99. Monitoring with lung function tests in airway diseases

P915

Pulmonary function in sarcoidosis: A review of 85 cases using percentage predicted and lower limit of normal values to determine pattern of pulmonary function deficit

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Previous studies have shown airflow limitation is common in Sarcoidosis. Recent evidence (Chest 2011; 139:52-59) suggests using fixed percentage predicted (PP) values may discordantly classify patients compared to using fifth percentiles as the lower limit of normal (LLN). We studied PFT patterns, and the effect of classifying by PP and LLN.

Our study assessed the PFT results found in consecutive patients presenting with Sarcoidosis to one medical team over a 14 year period. Eighty-five patients fulfilled the entry criteria. All had PFTs available. Patients were classified into normal, obstructive, restrictive and mixed deficits using the ATS/ERS flowchart for PFT interpretation. Classification by PP and LLN values were compared. Eleven patients (12.9%) were classified discordantly comparing PP with LLN methods. Six had normal PFTs classified by LLN, but abnormal by PP values. Normal lung function (PP 64.7%, LLN 68.2%) was the commonest pattern. Obstruction was the commonest abnormality (PP 24.7%, LLN 21.7%). Patients with obstructive deficits were more likely to have ever smoked.

The frequency of airflow obstruction in this study was 24.7% when classified by PP, equivalent to findings from a similar cohort (Resp Med 1991; 59:64 - 24.3%)

157s
Conclusion:
COPD (TS-COPD) and biomass smoke-induced COPD (BS-COPD) in an OAD tool for OAD in large epidemiological studies.

SAO was 49%, 27.5% and 46.6% respectively. Use of PEF/Delta1 predicted (Group B) and 1169 had both PEF <Of the 3348 subjects who performed spirometry, 1433 had PEF (SAO) as FEF25-75% predicted (Group A), 746 had at least one respiratory symptom but PEF <65% of predicted.

Results:
Twenty four patients (19.8%) showed improved FEV1 and/or PEF values
Cipla Ltd. India). Subjects with presence of at least one respiratory symptom
was administered a respiratory health questionnaire and
7154 employees from 24 bus depots and 7 cities and towns of Andhra Pradesh State in India were administered a respiratory health questionnaire and performed peak flow meter using an EU scale Peak Flow Meter (Breathometer, Cipla Ltd India). Subjects with presence of at least one respiratory symptom and/or PEF values <80% predicted underwent Spirometry according to ATS/ERS standards. OAD was defined as FEV1/FVC <70%, small airways obstruction (SAO) was defined as Flow 65% predicted.

Conclusion:
The results of this study show about 20% of patients with SPM fitted in moderate COPD had FEV1 improvement 6.35 vs. 6.71±34.11, p = 0.33).

Conclusion:
We reviewed the patients’ data to evaluate the characteristics of the patients who have marked improvement of spirometry (SPM) after regular Tx among patients with SPM below COPD stage II by GOLD guideline.

Comparison between presence of respiratory symptoms and peak expiratory flow (PEF) values <80% predicted as screening tools for obstructive airway diseases.

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When screening large populations for OADs, it is not known whether respiratory symptoms or PEF is a better predictor.

Aim:
To compare predictive values of presence of respiratory symptoms vs PEF values < 80% predicted for detecting OADs.

Methods:
7154 employees from 24 bus depots and 7 cities and towns of Andhra Pradesh State in India were administered a respiratory health questionnaire and performed peak flow meter using an EU scale Peak Flow Meter (Breathometer, Cipla Ltd India). Subjects with presence of at least one respiratory symptom and/or PEF values <80% predicted underwent Spirometry according to ATS/ERS standards. OAD was defined as FEV1/FVC <70%, small airways obstruction (SAO) was defined as Flow 65% predicted.

Aim:
To evaluate the accuracy of FOT in assessing disease severity in elderly COPD patients.

Introduction:
CF lung disease starts in small airways. SAD is visible on chest-CT as trapped air (TA). For routine monitoring of CF lung disease spirometry parame ters are used. Forced expiratory flow after 75% of vital capacity is exhaled (FEF75%) is a sensitive marker of SAD. Lung Clearing Index (LCI) obtained by Multiple Breath Washout test (MBW) has been advocated as a parameter to monitor SAD. Whether LCI is more sensitive than FEF75 to detect SAD is unknown. Aims: to study the relation between FEF75 and LCI and trapped air on CT and between FEF75 and LCI.

Results:
CF patients (1-19 years, male =26). 36% had chronic pseudomonas. FEF75 mean 45.5% (range 7.5-119.2%) vs TS: 65% (range 7.5-119.2%) vs TS: 122% (range 7.5-119.2%) vs TS: 12%

Conclusion:
PEF values <80% predicted is a better predictor of OAD and SAO than presence of respiratory symptoms. We recommend use of PEF as a screening tool for OAD in large epidemiological studies.

The use of forced oscillation technique (FOT) in assessment and stratification of disease severity in elderly COPD patients

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Introduction:
Forced oscillation technique (FOT) is a fast, convenient technique for lung function measurement. However, its use for assessing disease severity in elderly COPD patients remains unclear. Aims: 1) to evaluate the accuracy of FOT in assessing disease severity in elderly COPD patients and 2) to determine the cut-off value of FOT for identifying severe patient group.

Methods: Spirometry confirmed COPD subjects were recruited from Kwong Wah Hospital, Hong Kong from Jan 10 to Jan 11. The “GOLD stages” of each patient were calculated. The correlation of different GOLD stages and FOT parameters including frequency resonance (FRes), frequency dependence (FDep), average resistance (RAvri), average reactance (XAvri) and resistance at 6Hz (R6Hz) were analyzed. The cut-off value of FOT to define ‘severe’ COPD group (%FEV1 ≥50% predicted) was evaluated.
Results: Totally, 102 COPD patients with a mean age of 70.3 ± 8.2 and median GOLD stage of 2 were recruited. FOT parameters correlated well with GOLD stages. Among the FOT parameters, FRes was the best to predict disease severity. Cut-off value of FRes > 29 has a sensitivity of 71% and specificity 69% in identifying severe patients (%FEV1 < 50%), with area under curve value 0.77.

Conclusion: FOT is accurate for assessing disease severity in elderly COPD patients. FRes value > 29 has a good sensitivity and specificity in identifying severe COPD patients.

P921 Reproducibility data of breath analysis through a gas sensors array and comparison to spirometry in COPD patients
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Background: There is insufficient information on reproducibility and intra observer variability of breath analysis, a technique proved to have classificatory and discriminative properties in respiratory diseases. Aim of this study is to therefore to compare variance over time of breath analysis and global spirometry in elderly patients and COPD patients.

Materials and methods: Data refer to the 9 COPD patients so far recruited. Patient underwent breath analysis and respiratory function study 3 times along a period of 3 weeks. The gas sensors array (based on 6 Quartz Microbalances (QMB) covered with different metalloporphyrins) used for this study was fabricated by Tor Vergata University, Rome. The reproducibility of sensors measurements and spirometry data were then compared.

Results: Results are summarized in figure 1 with panels A, B and C respectively representing the frequency shifts registered by the six QMB sensors (A) and twelve parameters obtained by global spirometry (B and C). Variance, mean value, confidence interval and outliers of a set of data are graphically depicted.

Figure 1

Conclusions: Spirometric values show a smaller variance respect to the QMB frequency shifts. However, the reproducibility of selected sensor data seems fair enough to allow follow up COPD patients.

P922 Patients with fluctuant peak expiratory flow value in the absent category are insensitive to dyspnea and are at risk for severe asthma exacerbation
Kumiyu Sugiyama, Hirokumi Hirata, Naoya Ikeda, Taichi Shiobara, Masamitsu Tatewaki, Fumiya Fukushima, Masafumi Arima, Kumiya Sugiyama, Hirokuni Hirata, Naoya Ikeda, Taichi Shiobara, University of Udine, Udine, Italy; 2Regional Coordination Centre for Rare Diseases, University of Udine, Udine, Italy; 3Society of Allergology, symptoms were classified into 8 categories ranging in severity from absent to severe attack. Average PEF was 75.2% (50.5–100) in absent, 64.5% (36.6–92.6) in wheeze, 57.3% (25.0–94.7) in mild attack and 43.6% (20.4–83.1) in moderate attack, and the personal best was 100%. Thus, differences in decreased PEF in cases with the same symptoms varied widely between patients. PEF in wheeze, mild and moderate attack did not correlate significantly with the duration of asthma, FEV1 or the proportion of personal best to standard PEF. These PEFs did not show a significant difference in the groups that were divided by regular treatment of asthma, but did show a significant negative correlation with the coefficient of variation of PEF when asthma was absent.

To reveal patients who are insensitive to dyspnea, the most important factor to consider is the coefficient of variation of PEF when asthma is absent. When we find such patients who exhibit fluctuant PEF, we have to intervene in their treatment, even when they claim to be stable.

Conclusion: FOT is an accurate and convenient technique for assessment of airway obstruction and airtrapping in elderly COPD patients.

P923 The use of forced oscillation technique (FOT) in assessment of airway obstruction and airtrapping in elderly COPD patients
Hoi Nam Tse, King Ying Wong, Ka Yan Wai, Kwok Sang Yee. Medical Department, Kwong Wah Hospital, Hong Kong, Hong Kong

Introduction: Forced oscillation technique (FOT) is a new lung function measurement technique that may have a role in assessing elderly COPD patients. Aim: To evaluate the accuracy of FOT in assessment of airway obstruction and airtrapping in elderly COPD patients.

Methods: Stable spirometry-confirmed elderly COPD subjects were recruited from Kwong Wah Hospital, Hong Kong. Subjects were assessed by both conventional plethysmography and FOT machine in the same visit. Airway obstruction was measured by FEV1%, Raw, Gw while degree of airtrapping was measured by residual volume (RV), total lung capacity (TLC), inspiratory capacity (IC) and RV/TLC ratio. FOT parameters like frequency resonance (FRes), frequency dependence (FDep), resistance at 6Hz (R6Hz), average resistance (Ravg), average reactance (Xavg) were obtained. The FOT parameters were then compared with the plethysmography.

Results: Totally, 106 patients were recruited. 93.1% were male with a mean age of 70.6 ± 8.3 and FEV1 of 53.4 ± 21.3. FOT correlates well with conventional plethysmography for measurement of airway resistance and airtrapping in elderly COPD patients. Among the FOT parameters, FRes showed the best correlation with FEV1 (r=0.608, p<0.001) and RV/TLC ratio (r=0.563, p<0.001).

Conclusion: FOT is an accurate and convenient technique for assessment of airway obstruction and airtrapping in elderly COPD patients.

P924 Pulmonary function and exercise tolerance in glycosogen storage disease type II (GSDII)
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Pompe disease is an autosomal recessive myopathy caused by deficiency of the lysosomal enzyme α-glucosidase. Enzyme replacement therapy (ERT) with human recombinant α-glucosidase (rhGAA) is effective in the treatment of infantile forms of GSDII, but experience in late-onset disease is still limited.
P925
Expiratory flow limitation (EFL) detected non-invasively as a phenotypic characteristic of COPD
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Within-breath change in reactance at 5Hz during tidal breathing reliably detects EFL in patients with COPD. We used the method proposed by Dellaca et al to determine presence of EFL and its relationship to spirometry and demographics of 424 healthy smokers and COPD patients from the Bergen cohort of the ECLIPSE study.

Aim: Establish the prevalence of EFL by GOLD stage and its relationship to dyspnoea and BMI.

274 stable COPD patients and 150 healthy smoking controls performed spirometry and tidal impulse oscillometry.

Results: Presence of EFL in healthy smokers, COPD grade 2,3, and 4 was 7%, 13%, 28% and 40% respectively. Inspiratory resistance and reactance at 5Hz were higher in COPD than smokers but differed little across GOLD stages.

Demographics

<table>
<thead>
<tr>
<th>n</th>
<th>BMI</th>
<th>MRC</th>
<th>FEV1</th>
<th>R5map</th>
<th>X5map</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy smokers</td>
<td>149</td>
<td>26±4</td>
<td>0.2±0.4</td>
<td>30.4±7L</td>
<td>0.28±0.07</td>
</tr>
<tr>
<td>EFL</td>
<td>3</td>
<td>32</td>
<td>1.0</td>
<td>3.9L</td>
<td>0.39</td>
</tr>
<tr>
<td>COPD GOLD 2</td>
<td>125</td>
<td>26±5</td>
<td>1.3±0.4</td>
<td>18±3L</td>
<td>0.39±0.12</td>
</tr>
<tr>
<td>non-EFL</td>
<td>13</td>
<td>30±7</td>
<td>1.9±1.2</td>
<td>1.5±3L</td>
<td>0.51±0.08</td>
</tr>
<tr>
<td>EFL</td>
<td>19</td>
<td>30±6</td>
<td>1.5±0.9</td>
<td>1.2±3L</td>
<td>0.41±0.10</td>
</tr>
<tr>
<td>COPD GOLD 3</td>
<td>30</td>
<td>24±5</td>
<td>1.3±0.4</td>
<td>11.6±3L</td>
<td>0.56±0.12</td>
</tr>
<tr>
<td>non-EFL</td>
<td>76</td>
<td>29±6</td>
<td>3.2±1.6</td>
<td>1.1±3L</td>
<td>0.50±0.12</td>
</tr>
<tr>
<td>EFL</td>
<td>20</td>
<td>30±5</td>
<td>2.6±1.5</td>
<td>0.8±3L</td>
<td>0.42±0.10</td>
</tr>
<tr>
<td>COPD GOLD 4</td>
<td>15</td>
<td>22±5</td>
<td>2.8±1.5</td>
<td>0.8±3L</td>
<td>0.43±0.16</td>
</tr>
<tr>
<td>non-EFL</td>
<td>10</td>
<td>25±5</td>
<td>2.4±1.4</td>
<td>0.7±3L</td>
<td>0.43±0.16</td>
</tr>
</tbody>
</table>

MRC: Medical Research Council dyspnoea scale; R5map: Inspiratory resistance at 5Hz; X5map: Inspiratory reactance at 5Hz; p<0.05.

Conclusion: EFL became more common in higher GOLD stages, but a significant number of patients in all GOLD stages were not flow limited at rest. In GOLD stage 2 and 3 EFL patients were more breathless, despite similar spirometry, but EFL also tracked obesity, which may contribute to both EFL and dyspnoea. Presence of EFL has potential to be an independent phenotypic characteristic in stable COPD.

P926
Area under the maximum expiratory flow-volume curve a sensitive parameter in the evaluation of airway obstruction
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Introduction: The most frequently used parameters for assessing bronchoconstriction and bronchodilation are forced expiratory volume in 1 s (FEV1) and peak expiratory flow (PEF).

Objectives: To assess the sensitivity of other parameters after induced bronchoconstriction and bronchodilation.

Methods: Forced vital capacity, FEV1, PEF, maximum expiratory flows (MEF) at 25, 50 and 75% of vital capacity and the area under the maximal expiratory flow-volumeMEF curve (Area ex) were measured in two groups of asthmatic patients after induced bronchoconstriction and bronchodilation.

Results: In 158 asthmatics without airway obstruction, bronchoconstriction was induced by inhalation of 1% histamine aerosol. The 20% fall in Area ex compared to baseline was found in all asthmatics, while the 20 and 15% falls in FEV1 were noted in 31 and 69% of the patients, respectively. Other parameters were less sensitive. Another 102 asthmatics with mild-moderate airway obstruction were treated with various bronchodilators. The 20% increase in Area ex was observed in all asthmatics, while the 20% increase in FEV1 was found in only 28% of the patients and the 15% increase in FEV1 in 56%.

Conclusion: In evaluation of correlation between dynamic functional parameters the most accurate parameter is Areaex – value defining surface under the expiratory part of “flow – volume” curve. Area ex was a sensitive parameter in the evaluation of airway patency in comparison witht MEF50, MEF25, MEF1, FEV1 and other parameters measured from the MEFV curve in our study patients.

P927
Short and long-term variability of oscillatory mechanics parameters in asthma
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Increased temporal fluctuation of oscillatory mechanics parameters measured over 15 minutes has been suggested to be a specific feature of asthma, though this is still a controversial issue. We aimed to evaluate whether variability over time scales >1 day can reliably separate asthmatic from healthy subjects.

Within-breath respiratory resistance (Rrs) and reactance (Xrs) were measured by forced oscillations during 2min of tidal breathing at morning and evening for 6 months in 10 mild asthmatic and 10 healthy subjects. Short-term (within measurements) and long-term (2, 4, 8, 16 and 32 consecutive days) variability of Rrs and Xrs was characterized by their standard deviations (SDRrs and SDXrs). Short-term variability of either Rrs or Xrs was not significantly different between asthmatic and healthy subjects (p<0.05). SDRrs was significantly larger in asthmatics than in healthy subjects with a time scale ≥4 days using morning
Determination of respiratory flow by tracheal sound-frequency-analysis

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The established methods to detect the flow are pneumotachographic measurements, which are not always ideal to use regarding long term measurements and measurements during sleep. Thus it is interesting to find an alternative non-invasive method to detect the quantitative value of the flow.

There are some further appendages that use tracheal respiratory sound intensity, but there is no method suitable for measurements during a noninvasive ventilation. The aim was to create a new method, easy to use under different long term conditions, based on tracheal sound-frequency-analysis.

Up to now, 43 subjects (male, non-smoker, normal BMI, 18-60 years old, FEV1<80%) were tested. The subjects breathed during 15 minutes without and with different masks. The measuring method included a respiratory sound sensor which was affixed paralaryngeally on jugular and a pneumotachograph. The flow-curve was calculated using the envelope of frequency spectra via fast fourier transformation.

It was possible to achieve a very good correlation between the calculated flow-curve and the real flow (R=0.8) in all conditions.

This method is very easy to use and could be established for patients who are not eligible for conventional measurements (infants, measurement during sleep and for patients with noninvasive ventilation).

Peripheral airway function in COPD assessed by SF6

Per Gustafsson1, Emilia Viklund1, Sanna Kjellberg1

Background: Peripheral airways, particularly acinar airways, are involved in COPD. Sacin for He reflects inhomogeneity proximally in the acinus, and Scond indicates inhomogeneity in the small conducting airways. We evaluated the respiratory impedance during inspiratory and expiratory phase of normal breathing in COPD patients.

We recruited 26 outpatients with stable mild (n=13) and moderate (n=13) COPD at the University of Tokyo Hospital. The impedance of respiratory sound-frequency-analysis (Rrs) was measured by FOT using a MostGraph. Respiratory resistance (Rrs) and respiratory reactance (Xrs) during inspiration and expiration were evaluated at 5 Hz and at 20 Hz of oscillatory frequency.

The cv values of regional IVC, FVC, FEV1 and VT were significantly different between healthy adults and COPD patients (p values: 0.0102, 0.0050, 0.0022 and 0.0047). No differences existed between the young and elderly subjects. The average IVC, FVC, FEV1 and Vt in the chest cross-section were significantly different among the groups (p values: <0.001, <0.001, <0.001 and 0.0054). The highest values were noted in the young subjects, significant differences between the elderly and COPD patients were found in IVC, FVC and FEV1.

Conclusion: EIT is able to detect disease and age related differences in regional lung function. The heterogeneity of lung function is similar in the young and elderly healthy subjects but lower than in COPD patients.

Evaluation of respiratory impedance in COPD by forced oscillation technique using a MostGraph

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Background: COPD is characterized by not fully reversible airflow limitation and defined with the decrease in FEV1 by spirometry. The Forced Oscillation Technique (FOT) can detect impairments of lung function by measuring lung resistance and reactance during normal tidal breathing. MostGraph is one of the FOT, using multi-spectrum oscillation technique, and demonstrates the frequency-dependent and time-dependent respiratory impedance in 3-dimensional graphics.

Methods: We recruited 26 outpatients with stable mild (n=13) and moderate (n=13) COPD at the University of Tokyo Hospital. The impedance of respiratory system was measured by FOT using a MostGraph. Respiratory resistance (Rrs) and respiratory reactance (Xrs) during inspiration and expiration were evaluated at 5 Hz and at 20 Hz of oscillatory frequency.

Results: All indices of respiratory resistance, such as Rrs and Xrs, were slightly higher in moderate COPD than mild, although there were no significant differences. There was a tendency that the ratio between the difference of Rrsmax-min and the difference of Rrs20max-min within tidal breathing was higher in mild COPD than moderate (p=0.08).

Conclusion: The larger difference in Rrs20 between tidal breathing might be useful property to distinguish the severity of COPD.
Freeflowmetry – The new method of evaluation of the respiratory function phenotype

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Introduction: Freeflowmetry is the new method of air flow and air volume measurement during forced and free breathing through the open or partially closed mouth or through the nose. Application of tight silicone mask connected with dPP® pneumotachograph allows adaptation of the natural resistance of the oral cavity in order to reduce the airway collapse.

The aim of the study was to compare the results of examination performed with dPP® pneumotachograph with mouthpiece, with the results of examination performed with silicone mask

Method: The examinations were performed using PNEUMO® PC spirometer [abcMED, PL] in group of COPD patients: 6 female and 4 male at age of 75±5 years and in control group of healthy: 6 female and 2 male at age 73±6 years. The results are shown in table 1.

Table 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Spirometric</th>
<th>Freeflowmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIVC [L]</td>
<td>FVC [L]</td>
</tr>
<tr>
<td>COPD</td>
<td>1.55</td>
<td>1.04</td>
</tr>
<tr>
<td>Control</td>
<td>2.77</td>
<td>2.30</td>
</tr>
<tr>
<td>FEV1 [L]</td>
<td>510</td>
<td>390</td>
</tr>
<tr>
<td>FEV1/FVCmax [L]</td>
<td>0.92</td>
<td>0.76</td>
</tr>
<tr>
<td>fFVC-CM [ml]</td>
<td>0.59</td>
<td>0.78</td>
</tr>
<tr>
<td>fFVC [L]</td>
<td>1.63</td>
<td>2.45</td>
</tr>
<tr>
<td>ΔFVC [ml]</td>
<td>590</td>
<td>70</td>
</tr>
</tbody>
</table>

△FVC = FVC – FIVC; fFVC-CM = measurement of FVC through partially closed mouth; △fFVC = fFVC-CM – FVC.

Conclusion: Freeflowmetric examination can contribute to the optimization and individual adaptation of treatment, the determining of the phenotype of bronchial obstruction and/or airway collapse in common diseases such as COPD and asthma. Further studies are required for the comparison of freeflowmetric test results before and after physical exercise and before and after application of bronchodilator.

P934

Audit of a new mannitol challenge testing service in a UK tertiary centre

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Guys and St Thomas’ NHS Foundation trust (GSTT) is a tertiary hospital based in London, UK, offering specialist allergy and asthma clinics.

In July 2010, GSTT switched from using histamine to mannitol for performing bronchial challenge testing (BCT). BCT is an essential diagnostic investigation for identifying/excluding asthma and monitoring responses to treatment regimes.

We performed an audit of the new service, using mannitol between July 2010 and February 2011. We looked at patient demographics, (age, sex, baseline lung function), test outcomes (i.e. positive, negative, reasons for terminating test, fall in FEV1), sources of referral and clinical reasons for referral to our laboratory.

Table 1 shows patient demographics and baseline lung function. 60 patients were referred to the service (28M, 32F). The mean age was 40.2 yrs.

Table 2 shows source of referral and reason for referral.