gram and electroencephalogram were studied in healthy adults in the absence of surgery, during (1) cyclopropane anesthesia and (2) thiopental-meperidine-N_2O hyperventilation. A Jefferson ventilator provided continuously controlled respirations by intermittent positive pressure breathing (IPPB) at a constant rate and airway pressure range before, during and after the intravenous injection of the drug. Thus the respiratory and circulatory effects of the muscle relaxants were studied without interference from changes in respiratory patterns. *d-Tubocurarine:* During cyclopropane anesthesia the injection of *d*-tubocurarine increased the compliance from 8 per cent to 10 per cent of the control value (6 patients). The minute volume changes (indicating compliance and/or resistance changes) ranged from minus 6 per cent to plus 14 per cent of the control values (15 patients). The blood pressure, pulse pressure and heart rate varied less than 10 per cent of the control and there was no change in the electrocardiographic and electroencephalographic patterns (5 patients). With thiopental-meperidine-N_2O anesthesia the injection of *d*-tubocurarine caused essentially no changes in minute volume, blood pressure, pulse pressure, heart rate, electrocardiogram and electroencephalogram (5 patients). *Gallamine:* With cyclopropane anesthesia the injection of gallamine caused a slight increase in respiratory minute volume in 3 patients and no change in 5 patients. Tachycardia occurred in all 5 patients in whom circulatory measurements were made. The rise in heart rate varied from 45 to 98 beats per minute. The mean arterial blood pressure and pulse pressure changes were minimal. One patient had an episode of bundle branch block at the peak of the tachycardia. The electrocardiogram and electroencephalogram was unchanged in all the other patients. With thiopental-meperidine-N_2O anesthesia (5 patients) the injection of gallamine caused no change in minute volume. There was a moderate increase in heart rate (23 to 25 beats per minute). The mean arterial pressure rose slightly in all patients; the pulse pressure remained essentially unchanged. There was no change in the configuration of the electrocardiogram or electroencephalogram. Thus our preliminary data indicate that the histaminic side effects of *d*-tubocurarine, described in dogs, are absent or rare in healthy anesthetized adults. Gallamine caused a very marked tachycardia during cyclopropane anesthesia, while during thiopental-meperidine-N_2O anesthesia the tachycardia was of a minor degree. Similar studies using succinylcholine and decamethonium are now in progress. (*This study was supported by the Burroughs Wellcome Co., Inc., Tuckahoe, N. Y.*)

The Effect of Reserpine on the Action of Various Vasopressors. EDMOND I. EGER, II, M.D. AND WILLIAM K. HAMILTON, M.D. *Division of Anesthesiology, State University of Iowa Medical School, Iowa City, Iowa.* The amine oxidase inhibiting property of certain vasopressors has been hypothesized as the basis by which they act. Amine oxidase inhibition results in decreased epinephrine/norepinephrine destruction with a consequent increase in catechol amine level which in turn causes a rise in blood pressure. These vasopressors, then, are dependent for their action on the presence of epinephrine and norepinephrine. The recent finding that reserpine causes the elimination of epinephrine and norepinephrine would suggest that the above vasopressors would be ineffective following reserpine administration. To test this, a series of vasopressors with proven (ephedrine) or theoretical (methamphetamine, mephentermine, methoxamine) amine oxidase inhibiting properties was compared as to pressor effect with a series of vasopressors not thought to be amine oxidase inhibitors. This was done in hyperventilated dogs anesthetized with pentobarbital. The effects were noted, the animals allowed to recover, and 5–7 days later the identical procedure was repeated following the administration of 0.4 mg./kg. of reserpine intravenously 18 hours previously. The results were as anticipated for all of the vasopressors with the exception of methoxamine. Following reserpine the pressor action of intravenous ephedrine, methamphetamine, and mephentermine was decidedly diminished. On the other hand, the blood pressure response to phenylephrine, epinephrine, and norepinephrine was unchanged or even enhanced by prior administration of reserpine. Methoxamine was the exception in the series, and

remained effective or increased in effectiveness following reserpine. Although methoxamine is theoretically an amine oxidase inhibitor, there is no direct report concerning this in the literature. In summary, epinephrine, norepinephrine, and phenylephrine are all effective in combating the hypotension which follows the injection of reserpine. This is also true of methoxamine. This may be clinically useful in treatment of hypotension appearing in patients under anesthesia who have been on reserpine therapy. Although the cause of the above hypotension is not definitely known, one possibility in the light of the effect of reserpine on epinephrine and norepinephrine might be stated thus: The response of the body to depression of blood pressure is dependent at least in part on the release of epinephrine and norepinephrine. In the patient who has received reserpine, the response to depression of blood pressure caused by anesthetic agents may be impossible because of the scarcity of these amines. If this is correct then one logical way to correct the hypotension would be to supply the necessary amount of the missing catechol amines or some appropriate substitute.

Electromyography of the Diaphragm. B. RAYMOND FINK, M.D., AND S. H. NGAI, M.D. *Department of Anesthesiology, Columbia University College of Physicians and Surgeons, and the Anesthesiology Service, The Presbyterian Hospital, New York, N. Y.* This investigation into the electrical activity of the diaphragm was planned on the premise of a definite relation between the integrated electromyogram and the tension of skeletal muscle (*J. Physiol. 123: 214, 1954*). The object was to explore the usefulness of the integrated electromyogram as a measure of adequacy of respiration. Decerebrate cats were subjected to rebreathing of oxygen, to inspiration against increased resistance, to partial myo-neural block and to graduated doses of intravenous pentobarbital. Airway pressure, air flow rate, tidal volume, and the integral of diaphragmatic electrical activity were recorded continuously with a cathode ray oscillograph. The integral activity rate was averaged over each period of inspiratory flow, and the average used as the index of diaphragmatic activity in each breath. Activity was found throughout the diaphragm and when changes in the electrical activity rate occurred as a result of a respiratory stress, the changes were proportionately the same in all phases of an inspiration and in all parts of the muscle. When CO_2 was allowed to accumulate during rebreathing of oxygen, it was found that the rate of electrical activity was proportional to air flow rate and also to tidal volume. A similar linear relationship between electrical activity rate and tidal volume was found during the onset of and recovery from partial paralysis induced by succinylcholine. When the inspiratory flow resistance was increased, the electrical activity rate increased linearly with the added load. However, in this case, the duration of inspiration was always prolonged, whereas in rebreathing it was shortened. The effect of pentobarbital was to cause a prolonged inspiratory discharge, but at a decreased rate of activity. If the animal breathed spontaneously, the discharge rate recovered relatively rapidly over a period of five minutes, probably as a result of carbon dioxide accumulation. When carbon dioxide retention was prevented by means of artificial ventilation, a much slower recovery of activity took place. In the latter group of animals, the integrated electrical activity rate of the diaphragm proved remarkably sensitive to small doses of pentobarbital. Carbon dioxide retention, increased inspiratory resistance, muscle relaxants, and anesthetic drugs each produced a distinctive effect on the integrated electrical activity of the diaphragm. The clinical usefulness of these observations is being explored.

Prolonged Maintenance of Coronary Sinus Catheters in Dogs for the Study of Myocardial Metabolism. S. J. GALLA, M.D., A. W. R. WILLIAMSON, F.R.C.S., AND L. D. VANDAM, M.D. *Division of Anesthesia, Department of Surgery, Peter Bent Brigham Hospital and Harvard Medical School, Boston, Mass.* During investigation of the effects of anesthetic agents on the myocardial metabolism of dogs it was found necessary to develop a method of sampling blood from the coronary sinus in both the conscious and anesthetized states. Recent work (*Rudolph, A. M., and Paul, M. H.: J. Appl. Physiol. 10:327, 1957*) involving chronic catheterization of the pulmonary and