the leftward shifting of the force–velocity curve and reduction of rate of pressure development and peak pressure indicate that Ethrane evokes a negative inotropic effect upon the intrinsic contractile state of the heart. The decreased intensity of the active state may be related to the alteration of the chemical interactions of the contractile proteins. (Supported by USPHS Grant HE-01711 from the National Heart Institute.)

Hemodynamic and Respiratory Changes during Pulmonary Lavage. J. D. Smith, M.B., Ch.B., J. E. Millen, B.S., P. Safar, M.D., and E. D. Robin, M.D., *Departments of Anesthesiology and Medicine, University of Pittsburgh School of Medicine, Pittsburgh, Penna.* Pulmonary lavage, defined as the introduction of large volumes of fluid into the tracheobroncheal tree and alveoli of the degassed lung or lobe and evacuation of the fluid has been used in treating various lung disorders, particularly pulmonary alveolar proteinosis. This study describes changes in hemodynamics, intrathoracic pressure and gas exchange produced by pulmonary lavage in one patient with alveolar proteinosis and in three dogs and one calf with normal lungs. *Methods:* The technique was essentially that described by J. Ramirez-R. (Dis. Chest 50: 581, 1966) using a 39 F Carlens catheter inserted under topical anesthesia. The lavaging fluid consisted of 0.9 per cent saline solution buffered to *p*H 4.5 with sodium bicarbonate and containing heparin, 7.5 units/ml. The osmolality of the solution was 293 mOsm. Ventilation with 100 per cent oxygen was assisted. Central venous pressure (CVP) and arterial blood gas tensions were measured during progressive filling and emptying of the lavaged lung. The animals were anesthetized with pentobarbital. A catheter was inserted into the pulmonary artery under fluoroscopic control and a latex esophageal balloon was inserted into the midesophagus. *Results:* A. *Man.* Rises in CVP to maximum levels of 17, 20, and 21 cm H_2O were noted with the lung full of fluid, with rapid return to control levels during emptying. During four lavages, Pa_{O_2} increased significantly (mean = 244 mm Hg) over the degassed prelavage values (mean 76 mm Hg). During emptying P_{O_2} dropped to degassed, and occasionally to lower, levels. B. *Animals.* During lavage pulmonary arterial pressure rose to maximums of 26, 26, and 30 mm Hg in the three dogs; values returned to control levels during emptying (18 mm Hg). Pulmonary arterial wedge pressure changed in a parallel fashion. Intraesophageal pressures in two dogs rose by 16 and 13.5 cm H_2O. Similar changes were noted in the calf. Chest x-rays taken with the lung filled with fluid showed the mediastinum acutely shifted away from the liquid-filled lung. *Summary:* Unilateral filling of the lung with liquid results in a sharp increase in intrathoracic pressure, which is reflected by increases in central venous, pulmonary arterial, pulmonary wedge, and intraesophageal pressures. Pa_{O_2} is low in the degassed phase as a result of nonventilation of perfused areas. Addition of liquid leads to an increase in Pa_{O_2} as pulmonary vessels become compressed and blood flow is shifted to the gas-filled lung.

The Effect of Hexamethonium on the Catecholamine Response to Nitrous Oxide in Man. N. Ty Smith, M.D., E. I. Eger, II, M.D., L. B. Kadis, M.D., and D. Cullen, M.D., *Departments of Anesthesia, Stanford University Medical Center, Stanford, Calif. and University of California, San Francisco Medical Center, San Francisco, Calif.* We observed previously that the addition of nitrous oxide to halothane–oxygen anesthesia in man caused an increase in plasma norepinephrine levels, plus evidence of peripheral vasoconstriction. This phenomenon was investigated further in eight normal volunteer subjects. *Methods:* Halothane–oxygen was changed to halothane–oxygen–nitrous oxide (70 per cent) both before and after administration of 100 mg hexamethonium (C6). *Results:* The percentage changes in response to N_2O before C6 *vs.* after C6 were: serum norepinephrine levels (30.8, −24.4); cardiac output (dye dilution) (−2.9, 23.9); stroke volume (−4.5, 10.9); heart rate (1.6, 12.2); mean arterial pressure (11.8, 31.8); total peripheral resistance (14.8, 6.4); right atrial pressure (2.2, 0.7 mm Hg); left ventricular minute work (9.0, 64.4); left ventricular stroke work (7.8, 43.4); left ventricular stroke power (5.9, 33.6); tension–time index (7.1,

10.4); ejection–time index (−3.6, −2.5); mean rate left ventricular ejection (−3.1, 4.9); forearm (FA) blood flow (−18.3, −6.0); FA venous pressure (35.3, 14.8); FA venous compliance (−16.1, 0.2); FA resistance (48.0, 42.4). *Summary:* Hexamethonium changed the response to N_2O from predominantly vascular to predominantly cardiac. These results indicate that: (1) the vasoconstricting action of N_2O is not a direct effect; (2) the constriction does not arise from norepinephrine released directly by nitrous oxide at the presynaptic granules.

The Effect of Tetracaine on the Liberation of Potassium Produced by Succinylcholine. J. E. USUBIAGA, M.D., F. MOYA, M.D., L. E. USUBIAGA, M.D., and B. VESTAL, M.S., *Department of Anesthesiology, University of Miami School of Medicine, Miami, Florida.* Depolarizing muscle relaxants liberate potassium from skeletal muscles, an effect which is antagonized by the prior administration of curare. Since local anesthetics bear a pharmacologic resemblance to curare, the effect of tetracaine on potassium liberation produced by succinylcholine was studied. *Methods:* Ten mongrel dogs were anesthetized with pentobarbital intravenously, intubated and mechanically ventilated to maintain a steady Pa_{CO_2}. Femoral arteries and veins were cannulated with loops of plastic tubing so that drugs could be injected with blood samples collected with minimal disturbances of limb circulation. Tetracaine (1 mg/kg) was injected into one femoral artery and a control injection of saline was administered in the other. Within a minute, succinylcholine (0.5–1.0 mg/kg) was administered intravenously. Pulse, arterial blood pressure, twitch tension of the anterior tibialis muscles, and plasma potassium levels in blood samples collected from the control and pretreated limbs were compared. *Results:* In six of ten dogs, intra-arterial tetracaine decreased the twitch tension of the tibialis muscle by 10 to 40 per cent. This neuromuscular paralysis was not preceded by stimulation of the muscle, nor followed by an increase in blood potassium levels. Succinylcholine given intravenously produced a complete and prolonged paralysis in both limbs. In the untreated limb, muscle paralysis was preceded by muscle fasciculations and followed by a significant increase in plasma potassium, mean 0.45 mEq/l, SE 0.14, $P < 0.001$). In the extremity pretreated with tetracaine, muscle fasciculations and the increase in plasma potassium were not observed. *Summary:* Tetracaine prevented the muscle fasciculations and the rise in plasma potassium produced by succinylcholine. It also shortened the duration of muscle paralysis. The ability of local anesthetics to prevent muscle fasciculations and potassium liberation probably represents drug effects at two different sites, that is, at the motor nerve terminal and at the postsynaptic membrane. (Supported in part by USPHS General Research Support Grant FR 5363-07/1390397.)

Depression of Antibody Production by Halothane: A Dose Response. D. W. WINGARD, M.D., and L. J. HUMPHREY, M.D., *Department of Anesthesiology and Surgery, University of Kentucky Medical Center, Lexington, Ky. Methods:* The effect of halothane on antibody-producing splenic lymphocytes was determined in rats preimmunized with an intravenous injection of 0.3 ml of a 10 per cent solution of sheep erythrocytes. Three days following immunization, each test animal was exposed to an inspired concentration of 1 or 1.5 per cent halothane for one to four hours. Control observations were made in similarly treated animals that were not anesthetized. Following exposure to anesthetic, or the corresponding control interval, each animal's spleen was removed and the relative number of antibody-producing splenic erythrocytes determined by the Jerne hemolysis in gel technique. *Results:* Compared with controls, the numbers of cells producing antibody were decreased to similar degrees by both halothane concentrations after two, three, and four hours of exposure. *Summary:* Although the precise mechanism responsible for the reduction in antibody-producing splenic lymphocytes by halothane has yet to be elucidated, the data support the conclusion that the duration of anesthesia should be held to a minimum in order to avoid anesthetic-induced changes in immunity.