termination of weight change during operation and an accurate account of fluid administered to the patient, not only as fluid by itself, but also as anticoagulant solution accompanying each unit of blood.

Postoperative Ventilation Studies in the Recovery Room. THOMAS E. MACNAMARA, M.B., CH.B., BEATRIZ L. DE NAVA, M.D., TAPAN SARKAR, M.D., AND THOMAS F. MCDERMOTT, M.D. *Department of Anesthesiology, Georgetown University Medical Center, Washington, D. C.* The use of the Bennett Respiratory Ventilation Meter in random fashion as a teaching aid disclosed the fact that respiratory depression occurred frequently in the operating and recovery rooms. These deficits occurred in patients whose gross clinical condition appeared satisfactory to the anesthetist. Pulmonary ventilation measurements were made in 487 unselected, nonconsecutive adult surgical patients (from 15 to 70 years of age) who underwent general anesthesia following premedication with a narcotic, pentobarbital, promethazine, and a belladonna drug in varying doses. The measurements of respiratory exchange were made using the Bennett Respiratory Ventilation Meter. With the face mask being closely applied, measurements were made during 30-second periods with duplicate or triplicate determinations. Of these 487 patients:—256 had four measurements of ventilation: 45 minutes after premedication, upon arrival in the recovery room, upon leaving the recovery room, and day following operation; 123 had three measurements of ventilation: upon arrival in the recovery room, upon leaving the recovery room, and day following operation; 61 also had three measurements of ventilation: 45 minutes after premedication, upon arriving in the recovery room, leaving the recovery room; and 47 had two measurements of ventilation: upon arriving in the recovery room and leaving the recovery room. We observed that an inspiratory volume of 4 liters per minute was a normal average for this series. Of these 487 patients, 90 (16 per cent) showed 15 per cent or more pulmonary ventilation depression on arriving in the recovery room, followed by gradual recovery. Nine of the 317 patients who were measured preoperatively showed reduced ventilation of more than 15 per cent. Two patients showed more than the 15 per cent reduction on the following day. Sixteen patients had a reversal of this trend, being depressed on leaving the recovery room (or conversely having stimulation of respiration on entry to the Recovery Room). The following factors have been considered in this study; and, so far, there has been no obvious correlation between adequate pulmonary ventilation and: (1) type of operation, intra-abdominal, intrathoracic and others, (2) experience of the anesthetist, (3) use of relaxant drugs, (4) type of premedication, and anesthetic agent. In a few instances, gross depression of respiration could be traced to inexperience of the anesthetist. In conclusion, we found that this technique of mechanically measuring ventilation made us more conscious of adequate ventilation. The depression of respiration was readily reversed when detected. There was no obvious morbidity or mortality. The simplicity of the method allows for an easy adoption in any hospital.

Comparison Studies of Hepatic Function Following Anesthesia with the Halogenated Agents. LUCIEN E. MORRIS, M.D. *Division of Anesthesiology, University of Washington School of Medicine, Seattle, Washington.* The increasing interest in fluorinated or otherwise halogenated anesthetic agents during the past five years necessitates the evaluation of the effect of these new agents upon the functions of various systems. Therefore, a study has been made to compare possible hepatic changes subsequent to the use of each of several halogenated anesthetics, both in laboratory animals and in clinical practice. Rats were anesthetized with trifluoroethylvinyl ether, halothane, or chloroform under conditions of (1) high oxygen-low carbon dioxide; (2) high oxygen-high carbon dioxide; (3) low oxygen-low carbon dioxide or (4) starvation. Liver biopsies at 24, 48, and 72 hours were studied histologically. Liver biopsies were studied from a control group of animals given no anesthesia. Dogs were also studied for liver function changes after anesthesia with either halothane or chloroform under similar alterations of carbon dioxide and oxygen in the respired air. In these studies the chloroform and trifluoroethylvinyl ether anesthetics were most frequently followed

by necrotizing liver changes in the groups of rats subjected to fasting or low oxygen concentrations. Halothane appeared from the histologic sections to be relatively innocuous in the rat, and showed only transient effects in the dogs as measured by a battery of liver function tests. Some of the dogs subjected to chloroform exhibited reduction in hepatic function. In clinical usage, however, significant alteration in hepatic function was *not* produced in the patients studied subsequent to chloroform (*Poble, F. J.: Wisconsin Med. J. 47: 476, 1948*) or trifluoroethylvinyl ether (*Stavney, L. S., and Morris, L. E., unpublished data*) or halothane (*Morris, L. E., and Feldman, S. A., unpublished data*) if careful attention was paid to avoidance of hypoventilation and hypotension. Definite interference with hepatic function was shown after administration of chloroform in which high levels of carbon dioxide were allowed to occur during the period of anesthesia (*Sims, L., Morris, L. E., Orth, O. S., and Waters, R. M., J. Lab. & Clin. Med. 38: 388, 1951*). Similar investigations in which patients were exposed to halothane and carbon dioxide demonstrated closely comparable hepatic damage as measured by liver function studies. On the other hand, patients subjected in a similar way to trifluoroethylvinyl ether and carbon dioxide showed no apparent change in liver function. This indicates a marked species variation in the response to various halogenated anesthetics, the need for further study in humans, and the need for selecting laboratory animals which behave similarly to humans in the particular functions under study.

The Effects of Depressant Drugs on Respiratory CO_2 During the Anesthetic Period. D. W. Morrow, M.D., J. R. Miller, M.D., R. W. Gardier, Ph.D., and V. K. Stoelting, M.D. *Department of Anesthesiology, Indiana University School of Medicine, Indianapolis, Indiana.* This study was undertaken to establish the factor(s) responsible for carbon dioxide accumulation in the immediate postoperative period (*Hamilton, W. K., and Devine, J. C.: Surg. Gynec. & Obst. 105: 229, 1957*). Patients were selected at random without regard to surgery, anesthetic or anesthesiologist. End-expiratory carbon dioxide was monitored before and after premedication when given, during surgery and for 30 minutes postanesthesia using a to-and-fro sampling method (*Collier, C. R., Affeldt, J. A., and Farr, A. F.: J. Lab. & Clin. Med. 45: 526, 1955*). Except during operation, spirometric tidal and minute volumes were measured concomitantly. Continuous blood pressure, electrocardiographic and electroencephalographic recordings during anesthesia were made on a 4-channel Grass polygraph. Nitrous oxide, ether, halothane and cyclopropane were the anesthetic agents used. Nitrous oxide was supplemented with a barbiturate (methohexital, thiamyal or thiopental) and meperidine or a barbiturate alone, with or without premedication. Anesthesia was induced with an ultrashort acting barbiturate in patients given halothane. Either dimethyl tubocurarine iodide or succinylcholine chloride was used for relaxation if necessary. Premedication with morphine sulfate (9 ± 0.3 mg.) and scopolamine (0.4 mg.) intravenously caused an average 20 per cent decrease in both tidal and minute volume within 15 minutes after administration without changing the mean recorded end-expiratory carbon dioxide. During operation, carbon dioxide accumulation occurred in only 2 of the 6 anesthetic series. These were (1) during the induction period in the series with nitrous oxide and barbiturate without premedication and (2) during the midsurgical period with halothane. Also, only in these groups was there carbon dioxide accumulation in the immediate postoperative period. Carbon dioxide levels returned to normal within 20 minutes. The recorded increases in mean tidal volume were apparently responsible for reducing the postoperative elevated end-expired carbon dioxide. The carbon dioxide retentions were in the range of those mentioned by Hamilton and Devine (45–61 mm. Hg). In this series, premedication did not appear related to the observed expiratory carbon dioxide elevations. Overly zealous administration of barbiturates might be a factor responsible for the postoperative respiratory depression.

Succinylcholine in Obstetrics: Investigation of Its Transmission Across the Placenta. F. Moya, M.D., N. Kvisselgaard, M.D., and L. S. James, M.D. *Department of Anesthesiology, Columbia University College of Physicians*