Correlation between blood pressure, intraocular pressure and intracranial pressure – a pilot study

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PURPOSE

- To simultaneously measure intraocular pressure (IOP), intracranial pressure (ICP) and blood pressure (BP) variations in glaucoma patients previously provided with an implantable intraocular sensor (EYEMATE-IO™), while inducing controlled orthostatic pressure variations with the use of a tilt table.

METHODS

- A tilt table was used to induce controlled variations in IOP and ICP, in order to simulate normal upright and supine positions. (Fig. 1)

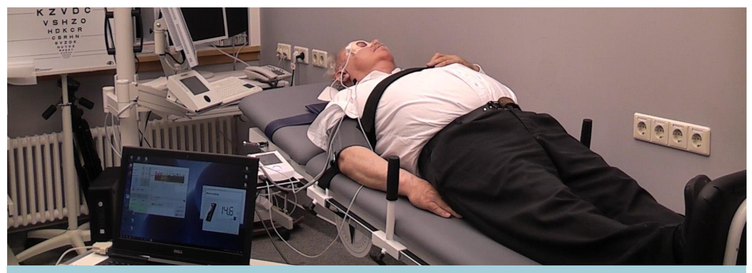

Figure 1: Tilt table setting during a measurement

- IOP was continuously monitored by EYEMATE-IO™ (Implandata Ophthalmic Products GmbH) with the help of an external antenna. (Fig. 2, 3)

Figure 2: Dimensions of the EYEMATE

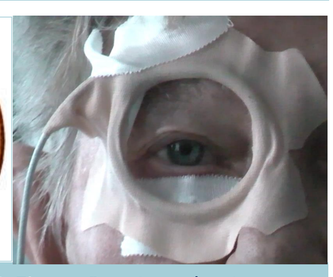

Figure 3: external antenna fixed to a patients eye

- Changes in ICP were monitored by the ELIOS™ (Echodia SAS) utilizing distortion product oto-acoustic emissions (DPOAE). (Fig. 4)

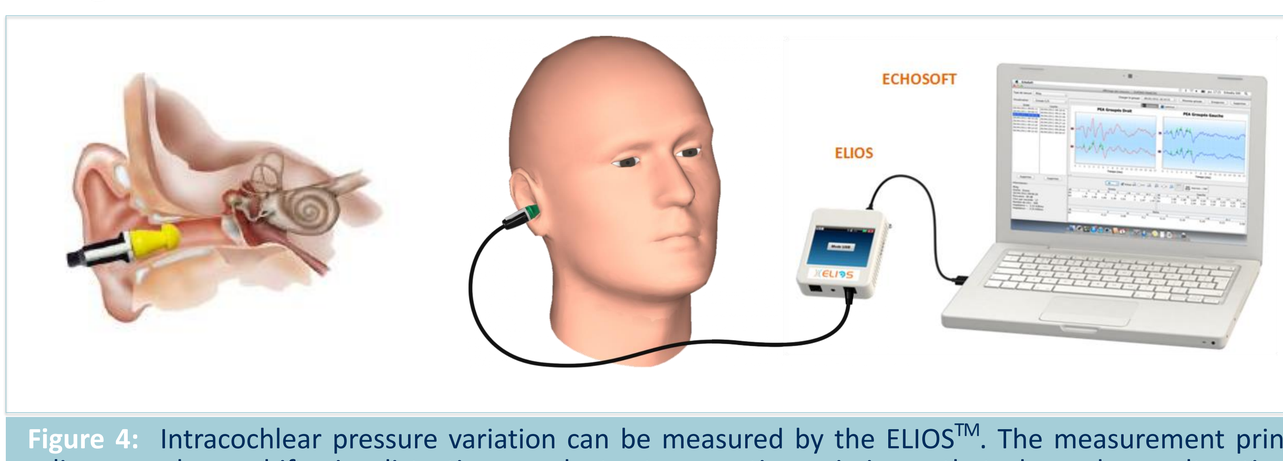

Figure 4: Intracochlear pressure variation can be measured by the ELIOS™. The measurement principle relies on phase shifts in distortion product oto-acoustic emissions, that depend on alterations in intracochlear pressure. Because of a fluid duct between the cochlear endolymph and the cerebro-spinal fluid (CSF), there is a direct correspondence between intracochlear and intracranial pressure variations[2].

- Heart rate (HR) and blood pressure (BP) were measured with a digital arm sphygmomanometer.
- Patients were measured in four different positions (Fig. 5):

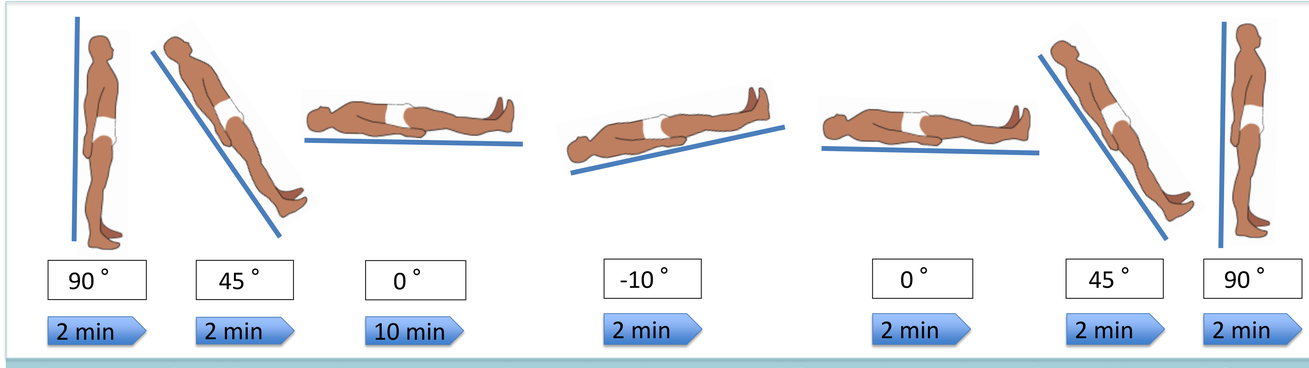

Figure 5: Tilt table experiment setup: the patient is measured for 2 minutes in each position and for 10 minutes during the first supine (0) position.

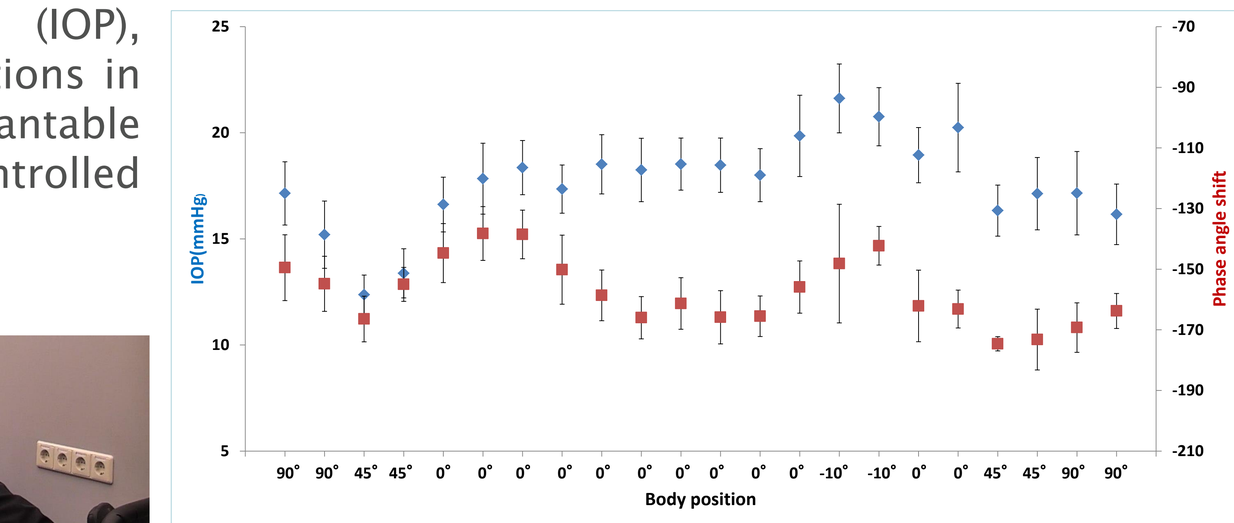

Figure 6: IOP and ICP variations of Patient 01_001 during changing the body positions. There is a notable increase of IOP in the supine (0°) and head down (-10°) positions. ICP initially increases in parallel, but quickly drops during the 10min supine position, while IOP remains stable. ICP increases again with changing to the head down position.

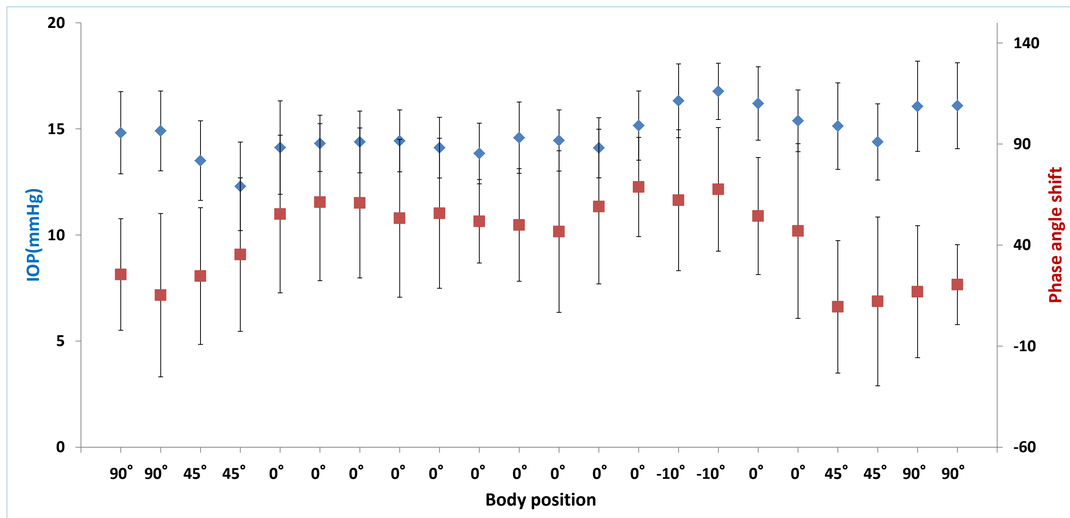

Figure 7: IOP and ICP variations of Patient 01_003 during changing the body positions. In this patient ICP increases with tilt, but does not drop during the extended supine position.

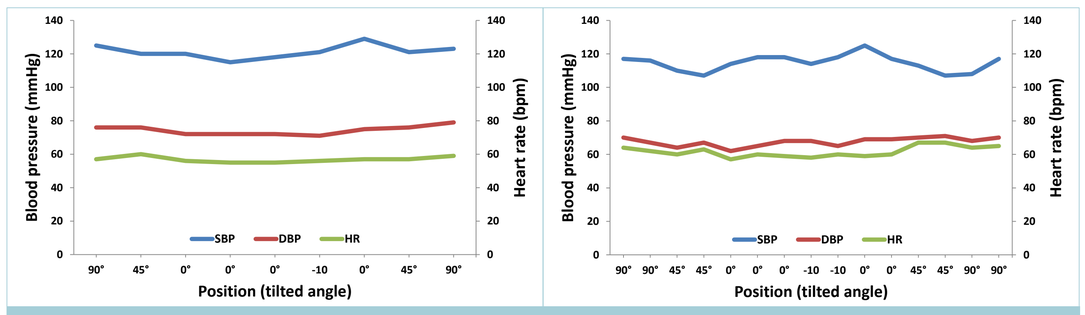

Figure 8: Blood pressure and heart rate of Patients 01_001 and 01_003 during tilt table experiments. Both BP and HR slightly dropped reproducibly, likely due to relaxation of the patient.

CONCLUSIONS

- 9 patients measured so far
- 2 patient ICPs excluded because of presbyacusis
- IOP and ICP depend on body position, both increase with increasing tilt
- BP and HR decrease with increasing tilt, potentially due to patient relaxation
- Extended supine position experiment hints at differences in ICP regulation between subjects, with potential implications for translaminar pressure gradient and thus glaucoma progression rates.

REFERENCES

1.Choritz *et al.;* 2018; submitted to American Journal of Ophthalmology
2.Giraudet *et al.;* 2017; Critical Care; doi: 10.1186/s13054-017-1616-2

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