At Bishkek the 1st group had the higher max VO2 value, but after the ascent at HA the max VO2 significantly decreased at that group (from 45,8 to 38,8 ml/min/kg, p < 0.01), while the 2nd group demonstrated the nonsignificant max VO2 reduction. Later these differences disappeared.

Obtained data can denote the presence of the interrelation between sPAP response to HA hypoxia and decrease of the physical capacity at HA. This supposition should be tested on a larger sample of volunteers.

P3787

Slowly adapting strtech receptors upregulate mixed cough responses in the rabbit

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Rationale: Inhibition of slowly adapting stretch receptors (SARS) inhibits the cough reflex (CR), but it is not clear whether SARS stimulation facilitates CR and/or expiration reflex (ER). The issue is relevant to the long term understanding of chronic cough because those mechanisms that regulate cough are poorly understood.

The aim of the study was to demonstrate whether SARS stimulation by continuous positive airway pressure (CPAP) alters CR and/or ER in the rabbit.

Methods: 5 rabbits were anesthetized and tracheostomized. The trachea was exoposed to punctuate mechanical stimuli at control and with 4-5 hPa CPAP. 24 stimulations were aimed in each condition in each animal. CR and ER were identified from airflow and volume signals, diaphragmatic and abdominal muscle electrical activity. The reflexes were defined as a forced expiratory effort preceded (CR) or not (ER) by an augmented inspiration. Mixed responses were differentiated from the pattern of the first breath as ER/CR and CR/ER.

Results: 241 stimulations, evenly distributed in inspiration and expiration, were obtained at control (n = 121) and on CPAP (n = 120). The overall incidence of positive responses significantly increased from 66% at control to 85% on CPAP (p = 0.0005). Incidence of ER, CR or CR/ER was not significantly altered. In contrast the mixed ER/CR response significantly increased from 14% at control to 38% on CPAP (p = 0.0005).

Conclusions: SARS stimulation up regulates airway defensive reflexes, namely ER/CR. Thus SARS appear to sensitize preferentially those ER-facilitated coughs. It is speculated that a proper identification of airway defensive responses in patients may be relevant to a better understanding of chronic cough.

P3788

The effects of respiratory muscle fatigue on swallowing physiology in healthy young adults: Preliminary results

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Introduction: Fatigue of the respiratory muscles has been associated with swallowing disorders in many respiratory and neurological diseases, however, the mechanism with which fatigue affects the swallowing function remains unclear. Aims: The aim of the present pilot study was to examine the effects of respiratory muscle fatigue on swallowing physiology in healthy adults.

Method: Participants included 10 healthy young adults randomly assigned in two groups: an expiratory and an inspiratory muscle group. Respiratory and electrophysiological measurements were obtained during the following tasks: three a)5ml water swallows, b)100ml continuous water swallows and c)solid swallows (cracker), at three time points: at baseline, immediately post exercise-induced fatigue, and finally, after a 15-min rest period. A loaded breathing device was used to induce fatigue. Surface electromyography was employed to capture muscle activity of the submental and the infrahyoid muscles during swallowing.

Results: Electromyographical findings showed that, for the submental muscle group, the integral was found to be significantly higher during the immediate post-fatigue condition compared to both the baseline and post- rest conditions (p<0.05) in all tasks for both the inspiratory and expiratory groups.

Conclusion: These preliminary results suggest that fatigue of the expiratory muscles has an effect on selective electrophysiological measures of swallowing. The greater impact of the submental muscles during swallowing compared to the infrahyoids could be a compensatory strategy, given the fatigue of the lower respiratory muscles.

P3789

Orthodeoxia in hypoxaemic morbid obesity reverts one year after bariatric surgery

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Introduction: In morbid obesity (MO), pulmonary gas exchange (GE) abnormalities are influenced by postural changes that are known to improve after bariatric surgery (BS).

Objective: To unravel the determinants of GE in MO at upright (U) and supine

396. Various issues in clinical physiology

P3785

Acute effects of volume-oriented incentive spirometry on chest wall kinematics in patients chronic stroke

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To study the acute effects of incentive spirometry (IS) volume-oriented on chest wall kinematics in chronic stroke patients and healthy subjects.

Volume of chest wall (CW), abdominal (ab), abdominal rib cage (RCab) and pulmonary rib cage (RCp) compartment were assessed in 20 chronic stroke patients (experimental group,EG) age 56±9.7 years old, FVC%:81.5±10.9% and FEV1/FVC%:80.5±9.7 and 20 age-matched healthy subjects (control group,CG), age 56.5±10.3 years old, FVC%:95±6.8% (p=0.0028) and FEV1/FVC%:80.5±8.4 by Optoelectronic Plethysmography. Protocol comprise 3 moments: quite breathing (OB), volume-oriented IS (3 series/10 repetitions) and recovery quite breathing (rQB). The tidal volumes of chest wall in EG was lower compared to the CG, in QB (0.4vs0.61L), IS (1.8vs2.3 L) and rQB (0.4vs0.5 L) (p<0.0001). The tidal volume increase in chest wall 75% in EG and 73.3% CG during IS. Different pattern of breathing were found in tidal volume in EG compared to CG on ab compartment: QB(54.1%vs43.7%), IS(43.3%vs40.9%) and rQB(48.9% vs. 46.2%); RCab compartment, QB(13.8%vs16.8%), IS(19%vs20.6%) and rQB(15.2%vs17.2%) and RCp compartment, QB(30.7%vs37.9%), IS(37.7%vs39.9%) rQB(32.9%vs37.3%). Right and left hemithorax volume were different in EG, QB ($\Delta Vt=0.06\pm0.04$ ml vs 0.02 \pm 0.02 ml, p=0.002), IS(Δ Vt=0.09 \pm 0.07 ml vs. 0.07 \pm 0.05 ml) and $rQB(\Delta Vt=0.07\pm0.07 \text{ vs } 0.02\pm0.03 \text{ ml})$ independent of stroke side impairment. Chest wall volumes are decrease in patients with chronic stroke. IS induces improvements in volume of chest wall in both groups; however, more pronounced in chronic stroke patients determining a breathing pattern similar that was observed in healthy subjects.

P3786

Decrease of physical capacity during acute induction at high altitude is associated with more pronounced increased pulmonary arterial pressure <u>Akpay Sarybaev¹</u>, Abdirashit Maripov¹, Almaz Akunov¹, Ulan Shermatov¹, Dhurati Majumdar², Shashi B. Singh², ¹High Altitude Department, National

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The aim is to assess the relation between physical performance (max VO2) and systolic pulmonary arterial pressure (sPAP) at high altitude (HA).

Subjects and methods: Twenty one subjects aged from 18 to 30 years were examined. After being examined at the low altitude (Bishkek, 700 m above sea level) all subject were transported at 3200 m.

At the HA patients were repeatedly examined in the 7th, 14th and 21st days of the sojourning, as well as on the 3rd day after coming down to Bishkek.

Results: The subjects were divided into two groups: the 1st group - "normoresponders" (n=14), subjects, whose sPAP was up to 35 mmHg in the first days at HA and the 2nd group - "normoresponders" (n=7), subjects with sPAP 35 mmHg or higher. Results are shown.

Comparison of maxVO2 between normo- and hyperresponders

Group	Bishkek	HA-7	HA-14	HA-21	Descent
Normoresponders Hyperresponders	43,7±1,7 45,8±1,2	40,4±1,1 38,8±1,5*	41,0±1,6 42,4±2,5	41,6±1,9 44,1±2,8	46,5±1,7 48,4±3,0
Hyperresponders	45,8±1,2	$40,4\pm1,1$ $38,8\pm1,5*$	42,4±2,5	44,1±2,8	4

max VO2: maximal oxygen consumption, ml/min/kg; *p<0.05 between max VO2 in Bishkek and at the 7th days of high altitude staying.

(S) while breathing ambient air, in random order, before and one year after BS. **Methods:** 15 (14 females; $51\pm(SE)2$ yrs; BMI, 47 ± 2 kg/m²) hypoxaemic -H-(PaO2, 73 ± 5 mmHg) and 8 normoxaemic -N- (PaO2, 89 ± 4 mmHg), matched for age, sex and BMI were studied before and after BS. GE measurements, including ventilation-perfusion (V'A/Q') distributions were performed.

Results: Before BS, H patients at U exhibited moderate V'A/Q' imbalance (low V'A/Q' areas (<0.1), 10±2% of QT) compared to S. In addition, PaO2 (by -4.1±0.4 mmHg) and PvO2 (by -1.5±0.1 mmHg) diminished ($p \le 0.04$, each) along with a trend to reduce QT (by -0.4±0.1 L/min) (p=0.09) at U. By contrast, N patients did not show GE changes. After BS, BMI decreased in both H and N patients (by 36% - 37%), and overall PaO2 at U improved (by +15.9±0.2 mmHg) ($p \le 0.03$, each). Moreover, H patients at U improved PaO2 (by +6.7±0.6 mmHg) compared to S and, V'A/Q' imbalance postural differences between Pre- and Post-BS also improved ($p \le 0.02$).

Conclusions: Hypoxaemic morbid obesity is associated with orthodeoxia. This novel finding may be related to a gravitational heterogeneous redistribution of pulmonary blood flow induced by systemic inflammation. Bariatric surgery reverts completely this phenomenon.

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P3790

Time-dependency of lung recovery after a 4-week exposure to traffic and sugar cane burning air pollutants

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Exposure to total particulate matter from urban air pollution (UP) or biomass burning (BP) has been associated with lung impairment. We investigated the time-dependency of lung functional recovery in BALB/c mice exposed to UP or BP particles. During 4 weeks they weekly received 3 nose-only instillations of 15 μL of distilled water (C) or UP or BP (15 $\mu g/15$ μL saline). Mice were weighed weekly. 1 (C1, UP1, BP1), 2 (C2, UP2, BP2), 7 (C7, UP7, BP7) or 14 (C14, UP14, BP14) days after the last instillation, pulmonary mechanics, FRC and histology were measured; catalase and superoxide dismutase activities were evaluated in lung homogenates. Body mass gain was similar among the groups. Pulmonary elastance and its viscoelastic component (cmH2O/mL), resistive and viscoelastic pressures (cmH₂O) were higher in UP1 (31.1±1.6, 7.2±0.3, 0.8±0.04; 1.5±0.1, respectively) and BP1 (31.0±0.4, 6.6±0.3, 0.8±0.04, 1.4±0.1) than in C1 (23.5±1.6, $4.3\pm0.1, 0.6\pm0.04, 0.8\pm0.1$, respectively). These parameters returned to control values at day 2, except for resistive pressure that normalized at 7 days. Alveolar collapse (%) was larger in UP1 (21.8±5.9) and BP1 (23.2±1.9) than in C1 (1.7±0.3) and returned to baseline at 7 days, while bronchoconstriction index and alveolar and bronchial lesion scores increased in UP1 (2.3±0.2, 3.0±0.3 and 2.3±0.4, respectively) and BP1 (2.3±0.2, 2.8±0.3 and 2.3±0.4, respectively) in relation to C1 (1.5 \pm 0.2, 1.0 \pm 0.3 and 0.8 \pm 0.4, respectively) and normalized in 2 days. No differences were found in FRC and oxidative stress. Thus, a 4-week exposure to UP and BP induced lung impairment that resolved 7 days after the last exposure. Supported by: FAPERJ, CNPq, MCT.

P3791

Exposure to hypercapnia and muscle function

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Hypercapnia has been purposed among the systemic factors participating in muscle dysfunction occurring in COPD.

Aim: To assess the effects of acute and chronic exposure to bouts of hypercapnia on peripheral and respiratory muscle function.

Methods: Two subgroups of 8 Wistar rats each were submitted to either a hypercapnic gas mixture ($FICO_2 0.5$) or room air, 2 h/d for 15 days. Maximal inspiratory pressure (MIP), lower limb dynamometry (LLD), breathing pattern, work of breathing, P0.1 and arterial blood gases were determined at the beginning and at the end of each exposure.

Results: Acute exposure to hypercapnia (1st single bout) did not involve changes in muscle function. However, chronic exposure to hypercapnic bouts resulted in a lower weight gain, and a decrease in both MIP (% ref) and LLD (% ref) in hypercapnic animals when compared with controls. Interestingly, acute exposure to hypercapnia in the last (15th) day also involved a decrease in both MIP and LLD. Acute hypercapnia resulted in increases in respiratory rate (RR) but minute ventilation (VE) and P0.1 remained constant. Chronic exposure to hypercapnic bouts did not change breathing pattern nor ventilatory drive.

Conclusions: Although a single acute exposure to hypercapnia did not induce changes in muscle function, repeated exposures resulted in both a loss in muscle strength and an increase in susceptibility to a further impairment with new hypercapnic bouts. The similar behavior of respiratory and limb muscle strength, both

normalized by rat anthropometry, indicates that the loss of force is the result of hypercapnia and not a consequence of either the increase in ventilatory work or the decrease in weight gain.

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P3792

Disturbance of airway patency is accompanied by a decrease of exhaled breath temperature in asthmatics

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Introduction: Allergy in asthmatics is accompanied with the increase of exhaled breath temperature. The correlation of this parameter with airway patency is known little about.

Aim: To study the correlation between bronchi patency and exhaled breath temperature in patients with bronchial asthma.

Methods: The exhaled breath temperature (T °C) during quiet breathing using a device "X-halo" (Delmedica Investments Pte Ltd), lung function (FEV₁, FEV₁/FVC) and the level of hydrogen peroxide (H₂O₂) in exhaled breath condensate (EBC) were studied in 82 patients with bronchial asthma (the mean age 35.0±1.1 years). **Results:** The patients were divided into two groups according to the presence of airway patency impairment or its absence (FEV₁ 80.8±2.69 and 108.3±2.09%; p<0.001; FEV₁/FVC 68.3±1.37 and 77.8±1.23%; p<0.001, respectively). In the group of patients with airway patency impairment there were a significant decrease of exhaled breath temperature (34.0±0.14°C) and the increase of H₂O₂ level (1.18±0.08nmole/ml) in EBC in comparison with the group of patients without lung function changes (34.5±0.14°C; p<0.05; 0.89±0.08 nmole/ml; p<0.05, respectively). There was found the correlation between the exhaled breath temperature and FEV₁ (r=0.21; p<0.05) and the bronchoilation response to β_2 -agonist (Δ FEV₁, r=-0.41; p<0.01), as well as between the level of H₂O₂ in EBC and FEV₁ (r=0.64; p<0.01).

Conclusion: The decrease of exhaled breath temperature in asthmatics is associated with the disturbance of bronchial patency and reversibility of bronchial obstruction.

P3793

Central alterations during prolonged exercise in normoxia and hypoxia

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Introduction: Prolonged cycling exercise in normoxia (N) induces fatigue due to both peripheral and central alterations. Interestingly, it has been reported that cerebral perturbations are greater during short-duration isolated exercise in hypoxia (H) compared to N¹. The purpose of this study was to test the hypothesis that central alterations are accentuated in H compared to N during prolonged whole-body exercise.

Methods: Ten subjects performed two sessions consisting of 3 80-min cycling bouts at 45% of their relative maximal aerobic power in N and H (FIO₂ = 12%). Before exercise and after each bout, transcranial magnetic stimulation was used to assess corticospinal excitability (motor evoked potential; MEP) and intracortical inhibition (cortical silent period; CSP) of knee extensors. Femoral nerve electrical stimulation was used to measure muscle characteristics. Voluntary activation was also assessed with both types of stimulation.

Results: A significant but similar torque reduction was observed at the end of the exercise in N and H. With the exception of CSP, a significant time effect was observed for all parameters. CSP was longer and the reduction of twitch peak torque was lower in H than in N. No other significant differences were observed between N and H.

Discussion: Fatigue level was found to be similar between N and H when exercise is performed at the same relative intensity. Even if the brain is importantly affected by hypoxia² as shown by the greater intracortical inhibition, this does not appear to further affect central motor drive.

References:

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P3794

Regional lung ventilation distribution among individuals with chronic heart failure after an inspiratory muscle training programm: A randomized controlled clinical trial

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Objectives: To evaluate regional lung ventilation distribution in patients suffering

from chronic heart failure (CHF) after completing inspiratory muscle training (IMT) and correlate it with functional capacity and quality of life among these individuals.

Methods and results: Nineteen CHF patients were randomly assigned to two groups: Control and IMT. Before and after muscle training, subjects were submitted to assessment protocol for respiratory muscles, digital spirometry, optoelectronic plethysmography (OEP), the six-minute walk test (6MWT) and a quality of life questionnaire (MLHFQ). There was no difference in lung function following the 12-week training period in either group. However, the IMT group showed an increase in actual and predicted MIP, higher MLFHQ score and greater distance walked in the 6MWT, as well as a reduction in the Borg scale after the 6 MWT in relation to the control. For the OEP, IMT group members exhibited higher values for total chest wall volume (Vcw), abdominal rib cage volume (Vrc,a) and abdominal volume (Vab) when compared to the control.

Conclusions: For patients with CHF, IMT proved efficient in improving muscle strength, functional capacity and quality of life. The present study also analyzed the distribution behavior of lung volumes for the thoracoabdominal system in this population, showing that larger abdominal rib cage and abdomen volumes may result in more effective diaphragmatic contraction.

P3795

Does SpO₂ correlate with SaO₂ in stable COPD patients?

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Background: Pulse oximetry is commonly used to measure oxygen saturations (SpO_2) in assessment of patients with stable COPD. This is considered to be equivalent to oxygen saturations measured on a blood gas analyser (SaO₂). The ATS, ERS and GOLD guidelines for COPD define suitability for long term oxygen therapy with PaO₂ less than 7.3kPa or SaO₂ of less than 88%.

Aim: To confirm if SpO2 correlates to SaO2 in stable COPD patients.

Methods: Retrospective study of patients with stable COPD attending oxygen clinics in an acute teaching hospital.

Results: N=73, Male 29%, Mean Age70 (range 53 - 93), Mean FEV1 0.89 L, current smokers 29%, 26% on oxygen, mean MRC grade 4, mean BORG score at rest 2 and mean hematocrit (HCT) 0.41.

On't' paired testing in all patients, no statistically significant difference was noted between SpO_2 and SaO_2 (p value: 0.972), the mean SpO_2 - SaO_2 is -0.012% (95% CI of -0.71 to 0.69).

However, in current smokers subgroup (N=21) high variation between these values was noted, with the mean SpO_2 - SaO_2 1.067%. There was a tendency for SpO_2 to be higher than SaO_2 (95% CI of -1.038 to 3.171).

There is no statistically significant relationship between SpO₂ and SaO₂ in COPD patients in relation to sex, age, severity of COPD, smoking status, MRC grade, BORG score, and HCT levels.

Conclusions: As the difference between SpO_2 and SaO_2 is high in current smokers, SpO_2 reading using pulse oximetry might not be reliable. Further studies with larger sample size are needed to evaluate this further.

P3796

Breathing patterns in mountaineers climbing to extreme altitude (7546m) <u>Tsogyal D. Latshang</u>¹, Ainara Garde², Alexander J. Turk¹, Thomas Hess³, Martina M. Bosch⁴, Daniel Barthelmes⁴, Jacqueline Pichler Hefti⁵, Marco Maggiorini⁶, Urs Hefti⁷, Tobias M. Merz⁸, Otto D. Schoch⁹, Konrad E. Bloch¹. ¹Sleep Disorders Center and Pulmonary Division, University Hospital, Zurich, Switzerland; ²Institut de Bioenginyeria de Catalunya and CIBER de Bioingenieria, Biomateriales y Nanomedicina, Universitat Politecnica de Catalunya, Barcelona, Spain; ³Pulmonary Division, Dept. of Internal Medicine, Cantonal Hospital, Winterthur, Switzerland; ⁴Department of Ophthalmology, University Hospital, Zurich, Switzerland; ⁵Institute of Laboratory Medicine, Cantonal Hospital, Aarau, Switzerland; ⁶Medical Intensive Care Unit, Dept. of Internal Medicine, University Hospital, Zurich, Switzerland; ⁷Department of Surgery, Cantonal Hospital, Aarau, Switzerland; ⁸Department of Intensive Caree Medicine, University Hospital, Aarau, Switzerland; ⁹Sleep Disorder Center and Pulmonary Division, Cantonal Hospital, St. Gallen, Switzerland

Background: We investigated breathing patterns and oxygenation in mountaineers climbing to extreme altitude to evaluate effects of hypoxemia and acclimatization. **Methods:** In 34 mountaineers (mean age 45y, 7 women) portable recordings of respiratory inductive plethysmography, pulse oximetry and ECG were performed during a climb to the summit of Muztagh Ata, China (7546m). Breath by breath ventilation was analyzed and periodic breathing quantified by spectral analysis. **Results:** Repeated recordings during 2 climbs from 4497-5533m within 5-8 days revealed an increase in oxygen saturation and periodic breathing and a decrease in heart rate (table). During the climb from 6865-7546m hypoxemia was pronounced. **Conclusions:** Mountaineers were able to climb to extreme altitude despite severe hypoxemia. The heart rate reserve was utilized to a greater extent than the ventilatory reserve. With acclimatization, periodic breathing increased despite a higher oxygen saturation, consistent with a persistently high ventilatory drive while the heart rate reduction suggested a decrease in sympathetic tone.

Abstract P3796 - Table 1. Physiologic adaptation during ascent to 7546m

	Climbs fro	m 4497–5533m	Climb from 6865–7546m	
	day 4 (n=33)	days 9-12 (n=32)	days 17-19 (n=19)	
Oxygen saturation, %	73±4	77±4*	68±3**	
Minute ventilation, L/min	33.1±8.1	35.3±7.5	31.1±9.6	
Minute ventilation, %MVV	25±11	24±11	22±8	
Mean inspiratory flow, L/min	1.1 ± 0.3	1.2±0.3*	1.1 ± 0.3	
Power of periodic breathing,				
arbitrary units	0.6 ± 0.1	$0.7 \pm 0.1 *$	0.6 ± 0.1	
heart rate, 1/min	122±15	112 ± 14	122±11**	
Heart rate, %HRmax	85±13	80±12*	86±9**	

Means±SD during 6-8h climbs; *P<0.05 vs day 4; **P<0.05 vs 4497m, day 9-12; MVV = 40*FEV1 at corresponding altitude; %HRmax = % of heart rate during maximal exercise at 5533m (Latshang 2011).

P3797

Tidal $N_{\rm 2}$ washout ventilation inhomogeneity indices in a reference population aged 7-70 years

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Background: The Multiple Breath inert gas Washout (MBW) method is increasingly used in research studies to assess ventilation distribution inhomogeneity. Normative data are needed when using the method clinically.

Methods: Spirometry and triplets of nitrogen (N2) MBW using a new device (Exhalyzer D, EcoMedics AG, Duernten, Switzerland) were recorded in 284 healthy subjects aged 7-70 yrs. Mean and SD were calculated in four age groups for LCI (Lung Clearance Index), indices of peripheral airway function based on concentration normalized slope III analysis (Scond, Sacin, Pacin), concentration normalized end-tidal N2 after 6 lung volume turnovers (Cn TO6), washout time (WoT) and moment ratios (m1/m0; m2/m0). **Results:** Results are tabulated.

Demography and Results (mean (SD))

Age groups	7-19 yrs	20-39 yrs	40-59 yrs	60-70 yrs
n (males)	44 (24)	82 (37)	110 (58)	48 (20)
Age, yrs	13.8 (3.1)	29.4 (5.6)	50.1 (5.6)	66.1 (2.9)
Height, cm	161 (16)	174 (9)	175 (9)	170 (8)
FEV1, % pred	101 (10)	102 (11)	103 (12)	112 (12)
LCI	6.54 (0.28)	6.70 (0.36)	7.28 (0.43)	7.78 (0.62)
LCI, ULN	7.09	7.41	8.11	9.00
LCI, CV%	3.6 (2.6)	3.0 (1.6)	3.8 (2.2)	3.1 (2.9)
Scond * VT	0.021 (0.004)	0.021 (0.008)	0.022 (0.009)	0.026 (0.013)
Sacin * VT	0.051 (0.012)	0.056 (0.021)	0.069 (0.030)	0.088 (0.038)
Pacin * VT	0.066 (0.023)	0.074 (0.034)	0.082 (0.049)	0.115 (0.075)
Cn TO6	2.89 (0.27)	3.02 (0.33)	3.55 (0.41)	4.03 (0.52)
WoT, s	137 (49)	163 (59)	172 (64)	169 (55)
m1/m0	1.46 (0.06)	1.48 (0.07)	1.60 (0.09)	1.72 (0.12)
m2/m0	4.15 (0.36)	4.34 (0.45)	5.14 (0.60)	5.98 (0.97)

ULN, Upper Limit of Normal.

Conclusion: Reference values for several different indices of ventilation distribution inhomogeneity obtained in a large healthy population over a wide age range are now available allowing for clinical use of this new N2 MBW method.

P3798

Validation of a multiple breath inert gas washout technique using a lung phantom

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Background: Multiple breath inert gas washout (MBW) is a technique for assessing ventilation heterogeneity by measuring the efficiency with which an inert tracer gas is washed out of the lungs.

Aims and objectives: We aimed to use a lung phantom to validate a previously published method for MBW (Horsley AR, *et al.* Thorax 2008; 63(2): 135-140). **Methods:** We built a one-compartment lung model consisting of an enclosed clear acrylic glass tank, partly filled with water at 37°C. The tank was fitted with an off-centre vertical partition that divided it into a larger and a smaller section, but did not reach the base of the tank, thus allowing the two sides to communicate. The lid of the larger section was connected to a bi-level positive airway pressure ventilator which exerted alternating high and low pressures on the water surface,

thus causing the water level in the smaller section to alternately rise and fall, simulating diaphragmatic movement. FRC, tidal volume (Vt) and respiratory rate (RR) were adjusted by altering the volume of water within the phantom lung and the ventilator settings. We performed MBW on the phantom lung at a variety of values of FRC, Vt and RR. Each experiment was performed in triplicate. Measured FRC was then compared to the true FRC in each case.

Results: Measured FRC was within 5% of true FRC in all but one experiment. The intraclass correlation coefficient for the triplicate measurements was 0.999, suggesting that the MBW technique is highly repeatable.

Conclusion: We conclude that MBW performed using an Innocor gas analyser is highly repeatable and accurate. Simple one-compartment lung phantoms appear to be a promising method for the validation of MBW systems.

P3799

Autonomic cardiac dysfunction in COPD: The role of 6MWT

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Introduction: Heart rate recovery (HRR) after maximal exercise is a marker of autonomic cardiac dysfunction (ACD) in Chronic Obstructive Pulmonary Disease (COPD). But it has not been evaluated HRR immediately after 6 minute walking test (6MWT) on this population. Our objective was to evaluate the kinetics of the HRR curve (HRRk).

Methods: We measured HRRk during 4 minutes after the 6MWT in 24 COPD patients (70±6 years, mean \pm SD, FEV1 54±17%) and 19 healthy subjects (68±10 years, FEV1 87±7%). To facilitate the comparison among groups and remove the effect of different peak HR, the HRR curves were normalized to a range of 1 at peak heart rate (HRPeak) and zero at 4 minutes into recovery (HRR4).

Results: We found differences at rest on HR (82 ± 13 vs $72\pm$ patients in healthy 12 beats, p = 0.017), HRR (HRR 1 = 14 ± 7 vs in patients and 21 ± 8 beats in healthy subjects, p = 0.003) and 6MWT (516 ± 79 vs patients 578 ± 84 meters healthy, p = 0.018). The slope of the standard and normalized curves were significantly lower in patients with COPD (k= 0.08 in COPD patients vs k = 1.48 in healthy subjects, p = 0.017).



Conclusions: In COPD patients HRRk was lower than healthy subjects after 6MWT. This abnormality is reflected from HRR1. 6MWT may be a simple test to detect ACD in COPD.

P3800

Relationship between six-minute walk distance and chronic obstructive pulmonary disease assessment test

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Background: Many patients with chronic obstructive pulmonary disease (COPD) are affected by the impairment in the ability to perform daily physical activities due to exercise intolerance, which can lead to a poor health-related quality of life. **Aims and objectives:** Our aim was to investigate the association of the six-minute walk distance (6MWD) and the COPD assessment test (CAT). We hypothesized that physical capacity has a more relevant association with quality of life than lung function.

Methods: This cross-sectional study was conducted in 2011 at the University Hospital of Basel, Switzerland. Patients with COPD stages I to IV were investigated. Functional exercise capacity was measured by the six-minute walk test according to the guidelines of the American Thoracic Society. Spirometry was performed according to current guidelines. Health status was assessed by the CAT. A forced entry multiple regression analysis was calculated. The regression included 6MWD, forced expiratory volume in one second in % of predicted (FEV1%predicted), age and Body-Mass-Index (BMI). The dependent variable was the CAT-score.

Results: Complete data were available for 73 individuals (age 67.0 \pm 9.8yrs, 58.9% male, FEV1%predicted 69.7 \pm 23.7%, 6MWD 434.5 \pm 99.1m, CAT-score 12.5 \pm 6.8, BMI 25.7 \pm 5.5). Age and 6MWD significantly contributed to the model (β =-0.49 respectively β =-0.46, p<0.01). BMI and FEV1%predicted did not significantly influence the CAT-score (β =-0.14 respectively β =-0.13). **Conclusion:** The association of the 6MWD and the CAT-score indicates that

Conclusion: The association of the 6MWD and the CAT-score indicates that higher physical fitness level is related to improved health status and thus decreased impact of COPD on an individual's life.

P3801

Reliability and reproducibility of arterial stiffness by pulse wave velocity (PWV) in stable COPD patients

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Background: Pulse wave velocity, a validated method for assessment of arterial stiffness, is widely used in studies evaluating cardiovascular risk and/or efficacy of new bronchodilators for improving arterial stiffness in COPD patients. However, PWV reproducibility studies are lacking in this population.

Methods: 38 stable COPD patients (79% men, 63 ± 8 years; FEV₁ = $53\pm 17\%$ of predicted values) were included. Using the CompliorTM device, the carotido-femoral PWV was measured at baseline (d0), after 2 weeks (d15) and 6 weeks (d42). Pearson or Spearman correlation coefficients and between-sessions Interclass Coefficient Correlation (ICC) allowed comparing PWV at d0 vs. d15 (short-term reproducibility) and d42 (middle-term reproducibility). The relationship between PWV and inflammatory status (CRP, TNF and IL6) were also investigated.

Results: Mean PWV values were 11.10 ± 1.91 , 11.05 ± 2.17 and 11.24 ± 2.25 m/s at d0, d15 and d42, respectively. For short-term reproducibility (d0 vs. d15), Spearman coefficient was r = 0.78, p < 0.0001 and ICC = 0.790 (range 0.632-0.885). For middle-term reproducibility (d0 vs. d42), Pearson coefficient of correlation was r = 0.76, p < 0.0001 and ICC = 0.749 (range 0.567 - 0.861). There was no significant link between PWV and inflammatory markers neither for baseline values nor for between-sessions differences, suggesting that minor changes in inflammatory status did not influence the reproducibility of PWV.

Conclusion: Using the CompliorTM method, PWV measurements had good reproducibility in stable COPD patients. Such assessment of arterial stiffness can be properly used as objective outcome for randomized trials.

P3802

Early oxygen desaturation is related to acute mountain sickness (AMS) development during acute high altitude (HA) exposure

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Early oxygen desaturation during HA exposure (both in the field and during HA simulated test) has been reported to be significantly related to AMS development. Aim: Monitor oxygen saturation (SpO₂) and AMS during the ascent from Alagna (1200m) to Capanna Regina Margherita (4559m) with an overnight stay in Gnifetti Hut (3647m).

Methods: 66 subjects (55M, 18-67 yrs), intending to climb M. Rosa, were recruited at the cable care station in Alagna, equipped with a 24-h data memory pulse oximeter (Pulsox-3Si, Minolta) and asked to fill the Lake Louise questionnaire for AMS diagnosis. 25 subjects (37.8%) showed a LL score \geq 3 (AMS+ group), 41 were in AMS-group.

Results: SpO₂% in AMS+ and AMS- was similar in Alagna (94.6*m*1.9 vs 95.1 \pm 1.2 n.s.) but lower in AMS+ during HA exposure: at 3275m, after 30-45 min. of cable car (85.5 \pm 4.1 vs 87.7 \pm 3.5,*); in Gnifetti Hut at rest (84.5 \pm 2.3 vs 86.4 \pm 2.4, **) and during the night (76.9 \pm 4.6 vs 79.5 \pm 3.7,*). AMS+ spent more time with lower SpO₂: time (%) at rest in Gnifetti Hut with SpO₂% <80 (15.8 \pm 13.8 vs 7.2 \pm 7.7,**) and during the night with SpO₂% <75, and <70 (33.2 \pm 32.9 vs 15 \pm 18.5, **; 11.8 \pm 19.3 vs 2.7 \pm 6.2, *). Only 34 subjects (26M) climbed to Capanna Regina Margherita (14AMS+); AMS+ maintained SpO₂% < (73.4 \pm 5.1 vs 76.8 \pm 3.8,*) and > time (hours) spent with SpO₂% <80 and 75 (3.5 \pm 1.2 vs 2.7 \pm 0.9, *; 2.5 \pm 1.4 vs 1.5 \pm 0.8,*). [* p< 0.05, ** p< 0.01]

Conclusions: Lower SpO₂ in AMS + occurs very early at the beginning of HA exposure after 30-40 min. of ascent. Subjects which subsequently develop AMS always spend more time with SpO₂ significantly lower than healthy subjects (AMS-).

P3803

The estimation of respiratory muscles (RM) status by echodensitometry in men with chronic obstructive pulmonary disease (COPD) <u>Alexandr Lemeschewskii</u>¹, Mikhail Nedzvedz², Alexander Pochtavcev³, Alexander Makarevich³, Sviatlana Lemiasheuskaya³. ¹ General Surgery, Belarusian State Medical University, Minsk, Belarus; ²Human Pathology, Belarusian State Medical University, Minsk, Belarus; ³Department of Internal Medicine No. 1, Belarusian State Medical University, Minsk, Belarus

Aim: Investigate the RM status.

Material and methods: We obtained the indices: homogenity (H), structural density (SD), echogenicity (E) and dispersion (D) of the internal oblique abdominal muscle (intOAM) by ultrasonic scanner. We carried out histological research of intOAM. Research was made in 20 COPD pts: 1st group (10 - 1st stage); 2nd group (10 - 2nd stage). Control - 12 healthy subjects.

Results: There have been areas of myolysis, cell proliferation of perimiysium, "ingrowth" of fatty tissue between myofibrils (MF). There is interstitial sclerosis, sections "contractions" of MF. Among the relatively preserved MF was found deep dystrophic one with protein granules of different sizes in the appearance of the sarcoplasm. The H in pts of the 1st and 2nd groups was 20.8 and 19.3 respectively (p < 0.05). The E also was different in pts of the 1st and 2nd groups (3.7 and 4.8). The D was increased in the 2nd group 18.6 vs. the 1st group 17.5. The SD had the tendency to decrease. Increasing of COPD severity was associated with significant enhancing of "contractions" (r=0.72), destruction of MF (r=0.69) and proliferation of fibroblasts (r=0.52). We detected the presence of negative correlations between H, SD and sclerosis (r=-0.39 and r=-0.51 respectively). Meanwhile the E was higher in these pts and correlated directly (r=0.48; p<0.05). The D was increased in the 2nd group with fat mass (r=0.62). This may indicate the accumulation of intramuscular fat in the second stage.

Conclusion: The proposed echodensitometric parameters reflect the degenerative processes occurring in the RM.