Assessment of tissue velocity imaging of both ventricles in vasoreactive patients

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The purpose: To estimate dynamics of right and left ventricular systolic and diastolic function by estimation Sa, Ea of the lateral tricuspid and mitral valve annulus during acute pharmacological testing (APhT) with inhaled nitric oxide (iNO) in patients with idiopathic pulmonary arterial hypertension (IPAH).

Materials and methods: In the study we included 11 pts (11 females) with IPAH aged 31-51 (mean age 39.8±7.4 years). All pts were performed right heart catheterization (RHC) with APhT and noninvasive vasodilator testing with iNO (20ppm for 10 min) before two hours to RHC. The estimation of SPAP was performed initially at rest and then at 10 min of nitric oxide Inhalation. All pts were responders. Echo included routing parameters and TVI was used for the estimation of systolic and diastolic function of RV/LV before and after APhT.

Results: In pts with IPAH (functional class II-III, WHO) the mean value of tricuspid regurgitation (TR) gradient was 64.8±11.5mmHg. In all pts included in the study the degree of TR was at least III. Taking into account right atrial pressure levels mean SPAP was 75±11.6mmHg by Transthoracic Doppler Echocardiography (TDEcho.) before APhT. Mean SPAP was 47.5±6.2mmHg by echo after APhT. According to RHC data mean SPAP was 76.8±16.6mmHg before test and 46.6±7.9mmHg after iNO. We found no significant dynamic of routine echo parameters. To 10’ of iNO there was significant improvement Sa, Ea of RV during APhT with iNO. There was improvement Sa, Ea of LV but not significant.
Six-minute walk test (6MWT) is an important prognostic marker in pulmonary hypertension (PH). We hypothesized that clinical improvement might not only be characterized by an increased walk distance but also by changes in heart rate. Therefore, patients underwent echocardiography, and laboratory values were recorded at the moment of baseline and follow-up.

### Results

Results: 76% of patients described an improved state of health compared with the follow-up (Nov. 2007 - Feb. 2009). NYHA functional class >1, 6MWD, laboratory values (uric acid, BNP) and also of hemodynamic parameters (mPAP, PVR, CO, CI) during echocardiography showed a significant difference between 16 vs 34 patients. These differences between baseline and follow-up are significant (p<0.001).

Conclusion: Quality of life is an important measure for PH patients. Improvement in quality of life correlated very well with other important measures of PH.

### P3918

The clinical relevance of heart rate increase in the interpretation of six-minute walk test in pulmonary hypertension

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### Background

Six-minute walk test (6MWT) is an important prognostic marker in pulmonary hypertension (PH). We hypothesized that clinical improvement might not only be characterized by an increased walk distance but also by changes in Borg dyspnea score (BDS) and heart rate.

### Patients and methods

Patients: PH patients with or without PH with but without an abnormal exercise-induced pulmonary arterial pressure (PAP) increase were included. Each patient performed a 6MWT with "normal", "less than normal" and "more than normal" effort.

Results: 23 patients with PH (n=1 pulmonary arterial hypertension, n=10 chronic thromboembolic PH, n=2 other; mean; PAP: 40±12mmHg) and 6 subjects with abnormal exercise-induced PAP increase (resting mean PAP: 16±6mmHg) participated.

### Conclusion

Conclusion: Based on our pilot study, heart rate may be suitable to assess the effort level of subjects and may be incorporated to refine 6MWT in the follow-up of PH patients.

### P3919

Wrist actigraphy predicts outcome in patients with pulmonary hypertension

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### Background

Pulmonary hypertension (PH) is a disease characterized by vasoconstriction, remodeling of the small pulmonary vessels, and a lack of endogenous prostacyclin. Prostacyclin and its analogues are potent vasodilators and widely used in PH treatment. Information on the quality of life of PH patients is limited.

### Methods

24 patients who suffer from different forms of PH and receive inhaled iloprost, either as first line or as add-on therapy, are followed. Patients received questionnaires concerning multiple aspects of their quality of life. NYHA functional class >1, 6MWD, results of the right-heart catheterization, and biomarker levels were recorded at the moment of baseline and follow-up (Nov. 2007 - Feb. 2009).

### Results

Results: Actigraphy revealed a mean±SD day-time with activity of 14.5±7.1±1 hours, activity counts were 146±125/min. Very severely impaired patients (mPAP 50±7.7mmHg) rested more time immobile during nights (8.2±5.1±1 min) and were less active during days (55±44 counts/min) compared to modestly impaired patients (mPAP 33±7.7mmHg; night-time immobile 6.5±6.9; day-time activity 229±148 counts/min; P<0.05 all instances). Of 19 patients followed for 4 years, 5 died, 1 underwent lung transplantation. Kaplan-Meier analysis revealed a shorter survival without lung transplantation in patients being active for less than 15h per day compared to patients with more than 15h of activity per day (log-rank P=0.026).

Conclusion: A long nocturnal rest and reduced day-time activity recorded by actigraphy are associated with severe hemodynamic impairment and reduced survival in patients with PH. Therefore, wrist actigraphy performed during everyday life in the patient’s home holds promise as a simple tool for assessment of disease severity and prognosis in patients with PH.
Abstract printing supported by Chiesi. Visit Chiesi at Stand B2.10.
differences were less pronounced. RVEDD, but not PAAAT/c or TAPSE was significantly correlated to RVSP. Telemetry and echocardiography both show a progressive response in the hypoxic period. Individual variability among animals resulted in different RVSP responses upon re-exposure to normoxic conditions. RVEDD correlated significantly with RVSP, whereas TAPSE and PAAAT/c seemed not suitable as surrogate markers for RVSP.

**P3927**

Correlation of computed tomography measurement of small pulmonary vessels with hemodynamic factors in pulmonary arterial hypertension

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Background: Previous studies have shown that the percentage of total cross-sectional area of small pulmonary vessels (CSA) for the lung area assessed on computed tomography (CT) is significantly correlated to pulmonary arterial hypertension (PAH).

Purpose: We aimed to study correlation of the percentage of CSA less than 5mm² (%CSA<5) with hemodynamic factors in patients with pulmonary arterial hypertension (PAH).

Materials and methods: 14 subjects (5 male, 53±12 yrs) with PAH underwent noncontrast CT scan and right heart catheterization (RHC). Three CT slices were selected from noncontrast CT images. The upper cranial slice was taken approximately 1 cm above the upper margin of the aortic arch, the middle slice was taken approximately 1 cm below the carina, and the lower caudal slice was taken approximately 1 cm below the right inferior pulmonary vein. We measured CSA less than 5mm² and lung area from each images, and calculated the percentage of total CSA for the lung area(%CSA<5). The correlation of %CSA<5 and hemodynamic data obtained by RHC were evaluated.

Results: %CSA<5 was 11.6±20.6% mean pulmonary arterial pressure(mPAP), systolic pulmonary arterial pressure (sPAP) and pulmonary vascular resistance (PVR) were 41±15 mmHg, 65±27 mmHg and 53±332 dyne sec cm⁻², respectively. The correlation coefficient of %CSA<5mm² with sPAP, mPAP and PVR were -0.60 (P=0.02), -59 (P=0.03) and -0.60 (P=0.02), respectively. The correlation coefficient of %CSA<5mm² with hemodynamic factors in patients with PAH (mPAP, mean pulmonary arterial pressure(mPAP), sPAP, mPAP, PVR) was -0.60 (P=0.02), -59 (P=0.03) and -0.60 (P=0.02), respectively. The correlation of %CSA<5 measured on CT images significantly correlate with sPAP, mPAP and PVR in subject with PAH.

**P3928**

Does lung function predict response to therapy in PAH associated with connective tissue disease?

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Introduction: PAH specific therapies have been trialled in several lung diseases without success. It has also been shown that a low FVC is associated with a poor prognosis in CTD-PAH.

Methods: From the Royal Free Hospital pulmonary hypertension associated with connective tissue disease database we identified patients with lung function tests within 6 months of right heart catheterisation performed to confirm pulmonary hypertension. Patients who had repeat haemodynamic studies within a year of diagnosis on first line therapy (bosentan) were included.

Results: There were no significant haemodynamic differences between groups at baseline (ANOVA). Follow up catheter studies demonstrated a good haemodynamic response with improvements in mean PA pressure (FVC ≥94%) and pulmonary vascular resistance (FVC >70%).

**Table 1. Histopathology**

<table>
<thead>
<tr>
<th>Study</th>
<th>Low DLCO (N=10)</th>
<th>Normal DLCO (N=10)</th>
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<tbody>
<tr>
<td>Lung biopsies</td>
<td>3</td>
<td>7</td>
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<tr>
<td>Eplaxit</td>
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<td>2</td>
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<tr>
<td>Autopsy</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Pulmonary vasculopathy</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Pulmonary capillary Haemorrhagitis</td>
<td>1</td>
<td>2</td>
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**Conclusion:** A PVD/PCCH-like pattern is more common in IPAH with low DLC0, while plexogenic arteriopathy prevails in IPAH with normal DLC0.


Thematic Poster Session

Halle A-27 - 12:50 - 14:40

Tuesday, September 4th 2012

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P3931
Prognostic relevance of changes in exercise parameters in pulmonary arterial hypertension
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Introduction: Exercise parameters measured at baseline predict survival in pulmonary arterial hypertension (PAH). However, it has not been determined whether changes in exercise parameters after follow up are useful to guide clinicians in their choices for (adjustment of) PAH treatment. The aim of this study was to determine changes in exercise variables after one year of PAH specific therapy and to monitor these changes to subsequent survival.

Methods: One year changes in cardiopulmonary exercise test variables and six minute walking distance (6MWD) were related to survival using Univariate Cox regression and Kaplan-Meier analysis in 40 PAH patients (mean age 44±2 yrs).

Results: A mean follow up time of 81 ± 15 (± 5) months, two patients were scheduled for lung transplantation and 10 had died. Survival analysis showed that from all exercise variables only one-year changes in maximal oxygen uptake (VO2, VO2/heart rate (O2pulse) and 6MWD were significant predictors of survival. Kaplan-Meier analysis (with ideal cut-off points estimated by receiver operating analysis) showed that patients with > 5% increase in VO2 or O2pulse had a significantly better cumulative survival (78 ± 12 % and 78 ± 10 %, respectively) compared to patients with < 5% increase in VO2 or O2pulse (cumulative survival 40 ± 13 % and 27 ± 20 %, respectively). Patients with < 6% decrease in 6MWD had a significantly better cumulative survival (84 ± 7%) compared to patients with > 6% decrease in 6MWD (cumulative survival 25 ± 15%).

Conclusion: Changes in VO2, O2pulse and 6MWD from baseline to one year predict survival in PAH. Consequently, these variables could be considered to guide treatment in PAH patients.

P3932
Iron deficiency in patients with systemic sclerosis-associated pulmonary arterial hypertension
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Background: Systemic sclerosis-associated pulmonary arterial hypertension (SSc-PAH) has a poor clinical outcome compared to other types of PAH. Recent data has shown that iron deficiency (ID) is associated with poor survival in idiopathic PAH. Inflammatory cytokines and increased hepcidin levels play a role. We hypothesise that hepcidin in patients with SSc-PAH is higher than in SSc patients.

Methods: Blood samples were collected from SSc-PAH patients (n=49) and systemic sclerosis patients without PAH (SSc, n=87) at one hospital. Inflammatory cytokines and hepcidin levels were measured in the serum. ANOVA revealed highly significant differences of hepcidin levels between the groups. The ROC analysis revealed a cut-off value of 16 pg/ml with a sensitivity of 86% and a specificity of 54% to diagnose SSc-PAH.

Results: The assessment of amplitude and angle of movement of the RVGC vector displacement, using an original method for secondary analysis of right ventricular function, showed that patients with SSc-PAH had a significant decrease in amplitude and an increase in angle of RVGC vector displacement compared to SSc patients.

Conclusions: Iron deficiency is more prevalent in SSC-PAH than in SSc patients and is associated with lower exercise capacity. The role of hepcidin in this process remains to be elucidated.

P3933
The sPAP/VO2max ratio during cardiopulmonary exercise testing as predictor of manifest pulmonary hypertension
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Background: Pulmonary hypertension (PH) is characterised by an inappropriate increase of pulmonary artery pressure (PAP) compared to cardiac output. We evaluated the systolic PAP (sPAP) during cardiopulmonary exercise test (CPET) in relation to maximum oxygen uptake (VO2max) as surrogate for cardiac output.

Patients and methods: We evaluated the sPAP/VO2max ratio in respect to presence or absence of PH. We retrospectively analysed right heart catheters studies (RHC) during CPET in 537 patients referred for workup of PH. We prospectively validated the ratio in 52 patients with normal echocardiography at rest, who underwent echocardiography during CPET followed by RHC.

Results: In the retrospective study, a manifest PH was found in 97 patients (69 precapillary PH, 28 postcapillary PH). The sPAP/VO2max ratio was mean 2.13 (SD 1.29) in both groups.

Conclusions: A sPAP/VO2max ratio of 3.4 or greater is considered to be a cutoff value for PH. sPAP/VO2max ratio of 2.13 is considered to guide treatment in PAH patients.

P3934
Novel method for assessment of the right ventricular contractile dysfunction in patients with severe COPD
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Aim: The aim of this study was to develop a new diagnostic criterion for RV contractile function assessment in patients with COPD.

Methods: Forty patients with COPD of II-IV stages (mean age of 58.6±7.3) were included in this study. Pulmonary hypertension (PAH, mPAP>30 mm Hg at maximum exercise) was diagnosed in 96 precapillary (ePH, 108 postcapillary (pPH). The sPAP/VO2max ratio was 2.13 (SD 1.29) in both groups. In 204 patients an exercise induced pulmonary hypertension (ePH, mPAP > 30 mm Hg at maximum exercise) was diagnosed in 96 precapillary (ePH, 108 postcapillary (pPH). The sPAP/VO2max ratio was 1.25 (0.80) in both groups. In 86 patients with normal pulmonary circulation at rest and during exercise the sPAP/VO2max ratio was 0.97 (0.67). ANOVA revealed highly significant differences of sPAP/VO2max ratio between the groups. The ROC analysis revealed a cut-off value of 0.61 with a sensitivity of 0.94 and specificity of 0.28 to detect manifest PH.

Conclusion: A sPAP/VO2max ratio of 0.61 can be measured by echocardiography during CPET. A ratio < 0.61 excludes manifest PH with a negative predictive value of 100%.

P3935
Plasma high fibrinogen and low plasminogen levels predict poor prognosis in patients with inoperable chronic thromboembolic pulmonary hypertension
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Background: Chronic thromboembolic pulmonary hypertension (CTEPH) comprises organizing thrombotic obstructions in the pulmonary arteries, and progressive pulmonary hypertension. However, there are few reports about the abnormality of coagulation and fibrinolysis system in CTEPH.

Purpose: The aim of this study was to investigate correlation between coagulation and fibrinolysis system, and severity and prognosis in patients with CTEPH.

Methods and results: We studied 91 patients (18 male, 55±4 SD, years, mean pulmonary arterial pressure 45±12 mmHg) diagnosed as having inoperable CTEPH at Chiba University Hospital between 1986 and 2011. We retrospectively investigated the relationship between plasma fibrinogen and plasminogen levels,
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severity and prognosis. Eighteen patients who had both high fibrinogen level (≥291 mg/dl, median) and low plasminogen level (<100.5 ng/ml, median) showed significantly lower cardiac index (2.27±0.66 vs. 2.70±0.58 L/min/m², p=0.0079), higher pulmonary vascular resistance (PVR) (1030±602 vs. 746±349 dyne*sec*cm⁻⁵, p=0.0090), and poor survival (5-year survival 35.4 vs. 88.6%, p<0.001) compared with other 73 patients. Multivariate analysis revealed that plasma fibrinogen, plasminogen, and PVR were independent predictors for survival.

Conclusion: Plasma high fibrinogen and low plasminogen levels are poor prognostic factors for patients with inoperable CTEPH.