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Title LUNG/THORAX COMPLIANCE AFTER BREATHING 730 TORR OXYGEN

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Introduction. Breathing 100% oxygen at one ATM decreases compliance in rats, rabbits and dogs. Adaptation to hyperoxic conditions[1] extends the period of 100% O_2 tolerance at sea level,[1] but little information is available about compliance during this period. Sequential lung/thorax compliance changes were therefore studied in rats during and after 730 torr oxygen breathing.

Methods. Groups of 300-400 gram CFE strain male, Sprague-Dawley rats were exposed, in a 300 liter acrylic environmental chamber, to 730 torr oxygen for 10 continuous days after a previously described adaptation period[1]. After adaptation rats breathed 150 torr O_2 in the laboratory with room air (RA) control rats until sacrifice. Lung/thorax compliance was measured in selected group members during adaptation, during high O_2 breathing and then on day 3, 7, 10, 14, 52 and 83 of air breathing. Fresh gas inflow, oxygen concentration, relative humidity, temperature and carbon dioxide were controlled and measured. Fresh wood shavings, food and water were supplied daily thru an air lock and distributed with full arm gloves built into the chamber to maintain environmental O_2 tension constant. After IM Ketamine and Inapsine, to allow exanguination and tracheal cannulation, lungs were inflated to 7 ml in 0.5 ml increments and then deflated in 0.5 ml decrements. Volume/pressive loops were graphed and highest compliance point plotted. The chest was then opened, pleural effusion measured, trachea and lungs excised, right lung weighed and left lung perfusion fixed with phosphate-buffered formaldehyde. Tissues were embedded in paraffin, cut into 5-7 micron sections, and stained with hematoxylin and eosin, Verhoef's and Masson's Trichrome stains.

Results. During adaptation and in the first three days of 730 torr O_2 breathing compliance decreased. (figure 1) Compliance increased during the next 7 high O_2 days, returned to control level four days after commencing room air breathing and remained above normal for the remainder of the study period. Pleural effusion accumulated during adaptation while breathing 730 torr O_2 but was not seen thereafter. Low compliance lungs showed aerated hyperemic areas mixed with dark red atelectatic areas with pulmonary congestion, perivascular and interstitial edema and intra-aveolar proteinaceous exudate (acute oxygen toxicity). High compliance showed white avascular scarred areas and transparent blebs with varying amounts of interstitial honeycombing and scarring (chronic oxygen toxicity). Lung weight increased as compliance decreased and decreased again as compliance increased.

Discussion. Interstitial pulmonary edema combined with pleural effusion presumably accounts for decreased compliance during adaptation and 730 torr O_2 breathing. Resorbtion of pleural effusion and perhaps interstitial fluid results in return of compliance to control level 4 days after cessation of high O_2 breathing. The predominence of enlarged air spaces and thin alveolar wells (emphysema) over scarring and thick walls probably accounts for the increase in compliance above normal after high O_2 exposure ends. Stabilization of lung/thorax compliance above normal after pulmonary injury suggests that healing of these oxygen induced emphysematous changes does not occur.

References. Paegle RD, Berhard WN, Turndorf H: Intermittent exposure to 40 percent oxygen prolongs rat survival in 100% oxygen. Anesth. Analg. 56:847-851, 1977