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Unilateral Topical Cortical Application of Penicillin: Electrographic Aspects

A New Complement to an Old Model

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Abstract. In 7 cats 800 IU of penicillin were applied diffusely over one hemisphere on the exposed neocortex. After 40 min all animals showed bilateral and synchronous burst discharges with a higher amplitude at the hemisphere where the penicillin had been applied. These data fill a gap in the literature concerning feline generalized penicillin epilepsy, in which penicillin is applied bilaterally on the exposed neocortex.

Introduction

Bilateral topical application of penicillin has been used for a long time as a model of generalized epilepsy. The role of cortical and subcortical structures in the genesis of the bursts in this model has been extensively studied [1, 7, 9, 14–17, 24, 25], and the role of the corpus callosum in the propagation of the generalized discharges is now firmly established [12, 19, 21–23].

Unilateral localized topical application of convulsant drugs has been widely used as a means of creating focal epileptic activity [2, 3, 13, 18, 26]. The appearance of mirror foci and the role of the cerebral commissures in its pathogenesis has also been determined [20].

Nevertheless, unilateral diffuse topical application of penicillin has never been reported. We have carried out experiments with unilateral topical application of penicillin under well controlled conditions.

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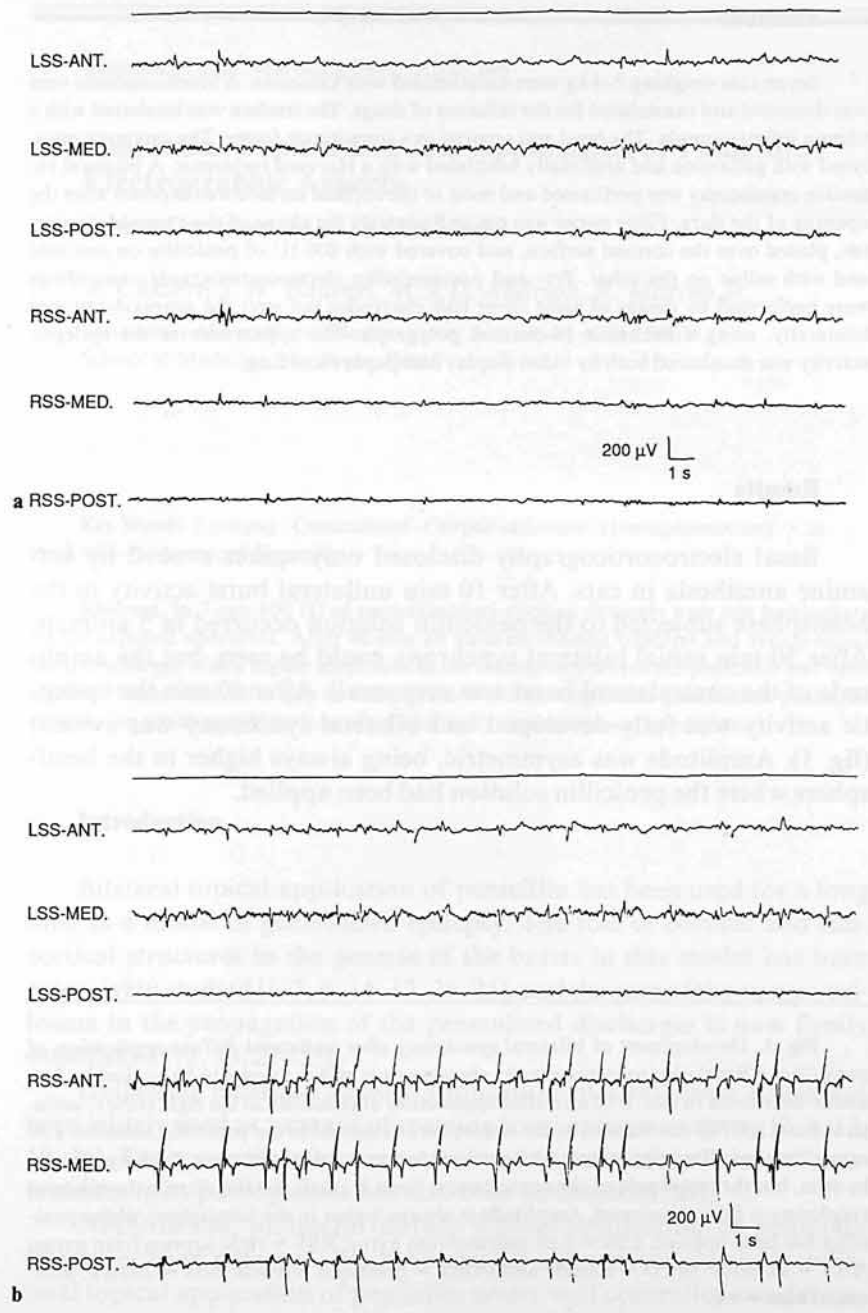
Methods

Seven cats weighing 2–4 kg were anesthetized with ketamine. A brachioradialis vein was dissected and cannulated for the infusion of drugs. The trachea was intubated with a human infant cannula. The head was secured in a stereotactic frame. The cats were paralyzed with gallamine and artificially ventilated with a Harvard respirator. A bilateral extensive craniotomy was performed and most of the cortical surface was exposed after the opening of the dura. Filter paper was cut to fit exactly the shape of the exposed neocortex, placed over the cortical surface, and covered with 800 IU of penicillin on one side and with saline on the other. Pre- and postpenicillin electrocorticographic recordings were performed by means of eight silver ball electrodes put over the suprasylvian gyri bilaterally, using a Beckman 16-channel polygraph. The appearance of the epileptic activity was monitored both by video display and paper recording.

Results

Basal electrocorticography disclosed only spikes evoked by ketamine anesthesia in cats. After 10 min unilateral burst activity in the hemisphere subjected to the penicillin solution occurred in 5 animals. After 30 min initial bilateral synchrony could be seen, but the amplitude of the contralateral burst was very small. After 40 min the epileptic activity was fully developed and bilateral synchrony was evident (fig. 1). Amplitude was asymmetric, being always higher in the hemisphere where the penicillin solution had been applied.

Fig. 1. Development of bilateral synchrony after unilateral diffuse application of penicillin. **a** Basal electrocorticography showing only spikes known to be evoked by ketamine anesthesia in cats. **b** 10 min after application of penicillin to the right cortex; unilateral burst activity can be seen in the hemisphere subjected to the penicillin solution. **c** 30 min after penicillin application; bilateral synchronous spike and wave discharges could be seen, but the amplitude of the contralateral burst is small. **d** After 40 min the bilateral synchrony is fully developed. Amplitude is always higher in the hemisphere where penicillin has been applied. LSS = Left suprasylvian gyrus; RSS = right suprasylvian gyrus; ANT = anterior; MED = middle and POST = posterior. Vertical bars = 200 μV; horizontal bars = 1 s.



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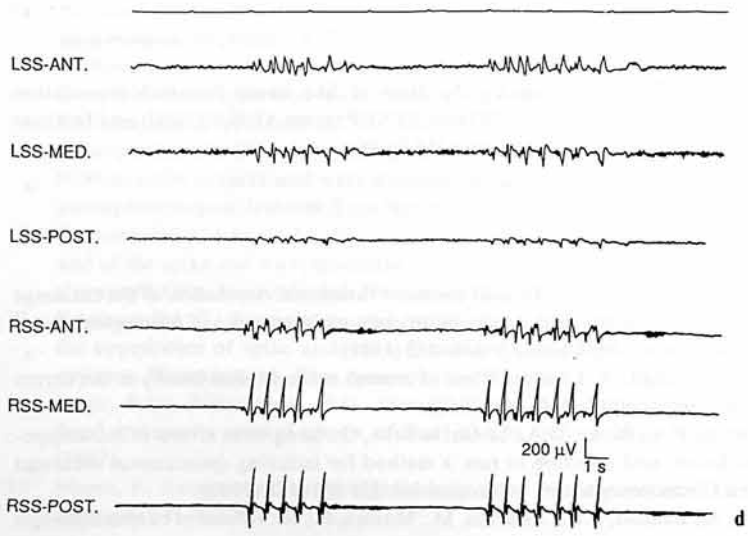

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Discussion

The present study was intended to fill a gap in our knowledge regarding the model of bilateral synchrony generated by topical application of penicillin [6, 8, 10]. This diffuse bilateral synchrony might be anticipated from prior studies with focal application of convulsant drugs and mirror foci appearance [20] and from the studies which clearly implicate the cerebral commissures, especially the corpus callosum, in the interhemispheric propagation of epileptic activity [4, 27–29].

The final electrographic picture might be used as a model of pathology where a diseased hemisphere generates epileptic activity that spreads, presumably through the cerebral commissures, to the other hemisphere, although in the experimental set described here there is no anatomical lesion, but only a physiological derangement.

Complete [5] or partial [11] callosotomy has been used as an alternative for hemispherectomy in some cases with hemispheric pathology and bilateral generalized epileptic activity. The present model will be suitable to study the effects and possible benefits of this kind of functional intervention in candidates for hemispherectomy. The behavioral correlates of this particular kind of bilateral synchrony should also be studied.

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