

**Electrodes for Blood  $pO_2$  and  $pCO_2$  Determination.** JOHN W. SEVERINGHAUS, M.D. *Cardiovascular Research Institute, University of California, San Francisco, Calif.* Direct electrical measurement of blood oxygen and carbon dioxide partial pressure has recently been made possible by the development and application of special electrodes. The Clark polarographic electrode is a platinum disc charged to  $-0.5$  volts in an electrolyte, KCl, separated from the blood by an oxygen permeable membrane, such as polyethylene. Oxygen molecules react at the platinum forming  $H_2O_2$  and  $OH^-$ . This results in current which is linearly related to  $pO_2$ . It has been found necessary to stir the blood at constant rate at the electrode surface, and to calibrate the electrode with blood of known  $pO_2$  prepared in a tonometer. The difference between blood and gas reading is viscosity related. Temperature and pressure must be constant, and no gas may contact the blood. A 0.4-ml. cuvette of stainless steel has been designed incorporating a tiny stirring paddle, and built into a liter water bath. The water bath also contains a tonometer for preparing equilibrated blood for calibrating the oxygen electrode. A transistorized current measuring device has been built using a null balance technique for accuracy. The  $CO_2$  electrode operates by measuring the pH of a film of dilute bicarbonate solution which is separated from the blood by a  $CO_2$  permeable membrane such as Teflon. The pH of the aqueous film is linearly related to the log of the  $pCO_2$  in the blood. The electrode is built into a 0.3-ml. cuvette which does not require stirring, and is not viscosity or pressure sensitive. It has been mounted in the same water bath with the  $pO_2$  electrode. A pH change of 0.01 represents about 2.5 per cent change in  $pCO_2$ . The response time is 1-2 minutes, and the electrode is calibrated with gas of known  $pCO_2$  directly in the cuvette. It requires a high sensitivity pH meter.

**A Comparison of Thiopental, Meperidine and Lidocaine as Depressants of the Cough Reflex.** JOHN E. STEINHAUS, M.D. *Department of Anesthesiology, Emory University, Atlanta, Ga.* Reflexes of the upper respiratory tract are often difficult to depress during general anesthesia especially when nitrous oxide

is employed. This study was designed to compare the depressant action of thiopental, meperidine and lidocaine on the cough reflex since these agents are frequently employed as supplements with nitrous oxide. Male patients between the ages of 26 and 65 and classified as physical status 1 or 2, were selected for this study. An induction dose of thiopental (2 mg./lb. of body weight) was injected followed by succinylcholine (0.5 mg./lb.) and tracheal intubation was accomplished with a cuffed endotracheal tube. No anesthetic jelly was applied. The patient's lungs were ventilated with 100 per cent  $O_2$  until muscle function returned as evidenced by beginning respiration. The test dose of drug was injected at minute intervals until spontaneous coughing subsided. Further doses were given until a readjustment of the endotracheal tube did not produce cough or until respiratory arrest occurred. The test doses of the thiopental and lidocaine were 0.5 mg./lb., that of meperidine 0.16 mg./lb. After the end point had been reached,  $N_2O$  was administered in a 70 per cent concentration by semiclosed technique for the remainder of the operation. The doses of the three drugs required to produce suppression of the cough reflex or respiratory arrest were determined in a randomly selected group of 10 patients for each drug. In the three groups of patients the induction dose of thiopental averaged between 335 and 350 mg. An average of 6 doses of the test drug was required to produce the end point and the mean doses of the three drugs were thiopental 475 mg., meperidine 160 mg., and lidocaine 515 mg. In the group which received thiopental during the test period, the end point was clearcut with 80 per cent (8) experiencing respiratory arrest and 20 per cent (2) showing cough suppression. Respiratory arrest developed in 80 per cent (8) of the patients receiving meperidine, and 10 per cent (1) had a suppression of cough. The end point was questionable in the tenth patient since he appeared to reach the two end points simultaneously. In contrast to meperidine and thiopental, lidocaine did not produce respiratory arrest and gave unequivocal suppression of cough in 80 per cent (8). In the remaining 2 patients a slight evidence of cough remained when the test had to be discontinued