250. Exhaled biomarkers in airway diseases

P2200
A simple practical method to partition lung peripheral and airway nitric oxide
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Background: By measuring FeNO at multiple flows and applying mathematical models of FeNO exchange dynamics, the signal can be partitioned into its proximal airway [Jno (nl/sec)] and distal airway/alveolar contributions [Calv (ppb)] using a linear regression. This method is time consuming, requires at least 3 exhalations and is affected by a number of limitations such as axial diffusion and turbulent flow. We developed a more practical method.
Methods: In a group of 29 normal subjects (38±2 yr; 20 male), 13 asthmatic patients (48±8 yr; 8 male, FEV1 90±4% predicted), 14 patients with chronic obstructive pulmonary disease (COPD) (63±2 yr; 10 male, FEV1 59±3%), and 12 patients with cystic fibrosis (21±4 yr; 8 male, FEV1 60±3%) we compared Calv and Jno with the variation of total NO production at 50 and 200 ml/s [Vno50-200 (nl/s)]. Vno was measured by calculating the average area under the curve (NO concentration/time) of two successive exhalations at each flow rate.
Results: Vno50-200 was strongly correlated with Jno in normal subjects (r=0.94, p<0.001), asthma (r=0.98, p<0.001), COPD r=0.93, p<0.001), and CF patients (r=0.74, p<0.05). This agreement was confirmed by the Bland and Altman test.
Conclusions: The flow dependent component of exhaled NO is determined by its bronchial production which can be estimated by measuring Vno50-200. This method is simple, does not require sophisticated equipment or mathematical models and is in agreement with Jno calculated mathematically with the conventional linear regression method.

P2201
Endogenous and exogenous metabolites in exhaled breath condensate in asthma
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Profile of metabolites in different biological fluids reflects the physiological and pathophysiological processes in the human organism initiated by internal and external factors. Exhaled breath condensate (EBC) analysis can provide information about the state of metabolic processes in the respiratory tract.
Aim: To investigate various metabolites in EBC in asthma patients and healthy controls.
Methods: EBC was collected from 20 asthma patients and 30 healthy subjects using an ECoScreen condenser. Metabolites were determined in EBC using gas-chromatography - mass-spectrometry method (GC-MS) and identified in NIST-2005 library.
Results: There were found semi-volatile metabolites (SVMs) in EBC in asthma patients and healthy subjects. SVMs belong to different classes of chemical compounds: saturated fatty acids (SFAs), hydrocarbons, alcohols, aldehydes, ketones, esters, phenols and alkaloids.The limit of compounds detection was 0.1-10 ppb. 18 SVMs are presented in the Human Metabolome Database (HMDB): 13 endogenous metabolites and 5 exogenous metabolites. SVMs were determined earlier in the blood, urine, but there is still no information in HMDB about these metabolites in EBC. The most representative group consisted of 12 SFAs, 11 of them are endogenous metabolites. The content of stearic and palmitic acids in EBC of patients with asthma was significantly decreased in compared with healthy. We found negative correlations between SFAs in EBC and spirometry parameters (FVC, FEV1 and FEV1/FVC) (p<0.05) in asthma patients.
Conclusion: The pathological process in the respiratory tract changes the expression of SFAs in EBC, indicating the involvement of these metabolites in the pathogenesis of asthma.

P2202
Exercise increases the hydrogen peroxide release in exhaled breath condensate
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Background: Exhaled breath condensate (EBC) contains numerous mediators of oxidative stress (NO, H_2O_2). Exercise is characterised by an increase of reactive oxygen species (ROS), which can also be found in EBC. Building of hydrogen peroxide (H_2O_2) can be induced by ROS. In order to get inside into the correlation of H_2O_2 release in EBC and exercise, we investigated H_2O_2 release at rest and at different levels of exercise.
Methods: 20 healthy subjects, (23.3±1.5 years), were investigated, during resting conditions as well as at 60%, 75%, and 90% of maximal work capacity(p_{max}) (each lasting 5 minutes) on a cycle ergometer. 100 L exhaled air along with capillary blood samples were collected under stationary load conditions. EBC was obtained by cooling the exhaled air volume to -20°C. H_2O_2 was analyzed using the EcoCheck device (EcoCheck, FILT). H_2O_2 was analyzed using the EcoCheck device (EcoCheck, FILT). In further analysis the release per minute and the release for the total amount of water from 100 L exhaled breath were calculated.
Results: At rest H_2O_2 concentration in EBC was 216±52 nmol/L, H_2O_2 release in the collected EBC was 115±45 pmol/min. At 60%, 75% and 90% of p_{max}, H_2O_2 concentration in EBC increased to 288±80, 322±71, 334±95 nmol/L (p<0.01). Taking the theoretical water volumes of 4.4 ml EBC derived from 100 L exhaled air into account, H_2O_2 release increased to 160±75, 250±88 and 357±162 pmol/min (p<0.001). The correlation of H_2O_2 release and ventilation can be described by r=0.8.
Conclusions: In healthy subjects, a nearly 3-fold increased of H_2O_2 release in

EBC was found during exhausting exercise. The elevated levels of H_2O_2 may be interpreted as an increase of ROS during exhausting exercise.

P2203

Protein markers in the exhaled breath condensate of lung carcinoma patients

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Background: Analysis of exhaled breath condensate (EBC) is an emerging method of noninvasive diagnosis of pulmonary diseases. The growing number of biomarkers identified in the EBC, allow to diagnose a wide range of diseases. The aim of this study was to identify protein markers in EBC of lung cancer patients by mass spectrometry.
Materials and methods: EBC of 25 patients (mean age -55 years) with different forms of lung cancer were collected using R-Tube™, freeze dried, treated by trypsin. Bathes were analyzed by nanoflow LC-MS/MS with a 7-Tesla Finnigan LTQ-FT mass spectrometer. The list of direct peptide mass and mass of their fragments, with following identification of proteins in the Mascot databases was generated by means of Bioworks Browser 3.1SR. Previously obtained data from healthy volunteers served as a control.
Results: Proteins which are non-specific for healthy people EBC were identified at more than half samples e.g. Keratin II-2-protein used in the test-systems for the differentiation of epithelial origin cells circulating in blood of cancer diseased persons, Collagen α - the protein that reflects the degradation of connective tissue cells; Hemoglobin subunits - characterized bleeding, as evidenced by clinical disease. In 31% of EBC samples detected proteins are also not typical of the healthy volunteers: Human lactoferrin, Zinc finger CCCH domain-containing protein 11A, Sex hormone-binding globulin, Protein shroom3.
Conclusion: In conclusion, the identification of specific proteins in the EBC of patients with cancer of respiratory system and their comparing with healthy donor matrix can provide significant data for early diagnosis of onco-pulmonary disease.

P2204

Particle content in exhaled air depending on breathing maneuver

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The airway opening generates particles in the distal airways. At high exhalation flows, particles can be formed due to dynamic compression in more central airways. The aim with the present study was to compare particle number and size distributions as well as concentrations of SpA in PEx formed during tidal breathing, airway opening and dynamic compression using forced exhalations.
Ten healthy volunteers performed three different types of breathing maneuvers in randomized order; Reference maneuver (R): no airway closure and no dynamic compression (slow expiration), Dynamic compression (DC): maximal exhalation and no preceding airway closure, Airway opening (AO): slow expiration preceded by an inspiration from tidal lung volume. PEx were counted, sampled and analyzed for surfactant protein A (SpA) content using ELISA.
Compared to the R maneuver; the DC maneuver doubled the particle concentration and the AO maneuver gave a ten times increase in the amount of particles per liter exhaled. Flow volume curves indicated that dynamic compression was limited by the back pressure in the instrumentation.
The mass ratio of Sp-A in the PEx were highest in PEx using the R maneuvre; 13% v.s 5%DC ($p<0.001$) and 3%AC ($p<0.001$), DC to AC difference was not significant ($p=0.1$). The size distributions were similar in all maneuvers.
Conclusion: In conclusion, fast exhalation flows generates more particles than slow exhalation flows, but probably not by the dynamic compression mechanism.

P2205

Exhaled breath temperature in COPD patients

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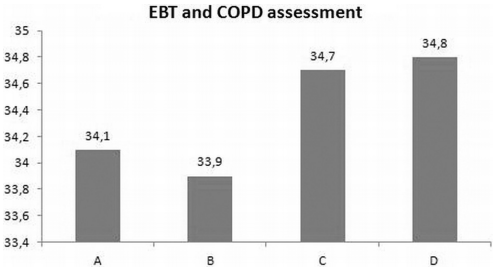
Introduction: Chronic obstructive pulmonary disease (COPD) is a common airway inflammatory disorder with structural degradation of the airway tissue. Previous reports showed that patients with COPD had EBT lower than normal subjects. Recently, a new combined COPD assessment was established based on the symptoms, spirometric classification and risk of exacerbation (GOLD 2011).
Objectives: Evaluate the EBT in COPD patients according to the new combined COPD assessment and compare to healthy subjects.
Methods: EBT was measured (using the X-halo, Delmedica, Singapore) in 80 COPD patients (FEV1% 54±14, age 60±8 years, 46 males) and 80 healthy controls. Lung function, COPD Assessment Test (CAT), exacerbations and previous treatment was performed.
Results: There was not differences EBT between COPD patients 34,2°C vs healthy subjects 33,9°C. There was no correlation between EBT with FEV1% (r=0,23) and EBT with CAT (r=0,01) but patients with previous exacerbations had EBT more than patients without exacerbations (34,7°C vs 33,9°C, $p<0,001$) According to the new combined COPD assessment (20 subjects for each group), the EBT was: Group A 34,1°C, Group B 33,9°C, Group C 34,7°C and Group D 34,8°C. ($p<0,001$ between Group B vs Group C and D).



Conclusion: Our results showed that COPD patients with frequent exacerbations, 2 or more per year, had increased of Exhaled Breath Temperature, therefore may reflect inflammation in the COPD lung.

P2206

Concentrations of nitric oxide metabolites in the exhaled breath condensate in children with different bronchial asthma control

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Although bronchial asthma (BA) is an inflammatory disease, the clinical tools that evaluate asthma control today do not include the qualitative measures of inflammations.
Objective: Determination of correlations between total concentration of nitrates and nitrites (TNN) in the exhaled breath condensate (EBC) and children asthma control level determined using the Asthma Control Questionnaire (ACQ).
Material and methods: 81 patients with atopic BA (from 6 to 17 years old) were clinically evaluated. Patients completed ACQ, underwent spirometry, and measurements of their TNN in EBC. In 55 children, the high BA control (ACQ=0.29±0.26) was diagnosed. 13 children had partially controlled BA (ACQ=0.96±0.20), and 13 children had only bad BA control (ACQ=1.95±0.33). Among the children with high BA control, 27 had no steroid (IGKS) treatment, 28 had only basic IGKS therapy. All children with partial or bad control had IGKS therapy.
In 27 steroid-naive patients with high-controlled asthma, the TNN in EBC was 6.24±2.93 mkM. In 28 patients with controlled BA taking IGKS, TNN was 4.66±2.34 mkM ($p=0.03$). In patients with partially controlled BA, TNN level was 6.23±2.62 mkM; in patients with bad control - 6.52±2.62 mkM. The correlation between TNN and ACQ scores was found in the whole group ($p=0.047$), however, the significance was varying in groups with different therapy. In the group of steroid-naive patients, $p=0.07$; in patients treated with IGKS, $p=0.024$.
The interpretation of TNN in patients with BA, if it is performing for the additional characterization of the control level, should include the consideration of therapy taking by patients.

P2207

Saturated fatty acids in exhaled breath condensate in COPD patients

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In recent years suggest that individual saturated fatty acid (SFA) has specific properties which are associated with important biological functions. The composition of SFAs in exhaled breath condensate (EBC) in COPD has not previously been studied.
Aim: To identify SFAs in EBC and to assess their relationship with clinical and functional parameters in patients with COPD.
Methods: We have studied 20 patients with COPD and 30 healthy nonsmokers. EBC was collected using ECoScreen. SFAs in EBC have been identified by gas-chromatography - mass-spectrometry method (GC-MS) and NIST-2005 library.
Results: 12 SFAs (palmitic acid, stearic acid, myristic acid, etc.) have been identified in EBC in COPD patients. There were no differences in the content of SFAs in EBC in COPD patients and healthy subjects. We have found the relationship between EBC content of caproic acid (R=-0.46), enanthic acid (R=-0.61), caprylic acid (R=-0.50) and FVC in COPD patients ($p<0.05$). In addition, the content of myristic acid in EBC significant correlated with oxygen saturation (R=-

0.45), breath frequency (R=0.48), pulmonary artery systolic pressure (R=0.73), MRS dyspnoea scale (R=0.52) and Paggiaro symptoms scale (R=0.58) in COPD patients.
Conclusion: The content of different SFAs in EBC is associated with clinical symptoms and functional parameters in COPD patients reflecting their role in the inflammatory process in the lungs.

P2208
Spontaneous airway obstruction masks FeNO level in patients with asthma but not COPD
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Background: Airway calibers are related to changes in Fractional exhaled nitric oxide (FeNO) in asthma; however, this effect is not well understood especially during spontaneous airway obstruction.
Objective: The aim of this study was to evaluate whether FeNO levels could be masked by airway obstruction in patients wit asthma and COPD.
Methods: FeNO and spirometry measurements were performed before and after albuterol inhalation in 20 steroid-naive asthmatics with moderate to severe airway obstruction. For comparison, 15 normal subjects, 16 asthmatics using inhaled corticosteroids/long-acting β(2)-adrenoceptor agonist(ICS/LABA combination) and another group of patients with COPD were also studied. All the patients with asthma and COPD recruited had positive bronchodilator test (BDT).
Results: FeNO(median [25th-75th percentiles]) increased significantly after albuterol inhalation in steroid-naive asthmatics 61.50[40.50-85.00]vs.80.00[53.00-108.00], *P*=0.000) but not in treated asthmatics 27.50[20.25-35.00] vs 25.00[17.25-38.00], *P*=0.741), COPD 13.00[9.50-22.00] vs.11.00[6.50-16.00], *P*=0.017) and normal subjects 11.00[8.00-14.00] vs.11.00[8.00-13.00], *P*=0.424). The absolute increase in FeNO correlated significantly with the absolute increase in FEV1(*r*=0.48, *P*=0.000) in whole asthma patients. There was no significant correlation between FeNO (including pre-and post-bronchodilator) and FEV1 (or FEV1%) in all four groups.
Conclusions & clinical relevance Spontaneous airway obstruction reduces FeNO level in patients with steroid-naive asthma but not treated asthma and COPD.

P2209
No difference between measured and calculated $F_ENO_{0.05}$ with the clinical software for extended NO analysis
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The extended NO analysis, with the calculations of alveolar NO (C_ANO), airway wall NO ($C_{aw}NO$), diffusion rate of NO ($D_{aw}NO$), gives more information of the respiratory system than a single value. It demands an exhalation at low flow which is difficult in children.
The aim was to identify the lowest flow to use for the extended NO analysis, non-linear method (Högman & Meriläinen algorithm, HMA)[1]. In addition, the clinical software using the HMA is incorporated in the CLD 88sp NO analyser (ECO Medics AG, Switzerland) was tested with these optimal flow rates.
Healthy subjects, smokers and atopic subjects with an age of 18-65 years participated. The lower flow rate of 10, 20 and 30 mL/s was tested in 20 subjects. The HMA was used to calculate the NO parameters and a significant difference was found with different flow rates. It was concluded that 20 mL/s could be used instead of 10 mL/s.
Subjects (n=32) volunteered to exhaled at 20, 50, 100 and 350 mL/s with the use of the clinical software. $F_ENO_{0.05}$ was calculated from the HMA. There was no statistical difference between the measured and calculated.

Measured	Calculated				
FENO 0.05 ppb	FENO 0.05 ppb	CANO ppb	CawNO ppb	DawNO mL/s	JawNO nL/min
11.7 (9.6–14.3)	11.5 (9.3–14.1)	0.8 (0.6–1.0)	45 (33–62)	14 (10–19)	674 (527–864)

Data given as geometrical mean and 95% CI, except CANO given as mean.

In conclusion, the clinical software with the HMA to calculate NO parameters could accurately generate $F_ENO_{0.05}$. The flow rates to use for the non-linear model for the NO parameters are 20, 100 and 350 mL/s. Therefore patients need only to perform at three flow rates which make the extended NO analysis less burdensome.
[1] Högman *et al*. Respir Med 2002:96;24-30.

P2210
FeNO measurements in pregnant asthmatic women
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Background: The measurement of severity and control of asthma can be based on subjective or objective measures. It has been advocated that fractional exhaled nitric oxide (FeNO) can be used to monitor airway inflammation as it correlates with some markers of asthma.
The aim of our study was to assess the clinical usefulness of the assessment of FeNO for monitoring asthma during pregnancy.
Methods: It was a prospective cross-sectional study. We evaluated the medical data of 72 pregnant asthmatic women: FeNo results, atopic status, spirometry and ACT (asthma control test) (monthly, 257 visits in all; first visit between 8-22 Hbd). We assessed asthma severity on the basis of anamnesis considering mean doses of inhaled glucocorticosteroids taken by the patients and a management approach based on control according to the newest guidelines of Global Initiative for Asthma (GINA) throughout the last three months before pregnacy.
Results: We did not find correlation between FeNO levels at visit one (pregnancy) and asthma severity before pregnancy (p=0.97). In 22 women with worsening asthma during pregnancy, the mean FeNO during visits without asthma symptoms and with asthma worsening did not differ. A comparison of FeNO levels in the groups of women with well controlled asthma during pregnancy and FeNO with visits without asthma symptoms in the group of women with at least one asthma exacerbation did not differ. There was a statistically significant but low correlation between FeNO levels and ACT total scores results, and FeNO levels and FEV1 (r=0,21 and r=0,25 respectivelly).
Conclusions: FeNO does not seem to be clinically applicable to predict asthma prognosis during pregnancy, esspecialy beacouse of its high coefficient variation.

P2211
Investigation on the effectiveness of the Mostgraph and fractional exhaled nitric oxide measurement in chronic cough
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Objectives: Mostgraph, Fractional exhaled nitric oxide(FeNO) measurement, and pulmonary function tests were conducted in patients with chronic cough. The effectiveness of Mostgraph, FeNO measurement, and pulmonary function tests were examined in elucidation of pathology, differential diagnosis, and therapy evaluation of chronic cough.
Method: *s:* The subjects were 120 patients who presented with chronic cough. The respiratory resistance measuring device Mostgraph (Chest MI, Inc) was used. For FeNO, NIOX-MINO (Aerocrine) was used. Pulmonary function tests used spirometry. Imaging and blood tests were performed as diagnostic aids. Patients treated with combination of β stimulants and inhaled corticosteroid.
Results: Airway resistance at 5 Hz (Rrs5) and 20 Hz (Rrs20) as well as FeNO tended to increase in patients with chronic cough. Airway resistance and FeNO showed a significant reduction as symptoms improved. Pulmonary function tests showed no significant changes.
Conclusion: *s:* In patients with chronic cough, Rrs5 and Rrs20 increased, and FeNO tended to increase, but decreased with treatment. A combination of Mostgraph and FeNO measurement can be conducted quickly and noninvasively, and this study suggests that this combination may be useful in diagnosis of chronic cough, and in assessing the effectiveness of treatment.

P2212
FeNO (fractional exhaled nitric oxide) measurements in pregnant asthmatic women. The long-term, intra-subject variability of FeNO in controlled asthma
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Background: Fractional exhaled nitric oxide (FeNO) is considered a good non-invasive marker to assess airway inflammation in asthma and allergic rhinitis. It has been also proposed that adjusting anti-inflammatory drugs guided by the monitoring of exhaled NO could improve overall asthma control. However standards, the assessment of long-term repeatability of this parameter as well as the rate of change which can be considered significant have not been established yet.
The aim of our study was to assess the long-term, intra-subject variability of FeNO in pregnant asthmatic women with controlled asthma.
Methods: Pregnant, non-smoking women with asthma were recruited between 8 and 24 weeks of gestation. Exhaled nitric oxide (FeNO), lung function, and the asthma control test (ACT) were performed at monthly visits up to delivery. The data of 50 subjects with well controlled asthma (20-25 ACT, normal spirometric parameters, no change in treatment) during pregnancy were analyzed. The variability of the FeNO parameter was assessed in asthmatics using the variation coefficient (standard deviation x 100%/average).
Results: FeNO showed high coefficient of variation (CV): 35.8% (Me 32;Min 2.45, Max 121,9) in all women with well controlled asthma during pregnancy. There was no significant difference in CV between atopic 36,2% (35,5; 2,45-121,9) and nonatopic 33,9% (25,5; 11-71,9) asthmatic women (p= 0,98).
Conclusions: Long-term variation of FeNO was found to be not satisfactory be-

cause the variation coefficient was 35.8%. It means that changes of FeNO should be interpreted with caution.

P2213

No effect of breathing dry gas on exhaled nitric oxide concentration at rest

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Background: The prevalence of asthma in elite endurance athletes is high, in particular among skiers. Prolonged high ventilatory demands in a cold and dry environment may contribute to the development of, or worsening of the asthma. Training periods often take place at altitudes of 2-3000 meter where ventilatory demand and respiratory heat and water loss are higher. Measurement of exhaled nitric oxide concentration (F_ENO) is useful for monitoring eosinophilic asthma, but not neutrophilic.
Aim: To assess the effect of breathing dry air on F_ENO.
Methods: Nine healthy subjects aged 21 – 27 yrs (4 men) breathed dry air and humidified air for 90 min at rest in random order on separate days. F_ENO was measured with a chemiluminescence analyser (Eco Medics AG, Duernten, Switzerland) at an expiratory flow rate of 50 $ml \bullet s^{-1}$ ~15 min before and ~15 min after the exposures.
Results: There was no difference in the baseline F_ENO between the two days. After exposure to dry air F_ENO decreased from 23.3 (SD=17.5) to 20.9 (SD=15.2) ppb, and after humid air it increased from 24.9 (SD=14.4) to 22.9 (SD=13.6) ppb.
Discussion: Breathing dry air at rest did not influence F_ENO. Higher ventilatory demands result in larger respiratory water loss, which may be a trigger of a bronchomotor response. The transient reduction in F_ENO after exercise must be controlled for when studying the combined effects of exercise and dry air on F_ENO.

P2214

Fractional exhaled nitric oxide in bronchiectasis

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Fractional exhaled nitric oxide (FeNO) can be measured easily, rapidly, and noninvasively for assessment of airway inflammation, especially mediated by eosinophil, such as asthma. In bronchiectasis, the pathogenesis has been known as chronic airway inflammation and infection with abnormal airway dilatation; however, there are little studies to evaluate the clinical application of exhaled nitric oxide in bronchiectasis.
From March 2010 to September 2011, 30 patients with bronchiectasis diagnosed by chest high resolution CT performed FeNO, compared with various pulmonary diseases, including asthma (n=24), COPD (n=21) and other infectious diseases (n=25). All patients carried out eosinophil count with chemistry, simple radiograph, sputum examination and spirometry, if indicated.
FeNO (mean, ppb) in patients with bronchiectasis was 19.1, compared to 68.4, 31.7 and 18.9 in asthma, COPD and other infectious diseases, respectively. FeNO in bronchiectasis was significantly lower than asthma ($P<0.001$), however, no statistical differences were seen between bronchiectasis and other pulmonary diseases except asthma. No correlation of FeNO with eosinophil count in bronchiectasis was seen, despite the correlation was true in all of patients enrolled in study. FeNO in bronchiectasis with co-infection of nonmycobacterium tuberculosis was slightly lower than without co-infection (14.8 vs. 20.8). FeNO also tended to decrease along with multi-lobe involvements on CT.
FeNO in bronchiectasis was lower than other respiratory diseases, especially compared with asthma. Clinical application of FeNO to bronchiectasis might be considered in the subgroup by clinical situation.

P2215

The usefulness of the simultaneous measurement of IOS and FeNO in the management of asthma

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Background: The evaluation of airway lesions by impulse oscillometry (IOS) and the evaluation of fractional exhaled nitric oxide (FeNO) as the indicator of asthmatic airway inflammation attract attention. [Aim] To evaluate asthmatic airway lesions by simultaneous measurement of IOS and FeNO.
Methods: The subjects were the good controlled 65 patients with asthma (good controlled group), and 42 symptomatic treatment-free initial-visit patients with asthma (initial-visited group). These subjects were nonsmoker. For the patients in both groups, we measured IOS and FeNO at the same time. IOS measured by Masterscreen and FeNO measured by NIOX MINO.
Results: The level of FeNO was 73.1±7.5ppb in initial-visited group, and was 25.0±2.3ppb in good controlled group, and the initial-visited group significantly showed high level. In the good controlled group, the positive correlation was accepted between the following IOS parameters, such as the total airway resistance, the small airway component, the peripheral capacitive reactance and the reactance area, the resonant freguency and FeNO ($p<0.0001$), but the correlation was not found between the large airway component and FeNO. Whereas, in the initial-visited group, the association was not found between these IOS indicators and FeNO.
Conclusions: FeNO mainly shows the inflammation of the small airway in the good controlled patients with asthma. Whereas, in the treatment-free initial-visited patients with asthma, FeNO was reflecting the inflammation of various airway regions.
Discussion: By the simultaneous measurement of IOS and FeNO, the information about asthmatic airway lesions as the target of treatment is obtained in greater detail.

P2216

Asthma control test (ACT), fractionated exhaled nitric oxide (FeNO) and forced expiratory volume in 1 second (FEV1) correlation in asthma control

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Background: The current goal of asthma treatment is to achieve and maintain control. Numerous markers or measurements of control are available. Among them, functional parameters (spirometry), clinical assessment (symptoms and quality of life) and biomarkers of inflammation are the most widely used.
Objective: This study aimed to clarify the relationship between the Asthma Control Test (ACT), lung function especially forced expiratory volume in 1 second (FEV1) and fractionated exhaled nitric oxide level (FeNO).
Patients and methods: There is a prospective study, for two months, including 37 asthmatic patients followed up outside of an exacerbation. A clinical protocol was followed with an assessment of asthma control by an ACT, spirometry and measurement of exhaled NO.
Results: There were 18 males and 19 females with a mean age of 43 years (12-7 years). The ACT score ranged from 12 to 25 (median=19). Total control of asthma ($ACT \geq 20$) was obtained in 18 patients. The average value of FeNO in the total control group (29.1 ppb) was significantly better than those in the less controlled groups with an ACT <20 (48.2 ppb).
There was no correlation between FEV1 and ACT ($r=0.05$), and between FEV1 and FeNO ($r=-0.02$). On the contrary, a negative correlation was found between ACT score and FeNO ($r= - 0.2$).
Conclusion: We can postulate that the degree of bronchial inflammation is more sensitively detected by FeNO than by FEV1. The ACT is a good subjective tool for assessing the degree of asthma control which is more correlated with FeNO than FEV1.

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Standardization procedures for in-vitro measurements using differential ion mobility spectrometry (DMS)

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Introduction: Air contains a couple of non-gaseous volatile organic substances (VOCs). Differential Ion Mobility Spectrometry (DMS) is an analytical method for detection of VOCs with sensitivity in the ppt-range and the possibility of processing native steam-containing samples. A common problem is the pollution of samples by environmental agents, even with similar VOCs as in the samples. The method already was used for detection of bacterial growth.
Methods: For evaluation of ambient air influences on standardized in-vitro samples, bacteria-breeding grounds in closed vials were measured with room air as well as with filtered room air. This method should keep the water-content of the samples unchanged. The spectra were analyzed by a statistical program based on cluster analysis.
Results: The evaluation included up to 120 clusters of peaks. The number of peaks in filtered pure room air was significantly reduced and the total intensity was about halved. The reactant ion peak (RIP) of room air was 1.5-fold increased. Peaks and total intensity of the measured breeding grounds remained virtually unchanged.
Discussion: The filtering of air was capable to reduce environmental pollutants of in-vitro DMS measurements, even if the sample contains ambient air itself. The RIP of the sample tracings remains unchanged or was slightly increased, which can improve the sensitivity of DMS-measurements.
The investigation shows that it is possible to dispense with expensive carrier gases, what allows inexpensive diagnostic measurements in a contaminated environment.

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Volatile organic compounds may provide a new and promising tool for diagnosing interstitial lung diseases

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Diagnosing interstitial lung diseases (ILD) requires invasive techniques. A new, non-invasive diagnostic tool includes analyzing volatile organic compounds

(VOCs) in exhaled air as they can be applied as biomarkers of e.g. oxidative stress and inflammation.
To i*n vitro* mimic ILD-related damage, human epithelial cells were exposed to bleomycin and headspace air and supernatants were collected. The supernatants were used to analyze cytotoxicity and markers of oxidative stress and inflammation. The headspace air was analyzed using time of flight GC-MS after which a discriminating VOC profile was composed.
To *in vivo* identify VOC patterns specific for ILD patients, the breath of 50 ILD patients and 50 healthy controls was screened for distinctive VOCs.
The *in vitro* volatome consisted of >2000 compounds of which 5 VOCs correctly classified samples with 95% correctness using the original data set and 85% using cross-validated observations. Although chemical identification of these compounds is ongoing, preliminary data suggest that they are oxygen-containing poly-unsaturated hydrocarbons resulting from lipid peroxidation. Additionally, markers of oxidative stress and inflammation were elevated upon bleomycin treatment ($P<0.05$) whereas no cytotoxicity was observed.
The *in vivo* volatome consisted of >6000 compounds that are currently under analysis. Interestingly, preliminary data show that discrimination between patients and controls, as well as between various severity stages of ILD, is possible based on a limited VOC number.
VOC analysis appears to be very promising in detecting ILD-like changes *in vitro* and is currently investigated as a new tool for diagnosing ILD *in vivo*.

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Speech breathing pattern analysis in adults with a self reported history of asthma

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Background: While speech and breathing patterns are known to alter in acute episodes of respiratory disorders like asthma, it is not known if they alter in respiratory pathology, during stable periods of the disease.
Aims and objectives: To compare speech breathing patterns in healthy adults and those with a self reported history of asthma.
Methods: Eleven adults with a self reported history of asthma (mean age = 29) and 29 'healthy' adults (mean age = 34) with no history of respiratory disease were recruited from the University of Southampton. Breathing patterns were recorded non-invasively using Respiratory Inductive Plethysmography during 4 minutes each of quiet breathing, and 3 speech tasks: reading, describing and conversation. Offline analysis was performed where 6 breathing parameters were extracted; inspiration and expiration time (T_I, T_E), breath cycle time (Ttot), inspiration and expiration magnitude (IM, EM), and respiratory rate (RR).
Results: Inspiration time was significantly shorter at the 95% level in the asthma group (mean: 0.52, *sd:* 0.07) compared with the 'healthy' participants (mean 0.66, *sd* 0.12) (t: 3.27, $p = 0.002$). Although no statistically significant differences were found in other parameters, the asthma group had a higher mean RR during all speech tasks compared to the healthy group.
Conclusion: These preliminary findings suggest that ventilatory patterns during speech in adults with a self-reported history of asthma are characterised by a shorter T_I and faster RR compared to 'healthy' participants. Research with larger samples is needed to confirm these initial findings, as breathing patterns during structured tasks like speech could be useful for monitoring lung health.