group. Three had some delay but at the end of six hours were excreting "free water." Two subjects responded immediately to the water loads. When a period of antidiuresis occurred in the hydrated infants, it could not be attributed to significant depression of glomerular filtration rates nor to the type of anesthesia administered. In all subjects, regardless of their response patterns, normal renal excretion of water seemed to be present by six hours postoperatively. Hence, even during and after relatively short surface surgical procedures, varying responses are noted in respect to the renal excretion of water in infants. Nonhydrated infants exhibited a severe delay in renal water excretion. Hydrated infants exhibited responses that varied from delayed to prompt. In all cases studied, when a period of antidiuresis existed, it appeared to end six hours postoperatively.

Effect of Inhalation Anesthetics on Cardiac Cell Membrane Potentials. Evan L. Frederickson, M.D., Joseph V. Levy, Ph.D., and K. Ichiyanagi, M.D. *University of Washington, School of Medicine, Seattle 5, Washington.* There is ample evidence that inhalation anesthetic agents pass through cell membranes; this is easily demonstrated in red blood cells when separated from plasma. Changes in the cell membrane as recorded by transmembrane action potentials have not been demonstrated, and no references are known to us referring to the action of inhalation anesthetics. Transmembrane potentials from single cells of isolated rabbit atrial tissue were recorded *in vitro* during perfusion with modified Tyrode's solution containing various concentrations of cyclopropane, oxygen and carbon dioxide. These were recorded by means of a glass capillary microelectrode adapted for moving tissue (*Woodbury, J. W., and Brady, A. J., Science 123: 100, 1956*). Samples of the perfusate were analyzed for these 3 gases, at various times. Controls were run by replacing the cyclopropane with nitrogen to see if the effects noted were due to hypoxia. Contractile tension was recorded by utilizing a transducer attached to one end of the isolated atrium while the other end was supported by stimulated electrodes. Rate was controlled by driving at a constant rate. Results demonstrate that cyclopropane does effect the transmembrane action potential (MAP) by shortening the duration mainly by decreasing repolarization time. This change is most marked in phase I. However, this effect is blocked by atropine. There is no significant change in membrane resting potential even at high concentrations of cyclopropane—in contrast to the change occurring with hypoxia. The negative ionotropic change that occurs is directly related to concentration and is not changed by blocking the MAP changes with atropine. This is the first evidence of the effect of inhalation anesthetics on cardiac cell membrane we have seen wherein the dissociation of electrical and contractile events has been recorded.

Blood Gas Exchange During Endobronchial Anesthesia. Mitsugu Fujimori, M.D., W. Curtis Pearcy, M.D., and Robert W. Virtue, M.D., Ph.D. *Division of Anesthesiology, National Jewish Hospital, University of Colorado Medical Center, Denver, Colorado.* The value of endobronchial intubation in certain instances, as compared to endotracheal intubation, has been recognized for some well-defined reasons. Among these are that purulent material, blood, or secretions do not flow from the diseased lung to the good lung (*Bonica, J. J., and Hall, W. M.: Anesthesiology 12: 344, 1951; Bjork, V. O., Carlens, E., and Friberg, O.: Anesthesiology 14: 60, 1953; Oech, S. R.: Anesthesiology 16: 468, 1955, and Ruth, H. S., Grove, D., and Keown, K. K.: Anesthesiology 9: 422, 1948*), and that the surgeon has a nearly motionless operative field. Since Bonica and Hall gave no measurement of blood gas concentrations using this technique, it seemed worth while to measure blood gas exchange during administration of anesthesia through one lung and through both lungs. Measurements of end-expiratory (alveolar) carbon dioxide, arterial blood carbon dioxide content, and arterial oxygen saturation were made in 25 patients undergoing thoracic surgery, chiefly for lobectomies, with cyclopropane anesthesia. Premedication was 100 mg. pentobarbital and 0.4 mg. scopolamine per 70 kg. body weight. Anesthesia was induced in about half the patients with 75 to 150 mg. of thiopental before administering the cyclo-

propane. The others received only cyclopropane. Forty milligrams of succinylcholine were given to some patients just prior to intubation. Endobronchial intubation was carried out in 12 patients using a modified Magill catheter with a long lipped bevel as described by Bonica and Hall. The proper location of the tube was confirmed after the patient was in position for surgery, by auscultation. Thirteen patients were anesthetized, and a no. 39 double lumen Carlens catheter was put in place. All patients were in the lateral position for surgery. Measurements were made during endobronchial anesthesia under the following conditions when the Magill catheter was used: (1) before the chest incision; (2) with the chest open and the surgeon at work on the lung; (3) with the chest still open and respiration controlled after the chest procedure, and (4) after the chest was closed with the patient breathing spontaneously. The cuff was deflated, the endobronchial catheter slightly withdrawn and the cuff again inflated during procedures 3 and 4. The subjects whose trachea was intubated with the Carlens tube were studied under the following conditions during anesthesia: (1) essentially endotracheal, in that both lumina of the tube were open, before surgery began; (2) endobronchial, one lumen clamped, during surgery; (3) both lumina again open, essentially endotracheal with the chest still open and respiration controlled after the lung procedure; and (4) endotracheal after the chest was closed with the patient breathing spontaneously.

End-Expiratory Carbon Dioxide. Using the Magill tube, end-expiratory carbon dioxide was lower when endobronchial anesthesia had been discontinued (3.73 per cent) than when the patient's lungs were being ventilated with one lung (4.23 per cent). A more definite change was seen when the patient's respiration was no longer assisted (5.36 per cent) and he was breathing spontaneously with the chest closed. With the Carlens tube the results showed the same general changes. That is, end-expiratory carbon dioxide values were higher with endobronchial assisted respiration (6.15 per cent) than with endotracheal assisted respirations (4.58 per cent). Again, spontaneous respiration resulted in an increase of carbon dioxide concentration to 6.38 per cent. All values with the Carlens tube were greater than those with the Magill tube. *Arterial Carbon Dioxide.* Arterial carbon dioxide values were close to normal throughout, using either type of catheter. No significant changes occurred between endobronchial and endotracheal respirations. *Arterial Oxygen Saturation.* With the Magill catheter, the oxygen saturations were lower with respiration through only one lung than when both were used. Endobronchial values were 91 and 92 per cent, while the values with the endotracheal tube were 98 and 99 per cent. Using the Carlens catheter endobronchial respirations showed an average oxygen saturation of 90.3 per cent, while values using both lungs were 97.7, 97.4 and 94 per cent. Pre-incision values showed some diminution of oxygen saturation with endobronchial (Magill) catheter as compared to endotracheal (Carlens) respiration. Other comparisons of results with the Carlens and Magill tubes show a lower, but not statistically significant, average oxygen saturation with the Carlens tube. These latter comparisons were under similar conditions; *i.e.*, endobronchial versus endobronchial and endotracheal versus endotracheal. Although oxygen saturation were slightly below normal during endobronchial intubation and ventilation, none were diminished sufficiently to endanger the patient. [*Aided by USPHS Grant H-4308.*]

Studies on Carbohydrate Metabolism During Anesthesia. NICHOLAS M. GREENE, M.D., FRANCES J. MACKAY, M.D., AND J. K. S. BELL, B.A. *Section of Anesthesiology, Yale University School of Medicine, and Department of Anesthesia, Grace-New Haven Community Hospital.* Oxidative carbohydrate metabolism was studied in 19 adult patients. None of the patients had pre-existing hepatic, endocrine, or metabolic diseases, but were unselected as to age or type of operation. Premedication consisted in 18 patients of a barbiturate (100 mg./70 kg.) and atropine or scopolamine (0.6 mg./70 kg.) 45–60 minutes before induction of anesthesia. One patient received meperidine premedication, with no apparent effect on the results. In 5 patients cyclopropane was the anesthetic, in 6 thiopental-nitrous oxide, and in 8 ether preceded by induction with nitrous oxide. No other drugs were ad-