113. Lung function today and tomorrow I

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Peripheral airway function in adults with sickle cell disease

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Aim: Impulse oscillometry (IOS) requires minimal patient co-operation and assesses peripheral airway function. Our aim was to determine whether IOS indices were useful to identify lung function abnormalities in adults with sickle cell disease (SCD).

Methods: IOS measurements were performed on 36 adults, homozygous for sickle cell haemoglobin (HbSS), mean age 40.77 (± SD 13.80) years; the controls were 10 ethnically matched subjects. Respiratory system resistance (Rrs) at oscillation frequencies of 3Hz (Rrs3), 5Hz (Rrs5), 10Hz (Rrs10), 15Hz (Rrs15) and 20Hz (Rrs20), respiratory system reactance (Xrs) at an oscillation frequency of 5Hz (Xrs5), resonant frequency (fres) and reactance area (AX) were recorded. Frequency dependence of resistance between 3 and 20Hz (f-dr) was also calculated.

Results: Rrs was raised at all oscillometry frequencies in the SCD patients. Xrs5 and AX were increased in SCD patients (p= 0.00091, p=0.0006 respectively). The slopes of the linear transformations of frequency dependence of resistance (f-dr) curves were negative in SCD patients, but not in the controls ($p<0.0001$).

	Controls	SCD patients	p
Rrs 3 Hz (kPa l^{-1} s^{-1})	0.4150 (0.3050–0.4525)	0.5300 (0.4225–0.6845)	0.0034
Rrs 5Hz (kPa l^{-1} s^{-1})	0.3550 (0.2750–0.3950)	0.4575 (0.3685–0.5838)	0.0026
Rrs 10Hz (kPa l^{-1} s^{-1})	0.3050 (0.2550–0.3525)	0.3780 (0.3155–0.4565)	0.0077
Rrs 15Hz (kPa l^{-1} s^{-1})	0.2800 (0.2450–0.3400)	0.3325 (0.2800–0.4058)	0.0341
Rrs 20Hz (kPa l^{-1} s^{-1})	0.2650 (0.2475–0.3250)	0.3400 (0.2713–0.3924)	0.0377
Xrs 5Hz (kPa l^{-1} s^{-1})	-0.1000 (–0.1070, –0.0710)	-0.1410 (–0.2296, –0.0970)	0.0091
AX	0.2850 (0.1300–0.3875)	0.7100 (0.4225–1.881)	0.0006
Slope	0.0030 (0.00275–0.00625)	–0.2617 (–0.3676, –0.1977)	<0.0001

Conclusion: These results suggest adults with SCD have peripheral lung changes.

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Assessment of tracheobronchomalacia in relapsing polychondritis using impulse oscillometry

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Background: Airway involvement in relapsing polychondritis (RP) includes airway inflammation, airway narrowing and malacia. Systemic corticosteroid and immunosuppressive therapy does not always improve airway involvement making pulmonary interventions such as balloon dilation and stenting necessary. Impulse oscillometry (IOS) measurements can be safely performed in patients with airway involvement during quiet breathing before and after pulmonary intervention.
Objectives: To confirm whether IOS can assess airway involvement in RP.
Methods: Fifteen patients diagnosed with RP, based on McAdam's criteria participated in this study. Airway disease including: airway narrowing, airway wall thickness, calcification and malacia were confirmed by computed tomography (CT). IOS was performed in all patients and respiratory resistance (Rrs) and respiratory reactance (Xrs) were calculated in frequency ranges of 5Hz increments from 5 to 35Hz.
Results: Five patients developed into tracheobronchomalacia (TBM). R5-R20 and X5 showed a significant difference between patients with TBM and patients with only airway involvement (AI) (R5-R20:TMB 0.48±0.21kPa/(l/s), AI 0.15±0.27 kPa/(l/s), p<0.005, X5: TBM -0.48±0.17 kPa/(l/s), AI -0.22±0.25 kPa/(l/s), p<0.013). IOS was measured before and after stenting in 1 patient and a marked improvement was seen after stenting (before: R5 0.95kPa/(l/s), R20 0.5kPa/(l/s), -0.46kPa/(l/s), Fres 35.37l/s, R5-R20 0.45kPa/(l/s), after: R5 0.31kPa/(l/s), R20 0.29kPa/(l/s), -0.09kPa/(l/s), Fres 9.13l/s, R5-R20 0.02kPa/(l/s)).
Conclusions: IOS was useful in the evaluation of airway involvement in RP and R5-R20 and X5 were practical markers to differentiate patients with TBM.

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Diagnostics of loss in lung elastic recoil pressure using impulse oscillometry and body plethysmography

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Respiratory resistance at 20 Hz (R20) by impulse oscillometry (IO) characterizes airways resistance with inextensible walls. Airways resistance (Rtot) by body plethysmography reflects the total resistance of the first 8 - 10 bronchi generations. These indicators by different methods are close physiologically. The airways in patients with an emphysema are deprived of elastic support, so a lung compliance (CL) considerably increases. We have assumed that shunting of R20 increases with loss of lung elastic recoil.
Aim of the study is evaluation loss of respiratory resistance by IO with increasing of compliance and decreasing of lung elastic recoil.
Materials and methods: We compared Rtot and R20 in 67 healthy volunteers (32F/35M, 47±1 yrs) and in the patients with obstructive disorders - 41 patients with COPD (0F/41M, 56±1 yrs) and 52 patients with bronchial asthma (34F/18M, 47±2 yrs). We have used the relation Rtot/R20. All patients were performed investigation of lung elasticity using esophagus balloon.
Results: R_{tot}/R20 in healthy group was 0,79±0,03 and in patients with obstructive disorders it was 1,72±0,10 (p<0,01). The analysis R_{tot}/R20 in patients with obstructive disorders showed considerable difference of R_{tot}/R20 value in patients with normal lung elastic recoil and in patients with loss lung elastic recoil (1,24 and 2,08 accordingly, p<0,01). The correlation analysis showed moderate dependence R_{tot}/R20 with CL and coefficient of retraction (CR) (r=0,57 and –0,38 accordingly, p < 0,01).
Conclusion: The relation R_{tot}/R20 reflects loss in parenchymal elastic recoil pressure. In healthy and patients with obstructive disorders with normal lung elastic recoil it is less 1,24.

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Direct airway resistance response after deep inspiration in symptomatic asthmatics

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Introduction: Immediately after a deep inspiration there is a response in the airway resistance. In patients with asthma the response to deep inspiration (DI) is impaired compared with healthy subjects.
Aim: We want to investigate the airway resistance response after DI changes when subjects are exposed to a bronchoconstrictor.
Methods: All subjects were symptomatic asthmatics. They all preformed a tidal breathing challenge test (Mch) with methacholinebromide from 0.039–39.6 mg/ml in doubling doses. After each inhalation the airway resistance was measured by impulse oscillometry (IOS/PFT, Care Fusion, Würzburg) during 60-80 seconds with a DI at 30s. At 90s FEV_1 was measured. P-values >0.05 were assumed to be significant.
Results: We analyzed 24 tests. One patient was excluded because of spirometric induced asthma. In 12 cases we found a PC_{20} <16 mg/ml. In 11 patients there was no PC_{20} or a PC_{20} >16.

Results

	PC20<16	PC20>16	p-value
n	12	11	
Mean at baseline			
R5 (kPa·(L/s))	0.37	0.28	0.072
R5-R15 (kPa·(L/s))	0.08	0.06	>0.05
ΔR5	0.008	0.006	>0.05
ΔR5-R15	0.004	0.000	>0.05
Mean at highest concentration			
R5 (kPa·(L/s))	0.66	0.45	0.005
R5-R15 (kPa·(L/s))	0.26	0.15	0.038
ΔR5	0.08	0.04	>0.05
ΔR5-R15	0.05	0.03	>0.05

ΔR5 is the difference in R5 before and after DI, ΔR5-R15 is the difference in R5-R15 before and after DI.

We found a significant difference in ΔR5 between baseline and the highest concentration both in cases and non cases (resp. p=0.024 and p=0.022).
Conclusion: When PC_{20} is reached there is still an overall decrease in airway resistance after DI. Compared to those who didn't reach PC_{20} <16 the decrease is not significant but both groups had a high SE. The response to DI is highly variable in asthmatics.

P1188

Agreement of airway resistance measurements by two different techniques of body-plethysmography and impulse oscillometry in asthmatic patients

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Background: Airway resistance can be measured by different techniques of body-plethysmography and impulse oscillometry (IOS). So far there has been no systematic study comparing validity of these techniques in relation to clinical condition of the patients reported.
Aims and objectives: We investigated correlation between these techniques in assessment of airway resistance and asthma control test.
Methods: In 92 patients with asthma selected on the basis of ATS criteria for diagnosis of asthma and GINA asthma control test (ACT) questionnaire completed. Pulmonary function tests including body-plethysmography with airway resistance measurement and impulse oscillometry measuring total airway resistance at 5 Hz and 20Hz was done using IOS.
Results: ACT score has a significant correlation with a r value of - 0.34 with total airway resistance measured by body-plethysmography (p=0.003) and also significant correlation with r value of - 0.31 (p=0.002) with airway resistance measured by IOS at 5Hz but no significant correlation with airway resistance measured by IOS at 20 Hz. There is a significant correlation between airway resistance measured by body plethysmography and airway resistance measured by IOS at 5 Hz and at 20 Hz.
Conclusion: These finding indicates a good correlation of total airway resistance measured by body plethysmography and by IOS at 5 Hz as well as 20 Hz, which is stronger with the first, Also significant negative correlation between ACT score and airway resistance centered in peripheral airways measured by IOS at 5 Hz but not with the resistance at central airways measured mainly by IOS at 20Hz.

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sGaw as an alternative for FEV1 in the measurement of airway responsiveness to methacholine in patients experiencing chronic cough

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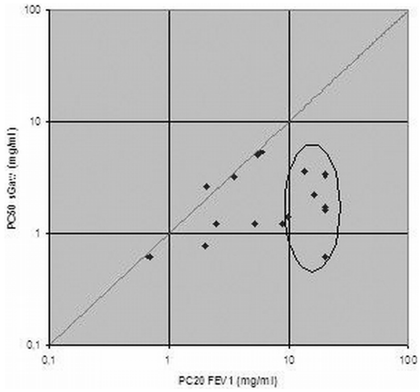
Background: A drop of 50% in specific airway conductance (sGaw) during a methacholine challenge test (MCT) is considered to be comparable to a drop of 20% in FEV1 to asses airway hyperresponsiveness (AHR). In our department patients with chronic cough tested with a MCT on a drop of FEV1 show an increase in cough without reaching a conclusive PC20.
Aim: To examine the correlation between drops in FEV1 and sGaw during MCT in chronic cough patients.
Methods: 16 patients with history of chronic cough were included for a cross-sectional study. Inclusion criteria: episodic chest symptoms, chronic cough and post bronchodilator FEV1/FVC ratio ≥ 0.70. Each concentration in MCT was followed by measurement of sGaw and FEV1. Linear regression was used to determine the correlation between PC20FEV1 and PC50sGaw.
Results: LogPC50sGaw was significantly lower than log PC20FEV1 p=0,004.
7 patients showed a positive response only to sGaw (Figure 1).
We found that a decrease of 20% in FEV1 was accompanied by 65% decrease in sGaw.



Conclusions: Patients with chronic cough show a larger response to methacholine by sGaw as compared to FEV1 than reported in the literature. This suggests that in this set of patients sGaw is relatively more sensitive in assessing AHR.
Implications: Chronic cough patients may exhibit AHR that remains unnoticed when performing MCT with FEV1.

P1190

WITHDRAWN

P1191
Non-invasive measurement of respiratory impedance in conscious guinea pigs utilising impulse oscillometry
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Aim: Since rodents are often utilised as models in respiratory research, we investigated a newly constructed Impulse Oscillometry System (IOS) which was modified to allow non invasive measurements of respiratory impedance in conscious guinea pigs.
Material and methods: Five female guinea pigs (body weight: 592.2±73.0 g) were included in the study. The animals were fixated manually in an extended supine position. a) Three consecutive IOS measurements, taken within a few minutes duration from each animal were used to evaluate short time variability. b) The results of measurements taken on three consecutive days at the same time of the day were used to assess long time variability. Coefficients of variation (CV%) were calculated for oscillometric resistance parameters between 5 and 35 Hz.
Results: Coefficients of variation (CV%) for Resistance parameters at selected frequencies are shown in table 1.

Table 1. Coefficients of variation (in %) for spectral Resistance in a short-time (study A) and a long-time study (study B) in five conscious guinea pigs; means and standard deviations

Parameter	Study A	Study B
R5	6.9±3.6	11.5±1.5
R10	7.1±4.8	13.6±2.8
R15	6.1±2.1	10.5±1.6
R20	5.3±2.3	8.9±2.0
R25	3.4±2.3	5.5±2.6
R30	2.7±1.6	3.2±2.0
R35	3.1±1.0	2.3±1.2

Conclusion: Putting awake guinea pigs in supine body position they get into a sleep-like condition. This was the preferred procedure to get well reproducible results of impedance spectra utilising impulse oscillometry in this species.
The authors appreciate the financial support of the German Federal Ministry of Economics (Berlin Germany, registration number IW 070139).

P1192
Appropriateness of ATS/ERS recommended lung volume reference values for contemporary Australasian children
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Introduction: There are only limited reference ranges for static lung volumes (LV) by Plethysmography (PLETH) or gas dilution (DIL) that encompasses the paediatric age range. International recommendations suggest the data from Zaplatel (PLETH) and Cook (DIL) be used pending appropriate data using modern equipment and most recent guidelines.
Aim: To assess the suitability of these recommended reference ranges to contemporary healthy Australasian children.
Methods: Healthy subjects performed LV measurements by DIL or PLETH according to the 2005 ATS/ERS guidelines. Data was compared to recommended reference ranges and expressed as% predicted.
Results: Measurements were obtained in 244 subjects aged 5 to 19 years (120 male) of which 121 and 144 performed LV by DIL and PLETH, respectively.

Lung volumes as % pred

	DIL (Cook % pred)			PLETH (Zaplatel % pred)		
	n	mean	range	n	mean	range
FRC	121	91.9	58–170	144	93.7	60–148
TLC	117	97.2	57–131	136	98.3	64–156
RV	113	80.5	13–266	130	81.3	9–194

FRC and RV measured by both methods were significantly lower than published values ($p<.001$). Individuals below the LLN for TLC, and outside the 95% CI for FRC and RV ranged from 4% for TLC by DIL to 55% for RV by PLETH.
Conclusions: Measured TLC agrees well with both PLETH and DIL reference values. FRC and RV by either method were significantly lower than predicted. A proportion of these healthy subjects would be considered to have LV outside the normal range. The recommended reference ranges for RV and FRC are inappropriate for use in Australasian children. New reference ranges using modern equipment are needed for this population.

P1193
Spacer device selection may not impact bronchodilator responsiveness (BDR) in asthmatic children
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Assessment of spirometry before and after bronchodilators is used in the diagnosis and management of asthma. The impact of spacer device selection on clinical BDR is poorly understood. ATS guidelines state 400µg of salbutamol should be used for BDR testing. The aim of this study was to investigate if spacer selection has an effect on BDR in asthmatic children and at what salbutamol dose BDR reached significance.
Methods: This study compared spirometry and BDR with a disposable spacer (Lite Aire; Thayer Medical) and a multi-patient use spacer (Space Pod; Medical

Developments International). Children attended the respiratory laboratory twice in 14 days, spacer selection was randomised. Spirometry was performed at baseline and after 200, 400, 800 and 1200µg cumulative doses of salbutamol.
Results: To date, 23 children (14 male) aged 9-17 have completed the study. No significant differences in absolute or relative increase in FEV_1 from baseline to any dose were found between the two spacers. The maximal BDR at 1200µg was 0.35 (0.02) L (Mean (SEM)) for the Space Pod and 0.33 (0.02) L for the Lite Air. Largest mean difference in device at any dose was 1% (20ml). At the initial visit 16 children had a significant BDR (200ml and 12% increase in FEV_1) at 400µg salbutamol, a further 2 at 800µg and 2 at 1200µg.
Conclusion: These data suggest that the differences in vitro spacer drug delivery performance may not translate to significant differences in the BDR of asthmatic children. These results suggest disposable spacers may be used in clinical BDR testing of children. The current ATS guidelines for BDR testing may underestimate the presence of a clinically relevant BDR in asthmatic children.

P1194
Feasibility and reproducibility of pulmonary function tests in preschoolers
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Relevance: Preschoolers present particularities that reinforce the importance of assessing their pulmonary function; however few studies have focused on pulmonary function tests in this population.
Purpose: To assess the feasibility of assessing breathing pattern through inductive respiratory plethysmography, spirometry and peak cough flow (PCF) in healthy preschoolers, as well as the test-retest reproducibility of these tests.
Methods: It was assessed the breathing pattern (tidal volume-Vt; respiratory frequency-f, inspiratory time -Ti, inspiratory duty cycle-Ti/Ttot, mean respiratory flow-Vt/Ti and rib cage motion-%RC), spirometry (forced vital capacity-FVC, forced expiratory volume in 0.5 second-$FEV_{0.5}$ and $FEV_{0.5}$/FVC) and PCF of 38 healthy children aged 4.8±0.6 years. To evaluate the test-retest reproducibility, 10 children (according to sample size calculation) were reassessed after three weeks. The study was approved by Ethics Committee. Feasibility was defined as the rate of success achieved by the children. Test-retest reproducibility was evaluated by paired t-test, considering significant $p<0.05$, and Intraclass Correlation Coefficient (ICC).
Results: The results showed a rate of successes of 100% for breathing pattern, 84% for spirometry and 90% for PCF. Regarding the reproducibility, there were no significant differences between the variables of any test and it were observed the following ICC values: Vt=0.74, f=0.87, Ti=0.88; Ti/Ttot=0.95, Vt/Ti=0.68,%RC=0.66, FVC=0.92, $FEV_{0.5}$=0.81, $FEV_{0.5}$/FVC=0.75, PCF=0.85.
Conclusions: These results suggest high rate of success in performing the pulmonary function tests and good test-retest reproducibility in healthy preschoolers.

P1195
Feasibility of spirometry-controlled chest magnetic resonance imaging (MRI) in children
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Standardization of inflation- and expiration level using a spirometer during chest-MRI is important to optimise image quality and interpretation. To perform the correct breathing manoeuvres in a MRI is a challenge for most children.
Aim of this pilot study: To evaluate the feasibility of spirometer-controlled chest-MRI.
Methods: A custom made MRI compatible spirometer (Masterscope, Carefusion) and a dedicated holder for the spirometer head was used. This allowed correct and child friendly positioning of the spirometer in the MRI.
Children practiced in supine position $\frac{1}{2}$ hour prior to MRI with a lung function technician the following breathing manoeuvres: slow vital capacity (SVC); a breath-hold (13 sec) at Total Lung Capacity and at Residual Volume; and flow volume and coughing to obtain dynamic images of central airways.
During the MRI the lung function technician sat site by site by the MRI technician and coached and monitored the child's performance and instructed the MRI technician when to start the acquisition.
Results: 14 Children (age 5 – 17 years, 9 boys) had a MRI. Each child was able to perform reproducible values for SVC's and flow volumes.
11 Children (79%) were able to follow instructions during the MRI and to complete all the requested breathing manoeuvres.
Images were of diagnostic quality in 11 children, and failed because of lack of cooperation in 3 children.
Conclusion: Spirometer-controlled chest MRI is feasible in most children and improves the standardization and the image quality of chest MRI. We recommend training of the child prior to the MRI and coaching of the child during the MRI by a lung function technician.

P1196
Early lung function testing in infants with aortic arch anomalies identifies infants at risk for airway obstruction
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Aortic arch anomalies (AAA) (vascular rings) are rare anomalies (approx. 3% of all cardiac anomalies) that can obstruct the upper airway. The preferred strategies for diagnosis and treatment varies among institutions. The aim of this study was to investigate the degree of airway obstruction in infants with AAA by lung function testing (LFT).
Patients and methods: Sixteen patients born between 2005-2010 with echocardiographic AAA (10 right sided (69%) and 6 double aortic arch (31%)) preoperative LFT was performed in the 39th (36th – 41th) postconceptional week (median (range)) body weight 3300 (2320 - 4360) g). Raw was measured by baby bodyplethysmography (Jaeger, Würzburg, Germany). With the same equipment the maximal expiratory flow at functional residual capacity (V'maxFRC) was measured using the rapid thoraco-abdominal compression (RTC) technique, according to international guidelines. V'maxFRC was also expressed in standard deviation scores (Z-scores) based on sex-, age and hight-specific reference values of healthy infants published by Hoo et al. AJRCCM 2002.
Results: Between Raw and the Z-score of V'maxFRC was a strong correlation ($r=0.768$, $p<0.001$). Most infants were within the normal range of V'maxFRC without statistically significant difference between right sided and double AAA. However, 3 infants (20%) were near or distinctly below the 10th percentile of V'maxFRC and had Raw >4.1 cmH2O/L/s, indicating upper airway obstruction.
Conclusion: Most infants with AAA had no impairment of the upper airway conductivity. However, early LFT may help to indentify and to monitor patients who may be at risk for significant airway obstruction.

P1197
Forced expiratory tracheal noise time in diagnostics of hidden bronchial obstruction among spirometry negative asthma patients
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Computer instrumentation (Korenbaum et al., 2008) provides a precise estimation of acoustic tracheal forced expiratory noises time (FETa). The purpose was an estimation of FETa efficiency as diagnostic test of hidden bronchial obstruction (BO). The sample consisted of homogeneous groups: young male asthma (BA) patients as a BO model (71 persons with spirometry confirmed BA and 78 persons with spirometry negative BA), control group (77 non-smoking healthy subjects and 44 smokers). FETa values were normalized by C – chest circumference, H – height, M – body mass. Diagnostic thresholds were defined by ROC-analysis. Percentages of deviation from the norm, revealed by acoustic indicators in groups were evaluated.

Percentages of BO, revealed by acoustic indicators and base-line spirometry (fixed cut-off)

Groups	Healthy non-smokers	Healthy smokers	BA patients with spirometry negative BO	BA patients with spirometry approved BO
FETa	16	27.3	41**	78.9*
FETa/C	17	25	49.2**	87.8*
FETa/H	18	27.3	47.4**	80.3*
FETa/M	13	22.7	46.2**	83*
FEV1/FVC >75%	2.6	0	0	74.6*

*p<0.001; **p<0.01 re healthy non-smokers.

Diagnostic efficiency of FETa and its normalized indicators in spirometry positive BA is very close to efficiency of base-line spirometry. Moreover, bronchial obstruction is acoustically diagnosed almost in a half of patients with spirometry negative BA, whereas healthy are indistinguishable from young smokers. Thus, FETa seems to be perspective for diagnostics of hidden bronchial obstruction, at least, in young male subjects. The study was supported by Far Eastern Branch of Russian Academy of Sciences grants No. 09-1-P21-08, No. 09-3-A-06-231.

P1198
Dynamic hyperinflation in patients with severe COPD
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Introduction: Dynamic hyperinflation (DH) is thought to be an important clinical feature in patients with COPD, but is difficult to measure.
Aim: To investigate DH in patients with COPD referred for bronchoscopic lung volume reduction and to test the feasibility of using metronome paced hyperventilation (MPH).
Methods: DH was measured by MPH using the breath-by-breath method (Oxycon Pro) in a 15-min protocol. After 3 baseline IC maneuvers, 3 MPH tests (40Hz for 60 sec; with 3 min. rest in-between) were performed. Each MPH test was directly followed by an IC maneuver. DH was defined as ΔIC/IC (decrease in IC/baseline IC) and calculated using the average of 3 IC's.

Patients: 29 patients with severe emphysema, Gold-IV (n=15): FEV1 23%pred (±4.9), Gold-III (n=9): FEV1 37%pred (±4.7) and Gold-II (n=5): FEV1 51%pred (±1.3) were tested. For Gold-IV RV was 239% (±55), TLCbox 136%pred (±18), IC/TLC-He 25% (±3) and 6MWT 340m (±62). For Gold-II/III RV was 189%pred (±70), TLCbox 134%pred (±15), IC/TLC-He 36% (±11) and 6MWT 413m (±84).
Results: All patients tolerated the MPH very well. IC variability was 4.6% (±3.0), and 8.6% (±4.4) after MPH. VE reached 28.8L/min (±12.6), calculated maximal VE (FEV1*37.5) was 34.5L/min (±15.5). MPH frequency was 39.7Hz (±1.4). For the Gold-IV patient group the IC of 1.83L (±0.47) decreased to 1.21L (±0.42) after MPH with a ΔIC/IC of 34% (±12). In Gold-II/III IC decreased from 2.39L (±0.93), to 1.79L (±0.63) with a ΔIC/IC of 23% (±12). In the overall group ΔIC/IC correlated with TLC-He (r=0.45, p=0.03) and FEV1 (r=-0.38, p=0.04).
Conclusion: Measuring DH is feasible using MPH, and can be used in the routine clinical setting. DH is significantly present in patients with COPD and increases with disease severity.

P1199

Impedance pneumography for assessment of a tidal breathing parameter in patients with airway obstruction

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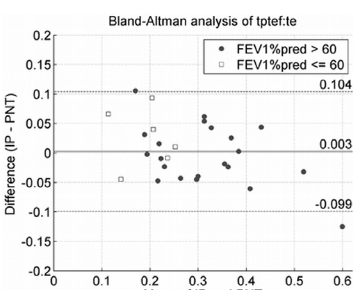
Introduction: Short-term tidal breathing analysis (TBA) parameters, like tptef:te, have indicated change in airway obstruction level in pediatric subjects, to whom conventional PFTs are inapplicable. Nocturnal TBA could provide new means for differential diagnosis and phenotyping of pediatric asthma. Recently, ambulatory impedance pneumography (IP) was reported to accurately estimate tptef:te in healthy subjects (Seppä, V.-P. et al. Chest 2010; 138(4S):816A).
Objectives: Assess the agreement between a direct pneumotachograph (PNT) measurement and the indirect IP measurement in estimating the tptef:te parameter in patients with suspected airway obstruction.
Methods: A simultaneous 3-minute tidal breathing recording of PNT and IP was conducted on 35 patients referred for spirometry in Tampere University Hospital. Reliable IP measurements were obtained from 27 subjects (age 18-65) having FEV1pred% mean 75% (range 26-103%) and BMI 24.8 (16.7-31.0). Agreement between methods was evaluated using the Bland-Altman analysis.
Results: The agreement between the methods was found very good with mean difference 0.00 and 95% CI -0.10, +0.10. The agreement remained high throughout the encountered range of tptef:te values and it did not degrade in patients with more severe airway obstruction (n=6, FEV1pred% ≤60%).



Conclusion: IP was found suitable for assessing a tidal breathing parameter regardless of presence of an airway obstruction.

P1200

Sound propagation estimation in vivo by self-mixing interferometer

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Background: Measurement on excised lungs and mathematical models suggested that velocity of sonic waves in lung parenchyma is related on its density. Assessing acoustic transmission through the human respiratory system could provide a potential non-invasive way of monitoring alteration in lung density as those occurring during oedema and cystic fibrosis.
We have developed a low-cost, non-invasive device based on the laser self-mixing interferometry (SI), to measure with high accuracy (360 nm) the displacement of targets without requiring any contact to the patient.
Methods: We analyzed 5 normal healthy subjects in supine position during quiet breathing while submitted to a sound pressure stimulus at their mouth at 100 Hz. Acceleration of two points of the chest wall (along the right second intercostal space AUR, in the middle of the clavicular line and the right anterior lower lobes on the anterior axillary line, ALR) has been simultaneously measured by commercial miniaturized accelerometers (ACC) and SI. Time delay between pressure at the mouth and each point of the chest wall AUR and ALR has been estimated by spectral methods.

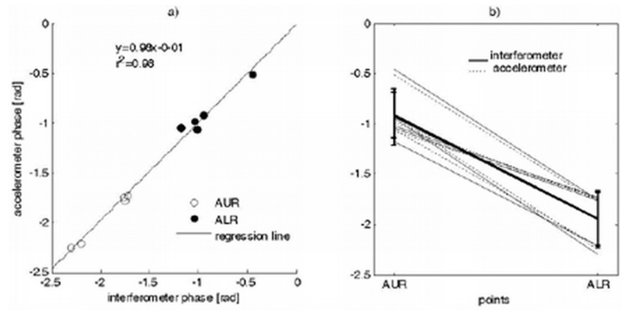

Figure: Panel a) phases estimated with interferometer versus phases by accelerometer, closed circles represent phases on AUR for each subject, while open circles represent phases on ALR. Panel b) phase delay vs pointing chest position as measured by SI (continuous line) and ACC (dashed line).

Results: Good agreement was found between phase delay estimated by ACC and SI ($r2=0.98$, $p<0.001$; Figure, panel a). Measured sound delays ranged between -2.30 and -0.45 with delays at AUR significantly smaller than ALR (-0.9085±0.2262 vs -1.9410±0.2655; $p=0.0002$).

P1201

Detection of pregnancy in horses by breath analysis using differential ion mobility spectrometry (DMS)

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Introduction: First results of pilot studies in human medicine, regarding the analysis of volatile organic breath compounds (VOC) for diagnostic purposes by means of spectrometric techniques encouraged us to investigate, whether one of these techniques is useful in veterinary medicine.
Material and methods: A portable spectrometric system – Differential Ion Mobility Spectrometry (DMS) – was utilised in a first pilot study in equine species. Breath samples of fifteen pregnant and ten non-pregnant mares were taken in these first investigations. Clusters of VOC's were evaluated using a special statistical algorithm and compared to serum levels of sexual hormones.
Results: It was possible to detect significant differences in clusters of exhaled peaks between pregnant and non-pregnant mares and discriminate between both groups with a statistical level of at least more than 95%. Calculating these clusters it is visible that certain VOC's were increased (cluster 17, 30, 72) in pregnancy, new clusters, not detectable in non-pregnant occurred in breath of pregnant animals (Cluster 24), or visible clusters with reduced peaks in pregnancy (cluster 68) were found. Surprisingly it was possible to identify a cluster (cluster 3) of VOC in breath which correlates with the estrone sulphate level in serum inversely.
Discussion: Veterinarians do a lot of work detecting pregnancy in farm animals. It would be very useful to replace this physically hard job by another detection method, like the analysis of volatile organic compounds in breath.
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P1202

Non-invasive method for investigation of inhaled carbon monoxide (CO) distribution between intra- and extravascular compartments

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Background: Therapeutic potential of inhaled CO at low concentration was demonstrated in the treatment of some human diseases [Ryter S. at al. Am J Respir Cell Mol Biol 2009; 41: 251-260]. Basic parameters of CO-dosing were: CO concentration in inhaled air, time of administration and carboxyhemoglobin (COHb) concentration in blood. However therapeutic effect of CO is defined mainly by interaction with intracellular enzymes in extravascular tissues.
Aim: To develop method for determination of CO contents in extravascular compartment.
Methods: Balance equation of total CO mass administrated into body (MCOt, mkmol) used for calculation of CO contents in extravascular compartment (MCOex, mkmol). COHb concentration (Ccohb,%) was defined by measuring of equilibrium CO concentration (Ceq, ppm) in exhaled air using high selective laser spectrophotometer. Total Hb mass (MHb,g) detected by preliminary administration of calculated CO amount (ΔMco, mkmol) as a result of single breath diffusion capacity test (Master Lab, Erich Jaeger) in 19 healthy volunteers (12 males and 7 females).

Results: ΔMco (a part of MCOt) varied from about 100 to 600 mkmol and Ceq deviations from baseline values (ΔCeq) were 2/8ppm. Following formula was found: MHb=8.95*ΔMco/ΔCeq. MHb was approximatly proportional to body weight (Mbody, kg). The ratio R=MHb/Mbody was equal about 9.8 for males and 8.0 for females. After additonal CO adminstration intravascular CO contents (MCOin, mkmol) is defined by formula: MCOin=0.11*ΔCeq*MHb, consequently MCOex=MCOt-MCOin.
Conclusion: Investigation of administrated CO distribution between compartments allow to optimize dosing regime and total CO dose value.