Literature Briefs

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Literature Briefs were submitted by Drs. A. Boutros, D. R. Bucchel, W. Mannheimer, D. H. Morrow, F. C. McPartland, J. W. Pender and H. Roe. Briefs appearing elsewhere in this issue are part of this column.

Circulation

EXTRACELLULAR FLUID Administration of furosemide to 17 hypertensive subjects resulted in a decrease in mean arterial pressure (17 per cent), a diuresis of 1,920 ml, and a decrease in plasma volume (10 per cent). Infusion of 5 per cent glucose in excess of the volume of urine formed was required to restore blood pressure and responsiveness to norepinephrine. The excess glucose solution reexpanded the extracellular space without correcting negative sodium volume or plasma volume deficit. These results further document the importance of the extracellular fluid in the regulation of arterial pressure. (*Davidov, M., and others: Relation of Extracellular Fluid Volume to Arterial Pressure during Drug Induced Saluresis, Circulation 50: 349 (Sept.) 1969.*)

Respiration

PULMONARY ARTERY LIGATION The amount of hemorrhagic pulmonary consolidation following unilateral pulmonary artery ligation was much less in dogs which breathed 5 to 6 per cent carbon dioxide in air for as long as ten days postoperatively than in control dogs which breathed air or which, in addition, received continuous infusions of isoproterenol. Carbon dioxide inhalation maintained bronchodilatation and increased ventilation, minimizing the incidence of atelectasis, which predisposed to hemorrhagic consolidation. Surfactant activity and pressure–volume characteristics of surviving lung were not affected by ligation of the pulmonary artery. (*Edmunds, L. H., and Holm, J.: Effect of Inhaled CO_2 on Hemorrhagic Consolidation due to Unilateral Pulmonary Artery Ligation, J. Appl. Physiol. 26: 710 (June) 1969.*)

BREATH-HOLDING A previous model for the control of breath-holding demonstrated that the total drive to resume breathing has two dynamic components, one of which is linearly related to the increasing P_{CO_2} without any threshold, while the other is a time-dependent non-chemical component arising from the absence of normal respiratory movements. A more complicated interaction is now suggested. The relationships between initial and breathing-point P_{CO_2} values and breath-holding times at different lung volumes in ten subjects were estimated. Alveolar P_{CO_2} was set at different levels by periods of rebreathing from a spirometer filled with 5 to 8 per cent CO_2 in oxygen. The subject held his breath to a breaking point at the appropriate lung volume at a P_{O_2} that was always higher than 180 torr. In most instances, the overall relationship between initial and breaking point P_{CO_2} values and breath-holding times were nonlinear. A plot of breath-holding time against alveolar P_{CO_2} demonstrated an inflection point, which may represent a threshold for CO_2 comparable to the one seen in steady-state ventilation, below which CO_2 makes no contribution to the drive to breathe. (*Patrick, J. M., and Reed, J. W.: The Interaction of Stimuli to Breathing during Breath-holding, J. Physiol. 203: 76P (July) 1969.*)

DISTRIBUTION OF INSPIRED GAS Effects of varying inspiratory flow rates on intrapulmonary distribution of inspired gas were studied in healthy volunteers by measuring concentration gradients of ^{133}Xe down the lung using external counters and also by recording shape of the alveolar plateau during exhalation. When inspiration was begun from residual volume, inspired gas was distributed preferentially to the apices of the lungs; this effect was much more pronounced during slow inspiration. When inspiration started at higher lung volumes (*e.g.*, 40 to 50 per cent of vital capacity) slow inspiratory flow rates caused a uniform increase in ^{133}Xe concentration down the lung, with basal segments having higher

concentrations. At rapid inspiratory flow rates, starting from higher lung volumes, apical concentration was somewhat higher and basal concentration was somewhat lower than with low inspiratory flow rates. Basilar airways were closed at residual volume and were opened earlier in inspiration by the relatively high transpulmonary pressures required to produce rapid inspiratory flow rates. At higher lung volumes, fast inspiration produced a slightly more even distribution than slow inspiration. (*Robertson, P. C., Anthonisen, N. R., and Ross, D.: Effect of Inspiratory Flow Rate on Regional Distribution of Inspired Gas, J. Appl. Physiol. 26: 438 (April) 1969.*) ABSTRACTER'S COMMENT: The findings that rapid inspiratory flow rates are associated with more uniform intrapulmonary gas mixing in healthy man are certainly contrary to our current thinking and practice. Those who advocate use of slow inspiratory flow rates to promote uniform distribution of inspired gas will be surprised to learn that they may be producing the opposite effect.

VENTILATION IN OBESITY Shunting and ventilation-perfusion relationships in a group of obese subjects were compared with those in a group of subjects of normal weight. Findings in the normal subjects were similar to those previously reported by other investigators. Significant ventilation–perfusion abnormalities were found in some obese subjects in that hypoventilated alveoli were relatively overperfused. In other obese subjects, large anatomic shunts occurred. The anoxemia without hypercapnia found in some obese subjects was related to overperfusion of underventilated areas or to perfusion of completely nonventilated areas. In addition to anoxemia, other abnormalities found frequently in the obese population were low expiratory reserve volumes, low maximum voluntary ventilation, and increased work of breathing, caused primarily by increased elastic work. (*Barrea, F., and others: Ventilation–perfusion Relationships in the Obese Patients, J. Appl. Physiol. 26: 420 (April) 1969.*)

CO_2 TENSION/CONTENT TABLES Tables relating oxygen tension and content under a variety of physiologic conditions, including different pH, temperature and hemoglobin concentration values are readily available. Similar tables are now available for the interconversion of carbon dioxide tension and content under various physiologic conditions. Such tables were produced on the line printer of an ICL system 4-50 digital computer. The program, written in *ALGOL*, was based on a previously-published computer procedure using the same primary experimental data as the Singer-Hastings nomogram, and therefore gives similar results. In addition to carbon dioxide tension or content, pH, hematocrit and oxyhemoglobin saturation are required. The most important factor affecting the position of the carbon dioxide dissociation curve is the base excess. For a single value of hematocrit and temperature, each table gives CO_2 contents corresponding to CO_2 tensions ranging from 12 to 100 mm Hg in steps of 2 mm Hg. (*Kelman, G. R.: Computer-produced Physiological Tables for Carbon Dioxide Tension/Content Interconversions, J. Physiol. 203: 30P (July) 1969.*)

LUNG MECHANICS Effects on pulmonary mechanics of varying airway CO_2 tension and systemic arterial CO_2 tension independently were studied in 14 patients undergoing surgical correction of acquired and congenital heart disease with the aid of total cardiopulmonary bypass. Systemic CO_2 was varied while the patients were on pump by "ventilating" the oxygenator with 12 to 14 liters of pure oxygen (average Pa_{CO_2} 25 mm Hg) or with 6 to 7 liters of 2 per cent CO_2 in oxygen (average Pa_{CO_2} 38 mm Hg). End-tidal CO_2 tension (P_{ET/CO_2}) could be decreased (average 2 mm Hg) by ventilating the lungs with pure O_2 and could be increased (average 48 mm Hg) by ventilating lungs with 5 to 10 per cent CO_2 in oxygen. Changes in resistance, compliance, elastic work and flow-resistive work due to changes in Pa_{CO_2} were not significant whether P_{ET/CO_2} was high or low. Significant increases in resistance, elastic work and flow-resistive work and decreases in lung compliance resulted from the lowering of P_{ET/CO_2}. These values were different from normal values (obtained from other studies) and values obtained with high P_{ET/CO_2}. The