

Changes in Chest Wall Acceleration of Rats after Exposure to Ozone

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INTRODUCTION & RELEVANCE

It has previously been shown that tidal volume and minute ventilation decrease in rats exposed to ozone [1]. In this study, pre and post exposure thoracic breathing patterns were measured in Sprague-Dawley rats (n=9) exposed to 2 ppm O₃ for three hours. The previous results of O₃ exposure in rats were confirmed. In addition to confirming the results of the effects of O₃ on tidal volume and minute ventilation, this study demonstrates a decrease in acceleration during the transition from deflation to inflation.

MATERIALS & METHODS

Thoracic breathing pattern was measured immediately before and one-hour post exposure to 2 ppm O₃. This flow signal was measured via a custom built head-out plethysmograph with a pneumotach (Fleisch #000) attached to a pressure transducer (Setra #239) to record flow. The signal was passed through a data acquisition card (National Instruments DAQCard-700) set for a 1000 Hz sampling rate, and into a computer for storage and analysis. A third order Butterworth low-pass filter with a cutoff frequency of 50 Hz was utilized to reduce unwanted noise in the signal. The filter was applied forward and backward to minimize phase shifting. Thoracic acceleration was calculated via a five point cubic smoothing derivative of flow [D(flow)/dt] and volume was found by integrating flow [∫(flow)dt] using the trapezoidal method. Flow-volume, acceleration-flow and acceleration-volume (Figure 1) curves were then examined to quantify acceleration losses due to O₃ exposure. During lung deflation air flows into the plethysmograph and is recorded as negative flow. Thus, the chest wall acceleration during the transition from lung deflation to lung inflation computes as a negative acceleration. Mean accelerations and standard errors were calculated based on the minimum values of 15 acceleration loops on the acceleration-volume charts.

RESULTS & DISCUSSION

Exposure of rats to 2 ppm O₃ for three hours resulted in a significant decrease in airflow acceleration during the transition from deflation to inflation. All nine animals studied showed a significant (p<0.0001) decrease in acceleration (Figure 2). This simple technique may prove useful in evaluation of inhalation exposure to O₃.

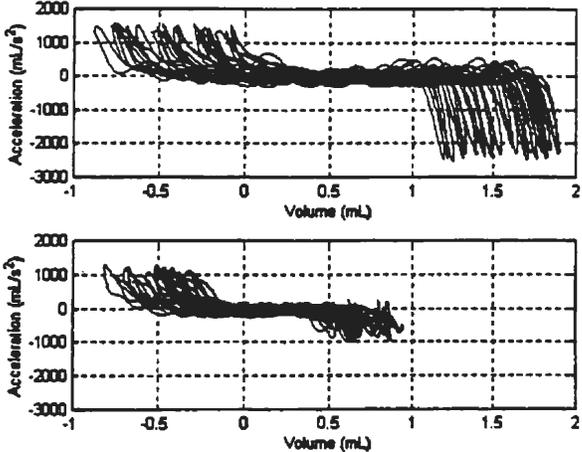


Figure 1. Acceleration-Volume curves pre (top) and post (bottom). Notice the decrease in acceleration after exposure.

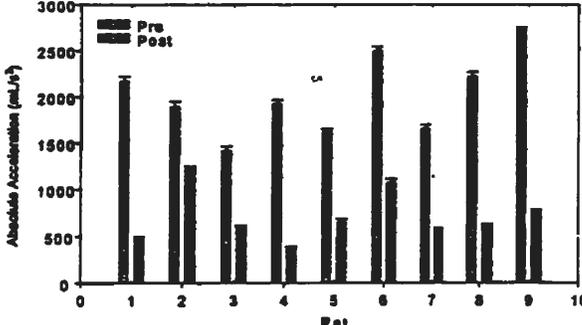


Figure 2. Pre and post exposure mean acceleration for each rat during the transition from lung deflation to lung inflation.

CONCLUSIONS

Exposure to 2 ppm O₃ has the effect of decreasing acceleration during the transition from deflation to inflation in laboratory rats.

REFERENCES

1) W.J. Mautz and C. Bufalino, "Breathing pattern and metabolic rate responses of rats exposed to ozone". *Respiration Physiology*, 76(1989) 69-78.