99. New issues in pulmonary function

P859

Patterns of lung function abnormalities in smokers as possible manifestation of "early" COPD phenotypes

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The notion that the earliest manifestation of COPD is an increase in gas trapping, with a decreasing VC that forces the FEV1 to decline with it, has been recently re-evaluated [1]. To assess the prevalent patterns of lung function abnormalities in smokers at the onset of COPD, we evaluate cross-sectional data of a longitudinal study on 321 non-outpatient smokers (mean age 55±10 years; 60% males) belonging in part to a smoking cessation program and in part to a lung cancer screening study. Smoking history and chronic respiratory symptoms were collected, and spirometry and lung volumes were determined, according to standardized protocols. Mean pack-years were 38±22 and 38% of the smokers reported chronic cough and/or phlegm and/or dyspnea; they were significantly older and smoked more pack-years than those without symptoms (for both $p<0.0001$). Mean value of all lung function parameters was within the normal range, however lung function abnormalities were observed in 43% of smokers: 15% had FEV1/VC<lower limit of normal and FRC >115% predicted, 19% had only airflow obstruction and 9% had an isolated increase in FRC without airflow obstruction. A similar pattern of increase in gas volume was found regardless the presence of respiratory symptoms or by considering either RV or RV/TLC. In conclusion, air trapping is not the prevalent pattern of lung function abnormalities in these two groups of non-outpatient smokers. Isolated airflow obstruction or isolated increase in air trapping could be an "early" expression of two different phenotypes of COPD.

Reference:

[1] P.T. Macklen. Therapeutic implications of the pathophysiology of COPD. Eur Resp J 2010; 35: 676-680.

P860

Airway distensibility with lung inflation following allogeneic haematopoietic stem-cell transplantation (HSCT)

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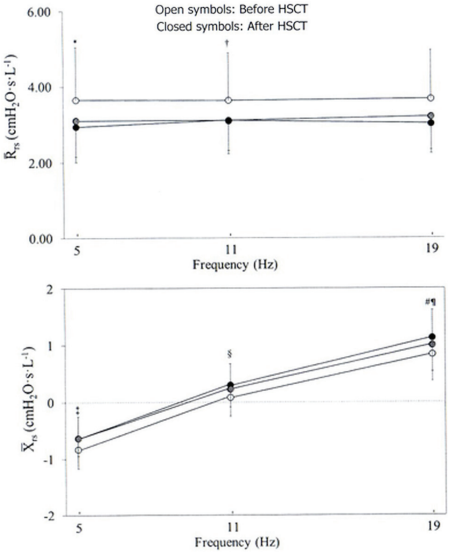

Figure 1

Background: In uncomplicated HSCT, absolute lung volume is reduced but the ability to reverse induced bronchoconstriction by deep-breath is enhanced.
Aims: To study whether this effect may be due to increased airway distensibility.
Methods: 23 subjects were studied before and 1-3 and 3-6 mo after HSCT. Resistance (Rrs) and reactance (Xrs) of the respiratory system were measured by FOT (5, 11 and 19 Hz) at FRC and TLC. The ratio of changes in respiratory conductance (Grs) from FRC to TLC to changes in lung volume ($\Delta Grs/\Delta V_L$) was used to estimate airway distensibility.
Results: Grs at FRC was larger at all frequencies whereas Xrs at 5 Hz was less negative after than before HSCT (Figure 1).
TLC was decreased by 5±2% whereas FRC was not changed. $\Delta Grs/\Delta V_L$ was steeper after than before HSCT ($P<0.001$), without differences after salbutamol (Figure 2, interrupted lines).

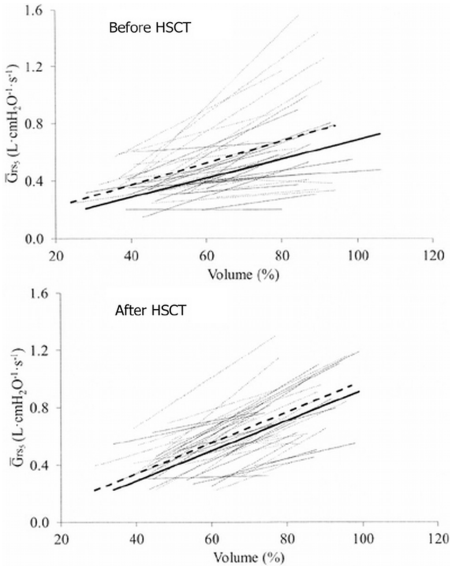

Figure 2

Tissue lung density, measured by quantitative CT scan (n=8), was increased after HSCT by 18±11% (P=0.0006).
Conclusions: Airway caliber and distensibility are increased after HSCT, likely due to an increased distending force of lung parenchyma.

P861

Study on mouth occlusion pressure in normal subjects and patients with obstructive or restrictive lung diseases

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Mouth occlusion pressure ($P_{0.1}$) is the mouth pressure developed against a complete occlusion at 0.1 second after beginning of inspiration from FRC. Consciousness, autogenous reflexes and various lung mechanics do not affect it. We did this study in sequence of arterial blood gas examination, flow-volume curve, body plethysmography, diffusion capacity and measurement of $P_{0.1}$. We divided the subjects into 4 groups such as normal control groups below 35 and above 50 years old, and the patient groups of obstructive and restrictive lung diseases. We measured $P_{0.1}$ during breathing of the ambient air and, again during 6% CO_2-rebreathing with simultaneous measurement of ventilatory parameters such as MV (minute ventilatory volume)/$P_{0.1}$, T_i/T_t (inspiratory time/total respiratory time), TV/T_i, and $P_{0.1}/TV/T_i$.
During breathing of the ambient air, $P_{0.1}$, $MV/P_{0.1}$ and $P_{0.1}/TV/T_i$ showed a significant difference between the control groups and patient groups, and between the patient groups of obstructive and restrictive diseases. During CO_2-rebreathing, $P_{0.1}$ and $P_{0.1}/TV/T_i$ showed a significant difference between the control groups and patient groups. $P_{0.1}$ and $P_{0.1}/TV/T_i$ correlated significantly. We did not find any difference between the patients with normal PaO_2 and those with hypoxemia. However, during CO_2-rebreathing, there was a characteristic change of $P_{0.1}$ in the hypercapnic patient group compared with the normocapnic patient group. As a result, $P_{0.1}$ and $P_{0.1}/V_T/T_i$ are the valid indices of central inspiratory neuromuscular drive and effectiveness of respiratory muscles contraction. They are useful in the diagnosis of advanced chronic lung diseases that accompany CO_2 retention.

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P862

An integrative and comprehensive approach to evaluate lung mechanics in seated and upright positions

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Ventilatory and sensorial differences have been found between treadmill and cycle in respiratory diseases. However, there are still many doubts about lung mechanics in these two body positions.

Methods: 5 male healthies were evaluated at quite breathing (QB) and voluntary hyperventilation (VH) in seated (ST) and upright (UR) with: transdiafragmatic pressure (Pdi) - oesophageal and gastric sensors, electromyography (RMS) of sternocleidomastoid, Intercostal, Rectus abdominis and External Abdominal Oblique (OblEMG), ribcage (RC) and abdominal (Ab) bi-dimensional movement by inductotrace (Volt), and flow measurement (L.min-1).

Results: At QB in ST with similar flows, we found: the chest wall movement was mainly the Ab, with similar Pdi than UR (20.9 vs 28.1 cmH2O) but with a lower gastric pressure (12.3 vs 21.9cmH2O, NS). Inspiratory muscles accessory were poorly recruited in both positions, but UR lead to higher activity of abdominal muscles (p=0.08).

During (VH): the chest wall increase was mainly dependent of RC in ST, while in UR the contribution of RC and Ab was the same. Despite the incPes was equivalent (305 vs 295%) in both positions during VH, gastric pressure augmented more in ST than UR (169 vs 109%, NS). Finally, VH in ST resulted in similar recruitment of insp accessory muscles but superior of exp muscle (incOblEMG 118% vs 83%, NS) than UR.

Conclusion: Seated is characterized by greater contribution of Ab to chest wall movement despite the lower gastric pressure and also lower exp muscle recruitment than UR. During hyperventilation, the increase of Ab contribution was also greater in ST. Ab compartment is more recruited and less contributing to chest wall mechanics in UR.

P863

Relationship between patient pulmonary function, exercise capacity and quality of life in chronic obstructive pulmonary disease (COPD)

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Background: Six minute walk testing (6MWT) and spirometry predict survival & morbidity in COPD. Impulse oscillometry (IOS) is superior to spirometry in predicting patient reported outcomes in COPD. The aim of this cross sectional study was to explore the relationship between spirometry, IOS and airways resistance using the interrupter technique (RINT) versus 6MWT and health related quality of life (HQOL).

Methods: Thirty-two (20 male) patients mean age 66yrs with COPD completed forced expiratory volume in 1 second (FEV1), IOS, RINT, 6MWT (with measurement of walking distance and desaturation) and St George's respiratory questionnaire (SGRQ). Spearman's rank correlation was used to examine the relationship between the measurements.

Results: Peripheral and small airways resistance and RINT were associated with 6MWD and desaturation.

Correlation Co-efficients for pulmonary function vs disease activity

Pulmonary function measure	6 minute walk distance	Change in oxygen saturation	St George's questionnaire activity score
Spirometry			
FEV1	0.50	0.62	-0.39
FEV1% predicted	0.25	0.7	-0.39
Impulse Oscillometry			
R5	-0.46	0.54	0.51
R20	-0.29	0.58	0.42
R5-R20	-0.49	0.52	0.45
Interrupter technique			
Rint	–0.47	0.63	0.41

Total (R5) central (R20) small (R5-20) airways resistance.

IOS outcomes were more strongly associated with St George's activity score than FEV_1 or RINT. Other components of SGRQ were not correlated with any physiological measures evaluated.

Conclusion: Although IOS was better than spirometry at predicting HRQOL; IOS and RINT were no better at predicting 6 minute walk distance than FEV1 and were inferior to FEV_1% predicted at predicting 6 minute walk desaturation.

P864

Expiratory capnography in brown Norway rat: Feasibility and effect of acute bronchoconstriction

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Rationale: The phase III slope of the expiratory volumetric capnogram (S3v)has been shown to increase with bronchoconstriction in asthmatics (ERJ 1994;7:318-323), however, the mechanisms involved remain speculative. We assessed the feasibility of expiratory capnographic slope analysis during acute bronchoconstriction in an experimental model in rat.

Methods: Rats undergoing a separate study were divided into 2 groups: sensitized to ovalbumin (OVA) and exposed either to air or to NO_2, 10 ppm, 6h/d, 5d/wk for 4 weeks. 24h after exposure, animals were anesthetized and mechanically ventilated. Respiratory mechanics were measured using multiple linear regression at baseline and after infusion of methacholine (MCH) (15 µg/kg/min (γ)). Exhaled capnograms were recorded during tidal breathing using a rapid CO_2 analyzer. The S3v was computed and averaged in a minimum of 10 respiratory cycles in each condition.

Results: Respiratory system resistance (Rrs) and elastance (Ers) significantly increased in response to MCH. Similarly, S3v increased during MCH infusion. This increase was significantly larger in NO_2-exposed animals.

Table 1

m±SD	Air-OVA (n=4)		NO2-OVA (n=4)	
	Baseline	MCH15γ	Baseline	MCH15γ
Rrs (cmH2O·s/ml)	0.89±0.05	1.47±0.49*	0.75±0.04#	1.58±0.56*
Ers (cmH2O/ml)	3.81±0.35	6.65±0.98*	4.02±0.36	7.35±1.96*
S3v (mmHg/ml)	2.45±0.07	3.32±0.46	2.49±0.15	4.33±0.44*#

*p<0.05 vs. baseline, within a group; #p<0.05 vs. Air-OVA, within a condition, by Kruskall-Wallis ANOVA on ranks.

Conclusions: Measurement of S3v is feasible in rat, and significantly increases following bronchoconstriction. This new experimental model will allow further study of the mechanisms associated with the increase in S3v.

P865

Effects of thoracic gas compression on airway responsiveness in asthma

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Background: The response to a bronchial challenge is usually assessed from the changes in the forced expiratory in 1 s (FEV_1). Yet this measurement is negatively affected by the thoracic gas compression.

Aim: To examine the effects of thoracic gas compression on the dose-response curve to methacholine (MCh) in asthma.

Methods: 28 male and 25 female asthmatic patients participated in the study. Methacholine challenge was performed in a flow-type body plethysmograph to compute simultaneously FEV_1 and compression-free FEV_1 (FEV_1PLETH). The doses of MCh that caused a decrease in FEV_1 and FEV_1PLETH by 20% of control were calculated by linear interpolation of the dose-response curve and transformed into natural logarithm.

Results: On average, $lnPD20FEV_1$ was significantly less that $lnPD20FEV_1$PLETH (5.49±0.94 vs. 5.74±1.00, p<0.001). The difference between $lnPD20FEV_1$ and $lnPD20FEV_1$PLETH was positively correlated with absolute TLC (r2=0.40) and height in cm (r2=0.27), and it was larger in males than in females (0.34 vs. 0.14, p<0.001).

Conclusions: Thoracic gas compression has a significant effect on airway responsiveness, which depends on absolute lung volume and, thus, anthropometric characteristics.

P866

Change of CP location during bronchodilatation

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Background: The wave-speed concept of flow limitation predicts a unique relationship between the MFSR-curve and the tube laws of the airways containing the choke points (CP). If the frictional pressure loss (Pfr) cannot be neglected J = Pel – Pfr must be substituted for Pel.

Aim: 1) To analyse data from Lambert et al. (JAP 52:44-46) in terms of motion of CP during expiration. 2) To measure upstream viscous pressure losses (Pfr) and J = Pel – Pfr (Comprehensive Physiology Volume 1, 2011: 1861-1881). The relationship between cross-sectional area (A) and transmural pressure (Ptm) – the tube laws were calculated from the relationship between V'max and J.

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Results: Bronchial dilatation increases maximal flow in all cases, but Pfr increases in two cases and decreases in two. Pfr increases when density dependence DD decreases, and increases when DD decreases. The A-Ptm curves show an irregular appearance reflecting the elastic properties of the more and more peripheral airways containing the CP during the expiration. Central and peripheral airways could be detected in each case. In three of four subjects CP at 50%FVC moved to more central airways after bronchodilatation.
Conclusion: The magnitude of Pfr is small, and the study is inconclusive. However, the study indicates that CP moves centrally in 3 of the 4 subjects with bronchodilatation. More experiments are needed.

P867
Lung-packing and stretching increases vital capacity in recreational freedivers
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Introduction: Lung volume is as an important factor for apneic diving performance, and diver's lung volume is larger than in matched controls. Some of this effect is likely due to predisposition, but elite divers often use stretching and "lung packing" in their training to improve lung capacity. Our aim was to study the effects on vital capacity of a training program involving a series of maneuvers typical of freedivers training.
Methods: Subjects were 13 recreational freedivers with a mean (SD) height; 179cm (8.4), weight; 73kg (13.8), age; 23 years (9.7), training apneic diving in average 1-2 h per week, and 8 matched control non divers. The diver's lung training involved a set of 5 different lung exercises with yoga and lung packing maneuvers 5 times a week for 11 weeks. Subjects VC was determined before and after the training program using 3 maximal expirations for slow VC, with the largest volume used.
Results: Mean (SD) VC had increased across the training period, from 5.9 (1.4) to 6.3 (1.5) L or by 7.5 (7.3) % ($P<0.01$). An increase in VC was observed in all but 1 subject. In the control group mean (SD) VC was 4.6 (0.7) L in test 1 and 4.7 (0.8) L in test 2 (NS), showing that the effect in divers was likely not due to retesting.
Discussion: The training used by elite divers, involving lung packing and stretching, may improve VC in recreational divers, despite previous dive training. The increase is more than twice as great as that previously obtained with only lung packing (Lindholm et al 2007). The main mechanism responsible could most likely be reduced chest recoil after stretching.
Conclusions: We conclude that vital capacity can be improved by training.

P868
Low-density lipoprotein cholesterol is associated with inspiratory capacity to total lung capacity ratio in AECOPD patients
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Introduction: Air trapping leads to a reduction in inspiratory capacity/total lung capacity (IC/TLC) ratio in patients with chronic obstructive pulmonary disease (COPD).Knowledge of the effects of low IC/TLC ratio (IC/TLC <0.25) on nutritional status and respiratory impairment during acute exacerbations of COPD (AECOPD) is limited.
Material/Methods: In 108 patients admitted to the hospital due to an AECOPD (75 men; median age, 72 years[interquartile range (IQR),65 to 76 years]; FEV_1,44.5±20.8%predicted),we measured pulmonary function (body plethysmograph), BMI and nutritional parameters, including serum albumin (ALB),prealbumin (preALB),cholesterol, triglycerides (TG), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), blood urea nitrogen (BUN),creatinine and creatine kinase (CK).
Results: Patients with low IC/TLC ratio (<0.25) had significantly greater pack-years of smoking, lower FEV_1, FEV_1/FVC, DLco SB and DLco/VA, and higher (1-FEV_3/FVC)%. Lower serum LDL levels were seen in group with low IC/TLC ratio compared to those patients with IC/TLC≥0.25 (2.36 vs 2.66mmol/L, p=0.042). The decrease in IC/TLC ratio correlated positively with serum LDL levels (r=0.29, p=0.002), and with the reduction of IC/TLC by every 1%, the change in LDL was 0.02mmol/L. No differences were observed in serum ALB, preALB, cholesterol, TG, HDL, BUN, creatinine and CK between both groups.
Conclusions: In patients with AECOPD, low IC/TLC is associated with lower serum LDL levels, meaning LDL may be a more sensitive marker for the detection of undernourishment.

P869
Assessement of eucapnic voluntary hyperventilation response in asymptomatic SCUBA divers
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SCUBA diving is a popular, yet potentially dangerous sport. Exercice, increased oxygen partial pressure and gas density, as well as saline microaspirations are only a few factors that may precipitate bronchoconstriction in SCUBA divers. The resulting air entrapment may have catastrophic consequences such as pneumothorax, pneumomediastinum, and tympanic perforation. Eucapnic voluntary hyperventilation (EVH) has been increasingly used to evaluate the risk of exercise-induced bronchoconstriction (EIB). However, result interpretation has been hampered by the lack of data pertaining to the expected response of asymptomatic individuals to EVH, as well as the lack of a defined gold standard. 10 asymptomatic SCUBA divers having perfomed at least ten dives in the last three years, with no diving-related respiratory complications and no identified air trapping on spirometry were questioned and performed EVH. The average subject was 29.56 years old. Average FEV_1 and FEV_1/FVC values were 3.62L and 0.80, respectively. EVH was performed using a standardised approach as suggested by Argyros *et al*. All participants reached a satisfactory voluntary minute ventilation defined by attaining a minute ventilation greater than 30 times the FEV_1 for 6 minutes. Post-EVH FEV_1 values decreased in all but one participant by an average of 4.67% (Range: 0 - 8%). In conclusion, our data provides evidence that EVH is a specific test; moreover, post-EVH FEV_1 decreases of less than 10% is an appropriate cut-off in ruling out EIB in low-risk individuals.

P870
Effects of airway smooth muscle activation and unloading on short-term variability of inspiratory impedance in healthy and asthmatic subjects
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Background: Short-term temporal variability of respiratory impedance is increased in asthma.
Aim: To examine whether airway smooth muscle unloading alters the pattern of bronchoconstrictor response as assessed by changes in inspiratory reactance (Xrs) and resistance (Rrs).
Methods: 14 mild asthmatics and 9 healthy male subjects were studied at control conditions, during methacholine (MCh)-induced bronchoconstriction, after chest wall strapping and during MCh-induced bronchoconstriction with chest wall strapped. Rrs and Xrs were measured at 5 Hz by forced oscillation technique. Rrs and Xrs variability over 5-min periods were estimated from the interquartile range of frequency distribution (RrsIQR and XrsIQR, respectively).
Results: The percent increments of XrsIQR with MCh, strapping and strapping plus MCh were larger than those of RrsIQR, though statistical significance was achieved only with the combination of strapping plus MCh ($p<0.01$, ANOVA).

CONDITION	ASTHMATICS		HEALTHY CONTROLS	
	Rrs, % increase	Xrs, % increase	Rrs, % increase	Xrs, % increase
MCh	165±71	196±100	201±122	252±238
Strapping	185±79	215±75	167±67	212±45
Strapping + MCh	251±156	356±187	276±203	346±219

Conclusions: Activation of unloaded airway smooth muscle causes greater instability in the airways contributing to the increase in Xrs than in those contributing to Rrs in both healthy and asthmatic subjects, suggesting occurrence of clustered bronchoconstriction.

P871
Acute effects of intermittent and continuous normocapnic hyperpnea on lung function and airway resistance in asthmatics
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Introduction: Bronchoconstriction following high-intensity ventilation in dry and/or cold air is often reported in asthmatics. We aimed to investigate the acute effect of intermittent and continuous high-intensity ventilation of humid and warm air on lung function and airway resistance.
Methods: 6 mild-moderate male asthmatics (age: 25±6 (SD) yrs, FEV_1: 98±11% pred.) performed, on separate days, 6x5min (5min pauses) of intermittent normocapnic hyperpnea (INH) and 1x30min of continuous normocapnic hyperpnea (CNH) by means of partial rebreathing. Tidal volume was set at 60% VC. Breathing frequency was adjusted to reach 60% MVV. Before, every 5min during (INH only) and 5, 15, 30, 45 and 60min after termination, lung function, airway resistance (R5Hz) and reactance (X5Hz) were measured. Individual maximal changes during INH and after INH and CNH were compared to baseline.
Results: FEV_1 did not change significantly from baseline during and after INH (-5±2%, p=0.05; -2±4%, p=1.0) and CNH (-2±3%, p=1.0). R5Hz significantly increased during INH (30±11%, p=0.02) and returned to baseline at 60min after INH (5±4%, p=0.41). No significant change was observed at any time after CNH (13±10%, p=0.38). X5Hz did not change significantly during and after INH (28±20%, p=0.26; 27±13%, p=0.06) nor after CNH (19±17%, p=0.71).

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Conclusion: In mild-moderate asthmatics, 30min of high-intensity intermittent and continuous NH with humid and warm air resulted in no clinically relevant changes in lung function, airway resistance and reactance. Thus NH by partial rebreathing might be a promising strategy to specifically train the respiratory system of asthmatics.

P872

The relationship between long-term correlations (self-similarity) in PEF and FEV1 in COPD

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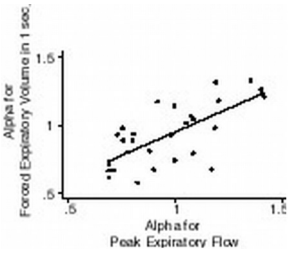
Introduction: Detrended fluctuation analysis (DFA) quantifies the rate of decay in self-correlation in a time series with an exponent "alpha" that is related to COPD exacerbation frequency. The relationship between α of different spirometric parameters in the same individual on the same days is not known.
Methods: We examined data from the London COPD cohort on 28 COPD patients who had recorded both FEV1 and FVC and PEF on daily diary cards for 300 days. Measurements were made after medication in the morning. At recruitment, these patients had a mean age (SD) 65.3 (9.3) years; FEV_1 1.08 (0.36) l, FEV_1 % predicted 37.3 (14.1), FEV1/FVC ratio 0.43 (12.8). DFA has been described (Frey et al Nature. 438: 667-70, 2005). The analysis was also repeated with data collected during exacerbations removed
Results: The patients had an α of 0.97 (SD 0.22) for PEF, 0.93 (0.22) for FEV_1 and 0.95 (0.23) for FVC. No differences was seen in any of the estimates ($p>0.24$). Figure 1 illustrates the relationship between alpha for FEV_1 and PEF ($r=0.69$; $p<0.001$). There was no significant difference if data collected during exacerbation data were excluded, PEF α was 0.95 (SD 0.19); FEV_1 α = 0.95 (0.19) and FVC α = 0.97 (SD 0.20).



Conclusion: In COPD patients, long-term correlations (self-similarity) exist in daily FEV_1, FVC and PEF. The estimates of α are similar and linearly related to each other.

P873

Feasibility and safety of mannitol challenge in pre-school children using forced oscillations

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Background: The mannitol dry powder challenge is used to identify exercise induced bronchoconstriction (EIB) in adults and school-age children. The forced oscillation technique (FOT) is suitable for assessing lung function in pre-school children and can be combined with inhaled challenge testing in this age group.
Aims: This study aimed to assess the safety and the feasibility of a mannitol challenge using FOT in young children with asthma and in healthy controls.
Methods: Healthy children and children with exercise induced symptoms (EIS group) aged 3-7 years were recruited. A mannitol challenge (Aridol, Pharmaxis, Australia) was performed. A positive response to mannitol was defined as wheeze on auscultation, persistent cough, SpO2 <90% or increase in respiratory system resistance at 8Hz (Rrs8) > 50% from control. The mannitol challenge was considered successful if the child completed the challenge to the final dose or a positive response was noted.
Results: To date, 6 healthy and 10 EIS children have been studied. 14 children successfully completed the mannitol challenge with no adverse events. Two healthy children aged 3 years did not complete the test due to lack of cooperation. Three children with reported EIS responded to the challenge with symptoms, and three children responded by an increase in the Rrs8 by >50% from the control measurement.
Conclusion: These preliminary results suggest that a mannitol challenge test is feasible in young children and can be performed safely.
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P874

Contribution of β2-adrenoceptors to bronchodilatation during exercise in healthy humans

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Background: Exercise in healthy subjects is usually associated with progressive bronchodilatation, which has been attributed to a decrease of vagal tone.
Aim: To examine whether β2-adrenoceptors also contribute to bronchodilatation during exercise in healthy humans.
Methods: 14 healthy male volunteers participated in the study. Maximum exercise test was performed at control conditions and after a non-selective b-adrenoceptor blocker (carvedilol 12.5 mg tablets b.i.d. until heart rate decreased by 10 beats/min at least) or an inhaled β2-adrenoceptor agonist (albuterol 400 mg through a spacer). Airway function was estimated from the partial flow at 40% of control forced vital capacity (V'p40) at rest and the slope of linear regression of V'p40 vs. minute ventilation (V'E) every 2 min during an incremental exercise test until exhaustion.
Results: After carvedilol, resting V'p40 was not significantly different from control (2.80±0.98 vs. 2.96±1.38 L s^{-1}) but the V'p40 vs V' E slope decreased from 0.033±0.019 to 0.012±0.014 L s^{-1} L^{-1} ($p=0.005$, ANOVA), suggesting less bronchodilator response to exercise. After albuterol, resting V'p40 significantly increased from control to 4.79±1.68 L.s^{-1} ($p<0.001$) but did not increase further during exercise (V'p40 vs. E slope 0.005±0.012 L s^{-1} L^{-1}).
Conclusions: In healthy subjects, bronchodilatation during exercise is at least in part mediated by β2-adrenoceptor activation.

P875

Ventilation parameters in asthmatic children after one week at 1400 meters altitude

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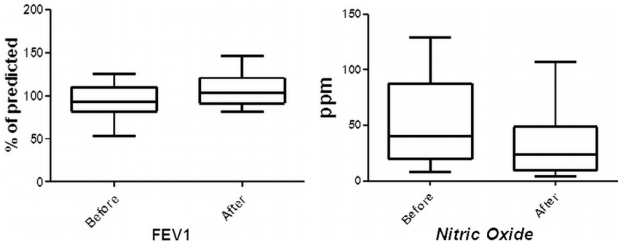
Introduction and background: Bronchial asthma prevalence is increasing. Many triggers are known but little about protective factors.
Aims and objectives: To find out whether 1400 meters altitude could modify ventilation parameters, NO (Nitric Oxide) concentration and clinical symptoms in 13 children after a week of uncontrolled physical activity.
Methods: Thirteen asthmatic children were evaluated at arrival and departure from a mountain resort for: FVC, FEV1, FEF 25-75 and exhaled NO concentration. Unscheduled physical activity were encouraged for eight hours daily.
Results: All the children showed improvement of FVC, FEV1, FEF 25-75.

Main ventilation parameters and NO concentation

	FVC mean value % predicted	FEV1 mean value % predicted	FEF 25-75 mean value % predicted	NO concentration ppm
Arrival	99	93	77	53
Departure	111	105	87	35
p*	0,0002	0,0002	0,0048	0,02

*t test paired two tails.



Conclusions: After a week permanence at 1400 meters resort all subjects showed an improvement in ventilation parameters, together with no episode of asthma exacerbations. This study suggests that physical activity in an healthy environment can be safe and feasible for asthmatic children.

P876

Airway resistance in COPD

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Chronic obstructive lung disease is characterized by airflow limitation, usually

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assessed by forced expiratory maneuvers (FEV1 and FVC). These maneuvers reflect a complex, dynamic relationship between patient effort, muscle strength, elastic recoil as well as airway resistance, which plays a dominant role in airflow limitation.
Within the Emphysema versus Airway Disease study (EvA) we examine postbronchodilator values for total resistance, in- and expiratory resistance (Rin, Rex) and specific resistance (sR) in COPD patients (n= 509; GOLD stage I-III, no current smoking).
Mean postbronchodilator values for total airway resistance are higher in patients compared to controls (0.35 vs 0.19 kPa*sec/L).
Looking at Rin versus Rex, the increase in patients is mainly due to a higher Rex (mean 0.50 versus 0.22 kPa*sec/L) compared to Rin (0.25 vs 0.15 kPa*sec/L).
Specific resistance, which is adjusted for volume to avoid errors because of hyperinflation, is elevated as well (1.64 vs 0.71 kPa*sec). All reported differences in mean values are highly significant with $p < 1*E-15$.
Mean values for Rex and sR are remarkably elevated in COPD and show a good association with GOLD stages, so they may be preferred for monitoring of COPD since they are obtained with tidal breathing.
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P877

The predictive value of inspiratory fraction to exercise capacity in patients with stable moderate to severe chronic obstructive pulmonary disease

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Objective: To study the relationship between inspiratory-to-total lung capacity ratio or inspiratory fraction to exercise capacity in patients with stable moderate to severe chronic obstructive pulmonary disease.
Methods: Pulmonary lung function test (PFT) and Cardiopulmonary exercise testing (CPET) were tested in 50 patients with stable moderate to severe chronic obstructive pulmonary disease and 34 controls, and measured the parameters of ventilation and gas exchange. The stopped reasons at the end of exercise testing were be noted.
Results: (1) IF was significant associated with peak peak VO_2%pred ($r=0.52$, $p<0.001$) in COPD and remained as independent predictor in the final model: peak VO2%pred = 65.9IF + 0.45FEV_1%pred + 35.8 ($R_C^2=0.39$, $p<0.001$), the sensitivity and specificity of IF for predicting exercise capacity were both better than FEV_1%pred. (2) The patients with IF<0.23 had more severe hyperinflation and lower exercise capacity. In the peak exercise, the patients with IF <0.23 had lower peak VE and lower peak VT than the patients with IF ≥0.23, and their peak breath frequencies had no significant difference.
Conclusion: Inspiratory fraction provides the efficient information to reflect lung hyperinflation and to estimate the exercise capacity in patients with stable moderate to severe chronic obstructive pulmonary disease, and its predictive value is better than FEV_1%pred.

P878

Effect of pulmonary rehabilitation on systemic inflammatory markers, muscle cross section area and functional parameters in interstitial lung disease

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Introduction: Interstitial Lung Diseases (ILD) are chronic debilitating diseases with severe exercise limitation. We studied the effect of pulmonary rehabilitation (PR) on systemic inflammatory markers, muscle cross sectional area and other functional parameters in patients of ILD.
Aims and Objectives: To evaluate the levels of C-Reactive Protein (CRP), Matrix Metalloproteinase 9 (MMP9), Tissue Inhibitor of Metalloprotinase (TIMP), 6 minute walk distance (6MWD), Mid thigh Cross Sectional Area on CT ($MTCSA_{CT}$) and Carbon Monoxide Diffusion Capacity (DLCO) before and after PR in patients of ILD.
Methods: Fourteen patients of ILD were evaluated at baseline and after 4 weeks of standard therapy. Supervised PR along with standard medications was then given for further 8 weeks.
Results: Mean values of CRP changed from 5.76*m*5.11 to 2.18*m*1.02 mg/L after rehabilitation [p=0.02]. MMP9 was 838.07±252.37 before and 547.93±168.57 ng/ml after PR [p=0.05]. Mean values of TIMP changed from 182.07±105.07 to 660.43±354.85 ng/ml after PR [p=0.04].
The Mean values of 6MWD changed from 379.43±47.94 to 493.78±47.47 m after PR [p=0.001]. Levels of DLCO changed from 6.23±2.45 to 13.87±3.85 ml/min/mmHg after PR [p=0.05]. Mean values of $MTCSA_{CT}$ changed from 8026.07±1141.96 to 10182.00±1752.10 mm^2 after PR [p=0.02]
Significant correlation was obtained between MMP9 and $MTCSA_{CT}$ [r=0.702, p=0.005] and between 6MWD and DLCO [r=0.764, p=0.001].
Conclusion: Pulmonary rehabilitation causes significant improvement in systemic inflammatory markers, muscle cross sectional area and functional parameters in ILD patients along with significant improvement in gas exchange.

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