Determining the Total Lung Capacity of Living Ringed Seals (*Pusa hispida*) Using CT Imaging Techniques

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Marine mammals rely on oxygen stored in blood, muscle, and lungs to support breath-hold diving and foraging at sea. Relative to terrestrial mammals, they have enhanced capacity to store oxygen in their blood and muscles. Due to the difficulty of studying respiratory systems in living animals, few in vivo studies have focused on the role of lungs in oxygen storage capacity. Although lung collapse is a mechanism by which many marine mammals avoid dysbaric injuries, gas exchange between the blood and lungs occurs until the point of lung collapse. Further, many species do not dive to the depth of predicted lung collapse – thus, the lungs must be accounted for when studying oxygen reservoirs in free-ranging individuals. We examined lung volume and oxygen storage capacity through the use of non-invasive, high-resolution CT imaging of living ringed seals (*Pusa hispida*). Ringed seals are among the smallest phocids. They are relatively shallow divers that exhibit moderate dive durations (typical dives < 100 m and < 8 min) and thus may rely on lung oxygen stores to a greater extent than deeper-diving seals. Here, five ringed seals undergoing rehabilitation at the Alaska SeaLife Center were anesthetized and intubated for scheduled veterinary procedures. Full body scans were obtained by CT in 0.65-2.5 mm sections at several lung pressures (0, 30, and/or 37 mm Hg) in both dorsal and ventral recumbency. The data were used to create 3-dimensional models of the respiratory tract so that total lung capacity, respiratory dead space, and minimum air volume could be determined. This study provides insight into how the lung capacity and respiratory characteristics of ringed seals compare to other species. Further, these data can be combined with previous assessments of blood and muscle oxygen stores to produce more accurate estimates of the relative contribution of the lungs to diving oxygen stores in one of the smallest marine mammals.