TITLE :REGIONAL BRAIN FUNCTION DURING HALOTHANE ANESTHESIA

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Introduction. It has long been known that some anesthetics may interfere with synaptic transmission thus presumably interrupting nerve cell function and circuits (1), perhaps selectively (2). Another more common observation is that during anesthesia cerebral oxygen metabolism (CMR_{O2}) is depressed (3). It follows from these observations that a substantial decrease of nerve cell activity has occurred. Whether these changes are region specific or generally distributed is of importance to understanding the physiological basis of anesthesia. Since CMR_{O2} is stoichiometrically related to the rate of glucose utilization (CMRglu), we measured regional CMRglu (rCMRglu) in rats anesthetized with 0.5-1.5% halothane as the next logical step in studying the mechanism of anesthesia.

Methods. All rats were paralyzed and artificially ventilated to maintain P_{CO2} (35-42 Torr) and P_{O2} (>90 Torr). Body temperature was kept at 37.5°C and the electroencephalograph monitored continuously. rCMRglu was measured using [2-^{14}C]glucose as previously described (4). Briefly, a single injection of [2-^{14}C]glucose was given intravenously and plasma glucose specific activity monitored thereafter. At 10 minutes rats were killed, brains removed and sections of 20μm thickness were cut for quantitative autoradiography. The amount of ^{14}C in any given region was determined densitometrically by comparison to calibrated standards. This quantative divided by the plasma glucose specific activity integral yields rCMRglu. Inspired halothane was delivered at 0%, 0.5%, 1.0% and 1.5% in oxygen for a period of one hour to allow for equilibration. Considerably shorter times (about 5-10 mins) were necessary to reach a steady state as judged by EEG changes.

Results. Table 1 contains rCMRglu measured in discrete brain areas at the various inspired halothane concentrations.

Discussion. It is clear that at 1.5% halothane there is a general depression (15% average) in most of the areas examined. Although not all reached statistical significance, the trend is obvious and the results are in reasonable agreement with earlier measurements (5,6). The greatest effect was in those areas concerned with auditory or visual systems. Interestingly the thalamus, including the anterior thalamic nuclei, part of Pape's circuit, were depressed, while no effect was observable on the reticular formation. The pattern observed differs somewhat from that found by Shapiro et al. studying the effect of 0.8% halothane on the incorporation of ^{14}C-deoxyglucose into brain of monkeys (6).

The relationship between anesthetic potency and metabolic depression is less obvious. At 0.5%, which we find sufficient to maintain surgical anesthesia, the changes in rCMRglu are slight and in fact cortical activity is actually increased in the frontal and parietal areas. These results suggest that the early effect of halothane at low concentrations may be to interfere with the orderly behavior of neuronal circuits, thus altering awareness.

Table 1

Regional Glucose Utilization

All values are given in μmol/min per 100 g. The symbols * and ** indicate statistical significance at the 5 and 1% levels respectively as compared to unanesthetized controls.

	0%	0.5%	1.0%	1.5%
Frontal cortex	92	98*	82*	79*
Parietal cortex	100	108*	92*	90*
Occipital cortex	91	94	84*	79*
Temporal cortex	100	102	90*	88*
Insular cortex	77	83	66*	64*
Pyriform cortex	70	72	62*	65
Hippocampus	62	62	62	56
Septal nuclei	55	55	49	50*
Anterior thalamus	119	102	102	90**
Ventral thalamus	94	80	85	72*
Hypothalamus	58	58	62	59
Lateral geniculate	88	82	83	69**
Medial geniculate	106	92	91	79**
Superior colliculus	83	83	89	75
Inferior colliculus	141	126	111	104**
Striatum	87	75	76	70*
Globus pallidus	43	46	45	43
Amygdala	68	72	71	62
Interpeduncular	111	104	133	113
Substantia nigra	70	62	62	60
Reticular formation	56	57	58	54
Cerebellar cortex	100	85	85	69*
Pons	71	67	67	64

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