Correlations between changes of activity of the renal sympathetic nerve and behavioural events in unrestrained cats

Die Beziehungen zwischen Veränderungen der Aktivität sympathischer Nierennerven und Verhaltensereignissen bei nichtnarkotisierten Katzen

F. Kirchner

With 9 figures and 1 table

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Summary

From the unanaesthetized cat sympathetic action potentials were recorded by means of implantable electrodes. The recorded sympathetic activity was correlated with the states of sleep and wakefulness. The reactions on asphyxia as well as on acoustic and emotional stimuli were studied.

The following results were obtained:

During synchronized sleep the sympathetic activity was not significantly increased in relation to wakefulness and relaxed wakefulness. During desynchronized sleep, the sympathetic activity was decreased significantly to zero except for some periods of flaring up. Arousal as well as alertness reactions were accompanied by a decrease of sympathetic activity. A strong increase of sympathetic activity was observed during emotional stress and during asphyxia.

The results were discussed in respect to authors, who have made suggestions concerning sympathetic activity after measurement of circulation parameters. It was found that the renal sympathetic nerve shows changes of activity, as proposed as generally valid for the sympathetic nervous system, whereas an influence of changes in sympathetic activity on renal blood flow seems to exist only during strong activation.

Since the first recordings of the electrical activity of sympathetic nerves were made by Bronk and coauthors (1932), such recordings were made in experiments on anaesthetized or decerebrated or chordotomized animals. In this way some aspects of the sympathetic regulation of circulation could be found; for instance pathways and functions of sympathetic reflexes. By comparison with sympathetic activity, vegetative parameters (blood pressure, heart rate, blood flow, pupil size, sweat secretion, or stomach contractions) could be defined partly as indicators of sympathetic activity. In experiments on unanaesthetized animals, these vegetative parameters were used as indicators of sympathetic activity.

We looked to find more direct information about the sympathetic nervous system in the unanaesthetized animal, by recording the electrical activity of sympathetic nerves by means of implanted electrodes. Cor-
relation of changes in the sympathetic activity with changes of other parameters should provide new information about the sympathetic nervous system. In the first experiments the renal nerve was used, because it is easy to prepare and already well investigated in the anaesthetized animal. Furthermore this nerve is relatively homogen concerning the type of fibers as well as the functions.

Methods

1. The implantable recording electrode

For minimizing the effects of the implanted electrode on the animal it was necessary to construct a very small electrode with very flexible cables. Fig. 1 shows such an electrode. Steel electrodes (D) were put into a plexiglas block (C). A groove in the plexiglas block crosses the electrodes, so that the nerve can be laid into the groove on the electrodes. The soldered connection between the steel electrodes with the cable (A) is insulated against the neighbouring tissue by a drop of adhesive (B). The outer insulation and the common shield of the both leads is dissected for 4 cm from the electrode for a greater flexibility of the cable near the nerve.

2. The implantation

The renal sympathetic nerve was exposed near the hilus by a paravertebral incision. The surrounding tissue was dissected from the nerve, leaving intact the blood vessels which supply the nerve. The nerve was laid into the groove of the electrode (fig. 1) and covered with a thin layer of lanoline, which should protect the nerve against influences from the adhesive which was used to fix the nerve on the electrode. The adhesive used was Isobutyl 2-Cyanoacrylate Monomer (Ethicon), a polymerisation adhesive which produces heat during polymerisation. This heat can destroy the nerve. The heat of fusion of the lanoline waxes should absorb the heat of polymerisation of the adhesive and thereby protect the nerve against destruction by heat. The success of the implantation depends on the dose of lanoline covering the nerve. Too much lanoline was driven away by body fluid during the hours following the implantation. Too small a dose of lanoline could not protect the nerve against destruction by heat. The nerve activity was abolished in half an hour after fixation. Finally we had success in one third of the preparations. The cable was laid through the back muscles and subcutaneously to the head, where it was joined to a multipolar connector which was fixed on the skull.