by Robertson, *et al.* (J. Physiol. *131* 436, 1952) not to interfere with carotid sinus and aortic arch baroreceptor function. The effect of circulating catechol amines released under different anesthetic agents may also be related to the response seen. Further investigation into the responses of large numbers of patients of various age groups to the different anesthetic agents will be carried out in order to determine if a specific stress-response relation can be developed.

The Effects of Methoxyflurane on the Renal Blood Flow of the Dog. ANTONIO BOBA, M.D., *Albany Medical Center Hospital Albany Medical College of Union University, Albany, New York.* Trauma and operation reduce renal blood flow and increase renal vascular resistance (Boba, A., and others: ANESTHESIOLOGY *20:* 268, 1959). The possibility should always be considered that an anesthetic agent might have specific renal vasoconstrictor and renal blood flow depressant effects, which might then compound the renal responses to trauma. Renal vasoconstriction is deleterious because it reduces the partial pressure of oxygen (Hostnik, W. J., and others: Surg. Forum, *10:* 872, 1960) and because it leads to significant histochemical alterations within the kidney (Pakdaman, P., and others: Ann. Surg., *155:* 140, 1962). *Method:* By means of a double lumen cannula (Powers, S. R., Jr., and others: Surgery *55:* 15, 1964) direct renal blood flows were measured in dogs before and during methoxyflurane anesthesia. Insertion of the cannula was accomplished under pentobarbital anesthesia; respiration was never assisted nor controlled because of the changes that both maneuvers induce on renal venous pressure. *Results:* GROUP A (3 dogs). Methoxyflurane was administered via a nonrebreathing system whereby the animal inhaled room air which was drawn through a wick vaporizer. Hypotension, apnea, decrease in renal vascular resistance and a decrease in renal blood flow were noted immediately following administration of methoxyflurane. All animals died during the experiment (average survival 106 minutes). GROUP B (4 dogs). Methoxyflurane was administered via a closed circle absorption which contained a draw through vaporizer. Only metabolic oxygen was added to the system. Hypotension, apnea, decrease in renal blood flow and an increase in renal vascular resistance were noted during methoxyflurane administration. All animals died during the experiment (average survival 127 minutes). GROUP C (3 dogs). Methoxyflurane was administered via a nonrebreathing system whereby the animal inhaled, from a bag reservoir, 100 per cent oxygen run through a Pentec vaporizer set at 1.5 per cent. Denitrogenation was carried out for eight minutes. Denitrogenation did not produce any detectable changes in arterial pressure, renal blood flow or renal vascular resistance. Methoxyflurane administration induced hypotension, apnea, increase in renal vascular resistance and decrease in renal blood flow. All animals died during the experiment (average survival 133 minutes). GROUP D (7 dogs). Same procedure as for group C, except that the Pentec's dial was set at 1.0 per cent. Four dogs did not survive the experiment (average survival 104 minutes) and 3 were sacrificed after five hours of continuous methoxyflurane administration. Denitrogenation did not produce demonstrable effects on arterial pressure, renal blood flow or renal vascular resistance. Methoxyflurane administration induced hypotension, decrease in renal blood flow, and increase in renal vascular resistance in all animals. The apneic animals died; those that survived exhibited marked bradypnea. GROUP E (5 dogs). Standard trauma (Boba, A., and others: Surgery *52:* 188, 1962) was administered before (twice) or after (three times) administration of methoxyflurane as in group D. The response to standard trauma is a neglible change in the blood pressure, a decrease in renal blood flow and increase in renal vascular resistance. This expected response was not altered by methoxyflurane administration. Apnea and death developed in all animals (average survival 150 minutes). *Conclusions:* Under the conditions of the experiment methoxyflurane was a very powerful respiratory depressant capable of producing apnea and death. It produced systemic hypotension. Its vascular effects on the kidneys were a diminution of renal blood flow and an increase in renal vascular resistance. Both effects are potentially dangerous to the kidney's parenchyma. Methoxyflurane does not pre-

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vent the kidney's vascular responses to trauma nor does it modify them once they have occurred. (Supported by N.I.H. Grant H 4382 and by a Grant from Abbott Laboratories.)

Aspiration of Gastric Juice—Physiologic Alterations. P. P. BOSOMWORTH, M.D., J. COYER, B.S., and L. R. BRYANT, M.D., *Departments of Anesthesiology and Surgery, University of Kentucky Medical Center, Lexington, Kentucky.* Certain physiologic alterations occurring with pulmonary aspiration of gastric juice were investigated utilizing dog lungs and intact dogs. *Method:* Lungs removed from 10 anesthetized 20-kg. dogs were perfused in a sterile chamber with 1,600 ml. of fresh aseptically drawn heparinized canine blood maintained at 38° C. and constant perfusion pressure (25 mm. of mercury) using a reservoir (Moore, T. C., and others: Arch. Surg. 87: 42, 1963). Ventilation was maintained with room air and supplemental CO_2 (control P_{CO_2} 35 mm. of mercury) utilizing a volume-constant pressure-variable respirator. Pulmonary artery and ventilation pressures were recorded. Arterial blood samples were analyzed for *p*H, P_{CO_2}, and P_{O_2}. Pulmonary blood flow and uptake of blood in the lungs were determined at 5-minute intervals. Eighty milliliters of gastric juice (*p*H 1.1) were instilled into the lungs after a control period of 20 minutes. Gastric juice was mixed with direct sky blue to study the location and rapidity of distribution of the gastric juice after aspiration in 3 isolated lungs. Sixteen 15-kg. dogs were anesthetized, intubated, and ventilated with 100 per cent O_2 utilizing a pressure-constant volume-variable ventilator. Catheters were placed in femoral and pulmonary arteries to record pressures and to recover samples for determination of *p*H, P_{CO_2}, and P_{O_2}. Ventilation volume, arterial pressures and airway pressures were recorded. Sixty milliliters of gastric juice (*p*H 1.1) were instilled into the dogs' tracheas after a 20-minute control period. *Results:* Gastric juice mixed with direct sky blue appeared at the lung surface within 18 seconds of the aspiration episode and extensive areas were blue within 3 minutes. Pulmonary blood flow through the isolated perfused lung (constant PAP 25 mm. of mercury) decreased from 923 ml./minute, S.D. ± 198, to 644 ml./minute, S.D. ± 245, within one minute of aspiration and fell to a stable low of 627 ml./minute, S.D. ± 219, 30 minutes later. This decreased flow was associated with an increase in the uptake of blood (450 ml. S.D. ± 38) retained in the lungs 30 minutes after aspiration. The particular component or exact location of blood retained in the lungs was not identified. Arterial *p*H fell in a near-linear fashion (7.45, S.D. ± 0.05, to 7.10, S.D. ± 0.11) within 30 minutes of aspiration. Arterial P_{CO_2} and P_{O_2} were not significantly altered, presumably because CO_2 production and O_2 consumption were minimal in the isolated lung. These observations suggest that the hydrochloric acid of gastric juice enters the blood stream. A determination of the degree of depletion of blood buffers would confirm this point. Airway pressure rapidly increased after aspiration (12.4 cm. of water, S.D. ± 3.1, to 23.2 cm. of water, S.D. ± 4.2) during pressure-variable, constant-volume ventilation, suggesting a significant decrease in compliance reaching a peak (26.4 cm. of water, S.D. ± 3.9) 35 minutes after aspiration.

Aspiration of gastric juice in the intubated, ventilated intact dog produced an immediate, significant fall in aortic pressure (137 mm. of mercury, S.D. ± 15.6, to 69 mm. of mercury, S.D. ± 21, systolic and 93 mm. of mercury, S.D. ± 15.0, to 28 mm. of mercury, S.D. ± 19, diastolic) 45 seconds after aspiration, returning to normal within 60 minutes. Pulmonary artery systolic pressure increased slightly despite systemic hypotension (21 mm. of mercury, S.D. ± 5.2, to 27.3 mm. of mercury, S.D. ± 14). Arterial *p*H fell (7.51, S.D. ± 0.15, to 7.13, S.D. ± 0.17) and arterial P_{CO_2} increased (31.0 mm. of mercury, S.D. ± 9.1, to 51.0 mm. of mercury, S.D. ± 8.9) with both values returning towards normal within 60 minutes. Arterial P_{O_2} during ventilation with 100 per cent O_2 dropped (403 mm. of mercury, S.D. ± 47.6, to 117 mm. of mercury, S.D. ± 95.4). Ventilation pressures during volume constant ventilation increased significantly (12.5 cm. of water, S.D. ± 2.6, to 24.8 cm. of water, S.D. ± 5.1). *Conclusions:* The isolated perfused dog lung preparation responded to the aspiration of gastric juice with decreased pulmonary blood flow, a significant increase in blood retained in the lungs, decreased arterial *p*H, little

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