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Heterogeneity of inhibitory mechanisms in the nucleus accumbens and preoptic area of the rat

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Microelectrode recordings of spontaneously active neurones in the nucleus accumbens and preoptic area of the urethane-anaesthetized rat showed similar responses to single square pulse stimulation (0.4–1.0 mA, 0.1–2.0 ms) of the amygdala or midbrain reticular formation. Responses were inhibitory or complex with an inhibitory component. Inhibition was either short (20–50 ms) or longer (100–300 ms).

Long inhibition was preceded by stimulus-locked action potentials (8–25 ms latency) in 36% ($n=56$) of observations but short inhibition was generally not preceded by excitation. Long inhibition may thus be due to activation of a recurrent pathway (Fenske, Ellendorff & Wuttke, 1975; Sakuma & Kawakami, 1975) whilst short inhibition may be a direct mechanism.

In order to determine whether these inhibitions are GABA-mediated, the effect of intravenous bicuculline (0.1–0.25 mg/kg) was investigated. Some cells showed cyclic changes in firing rate and when these were marked (>80%) the duration of inhibition, particularly that of long inhibition, was often altered. Thus, bicuculline-induced changes were considered with respect to changes in cell firing rate.

When a small or no change in firing rate occurred after bicuculline administration, the duration of long inhibition was reduced by 15–42% ($n=6$; Figure 1). However, the duration was increased if the firing rate was markedly raised, a change which was also observed in the absence of bicuculline.

Short inhibition was little affected by bicuculline unless the firing rate was markedly changed ($n=16$). Both types of inhibition could be evoked from the same neurone by stimulation at different sites and in these cases long inhibition was similarly reduced by bicuculline whilst short inhibition was little affected.

Thus long duration inhibition may be GABA-mediated but no evidence was obtained to support this view for short duration inhibition. It remains possible that short duration inhibition may result from the release of another transmitter.

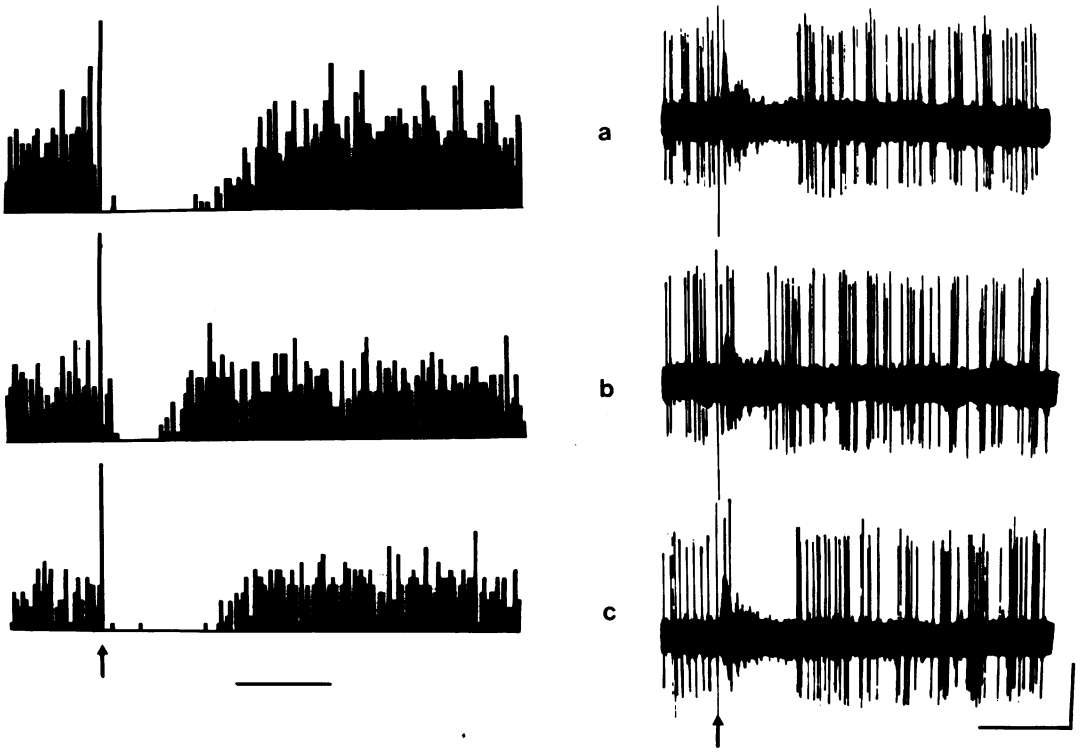

Figure 1 The effect of bicuculline (0.1 mg/kg i.v.) on long duration inhibition in the preoptic area of a urethane-anaesthetized rat. Each pair of traces shows a post-stimulus-times histogram constructed from responses to 200 single stimuli delivered in the amygdala (left) and ten superimposed oscilloscope sweeps of action potential traces (right). The position of the stimulus is indicated by the arrow. (a) Control responses. (b) Responses recorded during the action of bicuculline. The histogram was constructed from responses in the period 10–110 s after drug administration. The spike records were taken 30–40 s after bicuculline. (c) Recovery 20–22 min after bicuculline.
Time calibrations—100 ms. Voltage calibration—100 μV.

References

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