Korrelation okularer Parameter mit kognitiver Leistungsfähigkeit unter Schlafentzug

Correlation of ocular drowsiness parameters with cognitive performance under chronic sleep restriction and total sleep deprivation

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Objectives: Working shifts or extended hours may impair workplace safety because of sleep loss, increased sleepiness, and decreased performance. Autonomous eyelid and pupil motion reflect central nervous system activity and give insight in the individual drowsiness state. We examined the effects of chronic and total sleep deprivation on ocular drowsiness parameters in order to evaluate their predictive value of cognitive performance deficits.

Methods: After 3 nights with 8 h time in bed (TIB), 36 healthy adults (14F, 27±5 yrs) underwent either a chronic sleep restriction (CSR) routine (n=21; 5 nights: 5h TIB) followed by 1 recovery night (8 h TIB), or a control routine (n=15; 6 nights: 8 h TIB). Then both groups stayed awake for 38 h (TSD). Drowsiness was assessed using eyelid motion (Optalert Drowsiness Measurement System (ODMS)), the Pupillary Unrest Index (PUI; AMTech Pupillography), and the Karolinska Sleepiness Scale (KSS). Psychomotor vigilance lapses (PVT) were measured.

Results: Mixed ANOVA with Tukey adjustment showed that in comparison to baseline KSS (p<0.0002,), PVT (p<0.0148), and ODMS % total eye closure, blink total duration and negative amplitude-velocity ratio (all p<0.0354) were impaired after 5 nights CSR, but not Johns Drowsiness Scale (JDS) or PUI. TSD compared to baseline impaired KSS (p<0.0001), PVT (p<0.0001), and PUI (p<0.0401) in both groups, but ODMS parameters only in the experimental group (all p<0.0001). Only the impairment in ODMS was correlated with the impairment in PVT (range Pearson r -0.44 to -0.57, p 0.0479 to 0.0072) after TSD in the experimental group.

Conclusion: Increased drowsiness was detected by ODMS after CSR, by PUI after TSD, and by both systems after combining CSR with TSD. Only ODMS correlated with the PVT and only after combining CSR and TSD. Although eyelid and pupil motions are both based on central nervous control, they seem to differ in sensitivity possibly reflecting different central activity states.