

# Effect of Chronic Exposure to Ultrasonic Aerosols on the Lung

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Exposure for six hours to aerosols produced by ultrasonic nebulizers has been shown not to affect adversely the lungs of experimental animals. In order to evaluate the effects of long term exposure, 16 puppies were exposed to ultrasonic aerosols of normal saline solution or distilled water for 72 hours. Pathological changes compatible with severe bronchopneumonia were seen in all 8 animals exposed to saline; only 2 puppies exposed to distilled water had obvious pulmonary lesions. No significant alteration in pulmonary surfactant activity or deflation pressure volume curves were demonstrated. We conclude that continuous wetting of the lung with a high output of ultrasonic aerosol may be deleterious when used for prolonged periods. The exact time necessary to produce these lesions with various fluids remains to be determined. It seems reasonable to speculate, however, that the more hypertonic the fluid the more rapidly these lesions will develop.

HIGH HUMIDITY fog tents have been reported to be beneficial in the treatment of many acute pulmonary disorders.<sup>1</sup> Normal saline solution (0.9 N) or distilled water, nebulized through an air driven nebulizer, has most frequently been used as the source of the fog. With the recent introduction of ultrasonic nebulizers capable of producing a high output of small par-

ticles (97 per cent between 0.8 and 3.1 microns in diameter),<sup>2</sup> the use of these units as fog generators has been suggested.<sup>3</sup>

Irrigation of the lung with saline or distilled water has been shown to change the surface tension characteristics of extracted pulmonary surfactant.<sup>4,5</sup> On the other hand, the clinical use of these agents in nebulized form does not suggest the occurrence of pathological changes usually associated with the loss of normal surfactant activity. A recent report has demonstrated that exposure for six hours to ultrasonic aerosols of normal saline or distilled water, does not adversely affect the lungs of experimental animals.<sup>6</sup> The following experiments were conducted in order to evaluate the effect of long-term *in vivo* exposure to ultrasonic nebulization with these solutions.

## Methods

Sixteen puppies weighing 3 to 6 pounds were numbered consecutively and divided into two equal groups for study. Selection was random except that comparable numbers of mates from each of four litters were assigned to each group. Paired litter mates were then placed, 2 and 3 at a time, into identical semi-open metal and plastic chambers measuring 2 × 3 × 2 feet. Both groups of animals were then simultaneously exposed to aerosols of either physiologic saline solution (0.9 N) or distilled water for 72 hours. These aerosols were generated with a DeVilbiss Model 880 Ultrasonic Nebulizer, output set at 6 ml. of fluid per minute. To maintain tolerable temperatures, the aerosol was passed through a cooling coil before delivery into the chamber (fig. 1). At frequent intervals, samples of air from each chamber were analyzed for oxygen (Beckman Model D-2 Oxygen Analyzer) and carbon di-

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