Progressive Cardiopulmonary Dysfunction in an Adult Survivor of Preterm Birth

Taylor Levin[1,3], Arij Beshish[1,3], Kristin Haraldsdottir[1,3], Laura Tetri[1,3], David Pegelow[1,3], Gregory Barton[1,3], Rudolf Braun[1,3], Mari Palta[4], Kara Goss[3], Emily Farrell[1], Marlowe Eldridge[1,3]

Department of Pediatrics[1], Department of Medicine[2], John Rankin Laboratory of Pulmonary Medicine[3] and Department of Biostatistics and Medical Information[4], University of Wisconsin- Madison

The incidence of preterm birth, defined as being born less than 37 weeks of gestation, is rising globally and now accounts for approximately 12% of all births. As the lifesaving interventions for premature infants become more effective, more infants born preterm are surviving into adulthood. However, little is known about the long-term effects that these adults face. In this longitudinal study, a male born preterm in 1988 was studied at 22 and 27 years of age with a battery of tests to investigate the progression of cardiopulmonary dysfunction. This individual was recruited from the Newborn Lung Project (NLP), a multi-centered population-based cohort study of all very low birth weight (VLBW) infants admitted to one of six regional newborn intensive care units in Wisconsin and Iowa between 1988-1991. He was born at 24 weeks of gestation, weighed 822 grams at birth, received no surfactant, and was in the neonatal intensive care unit for a total of 109 days. At age 22 and 27, he performed pulmonary function tests (PFT) including diffusing capacity for carbon monoxide (DLCO) and graded upright cycle exercise tests to volitional exhaustion. From age 22 to 27, forced expiratory volume in 1 second over the forced vital capacity ratio (FEV_1/FVC) decreased 7.95%, from .88 to .81. At age 22, FEV_1 was 4.98 L (91% predicted) and at age 27 it was 4.65 L (89.4% predicted). FVC at age 22 was 5.64 L (87% predicted) and at age 27 it was 5.73 L (91.2% predicted). DLCO dropped from 46.2 ml/min/mmHg (98.4% of predicted) to 29.3 ml/min/mmHg (85.5% predicted). Taken together, the decreases in DLCO and FEV_1/FVC suggest that this subject has obstructive airway disease. Furthermore, the subject had hyperreactivity to methacholine at both time points, suggesting that he is at a greater risk for asthma.

During the graded maximal exercise tests at both visits ventilatory threshold (VT), VO_{2max} (L/min) and minute ventilation (VE, L/min) were analyzed. VT occurred at a higher percentage of VO_{2max} at age 22, 84.5%, compared to age 27, where it was 75.2% of VO_{2max}. VO_{2max} also decreased from age 22 to 27: 3.4 to 2.9 L/min. Oxygen (O_2) pulse decreased from 18.3 ml O_2/beat to 14.2 ml O_2/beat. These decreases indicate that as this subject ages, he has a greater fall in exercise capacity than expected. We were also able to compare VE at VT. VE decreased from 76.1 to 56.7 L/min at VT, though VT occurred earlier in the test. Finally, alveolar-arterial oxygen gradient (A-a)O_2 was compared using arterial blood gas measurements collected at rest. The (A-a)O_2 increased from 6.11 mmHg at age 22 to 10.3 mmHg at age 27. It has been documented that (A-a)O_2 increases with age, but only by an average of 1 mmHg per decade in healthy adults. This increase could possibly indicate changes in diffusion limitation, ventilation/perfusion matching, or hypoventilation. This case study suggests that preterm adults may have cardiopulmonary dysfunction and pulmonary gas exchange limitations that progressively worsen with age.