

**The Effect of Anesthesia and Muscle Relaxants on the Elastic Properties of the Human Thorax.** WALTER H. MASSION, M.D., AND J. M. WHITE, M.D. *Department of Anesthesiology, University of Oklahoma School of Medicine, Oklahoma City, Okla.* Recent studies on dogs have shown that total chest compliance decreases after the administration of curare (Safar, P., and Bachman, L.: *Anesthesiology* 17: 334, 1956; Massion, W. H.: *J. Appl. Physiol.* 11: 309, 1957). There is also evidence that anesthesia as such will affect the pressure volume characteristics of the human thorax (Nims, R. G., et al.: *J. Clin. Invest.* 14: 744, 1955). The present investigation was undertaken to determine the effect of curare and thiopental on lung volume and chest distensibility in men. Twelve patients scheduled for minor surgical procedures have been studied. The static total chest compliance and the functional residual capacity (FRC) were measured with the subject in the recumbent position. Determinations were made during the conscious state, during thiopental anesthesia, and after curarization. Endotracheal intubation was performed with a cuffed endotracheal tube which was then connected to a Benedict-Roth spirometer in such a manner as to permit inflation of the lungs and collection of expiratory volumes. The pressure in the airway was recorded with a water manometer. By relating the expired volume to the corresponding airway pressure the value for static total chest compliance was determined. FRC was measured by a closed system rebreathing method. A rubber bag containing a measured volume of oxygen was connected to the endotracheal tube at the end of an expiration. The patient was allowed to breathe and rebreathe from the bag for a time adequate for complete equilibration of gases between the lungs and the bag. A sample of the air in the bag was then analyzed on the Scholander micro-gas analyzer. The FRC was calculated from the initial volume of oxygen in the bag and the fraction of nitrogen after equilibration with the air contained in the lungs (Rahn, H., et al.: *J. Appl. Physiol.* 1: 725, 1949). The results of our study indicate a decrease of chest compliance as the patient passes from the conscious state to the anesthetized state. The mean static compliance at 20 cm. H<sub>2</sub>O pres-

sure in the conscious patients was 0.126 l./cm. H<sub>2</sub>O. During anesthesia the compliance decreased 44 per cent. Curarization increased compliance in 9 out of 12 patients, a decrease was found in 2 patients and no change in one patient. The average change of chest compliance after curare was + 4 per cent. FRC showed an increase of 8 per cent after induction of anesthesia and gained another 2 per cent after curarization. In summary, these studies show that curare does not appreciably affect human chest compliance as had been expected on the basis of earlier dog experiments. The decrease of compliance after induction of anesthesia is interpreted as the result of the abolition of intercostal muscle tone. Functional Residual Capacity changes encountered during anesthesia and curarization were minimal.

#### **Histopathological Effects of Prolonged Exposure of Nerves to Local Anesthetics.**

PHILIP PIZZOLATO, M.D., AND O. J. RENEGAR, M.D. *Clinical Laboratory, Veterans Administration Hospital and Department of Anesthesia, Charity Hospital, New Orleans, La.* Since Lemmon's (*Ann. Surg.* 111: 141, 1940) contribution to continuous spinal anesthesia, many modifications have been added. Although these procedures appear safe, it is possible that long and continuous exposure of a nerve to an anesthetic agent may produce irreversible damage. As no human material was available for study, a histopathologic study on animals was undertaken. In a previous publication (Pizzolato, P., and Renegar, O. J., in print), we have demonstrated mild and apparently reversible changes in nerves after instilling certain local anesthetics. These experiments were conducted after surgical exposure of the sciatic nerve and application of a polyethylene tube adjacent to the nerve. Since these procedures may cause injury, and consequently pathologic changes, another series of animals was studied without exposure of the nerve. Twenty-five rats were anesthetized with pentobarbital. Using sterile technique, a 23 gauge needle connected to a Baxter administration set R 33 was inserted through the skin and muscle to the underlying sciatic nerve. The other end of the tube was connected to a 5-ml. syringe, and the anesthetic was injected

by a low gear motor as previously described. The following anesthetics were used: procaine, 1 and 2 per cent; lidocaine, 1 and 2 per cent; chloroprocaine, 2 per cent; piperocaine, 1.5 per cent; hexylcaine, 2 per cent; tetracaine, 0.1 per cent and dibucaine, 0.07 per cent. Five milliliters were instilled over an approximately 8-hour period. Some animals were killed and the sciatic nerves removed at the end of the instilling procedures; the remaining animals were killed after 24 hours. Partial anesthesia of the hind legs was observed at the end of the 8-hour period and was gone, in most instances, at the end of 24 hours. The nerves were examined after preparation by usual histologic techniques. All local anesthetics tested produced a mild infiltration of neutrophils with a varying number of lymphocytes and macrophages enmeshed in a network of fibrin in perineural connective tissue and adjacent muscle. The nerve fibers showed prominence of axis cylinders and mild vacuolization of myelin with some loss of neurokeratin. In no instance did the nerve show fragmentation of axons, changes in the Schwann cells, leukocytic infiltration or hemorrhages. We believe that the prominence of axons is a significant change produced by anesthetics. These changes are considered as mild, as axons were never as prominent as observed after epineural injection of alcohol or trauma. Increase in the size of the myelin spaces is also a significant abnormality but was mild and nothing comparable to the instilling of 10 per cent sodium chloride, epineural injection of alcohol or trauma.

**The Influence of Premedicating Drugs on Vasomotor Stability During Spinal Anesthesia.** MIGUEL SANTIAGO, M.D., TILLMAN M. MOORE, JR., M.D., AND ROBERT B. DODD, M.D. *Department of Surgery and Division of Anesthesiology, Washington University, St. Louis, Mo.* Narcotics and barbiturates impair the body's ability to compensate for the stress placed on the peripheral vascular bed by tilting. Spinal anesthesia appears to expose the patient to a type of vasomotor stress not unlike that induced by tilting. This investigation seeks to determine the effect of morphine, meperidine and barbiturates on vasomotor stability following the induction of

spinal anesthesia. A total of 1,233 spinal anesthetics were given between July 1956 and June 1958. Records of 400 of these anesthetics were excluded to eliminate the following variables: anesthesia administered by other than a member of the Division of Anesthesiology, which introduces variation in management; anesthesia administered for operations entailing blood loss of a significant amount in the first hour, thus biasing the data toward hypotension; anesthesia administered for operations requiring unusual positioning of patients, which adds the factor of undue positional stress; administration of supplemental or complementary inhalation anesthesia, thus implying that the spinal anesthesia was either ineffective or inadequate; and, administration of no premedication or a combination of hypnotic and narcotic, which introduces more than one variable in the latter case. Following the criteria of Dripps and Deming (*Surg. Gynec. & Obst.* 83: 312, 1946), a fall in systolic blood pressure of 25 per cent or greater from pre-anesthetic levels during the first hour of anesthesia was considered significant. The incidence of hypotension following spinal anesthesia was determined for each decade of age. The age distribution of patient's receiving morphine, meperidine or a barbiturate was homogeneous both graphically and by chi-square testing. Neither a parasympatholytic drug administered with the premedication nor small intravenous doses of barbiturates for sedation during surgery affected the incidence of hypotension. **Results:** (1) In patients less than 50 years of age undergoing spinal anesthesia, the mean frequency of hypotension was 24.2 per cent with morphine, meperidine or a barbiturate as a premedicating drug. (2) However, among patients over 50 years of age, those given premedication of either morphine or a barbiturate had a significantly lower incidence of hypotension than those given meperidine. (3) Persons over 50 given meperidine as premedication had a significantly greater frequency of hypotension than those under 50 given the same drug. (4) The incidence of significant hypotension in all patients undergoing spinal anesthesia was 31 per cent. (5) Over the age of 50 the frequency of hypotension increased the older the patient regardless of the premedication.