Effect of Arterial Oxygen Tension on Cerebral Blood Flow at Different Levels of Arterial PCO_2

Cerebral blood flow is closely correlated to carbon dioxide tension of arterial blood over a wide range of $PaCO_2$[1]. Oxygen exerts a vaso-constricting effect at high tensions, while a reduction of arterial PO_2 produces no effect until a critical level of 30–50 mm Hg is attained[2]. The effects of combined alterations in arterial oxygen and carbon dioxide tensions on cerebral blood flow, however, are largely unknown although of considerable clinical and theoretical interest. In the present study the influence of different arterial PCO_2 tensions on the cerebrovascular responsiveness to alterations of arterial PO_2 between 50–140 mm Hg was investigated.

Methods. The experiments were performed in 31 cats, anaesthetized with nembutal (30 mg/kg body weight, i.p.). After tracheotomy the animals were curarized and ventilated with a Starling pump. 15 animals (group I) were ventilated at a normal rate and normal tidal volume with N_2/O_2 mixtures of different oxygen content. PaO_2 in this group was in the range of 55–140 mm Hg; $PaCO_2$ was 28.2 $\pm$ 1.83 S.D. In 16 experiments (group II) 3–5% CO_2 was added to the above gas mixtures. $PaCO_2$ varied between 35.5 and 72.5 mm Hg (mean 47.33 $\pm$ 12.6 S.D.). PaO_2 was in the range between 50–140 mm Hg.

Arterial blood pressure (Statham pressure gauge transducers) and end-expiratory CO_2 (IR analyser) were continuously recorded. Arterial PO_2, PCO_2 and pH were determined according to the micro-method of ASTRUP. Cardiac output was measured by thermodilution technique. Blood flow through forebrain, cerebellum and brain stem was determined under steady-state conditions of PaO_2, $PaCO_2$, mean arterial blood pressure, and cardiac output by means of the particle distribution technique[3]. In group II the determination of CBF was carried out after a period of 35–40 min of 3–5% CO_2 inhalation.

Results. The results of multiple regression analysis of the data are summarized in the Table. Cerebrovascular responsiveness to changes in PaO_2 in hypercapnia differs from that observed under normocapnia. In normocapnia no correlation between PaO_2 (varying between 55–140 mm Hg) and blood flow is seen; in hypercapnia, however, a significant negative correlation between PaO_2 and blood flow through forebrain, cerebellum and brain stem is observed.

It is concluded from these data that the response to combined alterations of PaO_2 and $PaCO_2$ is not simply additive. Similar results were obtained by SHAPIRO et al.[4] in man. AGNOLI et al.[5] observed that hypoxia prevents the adaption of CBF and CSFpH to chronic hypercapnia. These authors propose that hypoxia might interfere with active transport mechanisms involved in the regulation of the extracellular pH of the central nervous system. Our findings seem to constitute another aspect of the same phenomenon, namely an increased sensitivity to hypoxia under hypercarbia.

Zusammenfassung. Die Wirkung des arteriellen O_2-Partialdruckes auf die Durchblutung des Grosshirns, Kleinhirns und Hirnstammes bei normalen und erhöhten CO_2-Partialdrucken im arteriellen Blut wird an der anaesthesierten Katze untersucht. Die Wirkung des PaO_2 ist von der Höhe des $PaCO_2$ abhängig.

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Partial correlation coefficients between PaO_2, $PaCO_2$ mean arterial blood pressure (BP) and blood flow through forebrain (CBFp), cerebellum (CBFc) and brain stem (CBFs)

	Group	$PaCO_2$	BP	CBFp	CBFc	CBFs
PaO_2	I	0.0702	0.0092	—0.4242	—0.2515	—0.1330
	II	—0.3878	0.1080	—0.7161[b]	—0.6186[a]	—0.5612[a]
$PaCO_2$	I	–	—0.0969	0.8151[c]	0.8178[c]	0.9006[c]
	II	–	0.0892	0.3661	0.5881[a]	0.1133
BP	I	–	–	—0.1860	—0.3273	—0.3105
	II	–	–	—0.0614	0.1301	0.0183

Significant correlations: [a] $0.05 > p > 0.01$. [b] $0.01 > p > 0.001$. [c] $p < 0.001$.

[1] M. REIVICH, Am. J. Physiol. *206*, 25 (1964).
[2] S. SHIMOJYO, P. SCHEINBERG, K. KOGURE and O. M. REINMUTH, Neurology *18*, 127 (1968).
[3] H. FLOHR, Pflügers Arch. ges. Physiol. *302*, 268 (1968).
[4] W. SHAPIRO, A. J. WASSERMAN and I. L. PATTERSON JR., Circulation Res. *19*, 903 (1966).
[5] H. AGNOLI, N. BATTISTINI, M. NARDINI, S. PASSERO and C. FIESCHI, in *Cerebral Blood Flow* (Eds. M. BROCK, C. FIESCHI, D. H. INGVAR, N. H. LASSEN and K SCHÜRMAN; Springer Verlag, Berlin, Heidelberg, New York 1969), p. 79.

Chronic Effects of Nicotine on Rat Gastric Secretion

Tobacco smoking has been implicated as a contributory factor in the aetiology, and reduced healing, of peptic ulcers[1,2]. Furthermore, nicotine has been shown to increase the ulcerogenic potential of histamine in dogs[3] and the histamine-forming capacity of the rat stomach[4]. These facts suggest that nicotine and smoking may increase gastric acid and pepsin production, however, secretory data in the literature are contradictory ([5] review). We have recently shown that acute doses of nicotine depress gastric secretion[6,7], but this may not be directly applicable to the condition resulting from chronic alkaloid exposure. Reported here are the effects of chronic nicotine