transient and tachyphylaxis develops rapidly. The drug has a separate and independent atropine-like action on the heart. The sympathomimetic effect of gallamine offers a plausible explanation for the observations that it increases ventricular stroke work and cardiac output in mean and that it may precipitate transient arrhythmias in patients receiving cyclopropane.

Experimental Prevention of Decompression Sickness. SPENCER D. CAMPBELL, A.A., and RICHARD J. WARD, M.D., *Virginia Mason Research Institute and University of Washington School of Medicine, Seattle, Wash.* The method of prevention of decompression sickness following exposure to increased ambient pressure has changed little in the last 50 years. Divers are brought to the surface in stages, remaining a predetermined time at each stage to permit removal of the excess inert gas (helium or nitrogen) which has been dissolved in the body tissues by the high environmental pressure. Staged decompression is very time-consuming and not universally effective in preventing decompression sickness. Philip and Gowdey used heparin and depolymerized hyaluronate to reduce the incidence and severity of decompression sickness in rats who were compressed in air to 5.5 atmospheres, surfaced by stages and then taken to an equivalent altitude of 8,000 feet. The drugs were injected before compression or after decompression, but before exposure to altitude. Both drugs provided partial protection against decompression sickness. (Philp, R. B., and Gowdey, C. W.: Fed. Proc. 23: [2 part 1], 523, 1964). No reports of studies utilizing nebulization therapy during rapid decompression have been found. *Method:* Twenty 350 Gm, guinea pigs made a simulated dive to 250 feet (112 psig.) in a pressure chamber. After remaining at maximum pressure for 60 minutes, they were decompressed in ten minutes and observed for an additional 90 minutes. Ten served as controls; the other ten were exposed to 10 ml. of a nebulized solution which contained 1,800 units of heparin and 60 mg. of papaverine. Five ml. of the solution were nebulized in oxygen and 6 per cent CO_2 during the last half of decompression, beginning at a simulated depth of 140 feet (62.5 psig.). The remaining five ml. were nebulized in oxygen during the 90-minute observation period on the surface. *Results:* Five control animals died. Three had paraplegia, cyanosis, or continued convulsions throughout the observation period. A fourth had hind-leg paralysis for 40 minutes. Of the treated animals, only one died, and he exhibited distress before treatment was started. Two had transient hind-leg paralysis and seven were unaffected. Four of the six fatalities had massive aeroembolism. *Comment:* Results suggest that the heparin-papaverine mixture, nebulized in carbon dioxide and oxygen, can markedly reduce fatalities, severity and incidence of outward signs of decompression sickness.

The Effect of Water Particles on Airway Resistance in Normal and Bronchitic Patients. F. W. CHENEY, JR., M.D., and J. BUTLER, M.D., *University of Washington, School of Medicine, Department of Anesthesiology, Seattle, Wash.* The recently developed ultrasonic nebulizers produce a dense mist of fluid particles which permit large amounts of moisture to reach the lower airways. Because these mists often cause excessive coughing in patients, this study was designed to evaluate the effects of ultrasonically nebulized particles on airway resistance. *Method:* Airway resistance (R_A) was measured with the body plethysmographic method (DuBois, A. B., *et al.*: J. Clin. Invest. 35: 327, 1956). Simultaneous measurement of FRC and R_A allowed assessment of alterations caused by changes in lung volume.

Ten normal, non-smoking subjects and ten patients with chronic bronchitis or asthma were studied. An ultrasonic nebulizer (DeVilbiss, model 800) was used to nebulize solutions of normal saline, one-half normal saline and distilled water. As a control, the same solutions were nebulized by a heated bubble nebulizer. The ultrasonic nebulizer was set to deliver 3.5 ml./min. and the heated one to deliver approximately 1.0 ml./min. Measurements of R_A and FRC, an average of six, were made before and immediately following periods of 15-minute inhalations of the various solutions from each nebulizer. *Result:* The

mean control measurements of R_A at 0.5/l./sec. respiratory air flow were 1.5 cm. H_2O/l./sec. in normal subjects, and 3.2 cm. H_2O/l./sec. in patients with obstructive airway disease. Normal subjects were unaffected by inhaling any of the solutions from either nebulizer. The heated nebulization of the three solutions produced no change in R_A of patients with chronic bronchitis or asthma; but inhalations of these solutions nebulized by ultrasound caused an increased R_A in all patients, three of them in severe respiratory distress. The mean increase was 60 per cent with a range of 10 to 260 per cent. In both normal subjects and patients with obstructive airway disease, inhalations of distilled water nebulized by ultrasound caused uncontrollable coughing. The change in R_A apparently was not related to the coughing, because the normal subjects coughed but had no change in R_A, and patients who inhaled saline from an ultrasonic nebulizer did not cough but showed an increased R_A. The increase in R_A reached its peak in patients within ten minutes after cessation of inhaling the ultrasonic mist and gradually declined to control values within 45 minutes. Two patients with chronic bronchitis breathed isoproterenol (isuprel) immediately before inhaling a mist of distilled water nebulized ultrasonically and, in spite of severe coughing exhibited no change in R_A compared to their control values. *Conclusions:* The results indicate that R_A in the normal nonsmoker is not effected by short-term inhalation of mists of distilled water, or of half-normal saline, or of normal saline produced by either heated or ultrasonic nebulizers. Patients with asthma or chronic bronchitis exhibited a significant increase in resistance to respiratory airflow after inhaling mists of the three solutions from the ultrasonic nebulizer. Ultrasonic nebulization, commonly used for hydration of the airways in these patients, should be used with bronchodilators. Supported by PHS grants #10854-01 and #5-T1-GM-1160-03.)

Effects of Halothane-air on the Oxygen Uptake and Patterns of Metabolic Control in Rat Liver Mitochondria. PETER J. COHEN, M.D., and BRYAN E. MARSHALL, M.D., *University of Pennsylvania School of Medicine, Philadelphia, Penna.* Examination of mitochondrial functions is revealing since this organelle serves two primary purposes: (1) it is a locus of great energy production; (2) it is a major site of metabolic control wherein energy production is matched to energy requirements. A complete evaluation of mitochondrial metabolism includes both measurements of oxygen uptake (respiration) and examination of integrity of mitochondrial respiratory control. We have exposed mitochondria to various concentrations of halothane in air and have shown this anesthetic agent to have an effect on both aspects of mitochondrial function. *Methods:* Rat liver mitochondria were prepared by standard techniques, suspended in ice-cold sucrose-mannitol, and exposed to known concentrations of halothane vaporized in air (analyzed by gas chromatography) for 20 minutes. A portion of this exposed suspension was then equilibrated with air for an additional 20 minutes to permit examination of reversibility of halothane's effects. Control mitochondria were simultaneously prepared from the same animal and treated exactly as the experimental suspension except for exposure to halothane. Oxygen uptake was continuously measured with a vibrating platinum electrode (in a system maintained at 25° C.) prior to and following the addition of adenosinediphosphate (ADP) to the reaction medium (Chance, B., and Williams, G. R.: Biol. Chem. *217:* 383, 1955). Substrate (glutamate or succinate 10 m*M*), inorganic phosphate (10 m*M*), and oxygen (air-saturated reaction medium) were not rate-limiting. In the absence of phosphate acceptor (*i.e.*, ADP), oxidative phosphorylation cannot occur and mitochondrial respiration is normally inhibited (state 4 respiration) (Chance, B., and Williams, C. R., in *Advances* in Enzymology, Ed. F. F. Nord, Interscience, London, 1956). Addition of ADP to the suspension permits oxidative phosphorylation to occur, respiratory inhibition is relieved, and a considerable increase in oxygen uptake is observed (state 3). This increase persists until the added ADP has been phosphorylated. The ability of mitochondria to show both rapid and slow rates of oxygen uptake, depending upon the presence or absence of ADP, is