114. Mechanics, muscles and movement: aspects of airway mechanics, respiratory muscle assessment and field exercise tests

P1143

Impulse oscillometry (IOS) cannot detect vocal cord dysfunction (VCD) in asthma

Laurence Ruane[1], Kathy Low[1], Kenneth Lau[2], Peter Holmes[1], Paul Finlay[1], Phillip Bardin[1,3,4], Paul Guy[1,3]. *[1]Dept Respiratory & Sleep Medicine, MMC, Clayton, VIC, Australia; [2]Diagnostic Imaging, MMC, Clayton, VIC, Australia; [3]Monash Institute of Medical Research, MMC, Clayton, VIC, Australia; [4]Monash University, Monash University, Clayton, VIC, Australia*

Vocal cord dysfunction (VCD) complicates asthma and can be detected using

320-slice CT larynx (Low et al, Am J Resp Crit Care Med, 2011). However, this involves radiation and impulse oscillometry (IOS) may be a safe, convenient and non-invasive method to diagnose the condition. We assessed whether IOS may be able to identify VCD originally diagnosed by CT larynx.
Methods: 42 patients with asthma, matched for age, body-mass index (BMI) and baseline pulmonary function parameters were studied. 21 had evidence of VCD detected by 320-slice CT larynx. All patient had spirometry and IOS immediately following CT and relevant parameters were compared between patients with and without VCD.
Results: The groups were well matched but none of the IOS measurements differed between the groups. Mean values were virtually identical for all parameters and post-bronchodilator values were also similar.

Mean and SD of PFTs and IOS parameters measured

	VCD		Non VCD	
	Pre BD Mean (SD)	Post BD Mean (SD)	Pre BD Mean (SD)	Post BD Mean (SD)
Age	62.3 (15.0)		62.7 (9.8)	
BMI	31.2 (6.2)		29.5 (6.6)	
FEV1	1.71 (0.73)	1.81 (0.71)	1.93 (0.65)	2.04 (0.69)
Z 5Hz	0.81 (0.39)	0.76 (0.38)	0.69 (0.20)	0.63 (0.22)
Rrs 5Hz	0.72 (0.31)	0.69 (0.32)	0.64 (0.17)	0.60 (0.19)
Rrs 20 Hz	0.49 (0.14)	0.45 (0.16)	0.44 (0.13)	0.45 (0.16)
X 5Hz	–0.33 (0.29)	–0.29 (0.23)	–0.25 (0.13)	–0.22 (0.10)

Discussion: In spite evidence that IOS may differentiate upper and lower airway obstruction, this study shows conclusively that the non-invasive IOS technique cannot identify upper airway narrowing associated with VCD in asthma.
Conclusion: IOS does not detect VCD in a cohort of asthmatics with a diagnosis established by 320-slice CT larynx. Other safe and non-invasive methods to detect VCD are needed.

P1144
The six-minute walk test as a measure of exercise capacity in patients cured for pulmonary tuberculosis
Mikhail Chushkin[1,2], Valentina Aksenova[1], Elena Bogorodskaya[1], Sergey Mandrykin[2], Dmitriy Zhutikov[2], Eduard Tikhokhod[2], Andrey Belevskiy[3], Natalia Meshcheryakova[3], Sergey Smerdin[1]. *[1]Pulmonary Physiology, Research Institute of Phthisiopulmonology, I.M. Sechenov First Moscow State Medical University, Moscow, Russian Federation; [2]Rehabilitation, Medical Center, Central Bank of Russian Federation, Moscow, Russian Federation; [3]Pulmonary Rehabilitation, Pulmonology Research Institute, Moscow, Russian Federation*

The six-minute walking test (6MWT) is a simple method to evaluate the exercise capacity in patients with pulmonary diseases. The information about exercise ability of patients who underwent antituberculosis treatment is limited. The aim of the study was to evaluate the relationships between the 6MWT, pulmonary function, and quality of life (QoL) in these patients.
Methods: Seventy patients were included in the study. All the patients performed 6MWT. Pulmonary function was studied bt spirometry and plethysmography. QoL was studied by St. George's Respiratory Questionnaire (SGRQ) and UCSD Shortness of Breath Questionnaire (SOBQ).
Results: The six-minute walking distance was 520±107 M. There were significant correlations (Spearmen's test) between 6MWT and pulmonary functional parameters: FVC% (r= 0,41; p<0.01), FEV1 (r= 0,51; p<0.01), FEV1/FVC (r=0,25; p<0.05), PEF (r= 0,50; p<0.01), MMEF (r= 0,45; p<0.01), TLC (r= 0,40; p<0.01), FRC (r= 0,29; p<0.05), RV/TLC (r= -0,54; p<0.01), IC (r= 0,36; p<0.01), IC/TLC (r= 0,32; p<0.05). There were significant correlations between 6MWT and QoL: Symptoms SGRQ score (r= -0,54, p<0.01), Activity SGRQ score (r= -0,75, p<0.01), Impact SGRQ score (r= -0,72, p<0.01), Total SGRQ score (r= -0,73, p<0.01), SOBQ (r=-0,78; p<0.01).
Conclusion: The 6MWT may be a useful measure of exercise capacity in patients cured for pulmonary tuberculosis and correlates with pulmonary function and QoL.

P1145
Is there a relationship between walk distance and lung function parameters in different disease groups? Can we predict walk distance?
Jennifer Colbourne, Matthew Rutter, Karl Sylvester. *Lung Function Department, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom*

Limited data exists which specifies whether certain respiratory physiological characteristics in lung disease groups are associated with exercise response and functional ability.
Aims: 1) To determine whether relationships exist between the outcomes of exercise (six-minute walk test (6mwt)) and results of lung function in patients with specific lung disease. 2) Will relationships allow generation of equations to accurately predict walk distance?
Method: Retrospective analysis of lung function and concomitant 6mwt data from individuals who attended the lung function department between 2009-2011. Validation of generated predicted equations in separate classified cohort of subjects and comparison to Enright equations (1998).
Subjects: 352 patient's data collected. 5 classified with mixed lung disease excluded from analysis due to small sample size. Of the remaining 347 patients; 38 (10.9%) identified as restrictive, 158 (43.5%) obstructive and 151 (43.5%) normal as per ATS/ERS interpretation guidelines.
Results: Significant correlations exist between lung function and walk distance. Regression equations generated for restrictive (r=0.509 p=<0.001), obstructive (r=0.500 p=<0.001) and normal (r=0.500 p=<0.001) subjects. Validation analysis demonstrated more accurate disease specific walk distance prediction (Bland-Altman) than Enright (1998) predicted equations.
Conclusion: The regression equations demonstrated better predictive capability when compared to Enrights equations, thus supporting the requirement for disease specific regression equations.

P1146
Relationship between FVC and respiratory muscle strength in patients with amyotrophic Lateral sclerosis (ALS)
Guilherme Fregonezi[1], Palomma Russelly Saldanha Araújo[1], Tathiana Lindemberg Ferreira Macêdo[1], Mario Emilio[2], Selma Bruno[1], Vanessa Resqueti[1], Armele de Fátima Dornelas de Andrade[3]. *[1]Physical Therapy, Federal University of Rio Grande do Norte, Natal, RN, Brazil; [2]Neurouscular Disease Outpatients Clinics, Hospital Universitário Onofre Lopes - Federal University of Rio Grande do Norte, Natal, RN, Brazil; [3]Physical Therapy, Federal University of Pernambuco, Recife, PE, Brazil*

Aim: The aim of this study was to analyze the relationship between Forced Vital Capacity (FVC) and respiratory muscle strength in Amyotrophic Lateral Sclerosis (ALS) patients and healthy subjects.
Methods: We study 31 ALS patients and 28 healthy subjects by spirometry and respiratory muscle strength assessment (PImáx, PEmáx and SNIP). Patients were classified in relation to FVC in two grades FVC ≥ 75%pred. or FVC < 75%pred. Cut off points for respiratory muscle weakness were used for men and women: PImáx: 56.1 cmH2O/53.4 cmH2O; PEmáx: 70.6 cmH2O/57.2 cmH2O and SNIP 61.1 cmH2O/57.2 cmH2O respectively.
Results: Twenty-eight ALS patients (16 males), 54±12 year old and 28 healthy subjects were included in the study. We found in cross tab analysis between FVC-PImáx, FVC-PEmáx and FVC-SNIP a sensibility and specificity of 75%/58%, 81%/67% and 75%/67% respectively. We found a positive correlation between FVC%pred. /PImáx (r=0.724), FVC%pred /PEmáx (r=0.826) and FVC%pred/SNIP (r=0.748) in ALS patients (p<0.001). The relationship between PEmáx/PImáx in healthy subjects and ALS were PEmáx=16.46+1.13*PImáx and PEmáx=28.9+0.73*PImáx. A positive correlation was found between PImáx and SNIP in ALS patients (r=0.802) and health subjects (r=0.872). Furthermore, in ALS patients FVC% correlated with SNIP(r=0.748), PImáx (r=0.724) and PEmáx(r=0.826).
Conclusion: In patients with ALS the combination between FVC and respiratory muscle strength can increase early detection of respiratory muscle weakness.

P1147
Conditioning of whole body plethysmographs (WBPs) for prolonged measurements during exercise
Barbara Uva, Dario Bovio, Andrea Aliverti. *Dipartimento di Bioingegneria, Politecnico di Milano, Milano, Italy*

Due to the significant thermal drift determined by variations of temperature (ΔT) and relative humidity (ΔRH) in the box, in clinical practice WBPs are used only over short measurement periods. To allow measurements of lung volume variations by WBP over long periods and exercise tests, we developed 3 different air conditioning systems (A: peltier cells and fans; B: continuous bias flow produced by a negative pressure source; C: bias flow and fans) and studied their effects on ΔT and ΔRH within a flow-type WBP. In 5 healthy subjects, ΔT and ΔRH were measured during 1' of quiet breathing (QB), 5' of calf contraction submaximal constant exercise (EX) and 4' of recovery (REC).
In all subjects, ΔT and ΔRH were similar during QB, EX and REC. T increased linearly during QB and EX with different slopes and then plateaued during REC. Conversely, RH did not vary during QB and changed nonlinearly during EX and REC. During QB, ΔT averaged 0.3±0.2(SD), 0.3±0.1 and 0.3±0.1°C and ΔRH 1.4±1.5, 2.4±2.2 and 1.6±1.5%, respectively with A, B and C conditioning. During EX, ΔT was 0.8±0.2, 1.0±0.3 and 0.7±0.3°C and ΔRH 17.1±12.0, 28.1±7.2 and 24.7±7.9%, respectively with A, B and C conditioning. A and C were significantly more effective than B in controlling ΔT during both QB and EX (p<0.001). A was more effective than B and C in controlling ΔRH during both QB and EX (p=0.001).
In conclusion, combining a cooling device with air recirculation allows to keep T constant inside the WBP during prolonged measurements, even during EX. None of the 3 considered conditioning systems allows to control RH, however, the repeatability of RH variations suggests that thermal drift can be corrected by dedicated software.

P1148

Alterations in respiratory mechanics and pulmonary ventilation induced by *Chlamydia psittaci*

Carola Ostermann, Petra Reinhold. *Institute of Molecular Pathogenesis, Friedrich-Loeffler-Institut, Jena, Germany*

Chlamydia psittaci (*Cp*) is capable of inducing acute pulmonary zoonotic disease (psittacosis) or persistent infection occurring in patients with pulmonary emphysema and/or COPD. To elucidate the pathogenesis of this infection, a defined respiratory model in calves was recently introduced [1], which resembles the situation in humans more closely than mice. This investigation was undertaken to identify pulmonary dysfunctions induced by *Cp*.

Eighteen calves were inoculated with *Cp*, whereas another 18 control calves received uninfected cell culture. Respiratory disorders were characterized non-invasively applying pulmonary function tests from human medicine (i.e. impulse oscillometry and capnography) to spontaneously breathing animals from 7 days before challenge until 14 days post inoculation.

Compared to control calves, calves exposed to *Cp* had significantly increased respiratory resistance at low frequencies ($\leq$ 5 Hz), while respiratory reactance at all frequencies (3 – 15 Hz) decreased significantly, indicating that both obstructive and restrictive pulmonary disorders were induced by the pathogen. In spontaneous breathing, expiration was more impaired than inspiration. Alveolar hypoventilation was confirmed by decreased tidal volume, increased dead space ventilation, increased FRC, and decreased end-tidal CO_2.

In conclusion, this bovine model has been found to be suitable for studying functional host-pathogen interactions in the mammalian lung. Pulmonary dysfunctions assessed in this model provide relevant insights into the pathophysiology of acute respiratory illness induced by *Cp*.

[1] Reinhold P. *et al.* (2012) PLoS ONE 7(1): e30125.

P1149

Respiratory muscle strength after inhaled short acting beta-agonist administration in stable COPD patients

Alina Croitoru, Diana Ionita, Irina Pele, Daniela Jipa, Miron Bogdan. *Pulmonary Rehabilitation Center, National Institute of Pneumology, Bucharest, Romania*

Background: Complex mechanisms are involved in dyspnoea and exercise intolerance in COPD patients, one of these being the increased mechanical work of respiratory muscles.

Aim: To evaluate the increase in respiratory muscle strength after administration of salbutamol in COPD patients.

Subjects and methods: Stable COPD patients performed respiratory muscle strength measurements (maximal inspiratory pressure MIP, maximal expiratory pressure MEP) and body-pletismography (residual volume RV, functional residual capacity FRC). MIP and MEP were again measured 30 minutes after 400 micrograms of inhaled salbutamol was administrated.

Results: Twenty stable COPD patients were evaluated: stage II-IV GOLD, mean age 58.5 (±9) years, 17 males, mean FEV1 1.29 L (42.6% of predicted).

Mean respiratory muscle strength values were: MIP 73.8 (±22) cm H20 and MEP 132.2 (±35) cm H20. Thoracic hyperinflation was present in all cases: mean RV 231.8% and mean FRC 168.9% of predicted.

A slight increase in respiratory muscle strength was seen after salbutamol administration, without reaching statistical significance: mean MIP value increased to 76.4 cm H20 (by 2.6 cm H20, $p>0.05$), mean MEP value increased to 133.15 (by 0.9 cm H20, $p>0.05$).

Conclusion: The administration of 400 micrograms of inhaled salbutamol in our stable COPD patients did not significantly improve respiratory muscle strength. Further studies are needed on a larger population of COPD patients with different disease phenotypes.

P1150

EMG-pattern of respiratory muscles during Muller manoeuvre: Effect of body posture

Marina Segizbaeva. *Laboratory of Respiration Physiology, Pavlov Institute of Physiology, St. Petersburg, Russian Federation*

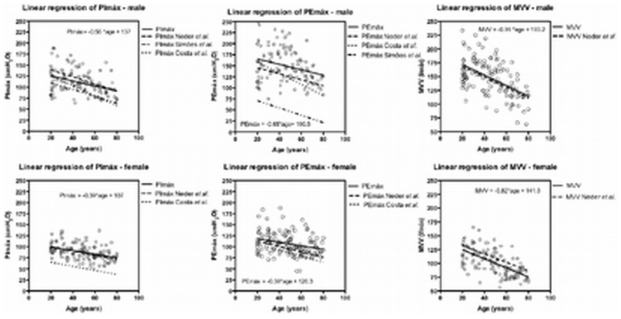
The voluntary maximal inspiratory effort is the manoeuvre requiring activation, recruitment and coordination of different respiratory muscles. A study was undertaken to describe the pattern of recruitment of inspiratory muscles used in the generation of maximal inspiratory effort in different body postures. 10 young normal human participated in this study. Maximal inspiratory mouth pressure (MIP) during Muller manoeuvre was measured in the standing, sitting, right side lying (RSL), left side lying (LSL), supine and head-down-tilt (HDT -30°) posture. The level of electrical activity of the diaphragm (D), parasternal (PS), sternocleidomastoid (SM) and genioglossus (GG) was studied during Muller manoeuvre in each of body postures. MIP in the standing position was 105.3±12.0 in men and 59.9±10.1 cm H2O in women (control). Both in men and women MIP did not significantly differ from control in the sitting, supine, RSL and LSL. But MIP in HDT was lower by 23% and 27% compared with control in men and women respectively. Integrated EMG activity of D during Muller manoeuvre was near the control in sitting, supine, RSL, LSL and significantly greater in HDT compared with standing. On the contrary, the PS and SM showed the highest level of activation during Muller manoeuvre in standing position, but its activation was significantly lower in HDT ($P<0.05$). EMG of GG was significantly greater in supine position and HDT while its activation was lower in sitting, LRS and LLS. We conclude that maximal inspiratory effort reflects a complex interaction between several muscle groups and changing in body posture from standing to HDT might influences the activation of different muscles resulted in lower MIPs in HDT.

P1151

Maximal respiratory pressure and maximal voluntary ventilation in Brazilian health population: A multicentre study

Guilherme Fregonezi[1], Palomma Russelly Araujo[1], Vanessa Resqueti[1], Ester Silva[2], Marlene Moreno[2], Jasiel Nascimento Junior[3], Larissa Carvalho[3], Ana Gabriela Cavalcanti[3], Armele de Fátima Dornelas de Andrade[3]. *[1]Physical Therapy Department, Federal University of Rio Grande do Norte, Natal, RN, Brazil; [2]Physical Therapy Department, Methodist University of Piracicaba, Piracicaba, SP, Brazil; [3]Physical Therapy Department, Federal University of Pernambuco, Recife, PE, Brazil*

Maximal respiratory pressures (MRP) and maximal voluntary ventilation (MVV) are worldwide measures used to assess respiratory muscle strength and endurance. Although there are references values established to Brazilian population different methodological procedure used in previous studies could contribute to wide variation in values published.This study was conducted in three centers in Brazil, Natal-RN, Recife-PE and Piracicaba-SP. Subject was evaluated in relation to anthropometrics parameters, physical activity profile, maximal inspiratory/expiratory pressure and MVV. Correlation and multiple linear regressions were used to predicted male and female MRP and MVV equations.We studied 244 subjects (114 male/130 female) distributed in different age group from 20 to 80 years old. The results showed a significantly positive correlation between MIP/MEP and height in female; negative correlation with age in both genders. A positive correlation between MVV, weight and height in male were found; in female, we found a positive correlation with height and negative correlation with age. In the multiple linear regression analysis only age continued to have an independent predictive role for dependent variables in MIP/MEP and MVV.



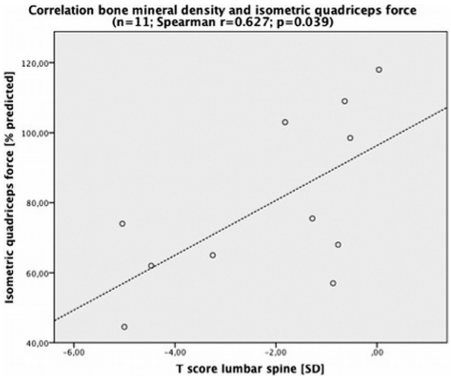
The results of this study provide a reliable reference equations of MRP and MVV for health Brazilian population from 20 to 80 years old.

P1152

Clinical impact of the relationship between low bone mineral density and peripheral muscle strength in patients with COPD

Glenn Leemans[1,2,3], Kris M.H. Ides[2,3], Lieve De Backer[2], Hilde Vaerenberg[2], Kevin De Soomer[2], Dirk Vissers[1,3], Wilfried De Backer[1,2]. *[1]Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk; [2]Respiratory Medicine, University Hospital Antwerp, Edegem; [3]Department of Health Sciences, Artesis University College Antwerp, Merksem, Antwerp, Belgium*

Introduction: COPD is a respiratory disease with systemic consequences such as osteoporosis. It is known that this impaired bone mineral density (BMD) correlates



with physical inactivity. If physical inactivity does depend on muscle strength, a correlation between muscle strength and osteoporosis must exist.
Objective: To evaluate how strong peripheral muscle strength is related to the loss of BMD in our COPD population.
Methods: Data of 11 patients in a pulmonary rehabilitation program is analysed. BMD at the lumbar spine and hip is determined by dual-energy X-ray absorption (DXA). DXA is performed based upon the patient's risk profile (long history of corticosteriods). The BMD is expressed as a T score. Isometric quadriceps force (IQF) is assessed by a computerized dynamometer during a voluntary maximal isometric contraction with the hip at 90° and the knee at 60° flexion. The highest value is taken.
Results: A significant correlation is found between T score lumbar spine and IQF in % predicted of the normal value (R=0.627; p=0.039). IQF is not related to the T score of the hip (p=0.385).
Conclusions: Lower BMD in the lumbar spine seems to relate with lower IQF in our COPD population. Strengthening of those quadriceps muscles in this specific COPD patients must therefore best be done in an upright, weight-bearing position during closed chain exercises to stabilise or increase the BMD of the lumbar spine.

P1153
The effect of lung hyperinflation on respiratory muscle strength in COPD patients
Kevin De Soomer, Hilde Vaerenberg, Lutje Claus, Wilfried De Backer, Ellie Oostveen. *Department of Pulmonary Medicine, Antwerp University Hospital, Antwerp, Belgium*

Introduction: Many COPD patients exhibit hyperinflation, due to premature closure of the airways and loss of lung elastic recoil, which impairs the respiratory muscle function.
Aim: To assess the relationship between the degree of lung hyperinflation and respiratory muscle strength.
Methods: 46 consecutive male COPD patients referred to the hospital's pulmonary rehabilitation program underwent lung function testing and assessment of respiratory muscle strength at baseline.

GOLD stage	n	Age (yrs)	FEV1 (%p)	RV/TLC (%)	MIP (%p)	TLC (%p)	MEP (%p)
2	8	67	59	47	98	103	104
3	26	67	37	58	80	125	86
4	12	62	25	67	68	129	61
total	46	66	38	59	80	122	83

Results: We observed a significant negative relationship between MIP and MEP *vs* the degree of hyperinflation.

n=46 COPD patients	MIP %p *vs* RV/TLC %		MEP %p *vs* TLC %p	
Pearson's correlation coefficient (r)	–0.56		–0.25	
Regression line: y = ax+b	a = –1.13	b = 146	a = –0.32	b = 121

The slope characterizing the MEP-TLC relationship was less steep than the slope characterizing the MIP-RV relationship (see figure), suggesting that, secondary to lung hyperinflation, the extension of the expiratory muscles is less detrimental to muscle force than shortening of the inspiratory muscles.
Conclusion: Both inspiratory and expiratory muscle strength were negatively associated with the degree of lung hyperinflation. Therefore, when interpreting MIP and MEP values in COPD patients, the degree of hyperinflation should be taken into account.

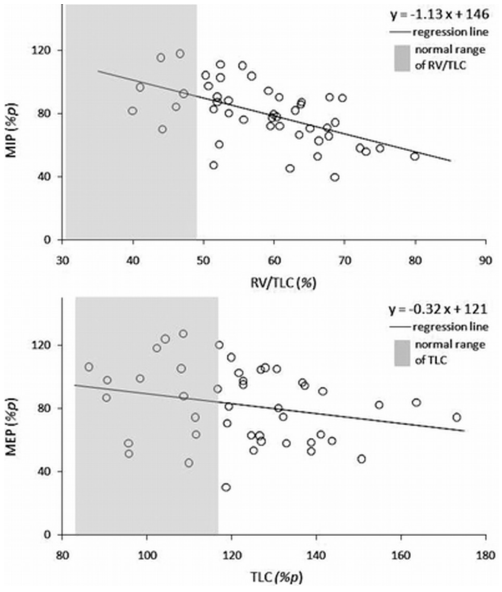


Figure 1. Relationship between maximal inspiratory pressure (MIP, top) and the maximal expiratory pressure (MEP, bottom) and the degree of lung hyperinflation at which the maneuver was performed.

P1154
Anesthesia induced changes of respiratory mechanics in rats measured by impulse oscillometry
Carmen Claudia Klein[1], Jens Thomas[2], Norbert Mieskes[3], Martin Hoffmann[2], Hans-Juergen Smith[3]. *[1]Veterinary Clinic, fzmb GmbH, Research Centre of Medical Development and Biotechnology, Bad Langensalza, Germany; [2]Medical Development, fzmb GmbH, Research Centre of Medical Development and Biotechnology, Bad Langensalza, Germany; [3]Medical Development, Research in Respiratory Diagnostics, Berlin, Germany*

Aim: Because anesthesia is often required in respiratory research of rodent species, whose influence on respiratory mechanics should be investigated utilising the non invasive Impulse Oscillometry (IOS) test.
Material and methods: Ketamine/medetomidine combination (study a), followed by urethane two weeks later (study b), were applied for anesthesia of ten female rats. IOS measurements were taken before and 30 minutes after drug application in each study.
Results: Breathing frequency and tidal volume decreased significantly due to anesthetics in both studies. Results of spectral resistance (R) and reactance (X), all in kPa L^{-1} s, as well as level of significance are presented in table 1.

Table 1. Medians (lower; upper quartiles) of R and X before and after medication of ketamine/dedetomidine (study a) and urethane (study b)

Parameters	Study a		Study b	
	before	after	before	after
R5	5.6 (2.6; 6.3)	6.6 (6.1; 7.0)*	6.1 (5.7; 6.4)	6.3 (6.1; 6.8)
R10	7.2 (6.1; 7.7)	5.8 (5.4; 6.0)**	6.9 (6.7; 7.0)	6.2 (6.0; 6.5)*
R15	5.3 (5.1; 6.3)	4.7 (4.4; 5.0)*	5.3 (5.2; 5.6)	4.9 (4.7; 5.0)**
X10	–2.9 (–3.1; –2.5)	–3.0 (–3.7; –2.6)	–3.7 (–3.9; –3.5)	–4.0 (–4.6; –3.7)
X15	–4.1 (–4.7; –3.4)	–3.4 (–3.7; –3.0)*	–5.0 (–5.3; –4.9)	–4.1 (–4.4; –3.9)*
X20	–5.4 (–5.7; –3.8)	–3.6 (–5.0; –3.1)**	–5.2 (–5.4; –5.1)	–4.1 (–4.0; –3.8)*

Signed rank test, *p<0.05; **p<0.01.

Conclusion: Anesthesia in rats leads to changes of their breathing pattern and various impedance parameters as well. These investigations are only possible using a non-invasive and non-cooperative technique like the IOS.
The authors appreciate the financial support of the German Federal Ministry of Economics (Berlin Germany, registration number IW 070139).

P1155
Detection of bronchial asthma using impulse oscillation system (IOS) in patients with normal spirometry
Roberto Lipsi, Anna Chiara Ogliari, Alice Biffi, Alessandra Cimino, George Cremona. *Servizio di Pneumologia e Fisiopatologia Respiratoria, Istituto Scientifico San Raffaele, Milano, Italy*

Background: The gold standard for the diagnosis of bronchial asthma in patients with a normal spirometry is currently the bronchial provocation test. IOS is a promising technique to assess airway function being simple to perform and able to quantify changes in peripheral airway resistance undetected by traditional spirometry.
Aim & methods: In order to assess whether IOS could be useful in detecting asthma in subjects with a normal spirometry, 23 (9 female, mean age 37 SD 17 years) non smoking patients referred for methacholine challenge testing (MCT) for chronic rhinitis or cough were studied by spirometry and IOS prior to MCT. All tests were performed on the same day in separate study rooms by different technicians blind to the results.
Results: Mean baseline FEV1 was 87 SD 10% of predicted. Ten subjects had a positive MCT with a mean PD20 dose of 0,5 SD 0,4 mgl -1. IOS showed higher baseline R5-20Hz values in MCT+ subjects (0,86±0,71 vs 0,27±0,14 cmH2O/l/s; p<0,05) and higher baseline Peripheral Airway Resistance (Rp) (2,61±1,3 vs 1,43±0,85 cmH2O/l/s; p<0,05). The was a strong negative correlation between baseline Rp and PD20 (r=-0,77, p=0,009). The area under the Receiver Operatine Curve (ROC) showed a accuracy of 0,78 (C.I.=0,66-0,88) using a cut-off value of 3,01 cm H2O/l/s.
Conclusion: We conclude that Rp may be a useful marker in predicting MCT response and provide a screening tool for detecting bronchial asthma.

P1156

An influence of low frequency noise on lung function

Larisa Kiryukhina[1], Dmitriy Gusarov[2], Alexey Seleznev[2]. *[1]Laboratory of Functional Investigations, Research institute of Phthisiopulmonology, Saint-Petersburg, Russian Federation; [2]Center of Medical and Biological Problems, Research Institute of War Medicine, Saint-Petersburg, Russian Federation*

Introduction: The natural irritants of lung mechanoreceptors are the differences of air pressure. In lungs even at insignificant influence of noise, there are waves of compression and vacuum parenchyma, deformation of alveoluses walls, bronchial tubes and blood vessels. Low-frequency noise, practically without distortions getting into a chest cavity, affects lungs already at small intensity. Low-frequency acoustic fluctuations in lungs lead to plethora in lung capillaries, a hypostasis of interalveolar partitions, focal haemorrhage.
Aim: To investigate an influence of low frequency noise on pulmonary function.
Materials and methods: We examined 28 artillerymen (all men, mean age 40,8±8,2 yr, work duration 10,1±3,6 yr) and 12 from them in 3 years later. All of them were exposed low frequency acoustic influence (acoustic impulses duration 200-400 msec with peak pressure 140-150 dB at 16-31.5 Hz). We performed spirometry, body plethysmography, investigation of lung elasticity and diffusion capacity for CO (DLCO).
Results: 54% of artillerymen from this group had decrease of residual volume (RV), 11% of them had decrease of total lung capacity (TLC) and 7% had decrease of vital capacity, 36% had decrease of lung compliance. 18% of artillerymen had decrease DLCO and 36% of them had decrease of ratio DLCO/VA. In 3 years we observed progress in decreasing of TLC, RV, intrathoracic gas volume, DLCO and DLCO/VA.
Conclusion: We concluded low frequency noise had conducted decreasing of static lung volumes and diffusion capacity.

P1157

A comparison of two analysers measuring exhaled nitric oxide concentration

Waldemar Tomalak, Jakub Radlinski. *Dept. Physiopathology of Respiratory System, Institute for TBC & Lund Dis. Rabka Branch, Rabka, Poland*

The measurements of the concentration of nitric oxide in exhaled air (FeNO) has been introduced in 90's of XXth century. FeNO appeared to be a useful marker of inflammation activity and is used as a tool in controlling asthma and its treatment. The aim of the work was to compare two analysers measuring FeNO: Sievers 280i (Sievers, USA) and HypAir (Medisoft, B). The Sievers analyser works on-line and uses ozone transducer to measure FeNO. Hypair analyses the sample off-line (time of analysis ~25s) and uses electrochemical transducer. In 76 patients (12.6±6.0 years) we have made measurements using both analysers in random order according to ERS/ATS recommendations. The subjects exhaled air through flow restrictor. At least three measurements that did not differ much than 5% were taken in each subject using both analysers, and the mean was taken as a result. The data were then analysed using Bland-Altman approach.
Mean value of FeNO for Sievers was 35.0±33.9 ppb (range 5-172 ppb) and 31.5±30.4 ppb (5-162) for HypAir respectively. The mean difference was 3.5±8.5 ppb; both measurements did not differ between them (paired t-test p=0.25). The measurements were strongly related to each other with r=0.971 and FeNO(HypAir) = 1.07+0.87*FeNO(SIEVERS).
Bland-Altman analysis showed, that correlation between difference and the mean was statistically significant (r=0.42, P<0.001) and positive. That means that the difference has a systematic character and cannot be omitted. When using results from both apparatuses the correction formula should be applied.

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Comparison of the fine particle fraction of fluticasone propionate/formoterol fumarate combination with other combination products

Johal Baljinder[1], Markus Howald[2], Manfred Fischer[3], Jonathan Marshall[4]. *[1]European Technical Development, Mundipharma Research Ltd., Cambridge, United Kingdom; [2]Medicinal and Regulatory Development, SkyePharma AG, Muttenz, Switzerland; [3]Medicinal and Regulatory Development, SkyePharma AG, Muttenz, Switzerland; [4]Mundipharma International Ltd., MINT, Cambrige, United Kingdom*

Background: A combination of the inhaled corticosteroid, fluticasone propionate, and the long-acting β2-agonist, formoterol fumarate has been developed in an aerosol inhaler (FLUT/FORM). As changes in flow rate have been shown to affect the in-vitro performance of inhalers, which could compromise in-vivo performance, this study evaluated the effect of flow rate on fine particle fraction (FPF) and dose (FPD) of FLUT/FORM and three available combination products.
Methods: Dose strengths used to deliver comparable treatment doses (FLUT/FORM, 250/10μg; beclomethasone/formoterol (BDP/FORM) pMDI, 200/12g; fluticasone/salmeterol (FLUT/SAL) DPI, 250/50μg; budesonide/formoterol (BUD/FORM) DPI, 400/12μg) were compared. Aerodynamic particle size distribution was determined by Andersen Cascade Impaction at 28.3L/min and 60L/min flow rates with a cut-off diameter of 5.0 μM and was calculated as % of label claim.
Results: FLUT/FORM provided a consistent and high FPF of approximately 40% for each component, with less than a 10% relative difference in the FPD emitted between flow rates. FLUT/FORM provided the highest FPF at both flow rates with BUD/FORM and FLUT/SAL delivering a FPF of less than 20% at 28.3L/min. The FPD of all three comparator products evaluated were affected by increases in flow rate from 28.3L/min to 60L/min, with BUD/FORM having a ~5 fold increase in FPD between flow rates and BDP/FORM showing a 50% difference.
Conclusion: The data confirm that FLUT/FORM emits a high FPF of approximately 40%. These data also demonstrate that FLUT/FORM has a higher FPF, that is less affected by changes in flow rate, than other combination products assessed.

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Does the model of parallel connected bronchi in each generation functionally correspond to the true dichotomy structure of the bronchial tree?

Liubov Barbinova, Xaver Baur. *Department of Clinical Occupational Medicine, Institute for Occupational Medicine and Maritime Medicine, University Medical Center Hamburg Eppendorf, Hamburg, Germany*

Background: The structure of the bronchial tree is described in Weibel's model as a dichotomy pattern of the airways branching. The classic calculation of airways resistance (R_{aw}) is, however, based on the assumption of parallel connected bronchi in each generation. We investigated the conditions, under which this assumption correctly represents the dichotomy.
Methods: We calculated R_{aw} by a classical model (parallel connected bronchi (PM)) und compared it with R_{aw} obtained by a dichotomous model (DM). In the latter, R_{aw} was calculated consecutively by pairs of branching in 23 generations. We simulated an obstruction of 50% of the bronchi to 0.5 (half) of their radius.
Results: In case of normal structure (all bronchi of each generation have ideal radius) provided both models identical R_{aw}.
Further analysis showed that PM is not sensitive for the spatial distribution of obstructive bronchi. It operates only with their number in each generation regardless whether the obstruction occurs in the same or in different segments.
DM is sensible to the heterogeneity of obstruction. The simulations of random distributed obstruction showed that DM leads to a 2.1fold higher R_{aw} compared to PM. Primarily vertical bronchial heterogeneity plays an essential role. By simulation of different patterns of topographical heterogenous obstruction, estimated R_{aw} is in DM on the average 4.3fold higher than in PM.
Conclusions: The classical model of parallel connected bronchi of each generation disregards the topography of obstruction that leads to falsely decreased R_{aw} estimation. Spatial heterogeneity of the obstruction is an important factor of R_{aw} increase.

P1160

Processing optimization of exhaled breath condensate previous to the analysis by mass spectrometry

Laura Nunez-Naveira, Luis Marinas-Pardo, Beatríz Lema-Costa, Ninoska Flores-Calle, Héctor Verea-Hernando, Carmen Montero-Martínez. *Respiratory Research Unit, CHU A Coruna. Biomedical Research Institute of A Coruna(INIBIC), A Coruna, Spain*

The Exhaled Breath Condensate (EBC) is a representative and non-invasive lung sample so the determination of its proteome might be useful to find disease-specific biomarkers. Most of the works published up to the date about this issue describe several problems to identify proteins by mass spectrometry.
Aims: To evaluate three methods of EBC concentration as a pre-processing step for the use of mass spectrometry protein identification. To optimize the storage conditions for the EBC.
Methods: EBC samples were collected with the EcoScreen Device (Viasys GmbH, Germany) and stored at -80°C. Protein quantification was performed by BCA methodology. Sample concentration was performed by liofilization, centrifugation with Amicon Ultra-2 filters (Millipore) or Reverse phase chromatography with POROS R2 resin. Proteins were identified by mass spectrometry.
Results: After processing, there were no differences between liofilization and filtration which yielded an insufficient concentration for mass spectrometry (64.38±25.97; average μg/mL±standard deviation). Protein purification with POROS R2 followed by tryptic digestion gave place to the identification of 13 proteins. Long term storage of EBC affected dramatically the protein stability.
Discussion: Protein concentration by reverse phase chromatography is necessary to determinate the EBC proteome by mass spectrometry. EBC samples should be analyzed within one year period to avoid protein degradation. This optimization is crucial to determinate the protein profile in EBC samples from different respiratory pathologies.

P1161

Clinical usefulness of the measurement of percutaneous partial pressure of carbon dioxide in respiratory patients

Takeshi Tanaka[1], Toshiaki Homma[1], Keisuke Aita[1], Hiroyuki Fukazawa[1], Masaaki Hagiya[1], Kennosuke Kadono[2]. *[1]Respiratory Medicine, Teikyo University Chiba Medical Center, Ichihara City, Chiba Prefecture, Japan; [2]Respiratory Medicine, Moriya Sleep Clinic, Moriya City, Ibaraki Prefecture, Japan*

Background: Arterial oxygen (PaO2) and carbon dioxide gas partial pressure (PaCO2) conditions due to many causes of respiratory diseases are very important to the respiratory patients. But in practice, usually on admission of the patients,

many clinicians tend to omit blood gas analysis, because this is an invasive, painful, expensive examination and not essential for the adaptation of medical insurance on the treatment of respiratory patients. So, we used a percutaneous carbon dioxide partial pressure (PtcCO2) analysis meter (TOSCA™) and measured PtcCO2 of respiratory patients and compared these results with the conventional blood gas meter.

Objectives: Forty of our respiratory patients who admitted to our clinic because of symptoms. Ten chronic obstructive pulmonary disease, ten pneumonia, ten interstitial pneumonia, ten lung cancer patients were enrolled. We gave them the informed concents and measured PtcCO2 and PaCO2.

Methods: The ear probe of TOSCA™ was put on the patient's ear pad. Five minutes after, we checked their respirations and if they were stabilized, PtcCO2 measurements have started. The PtcCO2, percutaneous O2 saturation (SpO2) and pulse rate on the display were checked and recorded. Then we measured PaCO2.

Results: The correlation between all PtcCO2 and PaCO2 was R2=0.97. If we mentioned full and detail, chronic obstructive pulmonary disease (R2=0.97), pneumonia (R2=0.99), interstitial pneumonia (R2=0.95), lung cancer (R2=0.86) and all data had significant correlations.

Conclusion: The measurement of PtcCO2 by the TOSCA™ is non-invasive and provides very useful informations on the patient's respiratory conditions before the treatment of diseases.