Conclusion: Inspiratory rib cage muscles did not seem to take over work of the diaphragm. However, in- and expiratory rib cage muscles play an important role in preventing the development of rapid shallow breathing. Thus, RMET likely provides a training stimulus not only to the diaphragm but also to the rib cage muscles.

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P2106

Chest wall kinematics during different levels of positive end-expiratory pressure in cystic fibrosis children

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Objective: To study the effects of different levels of positive end expiratory pressure (PEEP) on compartmental chest volumes.

Methods: Twelve patients with CF (12±2.7 years, FEV1/FVC%: 81±3.6 and FEV1%: 69±12) and ten age-matched healthy subjects (control group-CG; 11±1.8 years) with normal lung function. Both groups were evaluated by Optoelectronic Plethysmography in 3 minutes of quiet breathing (QB), 3 minutes breathing against 3 levels of PEEP: 10 cmH2O, 15 cmH2O and 20 cmH2O.

Results: Both groups were similar during QB. Intergroup analyses showed that the volume of chest wall was different between CF and CG at PEEP10 (Vtcw=0.486±0.180L vs 0.920±0.500L, p=0.036; respectively) and at PEEP20 (Vtcw=0.511±0.170L vs 0.996±0.430L, p<0.005; respectively). We found differences in respiratory rate between groups at PEEP15 (RR=42±1.71 bpm vs RR=22.6±7.44±0.006, and PEEP20 (RR=37±2.193 vs 20.3±8.1±0.00). CF intragroup analyses showed that Vtcw increased significantly in all levels of PEEP compared to QB (Vtcw=0.286±0.079L vs Vtcw=0.487±0.181L, p<0.001; respectively). PEEP20=0.512±0.167L, p<0.001, but no differences were found between PEEP levels. End expiratory lung volume increased in CF group (PEEP20 vs PEEP10) in comparison to QB (Vtcw=10.7±3.3±2L vs 10.3±3.5±4L, p<0.001; respectively). PEEP10 and PEEP20 differed significantly in chest wall volumes in CF and CG. All levels of PEEP improve chest wall volumes in CF children’s.

P2107

Influence of aerobic exercise training on respiratory muscle strength in obese Thai women

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Obesity is one of major risk factors for developing several respiratory diseases which is probably linked to respiratory muscle impairment. This study aimed to determine whether aerobic exercise training improves respiratory muscle strength (RMS) in obese women. Inspiratory pressure from residual volume (PImaxRV) or function residual capacity (PImaxFRC), sniff nasal inspiratory pressure (Pnsn) and maximal expiratory pressure (PEmax) were measured in 13 obese women pre- and post-aerobic exercise training programme performed at least 30 min per session; 3 sessions per week for 12 weeks. Results showed that aerobic exercise training significantly reduced body mass indices (BMI) (29.8±6.29 kg/m², fat mass (27.1±3.8 vs 23.9±3.76 kg) and body fat (37.3±2.5 vs. 32.4±2.5%) whereas fat free mass did not alter. Compared with pre-exercise, RMS was significantly greater in post-exercise (p<0.001), e.g. absolute PImaxRV (126.1±25.2 vs 116.2±38.3 cmH2O), PImaxFRC (119±6±26 vs. 105.8±1±528.4 cmH2O), Pnsn (113.2±221 vs 98.1±21.2 cmH2O) and PEmax (127.3±24.7 vs. 119±6±26.4 cmH2O). The data suggest that aerobic exercise training in obese women studied appears to increase the RMS which may be, partly, a consequence of decreased fat mass and body fat.

P2108

Inspiratory muscle strength training: A pilot study on laryngeal movements

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Introduction: Exercise induced vocal cord dysfunction (VCD) is a common condition, often confused with exercise induced asthma with unfortunate consequences.

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The evidence base for conservative treatment is limited but two single-case reports suggest effects from inspiratory muscle strength training (IMST).

Objectives: To run a pilot study that objectively visualizes laryngeal response pattern(s) to controlled training with IMST.

Methods: Ten healthy volunteers (range 21-26), were examined at rest with video recorded continuous transthoracic flexible laryngoscopy while performing a standardized training program using a resistive loading device (RespirSt). The resistance during the training sessions were set at maximal and 60-80% of the maximal attainable inspiratory mouth pressure (PImax). Laryngeal movements were scored by a senior laryngologist according to a preset scheme.

Results: Resistance set at 60-80% of PImax produced a measurable glottic abduction in all subjects. Increasing the inspiratory pressure to PImax, revealed no change in the abduction in seven subjects, while in two subjects abduction appeared to decrease. In one subject a paradoxical adduction was observed. Supraglottic adduction was seen in two patients at PImax. In all subjects larynx moved downwards during inspiration, and nine of ten subjects seemed to engaged all muscle groups in the hypopharynx during inspiration at PImax.

Conclusion: The study suggests that IMST may be an efficient tool in the treatment of exercise induced VCD. Large interindividual differences suggest a need for an individually tailored program, and underscores that objective methods must be used during instructions and training with IMST in these patients.

P2109
Diaphragm and quadriceps muscle fatigue in self-paced cycling exercise of different durations

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Introduction: Individuals are believed to pace cycling intensity in a time trial (TT) such that the level of quadriceps muscle fatigue (QF) attained is similar independent of cycling conditions. We aimed to assess whether diaphragmatic fatigue (DF), known to affect leg muscle fatigue, would also reach similar levels between different tests.

Methods: 12 healthy, young athletes (67 ± 6.3 min m⁻³ kg⁻¹) performed 15 and 30min cycling time trials (15TT, 30TT, randomised), on two different days. DF and QF were assessed by measuring reductions in esophageal and gastric transdiaphragmatic pressure/quadrieps force during magnetic phrenic/femoral nerve stimulation after exercise relative to before (ΔP/ΔQ).

Results: The average degree of ΔP/ΔQ did not differ -21.2 ± 12.8% (15TT) vs. -17.6 ± 9.3% (30TT, p=0.228) while ΔQ/ΔP, of the shorter and more intensive test -34.0 ± 5.7% (15TT) vs. -29.5 ± 6.9% (30TT, p=0.044). Individual between-test differences of ΔP/ΔQ, did not correlate with those of ΔQ/ΔP. However, individual ΔP/ΔQ of both TT’s taken together significantly correlated with the workload of the finish (last 30 s) relative to the maximal workload (R²=0.30; p=0.005).

Conclusion: The present work does not support the notion that the level of QF is the same, independent of cycling TT conditions. Knowing that DF develops early during exercise, these findings may indicate that DF possibly affected finish intensity via afferent feedback from the fatigued diaphragm, attenuating central motor output to working limb muscles.

P2110
Dyspnoea, respiratory muscle strength and hyperventilation in end-stage liver disease

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There are scarce reports on respiratory muscle strength in end-stage liver disease patients. On the other hand, decreased PaCO₂ due to hyperventilation is documented in patients with end-stage liver disease. Chronic dyspnoea is frequently reported by these patients, but it is not known if it is related to respiratory muscle strength and/or hyperventilation. We studied 48 consecutive, ambulatory, Caucasian patients (37 men) with end-stage liver disease, awaiting for liver transplantation. On the other hand, decreased PaCO₂ due to hyperventilation is well known to be present in chronic liver disease. In conclusion, increased heart size within thoracic cavity affects chest wall function in Chronic Chagas Cardiomyopathy. Significant reductions in aerial oxygenation soon after removal of pleural fluid, a fact that supports the notion of chronic dyspnoea, respiratory muscle strength, and hyperventilation.

P2111
Reproducibility of diaphragm thickness measurements by ultrasonography

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Although diaphragmatic variations of the length of zone of apposition are readily studied by ultrasonography (US), only preliminary studies have shown the possibility to use US to measure diaphragmatic thickness (TD). In order to determine reference values of TD during various maneuvers and to assess US measurement reproducibility, 8 healthy subjects (4M, 4F) were studied in supine and standing position during spontaneous quiet breathing (QB), slow vital capacity (SVC), maximal inspiratory (MIP) and maximal expiratory (MEP) pressure maneuvers, TD was measured on lateral ribcage using an US linear probe (7.5 MHz). Six subjects were examined by two different operators on two different occasions on a long time period (6-7 months). TD was determined by a custom-designed software for image processing at end-inspiration (EI) and end-expiration (EE) during QB, at TLC and at maximal pressures during MIP and MEP maneuvers. Overall average values are reported in the following table (values reported as mean±SD).

Diaphragm thickness (TD, mm)

<table>
<thead>
<tr>
<th>TB</th>
<th>QB</th>
<th>EE</th>
<th>TB</th>
<th>QB</th>
<th>EE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supine</strong></td>
<td>14.5±6.45</td>
<td>13.4±6.54</td>
<td>0.36±0.42</td>
<td>2.80±0.66</td>
<td>3.29±0.68</td>
</tr>
<tr>
<td>Standing</td>
<td>15.0±5.96</td>
<td>13.9±5.49</td>
<td>0.36±0.44</td>
<td>2.80±0.70</td>
<td>3.25±0.82</td>
</tr>
</tbody>
</table>

ANOVA analysis revealed that no significant differences were present between inter- and intra-observer measures, in both postures, and on both short and long time periods (p>0.05). In conclusion: a) US represent a reliable and reproducible method for TD assessment; b) TD varies of ~30% and ~20% in supine and standing position during QB; c) at TLC, TD is about two-fold higher than at FRC; d) during MEP, TD is maximum.

P2112
Effects of cardiomegaly on regional chest wall volume in patients with chronic Chagas cardiomyopathy

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Heart failure is commonly related to changes in breathing pattern in order to evaluate the specific effects of cardiomegaly on chest wall function in Chronic Chagas Cardiomyopathy (CC). We studied 12 CCC patients with cardiomegaly and 12 healthy controls. EE and tidal volume by Opto-Electronic Plethysmography (OEP) were measured. OEP data were acquired during quite breathing (QB) and inspiratory loaded breaths (ILB) with threshold set at 50% of MIP. During QB, patients with cardiomegaly showed lower percentage contributions to tidal volume of both pulmonary rib cage (VRCp%) (p=0.03) and abdominal rib cage (VRCa%) (p=0.02) compared to patients without cardiomegaly. During ILB, VRCa% (p=0.03), end-inspiratory (p=0.03) and end-expiratory (p=0.04) volumes of abdominal rib cage volume were reduced compared to patients without cardiomegaly. In conclusion, increased heart size within thoracic cavity affects chest wall function in the rib cage compartments. The lower rib cage displacement is affected especially during inspiratory efforts. This mechanical constraint leads to a restrictive breathing pattern, which is related to high elastic load to both inspiration and expiration.

P2113
Effect of thoracocentesis on respiratory muscle strength in patients with unilateral pleural effusion

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It has been known that patients with pleural effusion may display a temporary reduction in arterial oxygenation soon after removal of pleural fluid, a fact that...
is in discrepancy with the relief of breathlessness after evaporation of effusions. We investigated changes in respiratory muscle strength before and after removal of several quantities of pleural fluid in patients with relatively large unilateral pleural effusions. We studied 49 patients (36 male & 13 female) aged 61±7.3 yrs. (mean±SD) with large unilateral pleural effusions of varying causes. Patients were selected on the basis of CT-scan not to have significant parenchymal lesions that would possibly interfere with lung physiologic properties (e.g. tuberculous effusions, neoplastic from extrathoracic primary site, hypopneumonieffusions etc) All patients were tested with an electronic mouth pressure meter, both before and 30 minutes after completion of thoracocentesis. The quantity of fluid removed was recorded for each patient and ranged from 0.38 to 1.41 L, with a mean value of 0.8±0.25 L (mean±SD). Maximal Respiratory Pressures were recorded 3 times and highest values were selected for statistical comparison (paired t-test). Maximal Inspiratory Pressure before removal of fluid (MIPb) was -74±13 cmH2O while after (MIPa) was -88±13 cmH2O (p<0.01). Maximal Expiratory Pressure before (MEPb) was 104±15 cmH2O while after removal of fluid (MEPa) was 121±17 cmH2O (p<0.001). We can conclude that removal of pleural fluid is accompanied by an improvement in respiratory muscle maximal pressures that may partly explain the relief of breathlessness after thoracocentesis.

P2114
Spinal behavior during tidal and deep breathing in healthy male subjects
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Spine has joint connections with all ribs and has muscle attachments with a part of diaphragm, suggesting a key role in respiratory mechanics. In this study, we aimed to investigate movement of the spine during tidal and deep breathing at a seated posture in which the spine was free from artificial restriction. Three-dimensional motion analysis using an eight-camera system (60Hz) was performed in fifteen male healthy volunteers (mean age; 27±1.5 years). During tidal breathing, the spine moved very little (< 1 mm) while ventral parts of the ribs and the sternum well moved (15.9±2.5 mm) as "pump-handle". Lumbar spine moved ventral direction with deep inspiration to TLC while upper thoracic spine did with deep expiration to RV. These results suggested that spine was almost fixed during tidal breathing as the pivot of the ribs. Breathing to RV or TLC recruited varieties of supplemental respiratory muscles, and transformed spine.

P2115
Positive effects of inspiratory muscle training (IMT) on ventilatory response to progressive hypercapnia in healthy subjects
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Inspiratory muscle training (IMT) is known to improve inspiratory muscle capacity, whole body exercise capacity and the sensation of dyspnea. Until now the effects of IMT on ventilation during ventilatory stress, induced by hyperventilation or by hypercapnia, have not been examined. We speculate that, by improving inspiratory pump capacity, may affect ventilatory response during CO2-rebreathing.

Aim and study: The aim of our study was to analyze the effects of IMT on the ventilatory response during CO2-rebreathing tests in healthy subjects.

Methods: Eight healthy subjects (4 males, 4 females) performed specific IMT for 6 weeks. Maximal inspiratory pressure (Pi max) and endurance time during resistive breathing manoeuvres (lim) served as parameters for inspiratory muscle capacity. The ventilatory response to CO2, using the Read’s rebreathing technique, was analysed twice before commencement of IMT and once on the day after stopping IMT.

Breathing pattern during ventilatory stress changed in that the proportion of tidal volume on minute volume increased significantly. Cough intensity could be defined with a variety of measures that include thoracic and abdominal pressure, airflow, electromyography and subjective scales. Little is known about cough intensity in patients with chronic cough. We investigated the physiological characteristics of cough intensity in patients with chronic cough and normal subjects.

15 patients with chronic cough and 14 healthy subjects underwent measurements of esophageal pressure (Poes), gastric pressure (Pga), peak cough flow rate (PCFR), abdominal electromyographic activity and cough sound during voluntary coughs. The data from maximum cough efforts are presented. PCFR was normalised to predicted peak expiratory flow rate to account for gender and height differences. There was no significant difference in gender, age or lung function between patient and control groups. Maximum cough Poes was higher in patients with chronic cough than controls (188 ± 146cmH2O vs. 120 ± 60cmH2O, p<0.02). This difference was limited to females only; the male group was underpowered to detect a difference. Cough Pga was higher in patients with chronic cough than controls (151 ± 132 (cmH2O) vs. 144 ± 44 cmH2O, p<0.01). Moreover there was no difference between normal subjects and patients.

Conclusion: Maximum expiratory pressure was significantly higher in healthy obse subjects, compared to non obese control, possibly due to the increased work of breathing. Positive correlation between MEF and BMI and body fat% was observed.

P2118
Changes of active expiration respiratory muscle (RM) in men with chronic obstructive pulmonary disease (COPD)
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Background: For the present moment changes occurring in RM, during COPD, have been studied insufficiently.

Aim and objectives: to investigate the RM status and compare them with histo- logical data of biotropic muscular material.

Material and methods: The peak histogram of the internal oblique abdominal muscle (intOAM) was detected using ultrasonic scanner. We obtained the indices: ho- mogenerity (H), structural density (SD) and echogenicity (E). Histological research of biotropic material of intOAM has been carried out.

Research was made in 13 pts: 1st group: 8 at the 1st COPD stage; mean age 56 yrs; BMI 24kg/m2; 2nd group: 5 at the 2nd COPD stage; mean age 59 yrs; BMI 24kg/m2. Control group was formed of 10 healthy subjects compared according to age-, sex- and BMI.

Obesity and respiratory muscle power
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Introduction: In the past few decades obesity has become a global health problem. It could be a predisposing factor to a lot of cardiovascular, metabolic (such as dia- beta mellitus) and respiratory problems that may result in pulmonary obstruction or restriction.

Objectives: The aim of this study was to investigate the effect of obesity on respiratory muscle power and so on lung functions.

Methods: This was a cross sectional study performed on 52 subjects (35 females and 17 males) in the age range 17-23 years in Khartoum state during the period February to May 2010. The body mass index (BMI) was computed following the standard equation (BMI kg/m2) = (weight/height2). The percent of body fat was measured using Skinfold Caliber at the back of upper arm. Obesity was defined following the internationally accepted BMI cut-off points and ideal body fat percentages such as these from the American Council on Exercise. Pulmonary function tests (FVC, FEV1, FEV1/FVC ratio) were performed using micro-plus spirometer. Maximal expiratory pressure (MEP) was measured using Respiratory pressure meter. Statistical analyses were performed using the SPSS.

Results: The mean of MEP was significantly higher in obese subjects (p<0.002). The mean FEV1/FVC% was significantly higher in obese subjects (p<0.001). PCFR:predicted PEFR ratio 1.4 (0.4) 1.1 (0.5) *0.03

Conclusion: Maximum expiratory pressure was significantly higher in healthy obese subjects, compared to non obese control. The increase in the proportion of tidal volume on minute volume increased significantly.

All Patients Controls p-value
M-F 3.12 5.9 ns
Age (yrs) 55 (17) 54 (23) ns
Poes (cmH2O) 188 (49) 146 (51) *0.02
Pga (cmH2O) 201 (38) 172 (60) 0.2
PCFR:predicted PEFR ratio 1.4 (0.9) 1.3 (0.5) 0.6

Females
Poes (cmH2O) 181 (51) 132 (15) *0.02
Pga (cmH2O) 199 (40) 148 (44) *0.01
PCFR:predicted PEFR ratio 1.4 (0.4) 1.1 (0.5) *0.03

Presented as mean (SD).

Female patients with chronic cough have higher maximum cough pressures and cough flows than healthy controls. Further studies are needed to identify underly- ing mechanisms and investigate whether these findings are also relevant to male patients with chronic cough.
Results: Contractions, small sites of a fragmentation, stratification of myofibrils and proliferation of fibroblasts were observed at the 1st and 2nd COPD stage. We revealed scleroses of single muscular fibres and foci of sclerosis in intramuscular regions. The median H in the 1st and 2nd groups was 21 and 18 units respectively. Increasing severity of COPD was associated with enhancing of contractions and stratification of myofibrils. Thus, we detected the significant correlations between COPD severity and contractions (r=0.721) and with stratification of myofibrils (r=0.66). Indices H and SD were lower in pts with more sclerosis manifestations (r= -0.42 and r = -0.59). Whereas index E was higher in these patients (r=0.59).

The paper significantly correlated with intensity of proliferation of fibroblasts (r=0.56).

Conclusions: Indices H, E, SD reflect the pathological processes occurring in RM in COPD patients.

P2119 Acute inspiratory load effects on chest wall volumes distribution and inspiratory muscles activation

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Aim: The acute effects of inspiratory load (IL) on the chest wall volumes distribution and inspiratory muscles activation were studied. The inspiratory load can induce changes on the ventilatory pattern in order to analyze the acute effect of inspiration of inspiratory load (IL) on the ventilatory pattern and inspiratory muscle action, 39 healthy subjects (19M, 20F) were analyzed. Characteristics of male and female subjects respectively were: age,25.50±0.86 and 22.70±0.45 years, FEV1/FVC, 95.05±22.27 and 105.06±1.97%pred; maximal inspiratory pressure, 123.6±43.7 and 98.2±37.4 cmH2O. During IL, tidal and component volumes were measured by Opto-Electronic Plethysmography (OEP) simultaneously with the activity of bilateral sternocleidomastoid (STMD) and Diaphragm (DI) measured by Surface Electromyography (SEMG). For diaphragm SEMG, electrodes were positioned on the 7th e 8th intercostal spaces on anterior axillary line. For STMD SEMG, electrodes were positioned 5 cm below the mastoid process. IL was performed using Threshold0.8, with 2 minutes of breathing at different levels (initial load=10 cmH2O, then increments of 5 cmH2O, up to 40 cmH2O or exhaustion). Inspiratory time increased during IL compared to Quite Breathing (QB) (p=0.004). Tidal volumes of the total chest wall (Vcw) and pulmonary rib cage (VRcp) increased for loads ≥20 cmH2O (p=0.000). Total volume of the abdomen increased only for loads ≥30 cmH2O (p=0.03) in males and ≥20cmH2O in females. Median frequency of STMD started to decrease for loads ≥30 cmH2O (p=0.02), while that of the DI decreased only for loads ≥40 cmH2O (p=0.049). In conclusion, the acute effects of IL in healthy subjects occur before and are more intense on inspiratory rib cage muscles than the diaphragm.

P2120 Does lung transplantation improve chronotropic incompetence?

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Introduction: Chronotropic Incompetence (CI), or an attenuated heart rate (HR) response to exercise that has been widely established as a predictor of mortality in general populations and in patients with heart disease. CI has not been studied in patients with interstitial lung disease (ILD). It is of particular relevance in patients with ILD, despite abnormalities in pulmonary hemodynamics and cardiopulmonary parameters.

Objectives: Our primary aim was to see whether CI exists in patients with ILD during maximal exercise testing.

Methods: This is a retrospective review of 482 patients with ILD who underwent cardiopulmonary exercise testing (CPET) at Columbia University Human Performance Laboratory between 10/1999 and 2/2011. Patients had CPET with concurrent pulmonary function tests (PFT). Comparisons were made with paired samples t-test.

Results: The mean PFT and CPET variables for the 482 ILD patients (aged 56.6±11.0 years) analyzed are shown in table 1. Usual heart rate reserve used (HRRU) is 85% in normal subject populations.

P2122 Effect of posture on chest wall and diaphragm asynchronies in COPD

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In COPD hyperinflation alters the function of the inspiratory muscles. The zone of apposition of the diaphragm (ZOM) is reduced, thus COPD patients often show paradoxical movement of the lower rib cage. The aim of this study is to investigate if in COPD chest wall and diaphragm asynchronies are altered by posture. 24 severe COPD (FEV1=32.5±7.0%pred) and 12 age-matched controls (CTR) (FEV1=111.1±16.2) were studied during quiet breathing in seated (ST) and supine (SP) positions. Phase shift (θ) between pulmonary rib cage (RPC) and abdominal rib cage (RCa) and θ between RPC and the abdomen (AB) were assessed by opto-electronic plethysmography. The crano-caudal displacement of the ZOM (AZOM) was contemporarily measured by ultrasonography.

Neither θ between RPC and RCa or θ between RPC and AB was altered by posture in CTR. Conversely, in COPD patients, θ between RPC and RCa decreased when changing posture from ST to SP (θ=23.7°±19.5, 8.5±18.1 respectively, p<0.001) and AB in COPD showed a behavior similar to CTR while in ST (θ=3.13±13.3 in COPD, θ=4.1±4.5 in ST), but strongly differed in SP (θ=25°±18.2, p<0.001, COPD vs. CTR). Moreover, in COPD AZOM was linearly correlated to RCP in ST (r²=0.718±0.140), similarly to control subjects (r²=0.729±0.150), while it was significantly less correlated to RCa (r²=0.510±0.246, p=0.001). In COPD correlation between AZOM and both RCP and RCa decreased (r²=0.530±0.244, r²=0.511±0.230 p<0.001 in SP).

In COPD the diaphragm and RCa are uncorrelated in ST, but the synchronous action of the rib cage muscles and the diaphragm is similar to healthy. In SP the diaphragm is uncorrelated with both RCP and RCa, the asynchrony with the rib cage muscles seems to be pronounced.
P2123
Parasternal muscle contractility increases with aminophylline
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Introduction: The traditional theophylline bronchodilator, Aminophylline, is still widely used, especially in the treatment of COPD. However, in COPD patients the effects of theophylline have been inconsistent. Recently, Aminophylline was shown to increase ventilation and costal diaphragm contractility in awake canines (Jagers et al. Resp. Phys. 2009;167:273-280).

Aim: To investigate the effect of Aminophylline at therapeutic levels on the primary chest wall muscle, Parasternal Intercostal.

Methods: Sonomicrometry transducers and EMG electrodes were implanted in the left parasternal muscle. After recovery, the animals were studied awake, unanesthetized and breathing through a snout mask; air flow, ETCO₂, heart rate, muscle length and shortening, and moving average EMG were recorded during room air, and CO₂ stimulated ventilation, before and after loading and continuous infusion of Aminophylline at therapeutic levels.

Results: For N=5 dogs (mean 31.1 kg) 24 days post implantation. Aminophylline serum levels were 66.4 umol/L (therapeutic range 55-110). Minute ventilation increased significantly with Aminophylline: 6.7, 7.84, 11.8 and 16.6 L/min at room air, low (46), medium (52) and high (57 mmHg) CO₂ stimulated breathing respectively. Parasternal contractility increased significantly.

Conclusion: Parasternal muscle contractility increases with greater muscle shortening per EMG, in awake, intact canines, at therapeutic levels of Aminophylline.