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The effect of electroconvulsive shock on the cerebral metabolism of dopamine and 5-hydroxytryptamine

SIR,—Previous reports concerning the effects of convulsive treatment on the levels of 5-HT in brain have been at variance. While Garattini & Valzelli (1956, 1957), Jori, Valsecchi & Valzelli (1957), Fresia, Valsecchi & Valzelli (1957), Garratini, Kato & others (1960) and Breitner, Picchioni & Chin (1964) found significant increases in brain 5-HT concentration after a single electroconvulsive stimulation (ECS) in the rat and other species, Bonnycastle, Giarman & Paasonen (1957) and Bertaccini (1959) could detect no significant increase in 5-HT in rat brain after similar experiments.

Using dogs we have studied the effect of a course of electroconvulsive shock on the cerebral metabolism of 5-HT and dopamine by estimating the concentrations of their amino-acid precursors, tryptophan and tyrosine, and acid metabolites, 5-hydroxyindol-3-ylacetic acid (5-HIAA) and 3-methoxy-4-hydroxyphenylacetic acid (HVA), in samples of cerebrospinal fluid (CSF) drawn serially from the lateral ventricle. On each occasion that electroconvulsive shock was given, the dog was lightly anaesthetized with intravenous sodium thiopentone and 0·7 ml samples of CSF were withdrawn through a needle introduced percutaneously into a cannula previously implanted in the skull (Ashcroft, Crawford & others, 1968). The samples of CSF were taken at 0, 60, 120 and 150 min and an electroconvulsive shock of 150 V for 1 sec, was administered through bitemporal leads at 90 min. 5-HIAA and HVA were estimated by a modification (Ashcroft, Crawford & others, 1968) of the methods of Ashcroft & Sharman (1962) and Andén, Roos & Werdinius (1963); tryptophan and tyrosine were

TABLE 1. CONCENTRATIONS (μG/ML) OF 5-HYDROXYINDOL-3-YLACETIC ACID (5-HIAA) AND 3-METHOXY-4-HYDROXYPHENYLACETIC ACID (HVA) IN DOG LATERAL VENTRICULAR CSF DURING A SERIES OF ELECTROCONVULSIVE SHOCKS (ECS)

Day	Treatment	Dog 1		Dog 2	
		5-HIAA	HVA	5-HIAA	HVA
	Pre-ECS. Mean of two estimates at 0 and 60 min	0·18	1·21	0·17	1·28
1	Post-ECS. Mean of two estimates at 120 and 150 min	0·15	1·02	0·17	1·19
3	Pre-ECS	-	1·06	0·27	1·41
	Post-ECS	- -	1·03	0·27	1·82
8	Pre-ECS	0·31	1·44	0·29	1·43
	Post-ECS	0·31	1·51	0·24	1·43
10	Pre-ECS	0·31	1·35	Methodological difficulties	
	Post-ECS	0·32	1·33		
15	Pre-ECS	0·30	1·28		
	Post-ECS	0·30	1·15		
17	Pre-ECS	0·30	1·19		
	Post-ECS	0·32	1·24		

estimated by a modification (Moir, 1967) of the method of Hess & Udenfriend (1959) as applied by Guroff & Udenfriend (1962).

Throughout the experiments no significant changes were detected in the concentrations of tryptophan and tyrosine in CSF. There were no significant differences between the acid metabolite concentrations at 0 and 60 min, or between those at 120 and 150 min. Table 1 shows the mean concentrations of 5-HIAA and HVA in CSF before and after each shock treatment. While there was no alteration in the concentrations of 5-HIAA or HVA during a single shock experiment, the concentrations of both acids rose throughout the course of treatment (a comparison of the metabolite concentrations obtained on day 8 with those of day 1 showed significant alterations, 5-HIAA, $P < 0{\cdot}001$, HVA $P < 0{\cdot}02$), the increase in 5-HIAA concentration being particularly marked and well maintained.

These findings may indicate an increase in the permeability of the brain–CSF barrier to these acids following electroconvulsive shock treatment (Aird, 1958; Rosenblatt, Chanley & others, 1960) although no corresponding changes were observed in the concentrations of either tryptophan or tyrosine. An alternative explanation of our results may be that the shock facilitates the intracerebral hydroxylation of tryptophan, the normal rate determining step in the cerebral metabolism of 5-HT (Moir & Eccleston, 1968), thus inducing an increase in the turnover rate of 5-HT. This hypothesis fits well with the clinical data of Ashcroft, Crawford & others (1966), who found that the abnormally low concentrations of 5-HIAA in the lumbar CSF from patients with endogenous depression rose to levels in the normal range when clinical remission was induced by electroconvulsive shock or other means.

Unit for Research in Brain Metabolism,
Department of Pharmacology,
University of Edinburgh Medical School,
Teviot Place, Edinburgh 8, Scotland.

A. J. COOPER
A. T. B. MOIR
H. C. GULDBERG

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