The spontaneous and electrically-evoked release of endogenous amino acids from the rat visual cortex

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The application of salt solutions containing 50 mM potassium ions onto the surface of the visual cortex of anaesthetized rats significantly increases the rates of release of endogenous taurine and γ-aminobutyric acid (GABA), (Clark & Collins, 1975). In the present study, the effect of electrical stimulation on the release of endogenous amino acids is reported.

Male rats of the Wistar strain were anaesthetized with urethane and samples collected from the exposed visual cortex using perspex cylinders (Mitchell, 1963) containing 50 μl of Ringer solution (NaCl, 139 mM; KCl, 4 mM; $NaHCO_3$, 2.1 mM; $CaCl_2$, 1.26 mM; $MgCl_2$, 1.15 mM, glucose, 0.339 mM; NaH_2PO_4, 0.189 mM; bubbled with 5% CO_2 in oxygen) which was changed every 10 minutes. The taurine, GABA, glycine, aspartate, glutamate, glutamine and alanine content of each sample was measured using a modification of the dansylation procedure originally described by Briel & Neuhoff (1972). Bipolar platinum electrodes (tip separation 1.0 mm) were inserted 0.5 mm into the brain surface either in the perspex cylinder, or 1 mm outside its rim or on the contralateral cortex. After 5 control samples, the surface of the brain was stimulated (100 Hz, 2.5 mA, 1.0 ms for 5 min) and samples collected during the following 80 minutes.

Table 1 shows the resting release of the amino acids. Transcallosal stimulation or electrical stimulation adjacent to the cup significantly increased the release of the inhibitory amino acids taurine and GABA but significantly reduced the release of the excitants glutamate and aspartate. However, when the electrode was sited in the cup, electrical stimulation significantly increased the release of taurine, GABA and glutamate, whereas that of aspartate was unaffected. The results will be discussed in the light of the suggested neurotransmitter roles for these amino acids.

Table 1 Release of endogenous amino acids from the visual cortex of the rat

		Release following stimulation (x resting)		
Amino acid	*Resting release (pmol min^{-1} cm^{-2}) (n = 13)*	*Electrode adjacent to cup (n = 7)*	*Transcallosal stimulation (n = 6)*	*Electrode in cup (n = 10)*
Taurine	179 ± 20	2.59 ± 0.49	2.89 ± 0.35*	3.59 ± 0.59
GABA	22 ± 3	2.47 ± 0.18*	3.19 ± 0.43*	9.0 ± 2.3*
Glycine	91 ± 7	1.43 ± 0.32	2.08 ± 0.46	1.21 ± 0.28
Aspartate	182 ± 18	0.47 ± 0.08*	0.48 ± 0.14*	1.44 ± 0.22
Glutamate	413 ± 41	0.63 ± 0.12*	0.37 ± 0.06*	4.9 ± 0.69*
Glutamine	735 ± 70	1.17 ± 0.26	1.59 ± 0.29	1.28 ± 0.21
Alanine	98 ± 8	1.16 ± 0.24	1.19 ± 0.20	1.62 ± 0.18

In those experiments in which the preparation was stimulated transcallosally, or in which the electrode was adjacent to the cup, the mean of each group of 5 prestimulation samples was used to calculate the resting release of each amino acid as shown in the Table. Following stimulation, the maximum change in release in each experiment was identified and expressed as a multiple of the mean resting release of that experiment. In the other experiments, because the surface of the brain within the cup was punctured by the electrode, a different resting release was obtained (not shown) and used in calculating the results.

Each value is a mean ± s.e. mean. *n* = number of observations. An asterisk denotes a significant difference (Students *t* test) between the appropriate resting and evoked release ($P < 0.05$).

References

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