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

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because of the delay of surgery. Both of these patients required large amounts of drug and consequently the tests required excessive amounts of time. An interesting observation was the marked variation in the reflexes exhibited by the patients in this study. Two patients were eliminated from the study because they did not cough spontaneously when they recovered from the muscle paralysis. The results of this study indicate that lidocaine was an effective suppressant of cough without producing respiratory arrest. Both thiopental and meperidine produced respiratory arrest in a high percentage of patients before the cough reflex was suppressed.

Glutethimide (Doriden) as an Anesthetic Agent. C. R. STEPHEN, M.D. *Division of Anesthesiology, Duke Medical Center, Durham, N. C.* For several years *alpha*-ethyl-*alpha*-phenyl-glutarimide (Doriden) has been utilized as an orally effective nonbarbiturate hypnotic compound. Recently a preparation for intravenous administration (each cubic centimeter containing glutethimide, 50 mg., dissolved in polyethylene glycol 400) became available for trial. This report summarizes the results of animal and clinical investigations conducted to evaluate this drug as a hypnotic for induction of anesthesia. Eight dogs were given succinylcholine, 0.5 mg./kg. intravenously. Endotracheal intubation was performed immediately and the dogs maintained on artificial respiration with oxygen, employing a Palmer pump, while a femoral artery cutdown was done, a vein cannulated, and electrocardiographic and electroencephalographic leads connected. Respirations were monitored by means of a pneumotachygraph. Recordings were made on a Grass electroencephalographic machine with suitable transducers and demodulators. Control recordings were made as the animal was recovering from the succinylcholine apnea and then various amounts of glutethimide were administered intravenously. An original dosage of 40 mg./kg. produced usually a profound hypnotic and analgesic effect. With this dosage apnea persisted an average of 10.5 minutes. Normal respirations were present in about 20 minutes, with the animals gagging and moving on the table. Subsequent doses of 20 mg./kg. rarely produced apnea, but resulted in an adequate state of hypnosis for approximately 20 minutes. Each administration of glutethimide produced marked slowing of electroencephalographic activity, with sometimes burst-suppression activity and occasionally complete absence of electrical activity for several minutes. Moderate to marked hypotension accompanied these dosages. No electrocardiographic abnormalities of significance were noted. Several days after recovery the experiment was repeated in the same dogs utilizing thiamylal sodium (Surital) instead of glutethimide. Thiamylal sodium, 40 mg./kg., produced apnea lasting more than 60 minutes. This dosage also resulted in profound depression of electroencephalographic activity for several minutes, although hypotension was not a significant factor. The principal differences in the two drugs in these dosages were: (1) the shorter duration of activity of glutethimide, (2) the more profound respiratory depression of the ultra-short-acting barbiturate and (3) the greater degree of hypotension seen with glutethimide. Induction of general anesthesia was carried out in 58 adult patients, utilizing glutethimide in a manner similar to the ultra-short-acting barbiturates. In the majority of patients induction was rapid, smooth and free of apprehension, although seven patients (12 per cent) became garrulous or went through a short but well-defined "second stage" of anesthesia. The average amount of drug required to produce sleep or hypnosis was 500 mg., with the range varying between 200 and 1,500 mg. The average total dose administered was 850 mg., with one patient receiving 3,500 mg. over a period of four hours. The most remarkable differences between glutethimide inductions and ultra-short-acting barbiturate inductions were related to the character of respirations and oropharyngeal reflex activity. With glutethimide the respiratory rate was unchanged and the tidal volume reduced minimally if at all. At the same time, glutethimide obtunded reflex activity in the upper respiratory tract in a satisfactory manner. Oropharyngeal airways could be inserted without reaction within two minutes of the time sleep was produced. In 21 patients glutethimide induction was followed by rapid administration of nitrous oxide, oxygen and

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