periods; immediately before or after induction with cyclopropane or intravenous thio-
pental; 3–5 minutes prior to by-pass; 3–5 minutes after by-pass; at the end of surgery; 3–15 hours postoperatively; and first postoperative day. The following determinations were made on each sample: pH, total carbon dioxide, hemoglobin, hematocrit, serum sodium, potassium, chloride, and whole blood lactic acid. Carbon dioxide tension was calculated from pH and plasma carbon dioxide. Plasma bicarbonate values were adjusted for hemoglobin buffer and corrected to pH 7.40. Changes in corrected bicarbonate provided an index of changes in total fixed acids. All values were compared to values immediately before or after induction.

Respiratory alkalosis (pH 7.48, pCO₂ 26.2) occurred prior to by-pass from deliberate hyperventilation. This was accompanied by a 2.6 mEq./L increase in fixed acids and an increase in lactic acid of 1.5 mEq./L, in part the result of ether administration. Cardiopulmonary by-pass produced a slight fall in pH (7.45) and a rise in pCO₂ (29.6); however these values were not corrected for changes in body temperature since the latter was not monitored. The decrease in pH was associated with a further increase in lactic acid of 1 mEq./L. All blood values except lactic acid tended to return to control values in the samples following by-pass. Lactic acid remained slightly elevated even during the first postoperative day at which time respiratory acidosis was also present (pH 7.34, pCO₂ 49). In no patient did the pH fall below 7.30 nor the lactic acid except 6.5 mEq./L in the period immediately following by-pass. The sodium potassium and chloride values showed insignificant changes.

We conclude that the degree of metabolic acidosis produced by a perfusion rate of 35–50 cc./kg./min. for a period up to 20 minutes is not of clinical significance.

An Evaluation of the Cardiovascular-Respiratory Effects and General Pharmacologic Properties of 21 Hydroxy, 3-20 Dione Sodium Succinate (Hydroxy-
dione). F. A. Montmorency, M.D., A. Chen, M.D., H. Rubel, M.D., W. W. Glas,
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There have been numerous clinical studies evaluating the effects of hydroxydione since its development and introduction into clinical anesthetic. This study was designed to quantitatively determine the effects of hydroxydione in normal humans under control conditions when used as the sole anesthetic agent.

The subjects selected were 10 normal adult males between the ages of 30 and 55 requiring minor operative procedures. They were given hydroxydione alone without premedication. An induction dose of 20 mg./kg. in 5 per cent aqueous solution was followed by doses of 10 mg./kg. at 10-minute intervals until the subject reached electroencephalographic level IV narcosis. Cardiac outputs were determined by a modification of the Stewart dye dilution technique at levels 0 through level IV. Blood gases were performed by the manometric method of Van Slyke and Neill, venous samples being obtained from the right heart and arterial samples from the radial artery. Respiratory excursions were recorded on a Collins respirometer attached to the nonbreathing box-bag apparatus of Donald and Christie. Compressed atmospheric air was used as the sole respiratory gas mixture. Fronto-occipital electroencephalograms were recorded on a Grass electroencephalograph. Intra-arterial blood pressure was recorded from the radial artery on a Sanborn direct writer using the Statham strain gauge transducer.

There was a delay in onset of action of hydroxydione varying from 3 to 11 minutes. In all but one of the 10 patients electroencephalographic level IV narcosis was reached with the total dose administered. The dose necessary to produce level IV anesthesia varied from 14.7 to 40 mg./kg. No significant change in cardiac index was observed even with level IV narcosis. However, there was a tachycardia in association with a decrease in stroke volume in all stages of narcosis. A moderate progressive reduction in pulse pressure of 37 per cent from base line to level IV was observed. There was also a progressive mild drop in systolic and diastolic blood pressures of 23 and 14 per cent.
An average maximum drop in mean blood pressure of 17 per cent was noted. The most striking effect of this agent was the production of marked tachypnea. There was a consistent increase in respiratory rate of 100 per cent or more in all stages of narcosis with a concomitant decrease in tidal volume. An over-all increase in minute volume of 5.5 to 20 per cent occurred, however. No significant change in arterial or venous oxygen content or saturation was observed. There was a slight increase in arterial carbon dioxide content of 3.5 volumes per cent. No significant change in arterial pH was noted.

Electroencephalographic patterns of anesthesia were in agreement with those described for hydroxydione by Bellville and Howland. We found that stage I levels were very transient and that the patient may be awake at level I or II during the recovery phase. All patients, except those who reached level IV with the induction dose alone, showed marked generalized muscular twitchings and rigidity.

**Evaluation of Inhalers for Trichloroethylene, Chloroform and Fluothane.** S. H. NuaI, M.D., HENRY D. GREEN, CAPT. MC, JACK R. KNOX, M.S., AND HARVEY C. SLOCUM, COL. MC, Department of Experimental Surgery and Biophysics, Walter Reed Army Institute of Research and the Anesthesia and Operative Service, Walter Reed Army Hospital, Washington, D. C.

In the process of investigating the analgesic properties of trichloroethylene, chloroform, and Fluothane (1, 1, 1-trifluoro-2,2-bromochlorethane) and their possible application in the anesthetic management of mass casualties a series of anesthetic inhalers were evaluated. These included the Duke inhaler, a modified Duke inhaler, the Emotril inhaler, the Tecota inhaler, an experimental chloroform Tecota inhaler, and the Airlene inhaler.

Analysis of anesthetic vapor concentration as delivered from these inhalers was accomplished with a Perkin-Elmer double beam recording infrared spectrophotometer. The inhaler was charged with one of the three agents and connected to the intake tube of a Bird respirator pump with the infrared sampling cell interposed to achieve a total and continuous sampling. Anesthetic vapor concentration in relation to the available settings on the inhaler and the tidal volume and stroke frequency of the respirator was determined. The ability of the inhaler to maintain a given vapor concentration was also tested.

With the Duke inhaler the trichloroethylene vapor concentrations obtained were at slight variance with the information provided by the manufacturer. When charged with chloroform the increment in vapor concentration with each higher setting was of considerable magnitude. The modified Duke inhaler gave a more gradual increase in vapor concentration in this respect. The ranges of vapor concentrations were: trichloroethylene, 0.90 to 0.98 per cent; chloroform, 0.00 to 1.66 per cent; and Fluothane, 0.00 to 1.63 per cent. Lower concentrations were maintained for a period up to 60 minutes. With both the Duke inhaler and the modified Duke inhaler the vapor concentrations were sensitive to position changes of the inhaler, becoming higher when the inhaler was held horizontally. They were also sensitive to changes in air flow rate. Concentrations decreased when the minute volume was less than 7 liters.

With the Emotril inhaler an initial period of approximately twenty minutes was necessary for the vapor concentration to become stabilized. After stabilization, with a minute volume of 8 to 10 liters, the vapor concentrations were: trichloroethylene, “weak,” 0.27 to 0.33 per cent, “normal,” 0.43 to 0.49 per cent; chloroform, “weak,” 0.70 to 0.95 per cent, “normal,” 1.0 to 1.3 per cent; and Fluothane, “weak,” 0.33 to 0.53 per cent, “normal,” 0.50 to 0.80 per cent. The critical minute volume was 6 liters.

With the Tecota inhaler the vapor concentration became stabilized within the first few minutes. With a minute volume of 8 to 10 liters the vapor concentrations were: trichloroethylene, “minimum,” 0.27 to 0.30 per cent, “maximum,” 0.37 to 0.46 per cent; chloroform, “minimum,” 0.71 to 0.75 per cent, “maximum,” 0.90 to 1.16 per cent; and Fluothane “minimum,” 0.44 to 0.65 per cent, “maximum,” 0.80 to 1.0 per cent. The critical minute volume was 8 liters. With both the Emotril and the Tecota inhalers...