257. Physiology and diagnostic technology in obstructive sleep apnoea

P2203

Sleep disordered breathing detected by a new automated ECG analysis in subjects with insomnia

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Patients with severe complaints of insomnia are sometimes investigated in a sleep laboratory in order to test for other causes of their complaints such as sleep disordered breathing or other sleep disorders.

We investigated 64 patients with primary insomnia with cardiorespiratory polysomnography. Sleep stages, arousal and respiratory events were scored according to AASM criteria. ECG was analyzed by a special software (Hypnocore) which can provide a sleep evaluation and a respiratory event score by a new automated analysis. All patients were analyzed in two steps. The second analysis was performed on 54 patients after removing those with bad signal quality, arrhythmias and a total sleep time below 3 hours.

The analysis of respiratory events based on ECG in the group of 64 subjects resulted in 52 subjects (48 true negative, 4 false negative) with an RDI0<5/h. 12 subjects (10 true positive, 2 false positive) were scored with an RDI>5/h. Agreement was 0.91. For the second analysis agreement remained the same. Sleep stages in the second analysis were scored surprisingly good: 48.9% (ECG) vs. 48.7% (PSG) for light sleep, 15.7% (ECG) vs. 15.8% (PSG) for slow wave sleep, 14.0% (ECG) vs. 23.4% (PSG) for wake, and 19.9% (ECG) vs. 12.2% (PSG) for REM sleep.

Not many respiratory events occur in insomnia patients. These events are detected with a sufficient accuracy using the new ECG based algorithms. Sleep stage analysis based on ECG did show a good ability to distinguish light sleep, slow wave sleep, and wake/REM sleep. To distinguish wake and REM sleep by ECG alone has a lower accuracy due to high sympathetic activity in both states.

P2204

Respiratory polygraphy versus polysomnography for the diagnosis of obstructive sleep apnoeas in children

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Full attended polysomnography (PSG) is the gold standard for diagnosis of obstructive sleep apnoeas (OSA). No consensus exists on the reliability of Respiratory Polygraphy (RP) for that purpose in children. This study aims to assess reliability between RP and PSG of determining sleep-related respiratory data in children. Twenty children with suspected OSA (10 yrs, 4-16) had full PSG performed in the Paediatric Sleep Centre, Robert Debré hospital, Paris, France. One investigator (LH) performed analysis using 2 modes in a random order: PSG mode (neurophysiologic and respiratory traces available) and RP mode (EEG, EOG, EMG not available on screen). Sleep was scored in PSG mode using Rechtschaffen-Kales criteria, and in RP mode using those of Moss et al (2005) which are mainly based upon variation of cardiac rhythm. Respiration was scored in the same manner for both modes using commonly accepted paediatric criteria. Intra-class correlation coefficients (ICC) were calculated.

	ICC	95% CI
total sleep time	0.240	–0.215 to 0.610
OAH index	0.818	0.596 to 0.924
OA mean duration	0.521	0.114 to 0.778
H mean duration	0.235	–0.220 to 0.606
sleep time with OAH	0.463	0.038 to 0.746
minimal SaO2	0.952	0.884 to 0.981

When using PSG mode, total sleep time was 517 min (360-633), obstructive apnoea-hypopnoea (OAH) index was 6.3 (0.2-66) and minimal SaO2 was 86% (71-95). Low ICC was found for sleep data. There was some reliability between RP and PSG of measuring OAH index and minimal SaO2, but not of measuring mean duration of events and sleep time in OAH. These results prompt further studies to be performed in a higher number of children before determining recommendations of routine use of RP in children with suspected OSA.

P2205

Overnight oximetry as a screening tool for diagnosing obstructive sleep apnea in high altitude residents

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Aim: To determine the value of overnight nocturnal oximetry in strongly suspected cases of obstructive sleep apnea (OSA) among residents of high altitude.
Methods: This study is a retrospective analysis of prior overnight oximetry data of permanent residents staying at altitudes between 7000 to 8000 feet above the sea level who had a high pretest probability of OSA. The cases in this study were subsequently confirmed to have OSA by overnight sleep study (polysomnography). To determine the mean daytime and nocturnal oxygen saturation values for comparision with the study group, matched healthy non smokers residing in the area were studied by daytime and nocturnal oximetry.
Results: There were 12 males and 9 females in the study who had confirmed OSA.They were in the age group between 36 to 48 years. All had severe OSA.Nocturnal oximetry in these cases revealed more than 15 events of oxygen desaturation per hour of sleep with oxygen saturation falling more than 10 percent below pre-sleep awake baseline values. The awake oxygen saturation of all these cases were normal and were matching with mean value of 92 percent observed among 20 controls.The nocturnal oxygen desaturation among control group was less than 4 percent of awake values and events of desaturation were less than 5 times per hour of sleep.
Conclusion: Overnight oximetry is a useful screening tool in cases of OSA residing at high altitude areas.It can be used to confirm diagnosis of OSA in cases with a high pretest probability.

P2206

A new tool to help patients with obstructive sleep apnea syndrome (OSAS) make informed therapeutic choices

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There remains concern that patients may not be fully informed regarding their mechanical treatment options for OSAS: continuous positive airway pressure (CPAP) or oral appliance (OA).
Objective: To develop a tool to help clinicians inform patients about treatment options, and to assess its validity, reliability and acceptability.
Methods: We developed a decision board (DB), to present information regarding the potential benefits and side effects of the 2 treatment options, using the best available evidence. To test validity, we evaluated in 34 healthy volunteers the extent to which the respondents' preferences for a treatment changed predictably when the rate of effectiveness and side-effects were modified. Reliability was tested by re-administering the DB 2 weeks after (kappa test). The DB acceptability was evaluated in 68 consecutive patients newly diagnosed with OSAS, AHI=39 (22).
Results: In healthy volunteers, 58.8% chose OA, 41.2% chose CPAP. In the former group, 85% switched preference when the rate of effectiveness was reduced from 6/10 to 3/10, and 90% when the occurrence of occlusal contacts modification increased from 4/10 to 8/10. In the CPAP group, 57% switched when effectiveness was reduced from 10/10 to 5/10, and 42% when non compliance due to adverse effects increased from 3/10 to 6/10. Reliability was excellent (k=0.94). Concerning acceptability, 90% of the patients were satisfied with the information provided in the DB and 88% indicated that it helped them make a decision. The average score of true/false test of comprehension was 7.9 of 10 (range, 4 to 10).
Conclusion: The DB is a valid, reliable and acceptable tool to assess OSAS patients' preferences.

P2207

Comparing different flow rates (20 and 35 l/min) under high-nasal flow therapy for the obstructive sleep apnoea syndrome (OSAS)

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Introduction: We have demonstrated that 20 l/min nasal insufflation of airflow (HNF) can treat a subgroup of OSAS patients (Nilius G *et al.* Chest. 2010; 137:521-8). The aim of this study was to compare the effect of two flow rates (20 l/min (HNF20) and 35 l/min (HNF35)) on sleep disordered breathing.
Methods: 18 CPAP-naïve patients (6 women, age 56.6±7.3, BMI 32.6±3.8 kg/m^2, ESS 9.3±5.2) with more than 50% Hypopnoeas during a diagnostic night were recruited. During the treatment night both HNF20 and HNF35 were administered in a random order for a minimum of three hours each.
Results: The total event rate (AHI) in NREM/REM sleep was at baseline 25±13/37±23, at HF20 L/min 23±14/22±22 and at HF35 L/min 19,0±13/15±18 (P<0.05 for REM). There were significant improvement HI, but AI at 35 L/min versus 20 L/min in NREM and REM sleep. The lack of AI responses was associated with a significant increase in cenctral AI (baseline vs HNF20 vs HNF35; 1 vs 8 vs 6 events/hour). Nevertheless Oxygenation (T90) improved considerably with HNF35 compared to HNF20 and baseline in both sleep states.

	AHI			HI		
	Baseline	HNF20	HNF35	Baseline	HNF20	HNF35
NREM	25±13	23±14	19±13	19±8	12±8	11±7*
REM	37±23	22±22	15±18*†	28±18	13±15*	11±11*

*Significant improvement from baseline (p<0.05). †Significant improvement from HNF20.

Conclusion: A flow rate of 35 LPM of nasal insufflation is more effective in lowing obstructive hypopneas and improving oxygenation than 20 LPM. Nasal insufflation, however, can increase the event rate of central apneas, independently of the flow rate, which might offset therapeutic responses in some patients.

P2208

Variability in AHI and mean pressure over time in OSA patients treated with APAP

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Background: In patients with obstructive sleep apnoea (OSA), studies have shown that automatic positive airway pressure (APAP) treatment is comparable to continuous positive airway pressure (CPAP) in its cost effectiveness and efficacy. Patients with OSA are treated with APAP devices in our hospital.
Aims: Monitor changes in APAP and apnoea hypopnoea index (AHI) over a period of 3 months
Identify factors which affect changes in mean AHI and APAP
Methods: Symptomatic OSA patients [Epworth sleep score (ESS) >10, AHI>10) were offered APAP therapy and monitored prospectively for 3 months.Data was downloaded at 2 weeks and 3 months and analyzed using paired t test and multiple regression.
Results: APAP therapy was initiated in 26 patients (22 men) with a mean (SD) age of 51 (11.7) years. Mean AHI was 44.5 (25.5) and mean Epworth score was 12 (4.7).
Changes in mean AHI and APAP are shown in the table.

Table 1

Variable	Baseline	2 weeks	3 months	p value
Mean AHI(SD)	44.5 (25.5)	5 (4.1)	3.8 (3)	p<0.0001
Mean APAP	–	9.8 (2.5)	10.2 (2.9)	p=0.15

Multiple regression identified baseline AHI to be the only predictor of AHI change

over 2 weeks and 3 months ($p<0.0001$) while a higher mean APAP at 3 months was also found to be significant ($p<0.0003$)
Age, sex or body mass index did not affect changes in mean AHI or APAP.
Conclusions: In our study,AHI was significantly reduced after 2 weeks' treatment with APAP and continued to fall at 3 months even though mean pressure did not change noticeably.AHI change is greatest in patients with a higher baseline AHI and is affected by mean pressure at 3 months.This implies the influence of other factors such as change in upper airway muscle dynamics.Larger studies are needed to elucidate this complex relationship.

P2209
Manual vs. automated analysis of polysomnographic recordings in patients with COPD
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Background: Manual analysis of polysomnography (PSG) is time-consuming and computer systems have been developed to automatically analyse PSGs. Studies on the reliability of automated analyses in healthy subjects show varying results. In patients with Chronic Obstructive Pulmonary Disease (COPD) these studies have not been performed, while sleep quality can severely be disturbed in these patients. It is unknown whether automated analysis of PSG in patients with COPD provide accurate outcomes.
Methods: In a retrospective study the full-night polysomnographic recordings of patients with and without COPD were analysed manually and automatically. The outcomes of manual and automated analyses in both groups were compared using Bland-Altman plots, Students' paired t-tests, and Pearson's correlation coefficients.
Results: 50 PSGs from patients with COPD and 57 PSGs from patients without COPD were included. In both study groups agreement between manual and automatic analyses was poor in nearly all sleep and respiratory parameters, like the total sleep time, sleep efficiency, sleep latency, amount of REM sleep, no. of arousals, and the apnoea-hypopnoea-index.
Conclusion: Automatic analysis of PSGs in patients with COPD have poor agreement with manual analysis when looking at sleep and respiratory parameters and should therefore not replace the manual analysis of PSG recordings in patients with COPD.

P2210
Heart rate analysis using multiscale entropy in OSA patients under CPAP treatment – Pilot study
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One of the common effects of hypopnea/apnea events during sleep are arousals associated with heart rate change. Methods of nonlinear dynamics which analyze not only variability but also the complexity of the signal are the effective and relatively novel techniques used to analyze heart rate variability.
The aim of the study was to explore the possibility of detection of complexity changes of signal constructed from R-R intervals derived from ECG during full night PSG in OSA patients (in whom apnea/hypopnea events were eliminated by CPAP therapy) using informative entropy.
21 patients undergoing routine diagnostic in sleep lab were recruited for the study (15 male, 6 female; age 52±9 years; BMI 35.8±5.4kg/m^2; Epworth 13±5). The full night diagnostic PSG and the titration night using auto-CPAP under PSG supervisory (both according to ASSM rules) were performed (diagnostic to titration time: 60±31 days). The CPAP therapy was well tolerated (the RDI change from 72±30 during diagnostic night to 5.9±6.9 during titration night; ODI from 61±31 to 3.8±4.1; AI from 50±26 to 6.5±4.3). The R-R intervals were detected in recorded ECG signal (250Hz), and the multiscale entropy (Goldberg's MSE) was calculated for the scales 1-20.
In the low scales (up to 9) there were no significant difference between diagnostic and titration results. In the higher scales there were significant ($p<0.05$) differences.
The elimination of respiratory events has no significant effect on beat-to-beat heart rate complexity. However, using MSE analysis the results of eliminating heart rhythm changes associated with arousals are clearly visible.

P2211
Validation of a new polygraphy device for the diagnosis of obstructive sleep apnoea (OSA)
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Background: Snoring and OSA are such common problems that there is the potential to overwhelm the capacity of sleep laboratories. The goal of this study is to validate a new portable respiratory monitoring device (Alice PDX) against PSG during laboratory recordings, and to assess the devices ability to predict the presence of OSA in the home environment.
Methods: 45 suspected OSA patients (84.4% male, age 52.8±1.9 years, BMI 30.7±1.1 kg/m^2, neck circumference 43.3±0.8 cm and an ESS 9.9±0.7) were randomized to receive the following diagnostic routines over 3 nights: 1 night with self applied Alice PDX at home, 1 night simultaneous in Lab Polysomnography (PSG) and Alice PDX recording, and 1 in Lab PSG. The data were anonymised and then manually scored according to AASM criteria.
Paired t tests were used to compare each diagnostic modality to the reference in lab PSG, and correlation co-efficient calculated. Finally, the rate of diagnostic agreement was calculated.
Results: The Alice PDX was in diagnostic agreement with the simultaneously recorded reference PSG in 91.2% of studies. In 4.4% of studies the Alice PDX underestimated the AHI and on 4.4% of occasions the Alice PDX overestimated the AHI. Similar levels diagnostic agreement were observed when comparing PDX Home, and PSG Lab to the reference PSG recording.

Table 1

	AHI	P	r^2	P
PSG Lam Sim*	17.6±3.2			
PDX Lab Sim	15.9±2.6	0.2	0.85	<0.0001
PDX Home	13.5±2.2	0.2	0.71	<0.0001
PSG Lab	17.6±3.2	0.9	0.86	<0.0001

*Reference PSG.

Conclusions: The Alice PDX shows a high level of diagnostic agreement against PSG when used simultaneously and on a separate occasion at home. When used at home, the level of agreement is similar to a PSG performed on a separate occasion.

P2212
CPAP setting prediction in OSAS patients
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Aim: To determine how well anthropometric measures and data derived from a diagnostic polysomnography (PSG) study predict the CPAP setting required for therapy.
Method: Data of 158 women and 592 men who had a diagnostic overnight PSG study, a diagnosis of OSAS (Apnea-Hypopnea Index (AHI) >5 and daytime somnolence) and a CPAP titration study were retrospectively analysed. Regression analysis was used to assess the predictive value of age, height, weight, neck, waist and hip circumferences, systolic and diastolic blood pressure at rest and diagnostic PSG data AHI, desaturation index, minimum (min) saturation, average saturation, average apnea-hypopnea duration for determining the required CPAP therapy pressure setting.
Results: Backward regression analysis identified AHI, neck circunference and min saturation as predective parameters for the CPAP pressure. Age and BMI were entered at Step 1 hierarchical regression, explaining 6,1% of the variance in CPAP setting. After entry of AHI, neck circumference and min saturation at Step 2 the total variance explained by the model as a whole was 19,5%, $F(5,697) = 35,08$, $p<0,0005$. The three control variables explained an additional 13,8% of the variance in CPAP therapy pressure, after controlling for age and BMI, Fchange$(3,697) = 40,06$, $p<0,0005$. In the final model only the three control variables were statistically significant, with AHI achieving the highest beta value (beta=0,24 $p<0,0005$), then neck circumference (beta=0,17 $p<0,0005$) and finally min saturation (beta=-0,14 $p=0,001$).
Conclusions: OSAS severity, neck circumference and overnight minimum saturation have a statistically significant contribution of 19,5% on the variance of the CPAP therapy pressure, indipendently of the age and the obesity of the subject.

P2213
Capsaicin-induced cough reflex is inhibited by deep inspiration in children with mild asthma
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Background: Asthma is characterized by bronchospasms accompanied with frequent coughing, the pathogenesis of which is not clear. In healthy adults deep inspirations *(DIs) provide a protective effect against bronchoconstriction* triggered by metacholín, which correlates with the number of accompanying cough efforts. In adult asthmatics DIs have some spasmolytic effect, which decreases with age and severity of the disease. Our aim was to test the elicitability of cough reflex by capsaicin in children with mild asthma and their presupposed inhibition by DIs.
Methods: In 21 children (8 girls and 13 boys of median age 13.3 yr) with mild asthma ($FEV_1>80\%$) the cough reaction to inhalation of increasing concentrations

of capsaicin from a compressed air-driven nebulizer manifesting with *2 and 5 or more cough efforts* (C2 and C5) was tested. The effect of previous DIs was also examined.
Results: In control conditions 20.86 (14.58-29.8) umol/l of capsaicin provoked two cough reflexes (C2), but after 3-5 DIs similar reaction required significantly higher concentrations 29.02 (18.88-44.6) umol/l; *P=0.016.* Five or more cough efforts required increasing doses inhaled repeatedly in 1 minute intervals, which were not significantly higher after DIs 161.49 (77.31-337.33) umol/l, than without DIs 141.52 (68.77-291); *P=0.54.*
Conclusion: A series of 5 *DIs decreased the sensitivity of cough reflex* provoked by capsaicin in children with mild asthma, but such inhibitory effect of DIs disappeared after repeated applications of increasing doses of capsaicin, suggesting *reflex character of protective effect of DIs.*
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P2214
How we treat central apneas?
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In a time when sleep studies are progressively done out of sleep laboratories and the positive pressure devices have many automatic features that allow easy home titration, our sleep clinic thought it would be important to review the cases of central sleep apnea and their titration in the sleep laboratory.
Between 2009 and 2010 patients with central sleep apnea were selected and prospectively followed in our sleep clinic. Demographics, anatomic features, clinical symptoms, initial and therapeutic standard polissonography, associated pathologies and eventual improvements were described.
A total of eleven patients were selected, one female, mean age 64,5±13,3, mean body mass index 30,3± 3,9 kg/m^2, all snorers, nine referring hypertension, four with heart failure and five with a disease of the central nervous system. All but one referred daytime sleepiness and scored more than 10 in the Epworth scale. The polissonographies showed a mean apnea/hyponea index (AHI) of 44,1±14,7/H and a mean central apnea index of 21,3±8,9 representing 75±21,3% of all apneas. All patients initiated treatment in our sleep laboratory, at first with continuous positive airway pressure (CPAP) at a fixed pressure but seven patients had the need for bilevel positive airway pressure (BiPAP) Auto SV. In five patients most respiratory events were corrected allowing a normal AHI and there was a significant improvement in the remaining (mean therapeutic AHI-14,3). All patients improved their daytime sleepiness, maximum ESE of 6.
In conclusion effective treatment is possible with CPAP allowing reduction of costs but this is only possible if the therapy is titrated and started in a sleep laboratory.

P2215
Evaluation of an ambulatory device for the diagnosis of sleep apnea in 2 to 5 year-old children
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The Embletta portable diagnostic system is highly sensitive and specific in quantifying respiratory events during sleep (Respirology 15:336;2010). We tested this cardiorespiratory polygraphy for diagnostic purpose in children with clinical history of habitual snoring, sleep apnea, adenotonsillar hypetrophy. Recordings were performed overnight in hospital and attended by a parent who completed a detailed report of different events which occurred (speaking; crying;cough; sob; bruxism). Chest and abdominal wall movements, nasal pressure, oral airflow, snoring, arterial oxygen saturation, pulse rate, and body position were measured for at least 5 hours. All records were analysed manually and respiratory events were scored according to AASM criteria (2007). When necessary X flow which is the sum of the amplitudes of thoracic and abdominal movements, was used to determine obstructive apneas and hypopneas. We successfully performed polygraphy in 58 children who were 2 to 5 years of age (mean height=102 cm, range 125-70; mean weight=17 kg, range 11-27;16 F); obesity was present in 21% of children (BMI z score $\geq$ 1.645). The procedure did not produce interpretable results in an additional group of 5 children. There was no evidence of obstructive sleep apnea (OSA) in 32% of children. Severity of OSA was mild in 22, moderate in 6 and severe in 11 children. Numbers of apnea/hypopnea were assessed by X flows in 35% of children. Our study suggest that cardiopulmonary poligraphy by Embletta may be successfully performed in preschool-age children and generated a valid assessment of respiratory events.

P2216
Respiratory events related arousals, what are we doing about them?
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Respiratory events related arousals (RERAs) are a possible reason for excessive daytime sleepiness (EDS), fatigue and mood disturbances, a complex also known by the upper airway resistance syndrome.
Our aim was to detect the importance of this pathology within the overall sleep studies performed at our sleep laboratory.
Sleep and cardiorespiratory parameters were evaluated with standard polisonography (PSG) according to the recommendations of AASM. RERAs were identified by a flattening of the airflow registered by nasal cannula and/or a visible increase in thoraco-abdominal effort leading to an arousal.
All PSGs recorded during a period of 6 month with an apnea/hypopnea index of less than 15/h were reanalyzed by a single sleep specialist. Patients (pts) demonstrating RERAs in more than 50% of all breathing events were included for further study.
Within 303 sleep studies a total of 45 pts were included (14,8%), mean respiratory disturbance index 17,4±10,4/h. 71% were male, with a mean age of 54,6±14,8 years. In 42% of the pts sleep latency and in 63,8% sleep efficiency (mean 78.5±12.6%) were reduced. Decreased slow wave sleep was found in 55%. In 61% a reduced REM sleep was found and all pts had a high arousal index (41,6±18,3/hr).
Of the pts followed in our sleep clinic 50% showed an increased epworth scale (12.6±5.5), 56% were hypertensive and in 75% (BMI<30kg/m^2). 75% of the pts underwent a positive pressure therapy (ppt) with improvement of symptoms (ESE<8) and good adhesion. Contrary to other data we found a high% of males within the pts with mainly RERAs in PSGs.
As a conclusion, pts with RERAs should be evaluated for EDS for therapy with ppt improves daytime symptoms and is reasonably well tolerated.

P2217
Efficacy of the "tennis ball technique" in patients with positional obstructive sleep apnoea syndrome
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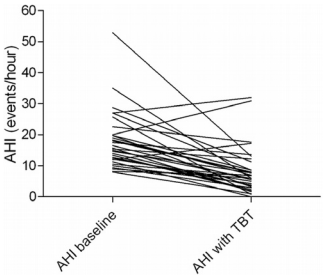
Introduction: In obstructive sleep apnoea (OSA) collapsibility of the upper airway is increased in the supine sleeping position, resulting in an increase of apnoea-hypopnoea index (AHI) and severity of apnoeic events.
Aim: To assess whether the "tennis ball technique" (TBT) prevents positional OSAS-patients from lying on their back and whether this therapy is effective in reducing AHI, severity of events and excessive daytime sleepiness (EDS).
Methods: Thirty three patients with positional OSA at baseline (14 mild, 17 moderate, 2 severe) were treated with TBT. After at least 4 weeks a second sleep study under treatment was performed to assess differences between baseline and follow-up percentage in supine position, AHI, minimal oxygen saturation and EDS. Treatment was considered successful when AHI reduced < 5/hour or reduced at least 50%.
Results: Supine sleeping position reduced from a median (IQR) of 33.2 (23.6-43.7)% to 6.6 (0.0-13.4)%, p<.001. AHI decreased from a median (IQR) of 15.4 (12.1-19.9)/hour to 6.0 (3.4-10.0)/hour, p<.001. Minimal saturation improved from a median (IQR) of 86.0 (83.3-87.8)% to 87.0 (84.3-89.0)%, p=.047. The Epworth Sleepiness Scale decreased from a mean (SD) of 11.2 (5.3) to 9.2 (5.3), p=.002. TBT treatment was successful in 23 of the 33 patients.



Conclusion: TBT is effective in reducing time spent in supine sleeping position and in reducing AHI and EDS, at least on the short-term.

P2218
Added value of a mandible movement automated analysis (MMAA) to a type 3 portable monitoring (PM) in the diagnosis of obstructive sleep apnea (OSA)
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In-laboratory polysomnography (PSG) is the "gold standard" for diagnosing OSA but is time-consuming and costly with long waiting list in many sleep laborato-

ries. Therefore, the search for alternative methods to detect respiratory events is growing.
The goal of this study was to validate a new diagnostic automated method.
We compared attended PSG to a PM (with or without a MMAA provided by a distance-meter) that were recorded simultaneously in 423 consecutive subjects (M/W: 292/131, age: 49±13; BMI: 29.3±7.1 kg/m^2) visiting a sleep laboratory.
Relevant final diagnosis were OSA (57%); UARS (6%); insomnia/anxiety/depression (11%); Circadian Disorders (4%); RLS (3.5%) and parasomnia.
Analysis of the data showed that an AHI index>15/h with PM was similar to an AHI>20/h with PSG. Accuracy characteristics of PM with or without MMAA are described in [Table 1], showing improvement in Sensitivity and Negative Predictive Value with MMAA. A Bland & Altman test corroborated the analysis. Correlation between PSG and PM with MMAA was excellent (r: 0.97).

Table 1. Accuracy characteristics of PM

AHI: PSG >20/h; Auto >15/h	NAF + SpO2	NAF + SpO2 + MMAA	p value
Sensitivity (%)	44	83	<0.01
Specificity (%)	100	96	NS
Positive predictive value	100	94	NS
Negative predictive value	66	86	<0.01

In conclusion, the addition of MMAA to a type 3 PM improves the accuracy in the detection of respiratory events and gives useful information. It improves Sensitivity and Negative Predictive Value, without a significant drop in Specifity and Positive Predictive Value, suggesting that it is an attractive device for the diagnosis of OSA.

P2219
Ultrasound evaluation of diaphragmatic function in obstructive sleep apnea
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Background: Little is known about diaphragmatic function during obstructive sleep apnea syndrome. On the other hand ultrasonography has been used to image the diaphragm diagnostically but not in obstructive sleep apnea. The aim of this study was to use ultrasound technique to evaluate and quantify diaphragm function in a rat model during sleep apnea under condition of normoxia.
Methods: Experiments were conducted in ten male adult Wistar rats weighing 350 gr, which were anaesthetized with Ketamine-Xylazine intraperitoneally. Animals were breathing after being tracheostomized and connected in a circuit with an electromagnetic valve which was closing periodically every minute for 10 sec for two hours, mimicking obstructive apnoeas. Supplemental oxygen was added to keep normal arterial saturation (SaO2:97%). Diaphragm Inspiratory Amplitude (DIA) (cm), Diaphragm Inspiratory Time (Ti) (sec), breathing period (Ttot) (sec), Diaphragm Motion Time (DMT) (sec) and Diaphragm Resting Time (DRT) (sec) were measured from the M- mode sonographic images. Data analyzed and compared between quite breathing (time 0) and breathing after two hours of airway obstructions (time 0+2).
Results: All diaphragmatic measurements (DIA,Ti,Ttot, DMT and DRT) from time 0 to time 0+2 were compared using the Wilcoxon signed-rank test and showed a statistically significant reduction ($p<0.05$) between the two time points.
Conclusions: These findings suggest that diaphragmatic function is affected acutely during obstructive sleep apnea. It is also indicated that diaphragmatic fatigue as expressed via DIA,DMT,DRT,Ti and Ttot is present independently of hypoxeamia after two hours of airway obstructions during sleep.

P2220
Effect of upper airway stimulation for quality of life and sleep architecture in patients with moderate-to-severe OSA
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Background: Electrical stimulation of the hypoglossal nerve can improve obstructive sleep apnea syndrome (OSAS). It is however unknown whether the stimulation affects sleep architecture and quality of life.
Methods: Inspire systems were implanted in moderate-to-severe OSA patients who failed, or were intolerant for CPAP. Sleep architecture was evaluated using lab-based polysomnography at pre-implant and post-implant, at which times Epworth Sleepiness Scale (ESS) and Functional Outcomes of Sleep Questionnaire (FoSQ) were also collected. Results are presented as Mean ± Std.
Results: Twenty eight subjects were implanted. The data collection is on-going and 18 have completed month-12 visit. Both ESS and FoSQ improve significantly from the baseline to the last visit. There was a trend toward increased percent of slow wave sleep and REM sleep at the last visit post-implant, but no significant change in total sleep time, sleep efficiency, percent of slow wave sleep or REM sleep was detected.

	ESS	FoSQ	Total Sleep Time, %	Sleep Efficiency, %	Slow Wave Sleep, %	REM Sleep,
Baseline	11.0±5.0	89.5±23.2	349.7±85.2	76.9±15.2	12.9±15.2	14.3±6.8
Last Visit	7.3±4.2*	99.8±16.3*	329.9±68.0	75.9±19.2	16.9±17.0	16.3±9.1

* $p<0.05$ between baseline and last visit

Conclusion: Preliminary findings showed that upper airway stimulation improves quality of life without changing sleep architecture in patients with moderate-to-sever OSA.

P2221
Upper airway collapsibility evaluated by negative expiratory pressure test in severe obstructive sleep apnea
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Introduction: Obstructive sleep apnea (OSA) is a risk factor for cardiovascular disease and could have serious consequences. Increased upper airway collapsibility is one of the main determinants of obstructive sleep apnea and its evaluation could be useful for identification.
Objective: To investigate usefulness of measurements of upper airway collapsibility by negative expiratory pressure application, as a screening test for severe OSA.
Method: 24 severe OSA and 24 normal subjects matched by body mass index referred to our sleep laboratory, underwent overnight sleep study and diurnal negative expiratory pressure test. Flow drop (ΔV) and expiratory volume in the first 0.2s ($V_{0.2}$) during negative expiratory pressure application was measured.
Results: ΔV (%) and $V_{0.2}$ (%) were statistically different between normal and apneic subjects. Apneic patients have greater falls of flow than normal subjects. Additionally, severely *apneic* patients exhale during the first 0.2 s of negative expiratory pressure application, an average of only 11.2% of the inspired volume compared to 34.2% of normal subjects. Receiver operating characteristic analysis showed that $V_{0.2}$ (%) and ΔV (%) could very accurately identify severe obstructive sleep apnea subjects (sensitivity of 95.8 and 91.7% and specificity of 95.8% and 91.7% respectively).
Conclusion: The percent expiratory volume at 0.2 s and flow drop amplitude is a highly accurate parameter to detect severe obstructive sleep apnea subjects. Pharyngeal collapsibility measurement during wakefulness using negative expiratory pressure is predictive of collapsibility during sleep.

P2222
Parasternal intercostal function during sustained hypoxia
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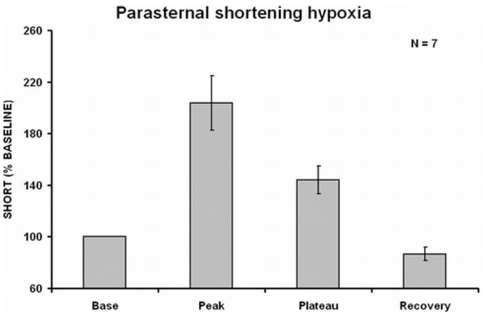
Introduction: In humans and other mammals, sustained isocapnic hypoxia for 20-60 minutes elicits a biphasic ventilatory response (roll-off), with initial peak ventilation followed by decline to a plateau. The activities of the respiratory muscles during the sustained hypoxic response are not known.
Aim: To study ventilation and actions of the chest wall muscles, specifically Parasternal Intercostal (PARA) during sustained hypoxia in awake canines.
Methods: After implantation of sonomicrometry transducers and EMG electrodes in PARA, and complete recovery, we measured airflow, oxygen saturation, end tidal CO2, moving average EMG and shortening (SHORT) of PARA, during room air ventilation (BASE), followed by 25 minutes of isocapnic hypoxia (mean 78% SpO2). The canines were awake, breathing through a snout mask. We report results 2-3 min after reaching SpO2 80% (PEAK) and final 5 min (PLATEAU) of sustained hypoxia, then room air breathing (RECOVERY).
Results: For N=7 (mean 28.9 kg, 28 days post implant), minute ventilation (VI) and tidal volume (VT) increased significantly from BASE to PEAK, then decreased



to an intermediate PLATEAU ($p<0.001$). Concurrently, mean EMG and SHORT of the PARA increased significantly from BASE to PEAK, then attenuated to PLATEAU ($p<0.01$).

Conclusion: As minute ventilation "rolls off" during sustained isocapnic hypoxia, there is a concurrent decline in shortening and EMG activity of the chest wall muscle, the Parasternal Intercostal.