

neuromuscular block and central depression from anesthetics. The finding of a decreased inspiratory force despite an adequate minute ventilation suggests a ventilatory handicap to the patient. This may cause a decreased ability of a patient to overcome even mild airway obstructions, to cough effectively and to take the occasional deep breath essential for the maintenance of normal pulmonary compliance. Apart from studying the inspiratory force we use this measurement clinically and find it useful in supplementing our evaluation of a patient's ventilatory capacity and recovery from the effects of muscle relaxants. We have established that an inspiratory force of 20 to 25 cm. of  $H_2O$  is necessary for adequate ventilation. Our experience suggests that the inspiratory force measurement may be a valid expression of ventilatory capacity, a "vital capacity measurement in the unconscious," and a useful and simple diagnostic tool.

**The Combined Use of Narcotics and Narcotic Antagonists for Premedication.** HENRY M. BRUNN, JR., M.D., FRANCIS F. FOLDES, M.D., PEARL G. McNALL, M.D., AND LUDWIG R. KOUKAL, M.D. *Department of Anesthesiology, Mercy Hospital and Section on Anesthesiology, Department of Surgery, University of Pittsburgh School of Medicine, Pittsburgh, Pa.* Forty unselected surgical patients (group 1) received intramuscularly 1.5 mg./kg. meperidine, 0.3 to 0.4 mg. scopolamine and 100 mg. of pentobarbital sodium about two hours before induction of anesthesia. Forty other patients (group 2), besides these drugs, were also given intramuscularly 0.02 mg./kg. levallorphan at the same time. At zero time, after topical anesthetization of the pharynx with 1 per cent tetracaine, pulse rate, blood pressure and respiratory rate were recorded and thiopental sodium 5.0 mg./kg. was injected in 2 minutes through the rubber sleeve of an intravenous infusion. At 2 minutes, the administration of a 4 liter to 1 liter nitrous oxide-oxygen mixture was started through a face mask. At 4 minutes, the same parameters, together with the respiratory minute volume, measured with a Bennett ventilation meter, were again recorded. At 5 minutes, 20 patients each of group 1 (subgroup 1A) and group 2 (subgroup 2A) received 0.4 mg./

kg. alphaprodine and 20 others of group 1 (subgroup 1B) and group 2 (subgroup 2B) 1.0 mg./kg. meperidine, intravenously, in 30 seconds. At 8 and at 12 minutes, pulse rate, blood pressure, respiratory rate and minute volume were again recorded. If at the time of the 8 minute reading, the patient was apneic, additional 0.02 mg./kg. levallorphan was injected intravenously. The administration of 5.0 mg./kg. thiopental caused little change in pulse rate, blood pressure or respiratory rate. The only difference observed between group 1, premedicated with meperidine alone, and group 2, premedicated with meperidine plus levallorphan was an 8 per cent decrease of the respiratory rate in the former and a 5 per cent increase in the latter. Levallorphan used with the premedication offered some protection against the respiratory effects of both alphaprodine and meperidine; for example, apnea developed in 12 out of 20 patients of subgroup 1A as contrasted with 2 out of 20 in subgroup 2A. Similarly incidence of apnea was 3 and 0 in subgroups 1B and 2B respectively. The depression of the respiratory rate and respiratory minute volume in the patients who did not develop apnea after intravenous alphaprodine (subgroups 1A and 2A) or meperidine (subgroups 1B and 2B) was also less in subgroups 2A and 2B premedicated with levallorphan plus meperidine. The results presented indicate that the intramuscular injection of 0.02 mg./kg. levallorphan afforded some protection against the respiratory depressant effects of large doses of narcotic analgesics administered intravenously 2 hours later. This protection, however, was less than that obtained when identical doses of levallorphan were injected intravenously immediately prior to, or after, the intravenous administration of identical doses of narcotic analgesics.

**Effects of Muscle Relaxants on the Lungs and Circulation in Man.** THOMAS J. DEKORNFELD, M.D., CHUNG J. PARK, M.D., AND PETER SAFAR, M.D. *Department of Anesthesiology, Baltimore City Hospitals, Baltimore, Md.* The effects of *d*-tubocurarine (0.3 mg./kg.) and gallamine (1.5 mg./kg.) upon lung-thorax compliance, airway resistance, radial artery pressure, heart rate, electrocardio-