330. Quality control in lung function and exercise-related issues

P3026

Over-reading spirometry – Man or machine?

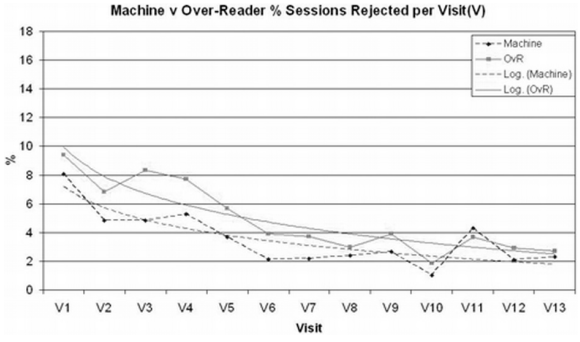
Aleck Harrison[1], Grant Sowman[2], Hardip KaurNagra[2]. *[1]Clinical Research, AJH Partners, Wallingford, Oxon, United Kingdom; [2]Phramaceutical Research, Vitalograph Ltd, Maids Moreton, Buckingham, United Kingdom*

The quality of spirometry improves in multicentre trials with the aid of over-reading and prompt feedback to sites [1]. Recently spirometer software has become more sophisticated with increased built-in quality control. So is there a need for human intervention?

An international trial with 519 asthmatic patients from 78 sites over 17 weeks produced 7297 spirometry sessions. The site spirometer program (Vitalograph Spirotrac®) determined the acceptability of each session with immediate feedback allowing the investigator to make decisions on the patients involvement. All sessions were e-transferred to the database and full visual inspection of the spirometry curves made by three expert over-readers with feedback within 48hrs, reading to ATS/ERS standards [2].

Session acceptance

Session	Machine Read		Over-Reader	
	n	%	n	%
Accepted	7631	96.3	7507	94.7
Rejected	296	3.7	420	5.3



The shape of both curves for rejected sessions follows that seen in other trials, the slope having been demonstrated to be due to prompt feedback. In studies with no feedback the rejection rate is constant [1].

Although there were small differences, this analysis demonstrates that despite hard objective parameters built into software there still needs to be the expert quality of the over-reader's eye.

References:

[1] Harrison A. Blow by Blow, Int Clin Trials J. 2009;4:68-70.

[2] Miller MR et al. ATS/ERS Standardisation of Spirometry, ERJ 2005;26;319.

The trial sponsors are thanked for the anonymous use of their data.

P3027

Predicting success in implementing a distance quality improvement intervention for asthma

James Stout[1], Clarissa Hsu[2], Karen Smith[3], Rita Mangione-Smith[4]. *[1]Department of Pediatrics, University of Washington, Seattle, WA, United States; [2]Center for Community Health and Evaluation, The Group Health Research Institute, Seattle, WA, United; [3]States Department of Pediatrics, University of Washington, Seattle, WA, United States; [4]Department of Pediatrics, University of Washington, Seattle Children's Research Institute, Seattle, WA, United States*

Objectives: To better understand the facilitators and barriers to successful implementation of a distance learning asthma QI program, develop a prediction tool based on this new knowledge, and validate the tool in a separate sample of practices

Methods: A University of Washington-based group has developed a distance learning asthma QI program called Spirometry 360, an on-line office-based program to improve asthma care by enhancing provider knowledge and skills for use and interpretation of spirometry. We interviewed a sample of 35 health care providers from 25 practices previously exposed to Spirometry 360. A coding scheme was developed using constructs from both the qualitative analysis of the interviews and the Competing Values Framework of Organizational Culture. After validating this process, analysis memos generated for each identified barrier or facilitator were used to develop closed-ended questions for the Quality Improvement Intervention-Implementation Success Scale (QII-ISS) survey.

Findings: The resulting QII-ISS includes three main dimensions: organizational features (6 sub-domains, e.g., multidisciplinary team approach to QI; 21 items), facilitators of implementation (6 sub-domains, e.g. having a QI champion in the practice; 21 items), and barriers to implementation (7 sub-domains, e.g., difficulty integrating changes into workflow; 31 items).

In Phase 2, the QII-ISS is now being administered to a new cohort of 50 practices prior to Spirometry 360 exposure to examine its validity for predicting successful program implementation. Results of QII-ISS validation among this first cohort will be presented.

P3028

Spirometry 360 on-line training and feedback: Spring 2011 course results and future plans

James Stout, Karen Smith, Bruce Culver, Allen Dozor. *Department of Pediatrics, University of Washington, Seattle, WA, United States Department of Pediatrics, University of Washington, Seattle, WA, United States Pulmonary and Critical Care, University of Washington, Seattle, WA, United States Pediatric Pulmonology, New York Medical College, Valhalla, NY, United States*

Although office-based spirometry is increasingly gaining acceptance in general practice, wide variations in test quality impede its use.

Spirometry 360 is a four-month interactive on-line training and feedback program currently delivered from the University of Washington to primary care practices around the U.S. It consists of: 1) Spirometry Fundamentals, a multi-media tutorial and reference tool; 2) interactive, case-based webinars led by clinical experts, and 3) an internet-based quality feedback reporting system that summarizes technique of de-identified spirograms automatically uploaded from the point of care.

We delivered the training for the second time in 2010 to 23 general practices from 4 states around the U.S. Results included a doubling of the acceptable spirograms for children younger than eight years from 40% at baseline to 80% at the end of training, and an overall increase in the acceptable spirogram rate from 49% to 71%. Among course participants, 100% reported that they would recommend the training to a colleague.

We are now delivering the course from February to June 2011 in two concurrent tracks to 70 pediatric and family practices, involving over 200 physicians and their support staffs from 35 states around the U.S.

We will present a detailed analysis of over 4,000 tests from the Spring 2011 course, with a description of the reasons for variance from the ERS/ATS 2005 Spirometry Guideline, to further understand practitioners' needs when performing office-based spirometry. We will also report on our plans for a "Train-the-Trainer" program with a goal of establishing independent training sites for ongoing delivery of the Spirometry 360 program.

P3029

Stature measurement: Potential for improved interpretation of pulmonary function

Sidsel Bendixen Holm, Christian Skjolvang Andersen, Camilla Borup, Flemming Madsen. *Respiratory Function Laboratory, Allergy and Lung Clinic, Helsingør, Denmark*

Introduction: Measurement of stature is a prerequisite for determination of the normal lung function since reference equations are based on stature (standing height).

Objective: The aim of this study was to investigate the optimal method to measure stature in a busy pulmonary function laboratory.

Methods: We measured the stature of 87 subjects using a digital-counter sta-

Agreement between methods in measurement of stature

	Number	Mean difference, cm	95% CI	
			Lower	Upper
Difference Harpenden – Harpenden	10	–0.29	–0.60	–0.02
Difference Harpenden – bench rule	87	–0.59	–0.70	–0.49
Difference Harpenden – ultrasound	86	–0.70	–1.06	–0.35
Difference Harpenden – ultrasound ceiling	85	1.36	0.87	1.84
Difference Harpenden – armspan	87	0.45	–0.48	1.38
Difference Harpenden – questionnaire	68	–0.98	–1.48	–0.49
Difference Harpenden – interview	86	–1.12	–1.58	–0.67

Mean difference is an estimate of "trueness" and the 95% Confidence Interval for the difference between individual measurements is an estimate of "precision".

diometer, a wall-mounted bench rule, and an ultrasound distance estimator. Stature was also estimated based on armspan measurement, and self-reported stature was recorded. Results were compared using Bland and Altman plots.
Results: See table. Neither ultrasound measurement nor self-reported stature was sufficiently accurate for clinical use. An unexpected observation was that the stadiometer was the fastest method.
Conclusion: Stature should be measured with the same accuracy as pulmonary function since clinical decisions are based on both. At present the most accurate and probably the fastest measurement of stature is obtained by using a stadiometer with a digital counter.

P3030
Spirometry quality in patients with COPD
Lalita Fernandes, Anthony Mesquita. *Respiratory Medicine, Goa Medical College, Panaji, Goa, India Respiratory Medicine, Goa Medical College, Panaji, Goa, India*

Background and significance: Many spirometries are performed on sick and elderly COPD patients. There is a general perception that it is difficult for such patients to perform spirometries. The 2005 ATS/ERS guidelines on spirometry recommends a repeatability of 150ml for FEV1 and FVC and 100ml if FVC is <1 litre. Our aim was to assess the repeatability criteria in COPD patients.
Methods: Spirometry was performed by 156 patients of COPD. Spirometry was conducted to obtain atleast 3 acceptable flow volume loops using spirometers meeting ATS/ERS standards. 131 patients with acceptable spirometry were evaluated for repeatability criteria and 40 COPD patients were evaluated for within individual repeatability criteria.
Results: Of the 156 patients of COPD, 131 (83.9%) had acceptable spirograms. 92% were males, mean (SD) age = 64 (7.8), mean (SD) FEV1% = 45.7 (14.76). 0.8% had mild COPD, 35.9% had moderate COPD, 49.6% had severe COPD and 13.7% had very severe COPD.

Repeatability(best to second best value)

Parameter	Repeatability per ATS/ERS	Median difference	95th Percentile	Sessions within limits
FEV1	150 ml	20 ml	90 ml	98.48%
FVC	150 ml	50 ml	130 ml	98.48%

We also analysed 963 spirometries done by 40 COPD patients and found that within individual repeatability for FEV1 and FVC is 26 and 64 ml respectively.
Conclusions: COPD patients despite severe disease condition can perform spirometries to meet ATS/ERS criteria for repeatability.
Reference:
[1] MR Miller et al. Standardisation of spirometry. Eur Respir J 2005;26:319-338.

P3031
Quality of spirometry in the elderly
Malgorzata Czajkowska-Malinowska[1], Waldemar Tomalak[2], Jakub Radlinski[2]. *[1]Department of Lung Disease and Respiratory Failure, Center of COPD and Respiratory Failure, Regional Hospital of Pulmonology, Bydgoszcz, Poland; [2]Department of Physiopathology of Respiratory System, National Institute for TBC & Lung Dis., Rabka, Poland*

Assessment of lung function in aged subjects became quite frequent. We have attempted to evaluate quality of spirometric examination in people aged ≥65 years. We have analyzed data from all the patients admitted to the Center of COPD and Respiratory Failure Regional Hospital of Pulmonology in Bydgoszcz in the period June-December 2010. Spirometry was performed by 3 experienced technicians using Jaeger's MasterLab calibrated prior to the measurements. There were 500 patients analysed (age range: 65-90; median: 72; mean ±SD: 73.1±5.7).We used quality error codes assigned by spirometer (according to ERS/ATS 2005 recommendations for spirometry).
Following errors are recognized: 1) less than 3 trials; 2) lack of reproducibility of FEV1 and 4) FVC; 10) cough or variable cooperation; 100) FET<6s or lack of plateau; 1000) BEV too high and 4000) abrupt end.
Out of 500 patients 32 were not able to perform spirometry (due to error 1 – 28 and 10 – 4). Out of the remaining 468 patients 195 (41,2%) performed spirometry without any errors. In the rest – software indicated (by frequency of occurrence) error 100; error 4; error 4000; error 2 and error 1000. In 232 patients 1 error was encountered, in 35 - 2; in 5 - 3 and in 1 – 4.
All examined patients reached FET>6s. If the error 100 (lack of plateau) would be ommited, the percentage of good spirometries rise to 91,2%.
We conclude that 6.4% of aged persons were not able to cooperate during spirometry. Those who cooperated - had problem with reaching the plateau at end expiration. Such the analysis of errors; repeated from time to time might be very useful in giving feedback to technicians - to make them much more careful in observing end expiration in aged persons performing spirometry.

P3032
Number of tests and the time needed to fulfil the quality criteria for plethysmographic measurements
Diana Ionita[1], Carmen Stroescu[1], Gabriela Weiss[1], Ileana Stoicescu[2], Madalina Burecu[2], Camelia Nita[3], Alina Croitoru[2], Daniela Dospinoiu[3], Felicia Cojocaru[3], Irina Strambu[3]. *[1]Respiratory Physiopathology Department, "M. Nasta" Institute of Pneumonology, Bucharest, Romania; [2]Clinical Departments, "M. Nasta" Institute of Pneumonology, Bucharest, Romania; [3]Clinical Department, Ascent Clinical Research Solutions, Bucharest, Romania*

Aim: Assessing the number of tests and the time needed to obtain quality sessions of body-plethysmography.
Subjects and methods: Body-plethysmography was performed in healthy subjects and in patients familiar with the testing, in order to obtain at least three acceptable measurements with repeatable parameters (at least four from the list: Raw, IC, VC, FRC and TLC). The number of tests and the time to obtain quality measurements were noted.
Results: One hundred and eighteen body-plethysmography sessions were performed in 10 weeks: 8 in healthy subjects, 73 in COPD patients and 37 in patients with other respiratory diseases.
All the subjects obtained at least 3 acceptable tests and had repeatable values for at least 3 parameters. One hundred and twelve subjects (95%) obtained repeatable values for 4 parameters and 92 subjects (78%) for all the 5 tested parameters.
In 13 subjects only 3 tests were needed to obtain repeatable values for the tested parameters, 22 subjects needed 4 tests, 26 subjects – 5 tests, 45 subjects – 6 tests and 12 subjects performed 7 tests.
The time needed to obtain correct sessions varied between 4 and 16 minutes (mean 9, mode 7 minutes), without counting interpretation, patient or device preparation, and infection control procedures.
No significant differences were seen in age, gender or FEV1 values between the subjects that obtained repeatable values after 3 or 4 tests versus (vs.) >4 tests, in 3-7 minutes vs. >7 minutes, for 4 vs. 5 parameters (p=NS for all tested associations).
Conclusion: Three to seven tests and 4-16 minutes were needed to obtain quality sessions in body-plethysmography. The data will help scheduling the tests and for quality control.

P3033
The use of biological control subjects to validate exercise testing with supplemental oxygen
Kevin De Soomer, K. Leemans, H. Vaerenberg, W. De Backer, E. Oostveen. *Dept of Lung Function and Pulmonary Medicine, Antwerp University Hospital, Antwerp, Belgium*

Some patients desaturate during exercise due to diffusion limitation of O2-uptake in the lung. To measure their exercise tolerance and its limiting factor, cardiopulmonary exercise testing (CPET) can be performed with supplemental oxygen (O2). The aim of our study was to validate the High/Low FiO2 software option on the Jaeger Oxycon Pro (Jaeger, Wurzburg, Germany) using biological control subjects. Three healthy lung function technicians (2F: 1M) performed multiple exercise tests, breathing either room air or a gas mixture containing 30% O2 and 70% N2. The exercise test consisted of a 3 min rest period, 3 min unloaded pedaling followed by 5 min steady state exercise at 40 and 80 Watt for the female subjects and 60 and 120 Watt for the male subject, respectively. The mean values of minute ventilation (V'E), CO2 production (V'CO2), O2 consumption (V'O2) and heart rate (HR) as measured during the last two min of every steady state interval were used for further analysis. Each subject performed 7 tests while breathing FiO2= 21% and 4 tests while breathing FiO2= 30%. Bland-Altman analysis revealed no systematic differences in V'E, HR, V'CO2 and V'O2 at all work rates for all subjects between FiO2= 21% and FiO2= 30% (see figure).

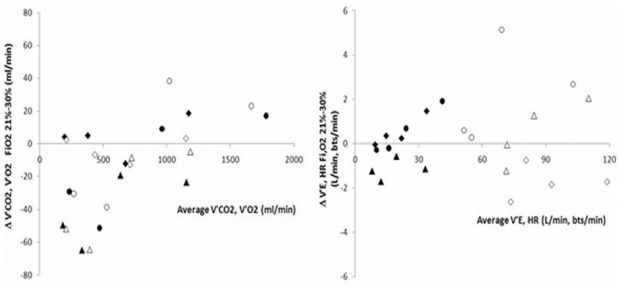


Figure. Bland-Altman plot of V'CO2, V'O2 (top) and V'E, HR (bottom) while breathing $F_{I,O2}$=21% and $F_{I,O2}$=30%. The different symbols represent different subjects. Open symbols: V'O2, HR; closed symbols: V'CO2, V'E.

We conclude that when using the High/Low FiO2 software option during CPET, V'CO2 and V'O2 are reliably measured while breathing 30% O2.

P3034

Novel strategies for quality control of forced spirometry

Felip Burgos[1], Batxi Galdiz[2], Carles Gallego[3], Montserrat Vallverdú[4], Pere Caminal[4], Diego Castillo[5], Jordi Ayza[6], Joan Escarrabill[7], Josep Roca[1]. *[1]Department of Pulmonary Medicine (ICT), Hospital Clínic - IDIBAPS- Centro de Investigación en Red de Enfermedades Respiratorias (CibeRes), Barcelona, Spain; [2]Department of Pulmonary Medicine, Hospital de Cruces -Centro de Investigación en Red de Enfermedades Respiratorias (CibeRes), Bilbao, Spain; [3]Oficina d'Estàndards i Interoperabilitat TicSalut, Departament de Salut, Generalitat de Catalunya, Barcelona, Spain; [4]Centre de Recerca en Enginyeria Biomèdica (CREB-UPC), Universitat Politècnica de Catalunya, Barcelona, Spain; [5]Department of Pulmonary Medicine, Hospital de la Santa Creu i Sant Pau, Barcelona, Spain; [6]TecnoCampus, TecnoCampus Mataró-Maresme, Mataró, Spain; [7]Master Plan for Respiratory Diseases, Health Ministry of Catalonia, Generalitat de Catalunya, Barcelona, Spain*

High Quality Forced Spirometry (HQS) in primary care (PC) enhances management of respiratory patients. We aimed at: a) developing standards to transfer FS data (HL7-XML) using DICOM; b) deploying web-based support to PC and Community Pharmacists (CPH); c) validating a new algorithm for automatic assessment of quality of the tests; and, d) assessing the web application

We explored 1430 subjects from 15 PC and 812 subjects from 40 CPH. The follow-up period was > 6m. The validation of the algorithm for automatic QC was done using 778 curves from 291 patients and the 24 flow-volume and volume-time curves from the ATS. The assessment by an expert professional and the score automatically generated through the algorithm were compared (Grade 0, rejected; Grade 1 accepted; and, Grade 2 doubtful test).

The percent of HQS increased from 57% to 78% during the study period (9 months). The CPH study showed on average 70% HQS. The performance of the algorithm for automatic assessment of spirometry quality control was acceptable (Sensitivity 96%; Specificity 95%).

Our results prompt the adoption of strategies to standardize the transfer HQS tests (HL7CDA R2) among providers. Thus, facilitating information sharing across the system and reducing duplicities. The automatic algorithm showed high applicability. All together, the study facilitates future strategies for early diagnosis of chronic obstructive diseases as well as long-term follow-up of patients.

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P3035

Preoperative determinants of the length of hospital stay in patients undergoing surgery for pancreatic cancer

Roger Carter[1], Oliver Aileen[1], V.V. Chandrabaln[2], John Kinsella[3]. *[1]Respiratory Medicine, Royal Infirmary, Glasgow, United Kingdom; [2]West of Scotland Pancreatic Unit, Royal Infirmary, Glasgow, United Kingdom; [3]Anaesthetics, Royal Infirmary, Glasgow, United Kingdom*

Introduction: Surgery for pancreatic cancer is associated with considerable morbidity. Both surgeon-related and patient-related factors are important in determining postoperative outcome. Therefore most pancreatic surgery is now carried out in specialist centres. However, patient optimisation is complex since factors that determine postoperative morbidity are less well understood.

Objective: To compare preoperative measures of patient comorbidity with length of hospital stay in patients undergoing pancreatic surgery.

Patients and methods: 103 patients who underwent surgery for pancreatic cancer (pancreatico-duodenectomy n=87,trial dissection with bypass n=16) had preoperative evaluation of body habitus, systemic inflammatory response (Glasgow Prognostic Score, mGPS) and routine blood analysis. Cardiopulmonary function (CPET) was measured in 54 patients. Length of hospital stay was recorded.

Results: The median length of hospital stay was 17 days. 39 stayed $\leq$ 14 days and 64 >14 days. Length of hospital stay was not associated with body habitus or systemic inflammatory response. However, in patients with CPET, more patients with low anaerobic threshold (p=0.030),high base excess (0.056) and high VE/VCO2 (p=0.022) had a hospital stay >14 days. Prolonged hospital stay was associated with pancreatico-duodenectomy (p=0.027) and anastomotic failure (p<0.001).

Conclusions: CPET was the only pre-operative objective measure that correlated significantly with prolonged hospital stay. Length of stay is a useful surrogate marker of post-operative adverse events. Although CPET does not predict specific complications, it may determine the host response to major surgery and its immediate sequelae.

P3036

Is there a difference between the results of the standard six minutes walking test (S6MWT) and the test with ventilation monitoring (V6MWT)?

Carmen Columbia Stroescu (Cocian)[1], Alina Croitoru[2], Diana Ionita[1]. *[1]Respiratory Physiopathology Department, "Marius Nasta" Institute of Pneumology, Bucharest, Romania; [2]Pneumology Department, "Marius Nasta" Institute of Pneumology, Bucharest, Romania*

Background: 6MWT is a validated test for the evaluation and monitoring of patients with cardiovascular and respiratory conditions. The standard test evaluates the initial and final heart rate (HR) and oxygen saturation (SaO2), and does not measure ventilation.

Aim: To assess (a) the similarities of the main parameters between S6MWT and V6MWT and (b) the mask-related discomfort during V6MWT.

Subjects and method: 23 patients (P) with respiratory diseases (15 COPD cases) and 5 healthy subjects (H) performed two S6MWT and one V6MWT, at 1 hour intervals. 6MWT distance (6MWD), initial and final HR, SaO2 and symptoms, and the mask–related discomfort were recorded.

Results: The mean 6MWD was 9 meters longer in S6MWT than in V6MWT (range -65, +135 m). In 7P (30%) the 6MWD was significantly different (>50 m) between the tests, with 5 P (22%) walking less and 2P walking more at the V6MWT.

The mean initial and final symptom scores were similar between the tests (difference <0.5 points). At the end of V6MWT, 8P (35%) had higher dyspnoea scores and 5P had higher scores for both dyspnea and fatigue.

The mean desaturation was similar between the tests, but 7P (30%) desaturated more at V6MWT (difference >4%).

The mean initial and final HR was similar, but 7P had higher initial HR and 9P higher final HR at V6MWT.

Mask-related discomfort was minor in 20P and 4H (86% tests), moderate in 2P and 1H, and major in 1P.

Conclusions: The mean results of the measured parameters were similar in V6MWT and S6MWT, but the 6MWD was significantly different in 30% of patients. The mask needed for the V6MWT was generally well tolerated.

P3037

Flow limitation at rest may identify a phenotype of chronic obstructive pulmonary disease (COPD)

Laura Malagrinò, Francesco Costa, Barbara Vagaggini, Claudia De Simone, Cristina Spanu, Alessandro Celi, Pierluigi Paggiaro. *Cardio-Thoracic and Vascular Department, University of Pisa, Pisa, Italy*

Background: Expiratory flow limitation at rest (FL) promotes dynamic hyperinflation (DH) during exercise in COPD patients.

Aim: To evaluate whether a specific FL phenotype can be identified in COPD patients.

Subjects and methods: 48 COPD patients (28 male, FEV1%: 53.4) underwent: pulmonary function tests (PFT), cardiopulmonary exercise test (CPET) with assessment of DH, Saint George's Respiratory Questionnaire (SGRQ), dyspnea scale (MRC), physical activity by Armband. We measured blood haemoglobin (HB) and inflammatory cells, CRP and Pro-BNP; sputum inflammatory cell count and neutrophil elastase. FL was evaluated according to Hyatt by overlapping the tidal and maximal flow-volume curves and categorized as either absent no overlapping, or present any overlapping.

Results: FL was observed in 38/48 COPD patients. Baseline difference between two groups are reported (*p< 0.05)

	Flow limitation (38)	Non-flow limitation (10)
FEV1 %	51.1±17.2	62.4±12.4
IC %	76.8±20.2	83.9±20.8
TLC %	112.1±14.1	114.9±16.6
TLCO %	68.1±22.9	87.8±32.8*
MRC	1.2±0.2	1.1±0.3
Daily steps	5932±3337	9199±5631*
SGRQ tot %	39.1±16.1	34.4±18.2
VO2/kg	17.1±5.5	20.0±4.6
Blood eosinophils %	2.8±1.7	6.6±4.7*
Pro-BNP	327.8±367.6	114.4±82.2 *
Sputum eosinophils %	5.7±10.8	18.6±16.8*
Sputum neutrophils %	76.6±15.4	57.4±12.4*
Sputum neutrophil elastase	3.6±2.6	1.1±0.8*

Only in FL group, VO2/kg was correlated (p< 0.05) with MRC, FEV1%, IC%, DLCO%, HD, DS, SGRQ tot%, HB, Pro-BNP.

Conclusions: Flow imitation at rest, as assessed by a simple, non invasive, inexpensive technique, identifies patients with clinical and functional characteristics suggestive of a specific "emphysema-like" phenotype.

P3038

Ventilatory exercise response at low altitude

Jerica Sinkeldam, Gwenda Commandeur, Herman Groepenhoff. *Pulmonology, VU University Medical Center, Amsterdam, Netherlands*

Introduction: At medium and high altitude there is an increased ventilatory response at sub maximal exercise tolerance due to a decreased aerobic capacity. However little is known about the ventilatory exercise response to sub maximal exercise at low altitude compared to sealevel. Therefore we conducted this study to test if the ventilatory response at sub maximal exercise differs at low altitude compared to sea level.

Methods: Nine healthy women were included to perform a submaximal cardio pulmonary exercise test (3 min, 50 and 100 watt), with gas exchange, heart rate and oxygen saturation measurements on a cycle ergometer at sea level and identical measurements at 1560 meters above sea level (Davos, Switzerland).

Results: See Table 1.

Table 1

	Sea level	1560 meter	p-value
50 watt			
VO2 (ml min^{-1})	956±56	1001±134	0.2842
VE (l min^{-1})	24.6±1.5	28.6±5.8	0.0484
Heart rate	104±13	117±13	0.0005
SaO2-puls (%)	98±1.5	94±1.7	< 0.0001
100 watt			
VO2 (ml min^{-1})	1496±57	1484±115	0.7210
VE (l min^{-1})	37.9±4.6	44.0±8.6	0.0227
Heart rate	133±17	138±17	0.1048
SaO2-puls (%)	97±1.6	92±3.4	0.0017

Conclusion: For an equal sub maximal oxygen uptake at low altitude there is already an increased ventilation compared to sea level. This is likely explained by impaired gas exchange.

P3039

Cardio pulmonary exercise testing: Mouthpiece or a mask? Does it matter?

Jerica Sinkeldam, Piet E. Postmus, Anco Boonstra, Herman Groepenhoff.
Pulmonology, VU University Medical Center, Amsterdam, Netherlands

Introduction: Cardio pulmonary exercise test (CPET) parameters can be measured with the use of a mouthpiece or a breathing mask. In clinical practice, patients often complain about a dry mouth when a mouthpiece is used which possibly influences CPET results. A more comfortable alternative, although with an increased change of leakage, is the frequently used breathing mask. Therefore we hypothesised that ventilatory CPET results measured by mouthpiece or breathing mask could be different.
Aim: To test this hypothesis we conducted this study to estimate ventilatory CPET differences between mouthpiece and breathing mask measurements.
Methods: Twelve healthy subjects performed two (3 minutes/40watt; incremental) maximal CPET measurements with steady state measurements of ventilation (VE) and oxygen consumption (VO_2) at sub maximum work levels. The measurements were taken on different days within one week in a different sequence. One using the mouthpiece (deadspace: 50 ml) and the other with a mask (Combitox, deadspace: 100 ml).
Results: See Table 1.

Table 1

	Mouth piece	mask	p-value
VE (l min^{-1})			
40 watt	20.7±3.6	23.1±2.5	0.00
80 watt	29.3±2.7	32.6 ± 4.3	0.00
120 watt	40.4±3.6	44.6±5.6	0.00
VO2 (ml^{-1})			
40 watt	882±103	884±70	0.94
80 watt	1276±97	1304±84	0.22
120 watt	1698±124	1741±127	0.19
Work (watt)			
Maximum	230±70	232±73	0.70

Conclusions: Due to the fact that the VO2 values between mouthpiece and mask measurements were not different, we concluded that the Combitox mask does not leak. However, the VE values measured with the mask were higher compared to those of the mouthpiece. This is likely explained by the higher amount of deadspace. The maximum work rate level attained with the mouthpiece or the mask was the same.

P3040

Is measuring ventilation during the six minutes walking test (6MWT) important?

Carmen Columbia Stroescu (Cocian)[1], Alina Croitoru[2], Diana Ionita[1].
[1]*Respiratory Physiopathology Department, "Marius Nasta" Institute of Pneumology, Bucharest, Romania;* [2]*Pneumology Department, "Marius Nasta" Institute of Pneumology, Bucharest, Romania*

Background: 6MWD and FEV1 are used as a one-time measure of functional status, as predictors of morbidity and mortality, and for measuring the response to medical interventions. The additional value of ventilation (VE) monitoring during the 6MWT is unknown.
Aim: Evaluation of VE during the 6MWT and it's correlation with the validated parameters (6MWD and FEV1).
Method: Patients (P) and healthy subjects (H) performed two standard 6MWT (S6MWT) and one 6MWT with VE monitoring (V6MWT), at minimum 1 hour intervals. The inspiratory capacity (IC) was measured before and after the V6MWT. VE profile and correlations between parameters were assessed.
Results: 23P (15 COPD cases) and 5H performed the tests.
The baseline VE did not correlate with FEV1 and 6MWD nor with the baseline or end-of-test IC.
Most subjects reached a VE plateau within the first 3 minutes of the test. The time to a stable VE did not correlate with the V6MWD or FEV1, but with baseline IC (r 0.428).
The peak VE, as well as the difference between initial and final (delta) VE, did however significantly correlate with FEV1 (r 0.696 and 0.686 respectively) and 6MWD (r 0.515 and 0.476 respectively).
Strong correlations were found between FEV1, V6MWD and baseline and end-of-test IC (r > 0,7), but not with the delta IC.
The correlation of ventilatory parameters (IC, peak VE, delta VE) with the 6MWD was proven to be FEV1 dependent as, when controlled for FEV1, these correlations did not remain significant.
Conclusions: Some ventilatory parameters measured during the 6MWT did correlate with the 6MWD and FEV1. The importance of VE profile evaluation during the 6MWT needs further assessment.

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Reference values for the incremental shuttle walking test

Vanessa S. Probst[1,2,3], Nidia A. Hernandes[1,2], Denilson C. Teixeira[1,2], Josiane M. Felcar[1,2], Cristiane G. Gonçalves[1,3], Daniela Hayashi[1,3], Rafael B. Mesquita[1,2,3], Sally Singh[4], Fabio Pitta[2,3]. [1]*Centro de Pesquisa em Ciências da Saúde (CPCS), Universidade Norte do Paraná (UNOPAR), Londrina, Brazil;* [2]*Laboratório de Pesquisa em Fisioterapia Pulmonar (LFIP), Universidade Estadual de Londrina (UEL), Londrina, Brazil;* [3]*Programa de Mestrado em Ciências da Reabilitação, UEL-UNOPAR, Londrina, Brazil;* [4]*Department of Respiratory Medicine, Glenfield Hospital, University Hospitals of Leicester NHS, Leicester, United Kingdom*

Background: Reference values for the incremental shuttle walking test (ISWT) which are applicable to the whole population need to be solidly established.
Objectives: This study aimed to determine which anthropometric and demographic variables influence the walking distance achieved in the ISWT in healthy subjects aged 18 - 83 years and to establish a reference equation for predicting ISWT for that population.
Methods: In a cross-sectional study, 242 healthy subjects (102 male) performed two ISWT and had their weight, height and body mass index (BMI) measured.
Results: In general, healthy subjects walked 810 [572 – 1030] m in the ISWT, presenting large variability (range 210–1820 m). The walked distance correlated with age (r = -0.76), height (r = 0.49) and BMI (r = -0.23) ($p<0.001$ for all), but not with weight (r = 0.06, p=0.315). A model of stepwise multiple regression showed that gender, age and BMI were independent contributors to the ISWT in healthy subjects, explaining 71% ($p<0.0001$) of the variability. The derived reference equation was: $ISWT_{pred}$ = 1449.701 – (11.735 × age) + (241.897 × gender) – (5.686 × BMI), where male gender = 1 and female gender = 0.
Conclusions: In conclusion, the variability of the ISWT is explained largely by gender, age and BMI. The reference values for the ISWT can be adequately predicted using the equation proposed in this study.

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Reference value of six-minute walking distance in healthy Pakistani subjects

Nisar Rao[1], Muhammad Irfan[2], Suleman Haque[2], Ali Zubairi[2]. [1]*Department of Pulmonology, Ojha Institute of Chest Diseasaes, Karachi, Sindh, Pakistan;* [2]*Section of Pulmonary & Critical Care Medicine, Aga Khan University, Karachi, Sindh, Pakistan*

Background: Six-min walk test (6MWT) is useful in assessing functional exercise capacity. We aimed to determine the 6MWD for healthy Pakistanis, identify factors affecting 6MWD and derive an equation.
Methods: 15-65yrs subjects were prospectively enrolled after screening. A standardized 6MWT was administered. SpO_2, HR, BP and dyspnea scores were determined pre and post-test.
Results: 296 subjects [211 (71%) men] participated with mean age 37.3±12 yrs. The mean 6MWD for all participants was 469.88±101.24m (range 180m - 756m) [men 502.35±92.21m; women 389.28±74.29m]. On univariate analysis gender, weight, height and age showed a significant relationship with the 6MWD. Sub analysis revealed a significant direct relationship between height (r=0.485, p=0.001) and weight (r=0.212, $p<0.001$). Gender and age were identified as independent factors in multiple regression analysis, and together explained 33% of the variance.
The regression equation predicting 6MWD is: $y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$
With an intercept term (β_0), slope parameters (β_1, β_2, β_3), one dichotomized variable of gender (X_1, X_1= "0" if the subject is female, and "1" if male).
The sex-specific prediction equations are:
6MWD (m) for men = 164.08 + (78.06∗1) – (1.90∗age) + (1.95∗height)
6MWD (m) for women = 164.08 – (1.90∗age) + (1.95∗height)
Comparison with published equations revealed a moderate overestimation of the 6MWD in our population.
Conclusions: 6MWDs among Pakistanis are shorter than predicted by reference equations in literature. The proposed equation gives predicted (mean) 6MWDs for adult Pakistani naïve to the test when employing standardized protocol. Prospective validation of this equation need larger community based studies.

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Pulse oximeter validation study

Geljit Johal, Jodie Hunt, Brendan Cooper. *Lung Function & Sleep, Queen Elizabeth Hospital Birmingham, Birmingham, West Midlands, United Kingdom*

Introduction: The aim of this study was to assess a) the reliability of our pulse oximeters for SpO2 and HR signals, b) to detect malfunctions, c) and to provide recommendations on SpO2 testing.

Methods: A pulse oximeter tester (Metron DEAG) was to test 12 Konica Minolta pulse oximeters over a split 6 month period. The suitability of the analyser was measured against a reference standard (OxSim-1 pulse oximeter simulator). The ranges that were simulated include SpO2 of 85%, 95% and 98% at heart rates (HR) of 80, 40 and 140 beats per minute (b.p.m) respectively.

Results: The Bland-Altman analysis did not reveal any significant difference at all 3 ranges for both analysers. The mean differences at SpO2 of 85% and HR of 40 b.p.m was -0.37% and ±2SD of (0.67- -1.39). At 95% 80 b.p.m mean difference of +0.67±2SD (+1.18 - +0.15) and 98% at 140 b.p.m a mean difference of 0.08% ±2SD (+0.44- -0.29). The difference between the two analysers was correlated better towards the higher range of SpO2. There was no variability in the simulated HR during the testing of all the pulse oximeters.

Discussion: The results of the study show that the oximeters appear to be remarkably stable over time.

Conclusions: The change in SpO2 over Period 1 (mean simulated readings of 86.1%, 95.8% and 98.0%) and Period 2 (mean simulated readings of 86.2% and 95.7% and 98.0%) was negligible. The P values for all three ranges (85% P value of 0.65, 95% P=0.59 and 98% P=0.47) were > 0.05 and therefore no significant differences in the data existed. We conclude that regular testing of pulse oximeters does not help predict failure or problems that aren't picked up by the regular operators.