Florida. Surgical anesthesia has been implicated as a possible teratogen in the nearly 50,000 women yearly in the United States who undergo operation and anesthesia during gestation. Regrettably, there is little direct evidence to support or refute this accusation. A comprehensive laboratory investigation of the teratogenic effects of anesthesia on the embryo and fetus has been instituted at the University of Miami. *Methods:* Chick embryos were chosen for the initial studies in order to eliminate complications of anesthesia in the mammal such as hypoxia and hypercarbia, which are known teratogens. After three days incubation and determination of viability by candling, 2,507 eggs containing live, genetically controlled embryos were divided into several test groups totaling 1,553 and control groups totaling 954 eggs. The anesthetic agent was passed over the eggs for six hours under incubation while compressed air flowed at the same rate over the control eggs. Anesthetics tested were 0.25, 0.5, 1, and 1.5 per cent methoxyflurane (Penthrane) in air; 0.5, 1, and 2 per cent halothane (Fluothane) in air; 1.25 per cent and 2.5 per cent fluroxene (Fluoromar) in air; and 25 per cent and 40 per cent tetraflurobromethane (Teflurane) in oxygen. Both test and control eggs were candled for viability each day and opened and examined for anomalies on the day of death, or, if still living, on the tenth day. All specimens were preserved in Bouin's solution and those not showing external anomalies were dissected and examined for internal anomalies. *Results:* The death rate of controls between exposure and day 10 was 12 per cent. This rate was not markedly changed after ½ per cent and 1 per cent halothane, 1½ per cent and 2½ per cent fluroxene, or ¼ per cent methoxyflurane. The increase to 19.5 per cent with 2 per cent halothane was not significant ($P < .06$). However, ½ per cent methoxyflurane caused a 22.4 per cent death rate ($P = 0.01$); 25 per cent tetraflurobromethane caused a 30 per cent death rate ($P < 0.01$); 1 per cent methoxyflurane caused a 54 per cent rate ($P < 0.001$); 40 per cent tetrafluobromethane 92 per cent ($P < 0.001$); and 1½ per cent methoxyflurane 96 per cent death rate ($P = 0.001$). Fetal anomalies appeared in 5.2 per cent of control embryos. Increases appeared after ½ per cent methoxyflurane—15.6 per cent ($P < 0.01$); after 2½ per cent fluroxene—16.5 per cent ($P < 0.001$); and after 25 per cent tetraflurobromethane—23.3 per cent ($P < 0.01$). The rate of anomalies did not increase with the higher fetal death rates. The combined risk to the embryo of death or a major nonlethal anomaly (control 14.8 per cent) was not increased by ½ per cent and 1 per cent halothane, but became 26.5 per cent after 2 per cent halothane ($P < 0.001$); after 2½ per cent fluroxene 25.6 per cent ($P = 0.01 - 0.02$); after 0.5 per cent methoxyflurane 29.1 per cent ($P < 0.001$); 53 per cent after 25 per cent tetraflurobromethane ($P < 0.001$) with higher concentrations tested slightly higher than the very high death rate. The particular type of anomaly encountered bore no relation to the agent used. *Conclusions:* Species differences, unequal rates of diffusion through the shell and the long duration of exposure greatly limit the clinical implications that may be drawn from this preliminary laboratory work in chicks. The findings underscore the necessity for concern and further study of the teratogenic potential of anesthesia in the human. (This work was supported by a grant from the Abbott Laboratories, North Chicago, Illinois.)

Acute Hemodilution with Plasma Expanders. MASUHIKO TAKAORI, M.D., LEROY C. HARRIS, JR., M.D., ROBERT LOEHNING, M.D., and PETER SAFAR, M.D., *Department of Anesthesiology, University of Pittsburgh, School of Medicine, Pittsburgh.* Treatment of massive hemorrhage with plasma expanders in the absence of sufficient cross-matched blood can maintain near-normal arterial pressures but reduces oxygen-carrying capacity. The degree of acute reduction of hemoglobin which can be tolerated has not been delineated. This study attempts to elucidate some of the circulatory and metabolic changes which occur in severe hemorrhage treated with dextran. Results of three controlled studies are presented. *Methods:* In all three studies, dogs (9–15 kg.) were anesthetized with pentobarbital (25 mg./kg. intravenously) and tracheal intubation was performed. The animals were then prepared for some or all of the following measurements: ECG, arterial pressure, carotid flow (rotameter), cardiac output (dye

dilution), and right auricular pressure. Arterial blood samples were analyzed for *p*H, P_{CO_2}, O_2 content, hemoglobin, hematocrit and lactic acid. After 45 minutes of anesthesia, control measurements were made, and graded arterial hemorrhage with immediate intravenous dextran replacement was carried out as follows: Initial hemorrhage of 20 per cent of estimated blood volume (10 per cent of body weight); then successive hemorrhages of 10 per cent of blood volume each, every five minutes, until hemoglobin 3 g. 100 ml. STUDY 1. *Spontaneous Respirations Versus Intermittent Positive Pressure Ventilation (IPPV) and Oxygen Versus Air.* The circulatory and metabolic effects during four types of respiration were compared: Group 1, spontaneous respiration with air; group 2, spontaneous respiration with 100 per cent O_2; group 3, IPPV with air; and group 4, IPPV with 100 per cent O_2; 7 dogs in each group. After a hemoglobin value of 3 g./100 ml. was reached, the animals were observed for 1 hour; subsequently, hemorrhage with replacement was continued until cessation of circulation. *Results:* (1) Progressive fall in arterial *p*H during spontaneous respiration with air and during spontaneous respiration with O_2 (7.37 ± 0.05 to 7.06 ± 0.10); less decrease of *p*H during IPPV with air (7.42 ± 0.07 to 7.24 ± 0.10) and no change in *p*H during IPPV with O_2 (7.51 ± 0.10 to 7.49 ± 0.10). (2) Circulatory deterioration began when arterial O_2 content had fallen below 4 volumes per cent (*i.e.*, average hemoglobin 3.5 g./100 ml. with air and 1.5 g./100 ml. with O_2); asystole occurred suddenly, approximately at 3 volumes per cent O_2, except in the IPPV with O_2 group where circulatory failure was more gradual. STUDY 2. *Adaptation to Hemodilution to 3 g./100 ml. Hemoglobin.* Ten dogs were hemodiluted as in study 1, but only to 3 g./100 ml. hemoglobin. Respiration: IPPV with 30 per cent O_2–70 per cent N_2; rate 20/minute; tidal volume adjusted to maintain end-expiratory P_{CO_2} near 40 mm. of mercury. At end of hemodilution, spontaneous respiration with air and observation for 24 hours. *Results:* (1) 7 of the 10 animals survived 24 hours. (2) *p*H fell from control 7.40 (± 0.04) to 7.30 (± 0.04) at 3 g./100 ml. hemoglobin; two hours later 7.30 (± 0.07); and 24 hours later 7.42 (± 0.07). (3) Cardiac index showed a consistant increase from control 4.34 (± 0.6) to 7.54 (± 0.7) at 3 g. 100 ml. hemoglobin; and two hours later 5.90 (± 1.30). The 3 dogs which died were those unable to maintain elevated cardiac index. (4) Lactic acid showed no consistant change and did not correlate with ability to survive for 24 hours. (5) After hemodilution to 3 g./100 ml., hemoglobin increased to 4.0 g. 100 ml. at two hours and 5.5 g./100 ml. at 24 hours (average). STUDY 3. *Long-term Survival after Hemodilution to 3 g./100 ml. Hemoglobin.* Five dogs of study 2 were observed for one week; all survived and appeared normal at the end of this period. They maintained normal *p*H (7.44 ± 0.03) and blood glucose; plasma proteins were low; plasma Na and K only slightly reduced. At one week the hemoglobin had returned to approximately 8 g. 100 ml. *Conclusions:* Although these results may not apply to man, particularly those with disease, they suggest that one can be liberal with the use of dextran in treating exsanguinating hemorrhage. Hemodilution below 3 g./100 ml. hemoglobin should not be exceeded. Oxygen and controlled hyperventilation prevented acidosis and delayed onset of asystole. (Supported by U. S. Army Contract No. DA-49-193-MD-2160).

Respiratory Effects of Trichlorethylene in Man. LT. D. A. TALCOTT, MC USN, LCDR. C. P. LARSON, JR., MC USNR, and CDR. D. R. BUECHEL, MC USN, *Department of Anesthesiology, U. S. Naval Hospital, Oakland, California.* In midcollicular decerebrate cats, trichlorethylene (TCE) in 1 and 2 per cent concentration depresses respiratory responses to inhaled CO_2 and elevates the electrical stimulus threshold of the medullary respiratory center (Ngai, Farhie and Brody, Fed. Proc. 22: 186, 1963). Aside from progressive reduction in tidal volume and elevation in respiratory rate with increasing depth (Dundee and Dripps, ANESTHESIOLOGY *18:* 282, 1957), little information is available regarding the respiratory effects of TCE in man. *Methods:* To obtain additional data in man, we measured ventilation and ventilatory responses to 2 and 4 per cent inhaled CO_2 awake and at two levels of TCE anesthesia in ten healthy patients. Six patients were unpremedicated and