffusion weighted MRI (DWI) of a 53y old patient with acute aphasia and right sided hemiparesis 4.5 hours after symptom onset. The left M1 could not be reanalyzed. (B): CT scan 2 days later shows large brain edema, clinically the patient had a new decrease in GCS.



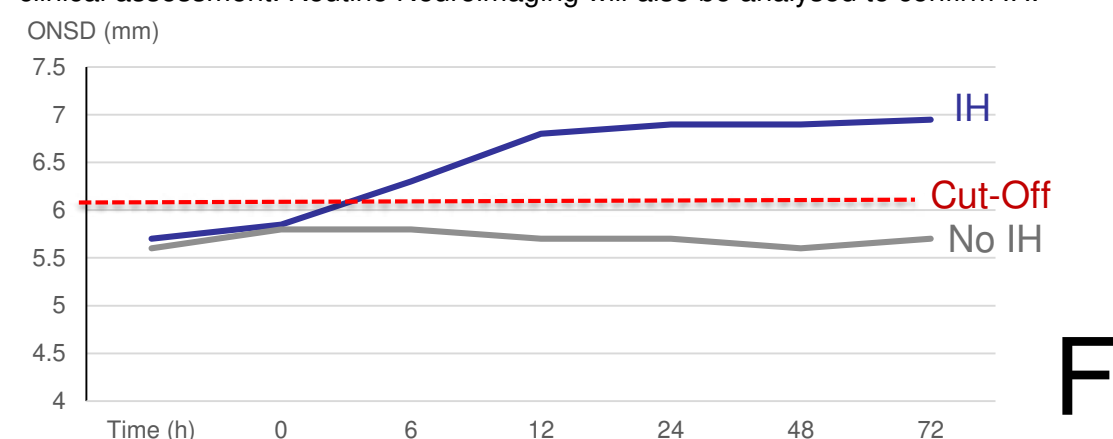
(C) ONS is performed in a patient by placing a 10 MHz linear transducer lightly upon the eyelid. (D): ONSD diameter measurement is performed 3mm behind the optic globe. Three measurements per eye are usually averaged to reduce variability.

Results

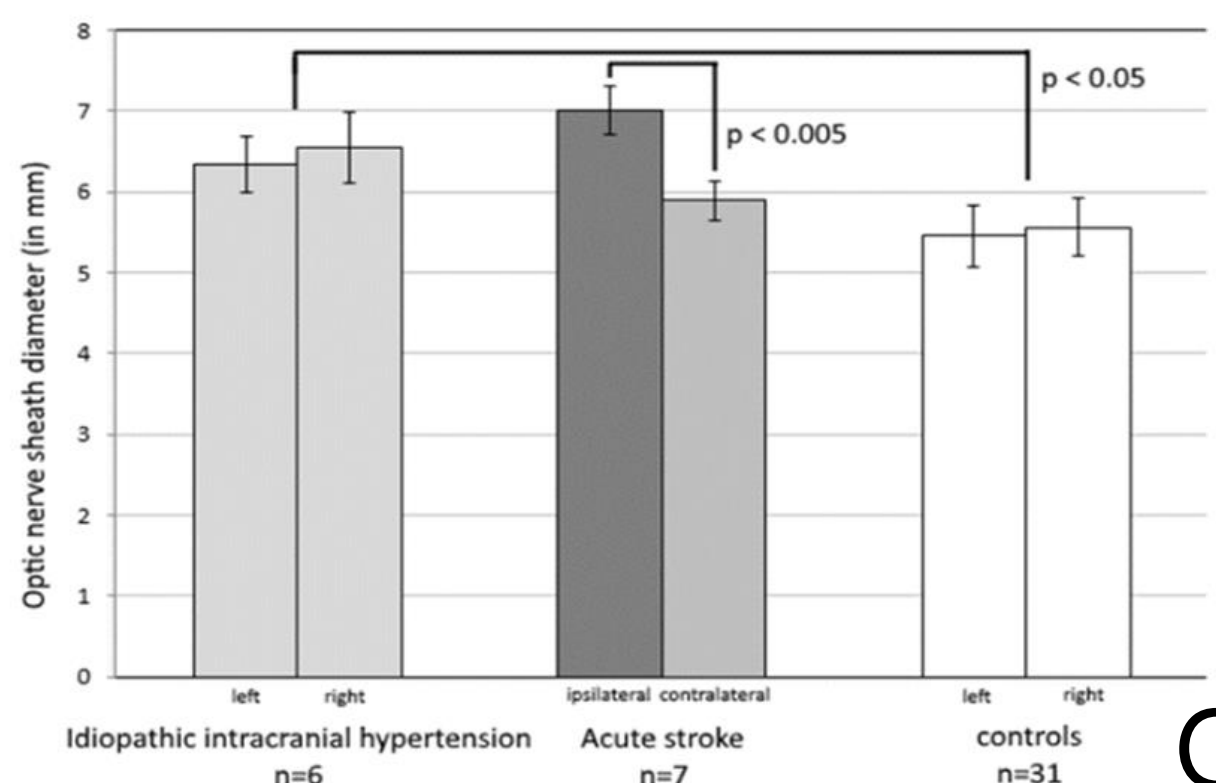
We are planning a single-center, prospective observer study, where ONSD will be repeatedly assessed in patients with occlusion of the internal carotid artery (ICA) and/or the proximal segment (M1) of the middle cerebral artery up to 120 hours after stroke onset (E). GCS and NIHSS are obtained every 6 hours in clinical routine, and will be used along with neuroimaging (CT/MRI) to confirm IH. Cut-off values for ONSD that best predict the presence of IH (F) will then be determined by a receiver operating characteristic (ROC) curve. Sensitivity, specificity and positive predictive value of this threshold to predict IH after stroke will be calculated. The study is supported through the «Young Talents in Clinical Research» beginner grant of the Swiss academy of medical sciences (SAMS) and the Bangerter foundation. Own preliminary data show that ONSD is indeed increased ipsilateral to stroke (G).



(E) Experimental plan. ONSD will be on several time points after stroke with routine clinical assessment. Routine Neuroimaging will also be analysed to confirm IH.



(F) Proposed model of ONSD dynamics in patients with versus without development of IH.



(G) Routine assessment of ONSD in patients with global IH (idiopathic intracranial hypertension), Focal IH (stroke) and without IH (controls). Mean and SD is shown.

Conclusion

If ONSD thresholds can be established to detect IH early after stroke, it could be further tested in a clinical trial to aid in decision making for hemicraniectomy in stroke patients.