Effects of electroconvulsive shock on the metabolism of 5-hydroxytryptamine in the rat brain

Varying reports have appeared on the effects of electroconvulsive shock (ECS) on 5-HT metabolism in the brain. Increases in 5-HT in the rat brain were found after single or multiple ECS treatments by Garattini, Valsecchi & Valzelli (1957), Hinesley, Norton & Aprison (1968) and Kato, Gozsy & others (1967), but no changes were found by Breitner, Picchioni & Chin (1964) and Feighner, Lao & others (1972). Engel, Hanson & Roos (1971) reported that a series of shocks increased the rate of depletion of 5-HT after inhibition of its synthesis, although the level of 5-hydroxyindoleacetic acid (5-HIAA), the principal metabolite of 5-HT, was unchanged. Cooper, Moir & Guldberg (1968) found that chronic ECS treatment increased the level of 5-HIAA in dog ventricular CSF.

This report deals with the effects of single and multiple ECS treatments on 5-HT and 5-HIAA levels in the rat brain. Maximal tonic-clonic convulsions were produced by giving shocks of 50 Hz alternating current (150 V for 1 s at 95 mA) via clips applied to the ears. Animals were lightly anaesthetized with halothane before being given the shock. 5-HT and tryptophan were assayed as described previously (Shields & Eccleston, 1972), and 5-HIAA by the method of Eccleston, Moir, & others (1966).

In the first experiment, rats were given a single shock and were killed after 3 h. There was a highly significant rise of 67% in the 5-HIAA level (Table 1), but no change in the 5-HT level. Unlike the results of Tagliamonte, Tagliamonte, & others (1972), there was also no change in the tryptophan level.

Table 1. *Effects of a single ECS on brain 5-HT, 5-HIAA and tryptophan levels.*

Group	5-HT (μg/g)	5-HIAA (μg/g)	Tryptophan (μg/g)
Control	0·22 ± 0·04 (8)	0·12 ± 0·03 (8)	6·06 ± 0·71 (8)
ECS	0·24 ± 0·05 (8)	0·20 ± 0·04 (7)*	5·17 ± 0·30 (8)

Animals were killed 3 h after ECS.
Results show mean ± s.d., with number of observations in brackets.
* Significantly higher than control, $P < 0·001$ (Student's t test).

In the second series of experiments, rats received chronic ECS treatment, one shock being given daily for a number of consecutive days. The animals were killed 24 h after the last shock. No significant changes were found in any of the groups however (Table 2).

Table 2. *Effect of chronic ECS on brain 5-HT and 5-HIAA levels.*

Number of days' treatment	Group	5-HT (μg/g)	5-HIAA (μg/g)
6	Control	0·24 ± 0·03 (8)	0·15 ± 0·02 (8)
	ECS	0·25 ± 0·04 (8)	0·16 ± 0·03 (8)
8	Control	0·32 ± 0·04 (7)	0·20 ± 0·03 (7)
	ECS	0·33 ± 0·03 (8)	0·20 ± 0·02 (8)
12	Control	0·26 ± 0·03 (8)	0·18 ± 0·04 (8)
	ECS	0·27 ± 0·02 (7)	0·19 ± 0·03 (7)
16	Control	0·28 ± 0·04 (8)	0·17 ± 0·02 (8)
	ECS	0·27 ± 0·03 (6)	0·16 ± 0·10 (6)

Animals were killed 24 h after last shock.
Results show mean ±s.d., with number of observations in brackets.

It appears from these results therefore that ECS causes an increase in the rate of 5-HT synthesis, as judged by the level of 5-HIAA, but the effect is only of a limited duration, even after up to 16 days' ECS treatment. As there was no increase in brain tryptophan after the single ECS, a likely cause of the increased 5-HIAA level would be an increased firing rate of the 5-HT-containing neurons, which is known to elevate the level of this metabolite (Sheard & Aghajanian, 1968).

It has been suggested that the clinical effectiveness of ECS treatment is due to its increasing the functional activity of 5-HT-containing neurons in the brain: Ashcroft, Crawford & others (1966) found an increase in 5-HIAA levels in the lumbar CSF of depressed patients upon remission of symptoms, most of the patients having received ECS therapy. The results presented here, however, do not support this theory.

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