Anesthesiology
V 75, No 3A, Sep 1991

A199

MODULATION BY CO_2 AND pH OF THE REACTIVITY TO $PGF_{2\alpha}$ IN HUMAN CEREBRAL ARTERIES.

Reinstrup P. M.D., Uski T. M.D. Ph.D. and Messeter K. M.D. Ph.D.
Departments of Clinical Pharmacology, Neurosurgery and Anesthesiology, University Hospital, S-221 85 Lund, Sweden.

INTRODUCTION

The tight connection between cerebral blood flow (CBF) and brain function seems to be mediated mainly by chemical factors released locally from the brain tissue. Carbon dioxide (CO_2) is the main end product of brain metabolism. The extracellular fluid surrounding the resistance vessels is buffered by the HCO_3-/CO_2 system. Thus, a change in brain metabolism will lead to a concomitant change in perivascular pH, which is regarded as the main factor modifying the tone of the vessels. The exact effect of CO_2 and pH on human cerebral pial arteries (PA) is however not known. The present study was performed in order to investigate these effects on isolated human cerebral arteries.

METHODS

Ring segments of PA (removed at surgery for underlaying gliomas) were suspended in organ baths containing Krebs solution. During control condition, the solution was bubbled with 30% O_2, 65% N_2, and 5% CO_2. Conditions resembling respiratory alcalosis and acidosis were attained by altering the CO_2-content in the gas mixture. Regulation of the pH value was attained by adjusting the $NaHCO_3$-content in the Krebs solution in order to maintain pH constant at different pCO_2 levels or to alter pH at a constant pCO_2. Contractions were induced by prostaglandin $F_{2\alpha}$ (PGF $1x10^{-4}$M). Results are expressed as % change in contractions from control conditions, and are given as mean $\pm$ SEM. Significant results (Wilcoxon's test $p = 0.05$) are indicated by *.

RESULTS

Contractions induced by PGF were depressed at high pCO_2 regardless if this "respiratoric acidosis" was allowed to be compensated by a change in pH (Table). Likewise, the contractions were depressed at low pH regardless if the "metabolic acidosis" was compensated by an altered pCO_2 (Table). On the other hand, a decrease in pCO_2, as well as an increase in pH, augmented PGF-induced contractions only when the resulting "respiratoric" or "metabolic" alcalosis was not compensated (Table).

COMMENTS

The present results suggest that isolated increase in pCO_2 or isolated decrease in pH attenuates PGF induced contraction on human cerebral arteries. A decrease of pCO_2 augmented the contractions only when extracellular pH was alcalotic. Hence, when a compensation of a respiratory alcalosis occurres, this may exclude the increase in cerebrovascular contractility initially attained by a lowering of the pCO_2.

TABLE

EFFECTS OF PCO_2 AND pH ON CONTRACTIONS BY PGF

No	pCO_2		pH		Contraction (%)	n	Wilcoxon
1	normal	(4.2)	normal	(7.44)	100 ± 0	6	control
2	low	(2.7)	high	(7.64)	110 ± 3	6	*
3	high	(7.2)	low	(7.17)	74 ± 9	6	*
4	normal	(4.1)	high	(7.75)	101 ± 4	6	-
5	normal	(4.3)	low	(7.14)	87 ± 6	6	*
6	low	(2.7)	normal	(7.37)	94 ± 6	6	*
7	high	(7.3)	normal	(7.47)	70 ± 16	6	*

A200

ALTERATION BY HALOTHANE AND ISOFLURANE OF THE REACTIVITY TO $PGF_{2\alpha}$ IN HUMAN CEREBRAL ARTERIES.

Reinstrup P., M.D., Uski T. M.D.,Ph.D., and Messeter K., M.D., Ph.D.
Department of Clinical Pharmacology, Neurosurgery and Anesthesiology, University Hospital, Lund, Sweden. S 221 85

INTRODUCTION. Volatile anesthetics has long been known to modulate the cerebral circulation.Their actions seems dependent on the ventilatory state of the patient. The influence of volatile anesthetics may be either secondary to changes in the metabolism of the brain, or they may primarily act on the cerebral arteries. In order to evaluate the direct actions of halothane and isoflurane on human cerebral arteries, an in vitro study was performed.

METHODS. Ring segments of pial arteries (removed at surgery for underlying gliomas) were suspended in organ baths containing Krebs solution. Contractions were induced by prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) $1x10^{-4}$ M. Conditions resembling normo- or hypocapnia, were attained by aerating the solution with 5.6% CO_2, or 3,0% CO_2 respectively. After obtaining control contractions during either of normo- or hypocapnia, isoflurane or halothane (MAC 0,4-1-2) were added to the gas mixture. Results are expressed as % change in contraction from control conditions, and are given as mean values $\pm$ SE. Significant results (Wilcoxon's test $p \leq 0,05$) are indicated by *.

RESULTS. During normocapnia contractions induced by $PGF_{2\alpha}$ were depressed significantly in a dose dependent manner by increasing halothane concentrations (fig). Similar effects were observed with Isoflurane although the vasodilating effect was less pronounced (fig). During hypocapnia the vasodilating properties of Halothane were attenuated (fig), whereas Isoflurane significantly augmented the contractile effects of $PGF_{2\alpha}$ (fig).

COMMENTS. Both Halothane and Isoflurane seem to be directly acting vasodilators in human pial arteries, even if the effect of the latter was small. However, at conditions simulating hyperventilation the actions of the two volatile anesthetics differed. Whereas halothane still attenuated the response to $PGF_{2\alpha}$, exposure to isoflurane potentiated the contractions. Thus, the results suggest that the opposing influence on CBF of these two agents observed in vivo may, at least partly, be the result of differences in their actions on the cerebral vasculature.

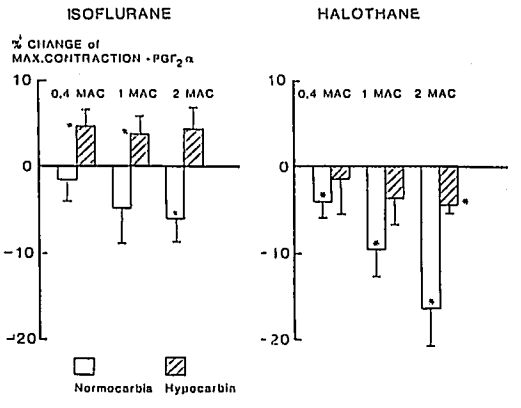

Fig. Effects of isoflurane (n=7) and halothane (n=6) on contractions induced by $PGF_{2\alpha}$, at normocapnia and at hypocapnia.