

Despite changes in volume of respiration, physiologic dead space to tidal volume ratios remained constant (Nunn, J. F., and Hill, D. W.: *J. Appl. Physiol.* 15: 383, 1960). From the results, it does not seem to matter whether the volume of gases is given by ventilator or spontaneously inhaled: the efficiency of carbon dioxide elimination is not altered. **Conclusion:** The results confirm the need for an increased oxygen concentration in the inspired mixture during weaning from controlled breathing but fail to show the constant increase in oxygen consumption previously reported (Supported by Grants HE-09337-03 and HE-10248-02 from the USPHS.)

Detection of Venous Air Embolism by Carbon Dioxide Monitoring. R. W. M. BETHUNE, M.D., and VERNE L. BRECHNER, M.D., *UCLA School of Medicine, Los Angeles, Calif.* The purpose of this project was to examine the value of carbon dioxide monitoring for the detection of venous air embolism. Experimental work was performed on dogs and the method was applied in the operating room. **Method:** For dogs instrumentation was similar to that previously reported (Brechner, V. L., Bethune, R. W. M., and Soldo, N. J.: *ANESTHESIOLOGY* 28: 240, 1967) with the addition of continuous monitoring of alveolar nitrogen and arterial blood gas analysis before and after embolism. Ventilation was controlled mechanically in all animals. For patients instrumentation included continuous ECG and alveolar carbon dioxide monitoring. EEG and central venous pressure were recorded for some patients. Ventilation was controlled mechanically in all patients. **Results:** In dogs the standard embolus (1.5 ml./Kg.) caused immediate marked increase in right ventricular pressure, abrupt marked decrease in concentration of exhaled carbon dioxide, no change or slight transient fall in systemic arterial pressure, and an increase in concentration of exhaled nitrogen. The increase in concentration of alveolar nitrogen was immediate, returning to pre-embolism level in one to two minutes. The RV pressure and alveolar CO₂ returned to pre-embolism levels in 5 to 20 minutes. Arterial blood gas analysis immediately before and after embolism showed an increase in

partial pressure of CO₂ after embolism. In 16 patients undergoing neurosurgical procedures in the sitting position the alveolar CO₂ was recorded continuously. Two patients had frank air embolism with extreme hypotension, necessitating repositioning and external cardiac massage. In both patients a fall in alveolar CO₂ was noted before catastrophic hypotension occurred. In a third patient rapid fall in CO₂ from a previously constant 2.6 to 1 per cent was not accompanied by any significant change in systemic pressure, but a minor transient cardiac murmur was probably heard. This fall in CO₂ was assumed to indicate early air embolism. The neurosurgeon concurred that air entry was probable; with application of wet packs no progression occurred. The alveolar CO₂ gradually returned to the level before embolism over 30 minutes. **Summary:** In dogs a venous air embolus of 1.5 ml./Kg. caused an increase in RV pressure, no change or slight transient decrease in systemic pressure, immediate abrupt fall in alveolar CO₂ and an immediate definite increase in alveolar nitrogen. Blood gas analysis immediately before and after a standard embolus showed an increase in partial pressure of CO₂ after the embolus. In patients an abrupt fall in alveolar CO₂ may be the only sign of early or small-volume venous air embolus. The fall in alveolar CO₂ may precede the onset of systemic hypotension by a period sufficient to permit local corrective measures and thus prevent massive embolism.

The Protective Effects of Succinylcholine Administration in Severe Hemorrhage in the Dog. WILLIAM A. BOYD, M.D., Ph.D., and DENNIS B. HILL, B.S., *The University of Texas M. D. Anderson Hospital and Tumor Institute at Houston, Houston, Texas.* It is believed that hypothermia induced prior to hemorrhage protects animals subjected to controlled hemorrhage because of the decrease in cellular metabolism which results at the reduced temperatures. Johnson *et al.* (Johnson, R. H., Smith, A. D., and Spalding, J. M. K.: *Physiol.* 169: 584, 1963) reported that muscular relaxation depresses metabolic rate. This study was done to determine whether succinylcholine administered prior to bleeding would protect