Sleep and breathing measurement and sleep and neurosciences

O035

AUTOMATED VS. EXPERT MANUAL ANALYSIS OF THE MULTIPLE SLEEP LATENCY TEST

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Purpose: To compare Compumedics Profusion PSG™ automated sleep analysis of Multiple Sleep Latency Tests (MSLTs) with expert consensus manual analysis.
Methods: Consecutive PSG with MSLTs were analysed using automated software (Compumedics Ltd (Abbottsford, Victoria, Australia) Profusion PSG™ V4.5 Build 531) ('Auto') and by two of nine experienced scientists. Discrepancies between scientists were discussed to establish expert consensus ('Final').
Results: Fifty consecutive patients referred for investigation of Narcolepsy were included. Two were excluded due to poor signal quality (1) and early test termination (1). The remaining 48 (37 M, 10 F, 1) had a median (range) age of 37 (17–63) years, BMI 28.0 (19.9–66.1) kg/m2, and mean sleep latency (MSL) 14.0 (1.5–20.0) minutes. Of five MSLTs with MSL <=8 min, Auto-MSL was also <=8 min. Of 43 MSLTs with MSL >=8 min, Auto-MSL was <=8 min in 12. MSL sensitivity was 100% and specificity 72%. For the one MSLT with >=2 SOREMs, Auto identified 1 SOREM. Nap-wise, Auto-SOREM sensitivity was 17% and specificity 98%; one of six REM-positive naps was detected by auto-analysis and there were seven false positive and five false negative SOREM results.
Conclusions: (1) Automated analysis poorly detected short MSL and SOREM occurrence but was able to rule out all true-negative MSLT results, in this MSLT dataset. (2) This comparison methodology and dataset facilitates robust prospective testing of other current and future algorithms.

O036

RESPIRATORY EVENT RELATED OXYGEN DESATURATION IS PREDICTIVE OF CARDIOVASCULAR MORTALITY IN SLEEP APNOEA PATIENTS

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Introduction: Cardiovascular disease (CVD) is the leading cause of death globally. The mechanisms underpinning the development of CVD in OSA are multifaceted and include sympathetic overactivity, endothelial dysfunction, inflammation, and oxidative stress. Nocturnal hypoxaemic burden—the cumulative exposure to hypoxaemia experienced overnight—may contribute to the pathophysiology of CVD. We investigated if polysomnogram SpO2 parameters can predict CVD outcomes in OSA patients.
Methods: Data from the SpO2 signals from 4689 polysomnograms (PSGs) of the Sleep Heart Health Study with CVD mortality outcome and complete covariate information was used. Analysis of the average SpO2 responses to respiratory events revealed a transient response from the event start that extended for four event lengths. Based on the response we developed a respiratory event related oxygen desaturation (REROD) parameter for quantifying the desaturation associated with respiratory events that is readily calculated. The performance of the parameter in predicting CVD death was assessed using an adjusted Cox proportional hazard ratio (HR) analysis and compared to other methods including hypoxic burden, T90 and ODI3.
Results: The COX analysis was adjusted for known covariates of CVD. The HR results indicate a dose-response relationship with the highest quintile providing a HR=2.0(95% C.I. 1.3–3.2).
Discussion: Our REROD metric predicts CVD mortality independent of confounding covariates and provides prediction performance superior to other hypoxemia metrics. A big advantage of our metric is its computational simplicity and reproducibility. We believe the metric is an important enabling step towards clinical methods that provide CVD risk stratification from the PSG.

O037

GENIOGLOSSUS MOTOR CONTROL FOLLOWING THE RETURN TO SLEEP AFTER BRIEF AROUSAL

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Rationale: Arousal from sleep has been shown to elicit a prolonged increase in genioglossus muscle activity that persists following the return to sleep and may protect against airway collapse. We hypothesised that this increased genioglossal activity following return to sleep after an arousal is due to persistent firing of inspiratory single motor units (SMUs) recruited during the arousal.
Methods: 34 healthy participants were studied overnight while wearing a nasal mask/pneumotachograph to measure ventilation and with 4 intramuscular genioglossus SMU electrodes. During stable N2 and N3 sleep, auditory tones were played to induce brief (3-15s) AASM arousals. Ventilation and genioglossus SMUs were quantified for 5 breaths before the tone, during the arousal and for 10 breaths after the return to sleep.
Results: A total of 1089 tones were played and gave rise to 236 SMUs recorded across arousal and the return to sleep in 20 participants (age 23±4.2 years and BMI 22.5±2.2kg/m2). Ventilation was elevated above baseline during arousal and the first post-arousal breath ($p<0.001$). The peak firing frequency of expiratory and tonic SMUs was unchanged during arousal and return to sleep, whereas inspiratory modulated SMUs were increased during the arousal and for 4 breaths following the return to sleep ($p<0.001$).
Conclusions: The prolonged increase in genioglossus activity that occurs on return to sleep after arousal is a result of persistent activity of inspiratory SMUs. Strategies to elevate inspiratory genioglossus SMU activity may be beneficial in preventing/treating obstructive sleep apnea.

O038

LOWER MEAN OXYGEN SATURATION IN SLEEP IS ASSOCIATED WITH WORSE COGNITIVE PERFORMANCE IN SUBJECTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Obstructive sleep apnoea (OSA) is a risk factor for cognitive impairment and has been associated with deficits in executive function, attention, and memory. Potential mechanisms of harm include sleep disruption and intermittent hypoxaemia. Our aim was

to investigate whether the apnoea-hypopnoea index (AHI), arousal index (AI) and mean oxyhemoglobin saturation in sleep (mean SpO_2) - conventional polysomnography (PSG) measures of respiratory disturbance, sleep fragmentation and nocturnal hypoxaemia respectively - were associated with worse cognitive performance in OSA subjects.
Methods: In this cross-sectional analysis, 75 subjects with PSG-confirmed OSA (age: 66.1yrs ± 7.1yrs, male: 51%) were recruited from a hospital sleep clinic and had their cognitive profile screened via the Addenbrooke's Cognitive Examination – Revised (ACE-R). Linear regression was used to determine whether AHI, AI and mean SpO_2 were associated with total ACE-R scores. Binary logistic regressions were then performed to determine whether increased severity of OSA (AHI ≥ 30 events/hour), sleep fragmentation (AI ≥ 30 events/hour), and hypoxaemia (mean SpO_2 ≤ 92%) increased the likelihood that participants would have worse cognition (ACE-R score ≤ 88).
Results: There was a modest positive association with mean SpO_2 and ACE-R score (r^2 = 10.4%, $p < 0.01$). Similarly, logistic regression found only increased hypoxaemia (mean SpO_2 ≤ 92%) to be associated with increased odds of worsened cognition (OR 3.00, 95% CI (1.090–8.254), $p < 0.05$).
Discussion: OSA-induced hypoxaemia, and not sleep fragmentation or respiratory disturbance, was found to be most strongly associated with deficits in cognitive performance.

O039

DIFFERENTIAL EFFECTS OF SLEEP DEPRIVATION AND SLEEP RESTRICTION ON ERROR AWARENESS

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Introduction: The ability to detect and subsequently correct errors is important in preventing the detrimental consequences of sleep loss. We report the first study to compare the effects of total sleep deprivation (TSD) and sleep restriction (SR) on error awareness.
Methods: Thirteen healthy adults (11F, age=26.8±3.4y) underwent a 34h TSD protocol, completing the Error Awareness Task (EAT: a combined Stroop/1-back/GoNogo task) at 4h and 27h post-wake. Twenty healthy adults (11F, age=27.4±5.3y) were studied both well-rested (WR: 9h sleep) and following SR (3 nights of 3h sleep), completing the EAT once/day (8-9h post-habitual wake). The EAT required participants to withhold responding to "nogo" stimuli and signal, via a button press, whenever they realised they made an error on these nogo trials.
Results: TSD did not significantly affect error rate (p=.712) or error awareness rate (p=.517), however, participants were slower to recognise errors after TSD (p=.004). In contrast, SR increased error rate (p<.001), decreased error awareness (p<.001), and slowed recognition of errors (p<.01).
Discussion: Three nights SR impaired the ability to recognise errors in real-time, despite a greater number of errors being made. Thus, impaired error awareness may be one mechanism underlying increased sleep loss-related accidents and errors in occupational settings, as well as at home. Interestingly, 1-night TSD did not lead to more, or impaired recognition of errors. TSD participants were slower to recognise errors, which may be problematic in safety critical settings. Technological and/or operational solutions may be needed to reduce the risk of errors going unrecognised.

O040

SLEEP RESTRICTION IMPAIRS THE ABILITY TO INTEGRATE MULTIPLE PIECES OF INFORMATION INTO A DECISION

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Introduction: Sleep deprivation impacts overall decision-making, though the impact on specific components of decision-making are less well studied, especially outside of total sleep deprivation. Here, we examine the effects of sleep restriction on the ability to integrate multiple pieces of information into a decision.
Methods: Healthy adults (n=41; age=27.9±6.0 years, 20F) lived in the sleep lab for 2 counterbalanced conditions: well-rested (WR: 9-hour sleep opportunity for 4 nights) and sleep restriction (SR: one 9-hour night, followed by three 3-hour nights). Following the last night of each condition, participants performed the decision task. Across 48 trials, participants first saw two containers, with different numbers of black and white balls. Eight balls were randomly drawn, with replacement, from one unknown container. Participants decided which container was used, based on the "odds" each container was used and draw results ("evidence"). Mathematical modelling determined the amount of weight given to odds/evidence. The "best" decisions integrate both pieces of information.
Results: When WR, participants utilised both pieces of information to make their decisions, though odds were given slightly more weight. During SR, the amount of weight given to the odds did not change, and the weight given to the evidence decreased significantly.
Conclusion: SR impaired the ability to integrate multiple pieces of information into a decision. Instead, participants focused on a single piece of easy-to-understand information and did not fully utilise a harder-to-understand piece of information. This has implications for complex applied environments where individuals have large amounts of information with which to make decisions.

O041

THE IMPACT OF INCLUDING OXYGEN DESATURATIONS OCCURRING DURING AWAKE EPOCHS ON THE OXYGEN DESATURATION INDEX

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Introduction: The oxygen desaturation index (ODI) is an important measure of sleep disordered breathing during polysomnography (PSG) however there is no accepted standard for its calculation. The AASM Manual for the Scoring of Sleep and Associated events (V2.6) does not specify whether oxygen desaturations occurring during awake epochs should be included. More generally, epoch-based scoring is potentially problematic for accurate ODI calculation. This study aims to compare the calculation of ODI including and excluding oxygen desaturations occurring during awake epochs and to determine the impact of sleep efficiency (SE) on any discrepancy.
Methods: Using twenty-one consecutive unattended PSG's for investigation of OSA, two oxygen desaturation indices were calculated from each PSG; one excluding (ODIsleep) and one including (ODIall) oxygen desaturations marked in awake epochs.