measures of fitness during one season of basketball.

## ESTIMATION OF $F_{102}$ IN SUBJECTS RECEIVING SUPPLEMENTAL OXYGEN DURING PROGRESSIVE EXERCISE.

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Supplemental oxygen treatment is commonly needed by patients with cardiopulmonary disease. Often during supplemental oxygen administration, the exact fraction of inspired oxygen ($F_{102}$) is unknown, especially during exercise when minute ventilation ($V_E$) varies with exercise intensity. The purpose of this study was to develop a technique to predict the $F_{102}$ in patients receiving supplemental oxygen based on $V_E$ and oxygen flow rate. Forty normal subjects between the ages of 20 and 40 completed a progressive exercise protocol on a cycle ergometer. During data collection a nasal cannula was openly attached to the inhalation port of a Hans-Rudolph nonrebreathing valve. The exercise protocol consisted of 4 stages, each 6 minutes long. During the first 3 minutes of each stage, the subjects inspired room air ($F_{102}$ = .209) and during the last 3 minutes subjects inspired air supplemented with oxygen at flow rates of 2 l/min or 3 l/min. During each exercise stage oxygen consumption ($VO_2$) was measured while subjects inspired room air and the fraction of expired oxygen ($F_{EO2}$), fraction of expired carbon dioxide ($F_{ECO2}$), $V_E$, tidal volume ($V_t$), and inspiratory time ($T_I$) were measured while the subjects inspired supplemented air. An estimation of $F_{102}$ was made at each stage using this formula:

$$F_{102} = .9997/[(V_{E(l/min)} * z/y) + 1]$$
where: $y = VO_{2\ (l/min)} + V_{E\ (l/min)} * F_{EO2}$; $z = 1-(F_{EO2} + F_{ECO2})$

Correlation analysis was used to compare $V_E$, $V_T$, and $T_I$ to the values obtained for $F_{102}$. The best correlate of $F_{102}$ was $V_E$ and when these parameters were plotted a curvilinear relationship was found. Following log transformation of $V_E$, linear regression analysis was performed. Equations to predict $F_{102}$ from $V_E$ were derived for oxygen flow rates of 2 and 3 l/min and are presented in the table. The range of $F_{102}$ during progressive exercise was .236 to .314 and .251 to .347 for the 2 l/min and 3 l/min flow rates, respectively. Furthermore, the $F_{102}$ dropped off rapidly between minute ventilations of 10-25 l/min, and then remained relatively stable at minute ventilations greater than 25 l/min. This suggests that patients using supplemental oxygen experience the greatest reductions in $F_{102}$ during initial exercise.

Table. Equations to Predict $F_{102}$

| | |
|---|---|
| $F_{102}$ @ 2 l/min | = .3779-.086 * log $V_E$ (l/min) |
| $F_{102}$ @ 3 l/min | = .4352-.1145 * log $V_E$ (l/min) |

## RESPIRATORY MUSCLE STRENGTH AND ENDURANCE FOLLOWING A CVA: A PILOT STUDY.

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The respiratory system plays a critical role in the supply of oxygen to tissues which support movement for the performance of functional activities. (Peele, 1996) Investigators of this pilot study have observed clinically that the respiratory status in individuals with hemiparesis following an initial cerebral vascular accident (CVA) is altered as evidenced by abnormal breathing patterns and shortness of breath. Haas and coworkers (1965) reported respiratory function is depressed in adults following a CVA. Decreased respiratory muscle strength and endurance due to neuromuscular weakness associated with CVA may contribute to this depression. The purpose of this pilot study was to compare the pulmonary function of adults following their first CVA with established normal adult standards to determine if respiratory muscle strength, as measured by negative inspiratory force (NIF), and endurance, as measured by maximal voluntary ventilation (MVV), are depressed following an initial CVA. A convenience sample of 7 females and 6 males, 40 to 60 years of age, admitted to the comprehensive rehabilitation unit within 3 weeks of having their first CVA consented to participate. All subjects were able to either propel a wheelchair or ambulate with no more than moderate assistance, had no severe thoracic cage disorders, and were determined to be medically stable by a physician. A Respiradyne II Plus Pulmonary Function/Ventilator Monitor (provided by Sherwood Medical, St. Louis, MO) was used to measure NIF and MVV as well as forced vital capacity (FVC), a measurement of maximal volume output, and forced expiratory volume in one second ($FEV_1$). For testing, the subject was supine with the upper body elevated to -45°. The pulmonary function tests were performed in the following order: NIF 3 times, FVC 3 times, MVV 1 time. Vital signs and oxygen saturation were monitored throughout the procedure. Maximal NIF and FVC values achieved were used for data analysis. (Moriss et al, 1971; Cherneack and Raber, 1972) Additionally, $FEV_1$, as calculated by the Respiradyne II Plus, for the maximal FVC trial was used for data analysis. Published prediction equations for normal pulmonary function standards (Ruppel, 1994) were used to determine each subject's expected NIF, MVV, FVC, and $FEV_1$ values. Expected $FEV_1$/FVC ratio was also calculated. A paired sample t-test was used to analyze the expected test values and the actual test values for each pulmonary function test. NIF for 12 subjects was -23.75 cm $H_2O$ to -71.09 cm $H_2O$ (21%-86%) below the standard. One subject exceeded her expected NIF by -74.44 cm $H_2O$ (91%). MVV was 66.37 L/min to 125.04 L/min (68%-87%) below the normal standard. FVC for all subjects was 1.56L to 3.76L (48%-76%) below the norm. $FEV_1$ was depressed by 0.97L to 3.01L (39%-84%) in all cases. Eight subjects exceeded the expected $FEV_1$/FVC ratio by 0.01L to 0.28L (1%-38%). The $FEV_1$/FVC ratio of the remaining subjects was depressed by 0.01L to 0.27L (1%-38%). There is a significant difference between the expected and the actual test values for NIF ($t=-4.00$; $df = 12$; $p=0.002$), FVC ($t = -13.97$; $df=12$; $p < 0.001$), $FEV_1$ ($t= -11.66$; $df = 12$; $p < 0.001$), and MVV ($t= -17.79$; $df = 12$; $p < 0.001$). There is no significant difference between the expected and the actual values for $FEV_1$/FVC ratio. These results indicate respiratory muscle strength, as measured by NIF, and endurance, as measured by MVV, are depressed in an adult following an initial CVA, $FEV_1$, and FVC also appear to be depressed. These findings are consistent with published reports that respiratory function is depressed in adults following a CVA. A compromised respiratory system depletes the amount of oxygen available to the body thereby potentially decreasing an individual's ability to perform functional activities. The results of this pilot study indicate medical management of

individuals following a CVA should include assessment of pulmonary function and provide respiratory strengthening exercises in the rehabilitation process to increase respiratory muscle strength and endurance. Further investigation of respiratory function in adults following an initial CVA is justified by the conclusions of this pilot study.

### CAN PULMONARY FUNCTION TEST AND ARTERIAL BLOOD GAS STUDIES BE USED TO PREDICT TOLERANCE TO PERFORM ACTIVITIES OF DAILY LIVING?

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The purposes of this study were to prospectively examine the relationship between pulmonary impairment and tolerance to Activities of Daily Living (ADLs) in patients with end stage lung disease and the relationships between the ADLs and pulmonary impairment according to specific diagnostic categories. Pulmonary impairment was measured by Pulmonary Function Tests (PFTs) and Arterial Blood Gas analysis (ABGs). The ability to complete ADLs was measured by the Physical Performance Test (PPT). The PPT is a time based test that measures fine motor and eye hand coordination, dressing, lifting and bending abilities, balance, walking, and stair climbing. In 1995, 138 patients were evaluated for lung transplantation. The criteria for entrance into this study included the patient being considered a potential transplant candidate and a documented left ventricular ejection fraction $\geq$ 45%. An ejection fraction > 45% was used to eliminate patients with cardiac dysfunction which may contribute to their functional limitations. During a one week evaluation for candidacy for transplantation, each patient was evaluated with PFTs, ABGs, cardiac testing, and PPT. The PPT was completed by a physical therapist. For this parametric data, the Pearson Product Coefficient Correlation was used to analyze the relationship between the results of the PFTs and ABGs with the score of the PPT for the entire group. For the entire group (N=112, 52 males and 60 females) there were statistical associations between the score the 9 item PPT and diffusing capacity (DLCO) (r=.27) plus the partial pressure of arterial oxygen ($PO_2$) and PPT (r=.31) with $p < .05$. The PPT did not statistically correlate with any other components of the PPTs and ABGs. Further analysis was completed comparing components of the PPT to pulmonary test results to determine if there were differences by diagnostic categories (pulmonary hypertension, N=13; nonseptic obstructive, N=38; septic obstructive, N=30; restrictive, N=16; other, N=15). In patients with pulmonary hypertension there was a correlation (r=.70) between the DLCO and the time to complete the eating task. In the nonseptic group there were correlations between stair climbing and DLCO (r=.44), stair climbing, and partial pressure of carbon dioxide ($PCO_2$) (r = .38) and a correlation (r= .38) between forced vital capacity and dressing time. In patients with septic obstructive disease there were statistical association for $PCO_2$ and walk time (r= .52); $PO_2$ and walk time (r=.51); $PCO_2$ and stair time (r= .55); $PO_2$ and stair time (r=.54); $PO_2$ and dressing time (r=.41). Finally, in the restrictive group there were correlations between the DLCO, $PO_2$ and alvcolar—arterial gradient and the ability to complete the ADLs that involved upper extremity use. Our results showed a low correlation between PFTs, ABGs, and the ability to perform items on the PPT. Therefore, PFTs and ABGs cannot be used as general predictors of function in patients with ESLD. It is therefore clinically important that a physical therapist's evaluation includes an assessment of a patient's ability to complete ADLs in order to fully assess the patient with ESLD who is being considered for lung transplantation. The results of a comprehensive physical therapy and medical evaluation are vital in identifying stable candidates for transplantation to facilitate good outcomes during a time of organ shortage and health care reform. There appears to be modest correlations between specific components of the PFTs and ABGs with walking and stair climbing, but further research is needed to examine the stability of using PFTs and ABGs as a predictor of gross motor functional impairments. Further research is also needed to examine the existence of functional characteristics of patients by diagnostic categories and evaluate the usefulness of measuring ADLs and physical capacity in predicting morbidity and mortality.

## POSTER PRESENTATIONS

### EFFICACY OF A SHORT DURATION, COMMUNITY BASED PULMONARY PROGRAM.

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Past studies have shown aerobic exercise programs to be beneficial physically and mentally for patients with mild to severe pulmonary disease. As a group, these efficacy studies have addressed individual or group programs of varied duration (8 to 40 weeks) provided by single or multidisciplinary health care teams to both in and outpatients (Holle, 1988; Goldstein, 1994; Mall, 1988). It is unclear whether a group program of relatively short duration is beneficial across a broad scope of diagnoses. The purpose of this research project was to examine certain benefits of a short term, community based, group pulmonary exercise and educational program.

Over the 13 month study period, 25 patients participated in a two hour session, three times a week for five weeks. Participant's mean age was 71 $\pm$ 9 and diagnoses included: emphysema (36% of patients), COPD (32%), exacerbation of pneumonia (12%), chronic asthma (12%), chronic bronchitis (8%). The program consisted of three tiers: a) education on respiratory function and management, b) supervised exercise, and c) detailed home program of specific exercises and reading assignments. Although the program included a multidisciplinary assessment which evaluated progress in all three tiers, this poster reports results from the supervised physical therapy exercise portion. Measurements were taken pre and postcompletion of the 5 week program and included: a) self paced level, indoor ambulation distance; b) self determined exercise tolerance on upper or lower extremity resistive equipment; and c) heart rates and dyspnea levels postambulation and exercise.

In general, participants made substantial progress in ambulation distance and exercise tolerance while reporting a reduction in dyspnea. All participants increased their ambu-