Sleep Breathing Disorders – 3

P242

5 years clinical experience with esophagopharyngeal pressure measurement

R. DE LA CHAUX, A. DREHER, C. KLEMENS, M. PATSCHEIDER, O. REICHEL, G. RASP and A. BERGHAUS
ENT Department, Ludwig-Maximilians-University, München, Germany

Introduction: Esophagopharyngeal pressure measurements are helpful in the differentiation of obstructive respiratory events by measuring the esophageal pressure during polysomnography. In addition the localization of snoring and obstructive respiratory events is possible with multichannel pharyngeal pressure measurement. Advantages and limitations of this method will be explained by an experience period of 5 years.

Methods: Between 2000 and 2005 esophagopharyngeal pressure measurements were done during nocturnal polysomnography in 90 patients with suspected obstructive sleep apnea syndrome. Only six patients (7%) did not tolerate the pressure probe. A specially developed, computer-based software allowed us to analyse the data manually and automatically for each separate channel.

Results: Without disruption of the physiological sleep architecture an increase of the esophageal pressure was found with increasing depth of sleep. Esophageal pressure correlated well with the respiratory disturbance index but prediction of the sufficient CPAP-pressure was not possible. 82 patients (91%) showed a high frequent snoring signal with localization in the velar region (73%), multilevel snoring was shown in 58 patients (64%). Success-rate of laser-assisted uvulopalatoplasty (LAUP) increased by preoperative measurement of esophagopharyngeal pressure. But analysis of the region of obstruction is difficult, however a velar region of obstruction was found in 65 patients (72%). In these patients the operative success-rate of tonsillectomy with uvulopalatopharyngoplasty (UPPP) could not be increased by additional preoperative esophagopharyngeal pressure measurement.

Conclusions: The most important value of esophagopharyngeal pressure measurement consists in the preoperative diagnosis of snoring patients. The method is limited by high financial and personal requirements.

P243

Apnea duration index (ADI) and apnea/hypopnea duration index (AHDI) as measurements of obstructive sleep apnea severity

A. OKSENBERG, E. ARONS and T. SHOCHAT
Sleep Disorders Unit, Loewenstein Hospital - Rehabilitation Center, Raanana, Israel

Objective: The total duration of apneas/hypopneas during sleep may represent an additional measurement of Obstructive Sleep Apnea (OSA) severity. The aim of this study was to assess the contribution of Apnea Duration (AD), Apnea/Hypopnea Duration (AHD), and Apnea Duration Index (ADI) (apnea duration/sleep hour), and Apnea/Hypopnea Duration Index (AHDI) (apnea + hypopnea duration/sleep hour), in comparison to Apnea Index (AI) and Apnea Hypopnea Index (AHI), as measurements of OSA severity.

Methods: The new parameters, AD, AHD, ADI and AHDI were assessed in 594 (469 (78.9%) males) consecutive OSA adult patients (Age = 53.2 ± 12.3, BMI = 30.9 ± 5.2, AHI = 38.2 ± 25.9) who underwent a polysomnographic evaluation at our Sleep Disorders Unit.

Results: The mean (± SD) for AD and AHD, for the entire group were 43.8 ± 59.8 and 95.5 ± 67.6 min. The mean (± SD) for ADI and AHDI for the entire group were 7.9 ± 10.4 and 16.9 ± 11.7 min/sleep hour, respectively. The mean (± SD) for AD and AHD for Mild were: 6.5 ± 7 and 35.8 ± 11.1; for Moderate: 21.3 ± 17.7 and 72.6 ± 24.8 and for Severe OSA: 96.3 ± 72.4 and 166.4 ± 60.3 minutes respectively. The mean (± SD) for ADI and AHDI for Mild were: 1.1 ± 1.2 and 6.2 ± 1.8; for Moderate: 3.7 ± 2.9 and 12.6 ± 3.9 and for Severe OSA: 17.2 ± 12.1and 29.7 ± 9.3 (min/sleep hour) respectively. The total AD and AHD as percentages of TST for Mild were: 1.8% and 10.3%; for Moderate: 6.2% and 21.2% and for Severe OSA: 28.4.1% and 49.1% respectively. The following correlations were all found significant ($P < 0.001$): Correlations between AI and ADI ($r = 0.96$) and AHI and AHDI ($r = 0.91$). Correlations between AI and ADI for mild, moderate and severe OSA were: $r = 0.94$, $r = 0.95$ and $r = 0.91$, respectively. Correlations between AHI and AHDI for mild, moderate and severe OSA were: $r = 0.59$, $r = 0.73$ and $r = 0.68$, respectively. Correlations between the Epworth Sleepiness Scale (ESS) and AHDI and AHI were also significant (both $r = 0.23$).

Conclusions: The ADI and AHDI measures show high agreement with AI and AHI at all OSA severity levels and thus appear to be reliable measurements of OSA severity.

P244

Agreement of apnea-hypopnea indexes based on visual and automatic detection

M. WOERTZ[1], P. ANDERER[3], G. GRUBER[2], S. PARAPATICS[1], R. ROSIPAL[1], B. SALETU[3] and G. DORFFNER[1]
[1]*Austrian Research Institute for Artificial Intelligence, Wien, Austria,* [2]*The Siesta Group Schlafanalyse GmbH, Wien, Austria and* [3]*Department of Psychiatry, Medical University of Vienna, Wien, Austria*

The study investigates the validity of a recently developed automatic detection system for breathing disturbances in sleep. The quality of the automatic detection software, which is part of the Somnolyzer24x7 framework, was determined by using correlation and the Bland-Altman analysis (Lancet, 1986). Results are based on data recorded in the SIESTA project. The detection algorithm for respiratory events uses 4 polysomnographic (PSG) signals: oxygen saturation, nasal airflow, movement of the chest wall and of the abdomen. Intervals of decreased airflow are calculated based on the determination of single inspiration and expiration maxima. For both effort signals, intervals with possible events are extracted similarly. An expert system is finally used for the detection of apnea and hypopnea events. For the present comparison, PSGs of 51 apnea patients (44 males and 7 females, aged 51 ± 10 years) were investigated. The visual apnea/hypopnea scoring was done by human experts from different European sleep labs. The human scored AHI was 45 ± 31 for the adaptation night and 41 ± 26 for the second night. The automatic detection resulted in an AHI of 42 ± 26 and 41 ± 22. The correlation between human and automatic indices were $r = 0.94$ and $r = 0.92$ for the first and second night, respectively. Bland-Altman analysis showed neglectable bias (2.7 and 0.5 for first and second nights, respectively) and the plots used to visualize individual differences suggested equivalence of human scoring and the automatic detection. The high correlation coefficients as well as the inspection of the Bland-Altman plots in 102 PSGs of patients with apneas proved the validity of the Somnolyzer 24x7 detection and thus justifies the usage of the automatic method in clinical studies.

Acknowledgments: This research was supported by Austrian Industrial Research Promotion Fund (Project 806765). The Austrian Research Institute for AI is supported by the Austrian Federal Ministry of Education and the Federal Ministry of Transport, Innovation and Technology.

P245

Transcutaneous CO_2 tension and sleep-disordered breathing

E. RAUHALA[1], S. HIMANEN[2], A. SAASTAMOINEN[2] and O. POLO[3]

[1]Department of clinical neurophysiology, Satakunta Central Hospital, Pori, Finland, [2]Department of clinical neurophysiology, Medical Imaging Centre, Tampere, Finland and [3]Department of pulmology, Tampere University Hospital, Tampere, Finland

Introduction: Transcutaneous carbon dioxide tension ($TcCO_2$) measurements are widely used in operation rooms and intensive care units to estimate arterial partial pressure of carbon dioxide ($PaCO_2$). It can be used reliably and safely for as long as 8 h. Thus it would also allow more accurate understanding of the breathing patterns and disturbances during polysomnography. Emfit (ElectroMechanical Film) is elastic, permanently charged electret film that converts mechanical stress into proportionate electrical energy. It is placed under the patient's back under the sheet to detect respiratory movements. The spiking phenomenon in Emfit signal correlates with partial airway obstruction. We measured changes in $TcCO_2$ in different breathing patterns: normal breathing, hypopneas, apneas and during prolonged spiking in Emfit signal.

Methods: Twenty-two patients with sleep-disordered breathing and at least one episode of prolonged spiking lasting over 3 min in Emfit were included in the study. The slopes for trend lines of $TcCO_2$ and oxygen saturation (SpO_2) during altogether 132 episodes of different breathing patterns were defined.

Results: The median slope of $TcCO_2$ was 0.4 (-1.5–6.7) for normal breathing, -0.02 (-9.3–7.8) for hypopnea, 0.3 (-5.6–6.7) for apnea and 1.65 (-2.8–14.9) for prolonged spiking episodes. The slopes during spiking episodes were significantly higher ($P < 0.05$ or 0.01) than during other breathing patterns. There were no significant differences in slopes of SpO_2 in different breathing patterns.

Conclusions: Transcutaneous carbon dioxide tension measurements can offer important additional information about consequences in sleep-disordered breathing. The results suggest that spiking phenomenon in Emfit signal represents partial airway obstruction with gradual elevation of $TcCO_2$ thus diverging from periodic breathing patterns.

P246

Evaluation of a portable recording device with actimeter and pharyngo-oesophageal catheter incorporated

B. Øverland[1], H. Akre[1] and O. Skatvedt[2]

[1]ENT, Lovisenberg Diakonale sykehus, Oslo, Norway and [2]Oslo, Norway

Background: Portable recording devices without electroencephalogram recordings are frequently used for diagnosis of obstructive sleep apnea (OSA). However, an exact measure of sleep is important, since the diagnosis is based on the average number of events per hour of sleep, the respiratory disturbance index (RDI). Actigraphy is a simplified method for distinguishing sleep and wakefulness by measurements of activity. The pharyngo-oesophageal catheter measures pressure in the oesophagus and the upper airways in addition to advanced flow measurements.

Methods: In this study, recording with a portable recording device (Reggie, Camtech, Norway) including an incorporated actimeter and a pharyngo-oesophageal catheter were done simultaneously with polysomnography in patients examined for OSA. The study was performed at the sleep-disordered unit at the Ullevaal University Hospital, Oslo, Norway.

Results: Fifty-two consecutive patients referred to the hospital for diagnosis of OSA were included. There was good agreement between the RDI obtained from the polsyomnography and the RDI obtained from the portable system. The estimated mean difference was 3.5, with a SD of 5.3 ($r = 0.98$). The sleep time calculated with the portable system was longer than the sleep time obtained by polysomnography, the mean difference was 46 min, SD 56 min ($r = 0.45$).

Conclusions: Sleep time calculations with the portable system overestimate the sleep time. Still, the RDIs obtained by the two systems show good agreement. There was a slight tendency for the portable system to provide a RDI which was too low. The difference was small, and in most cases, it will be of no clinical significance. The portable system does highly advanced respiratory measurements and is especially valuable for milder forms of OSA.

P247

Frequency analysis of snoring sounds: a novel diagnostic tool in patients with sleep disordered breathing

M. HERZOG[1], T. BREMERT[1], A. SCHMIDT[2], B. VENOHR[3], W. HOSEMANN[1] and H. KAFTAN[1]

[1]Otorhinolaryngology, University of Greifswald, Greifswald, Germany, [2]Otorhinolaryngology, University of Würzburg, Würzburg, Germany and [3]Community Medicine, University of Greifswald, Greifswald, Germany

Background: Snoring occurs in patients with sleep disordered breathing. The severity of snoring can range from primary snoring, snoring with upper airway resistance syndrome (UARS) to snoring in patients with obstructive sleep apnea syndrome (OSAS). Up to now snoring sounds are sometimes neglected in the diagnostic procedure. Aim of the study is to introduce the frequency analysis of snoring sounds as a useful method of investigation in patients with sleep disordered breathing.

Method: Sixty-one patients with suspected sleep disordered breathing underwent night time polysomnography including a digital recording of snoring sounds. Snoring sounds were analysed by Fourier transformation and the obtained data were correlated with the polysomnographic findings.

Results: High frequency snoring sounds (2500–4000 Hz) correlate significantly with an increase of the respiratory disturbance index (RDI) and decreased mean and minimal nocturnal blood oxygen saturation, whereas patients with low frequency sounds (80–200 Hz) did not reveal increased respiratory events. Primary snorers showed a low frequency peak maximum contrary to patients with OSAS who presented a high frequency peak maximum. Considering the harmonics of snoring sound in combination with other polysomnigraphic results like paradox breathing, cardiac frequency and arousals patients with UARS can be distinguished from OSAS and primary snoring.

Conclusion: Different types of snoring sounds like primary snoring, OSAS and UARS snoring can be distinguished by analysis of snoring. Frequency analysis of snoring sounds turns out to be an useful diagnostic tool in patients with sleep disordered breathing.