INRINIC CONNECTIONS OF THE RAT COCHLEAR NUCLEUS

A.G. Paolini, N.A. Morgan and G.M. Clark, Department of Otolaryngology, University of Melbourne, Parkville, 3052.

In mammals three subdivisions of the cochlear nucleus can be distinguished: the dorsal (DCN), the posterior (PVCN) and the anteroventral (AVCN) cochlear nucleus (CN). The intrinsic connections between and within these areas have not been well defined. Wickesberg et al. revealed that projections from DCN to AVCN in the mouse are frequency specific and tonotopic. In contrast Synder and Leake in the cat revealed projections from AVCN to PVCN and DCN but only modest projections from PVCN and DCN to AVCN with no frequency specificity observed. These previous studies utilized the retrograde tracer horseradish peroxidase. We investigated this apparent contradiction further, using neurobiotin, a retrograde and anterograde tracer, to examine connections within the cochlear nucleus of the rat, with emphasis on the AVCN subdivision. Male rats were anaesthetised with urethane (1.3g/kg i.p), placed in a stereotaxic frame, the crania and dura removed and the cochlear nucleus exposed. The cochlear nucleus of six rats was injected with neurobiotin. Four injection sites were localized within AVCN subdivision, one in PVCN and one in DCN. We found reciprocal connections to exist between AVCN and DCN with tonotopicity restricted to those projections from the anterior AVCN to DCN. Reciprocal projections were also observed between PVCN and DCN, however these were not tonotopically organised. Restricted projections from anterior AVCN to PVCN were observed, but no connection from PVCN to AVCN was present. Within the AVCN subdivision projections were seen between posterior and anterior AVCN, with the latter also shown to have intrinsic connections. The majority of interneurones involved in the CN intrinsic circuitry were identified as stellate cells. Auditory nerve fibers were also retrogradely labelled with neurobiotin. Auditory nerve terminals were shown to be present in all subdivisions following localised injections. The organization of connections between and within CN subdivisions suggests that the AVCN may not only maintain frequency specificity of auditory information to DCN and to a lesser extent PVCN, but may also modify incoming auditory information through its intrinsic circuitry. In addition, auditory information processing in AVCN may be further influenced by feedback from the DCN.


INTRACELLULAR RESPONSES OF ANTEROVENTRAL COCHLEAR NUCLEUS NEURONES TO INTRACOCHLEAR ELECTRICAL STIMULATION IN THE RAT

A.G. Paolini and G.M. Clark, Department of Otolaryngology, University of Melbourne, Parkville, 3052.

The anterior division of the ventral cochlear nucleus (AVCN) is the first relay station of the auditory pathway. Currently little is known about the intracellular physiological responses of neurones in the AVCN to electrical stimulation of the cochlea. We investigated the effect of cochlear electrical stimulation in the rat AVCN using in vivo intracellular recordings. Male rats were anaesthetised with urethane (1.3g/kg i.p), placed in a stereotaxic frame, the crania and dura removed and the cochlear nucleus exposed. A small modified version of the Melbourne/Cochlear scala tympani banded electrode array was inserted in the cochlea after exposure of the round window. Microelectrodes containing 1M potassium acetate (40-110 MΩ), or neurobiotin (4% in 1M potassium acetate, 50-100 MΩ), were inserted into the AVCN after visualisation. Upon neurone impalement the cochlea was stimulated using biphasic pulses (100μs/phase) up to 2.5 mA in intensity. Twenty stable impalements were made in the AVCN. The majority (19/20) of AVCN neurones responded with depolarisation, followed by a hyperpolarising response to stimulation with 18 neurones eliciting a spike response at higher stimulus intensities. In 13 neurones the depolarisation could be separated into two monosynaptic EPSP components. An additional polysynaptic EPSP component with longer latency was seen in six of these neurones. Of the remaining seven in the sample, six showed only a single monosynaptic EPSP and one only an IPSP response. A polysynaptic IPSP response was also seen following the second of the two response types could be distinguished based on the degree of spike afterhyperpolarisation. Four cells which responded with three EPSP components, showed no spike afterhyperpolarisation. Only one of these was identified and found to be a stellate cell having intrinsic connections. Six cells which responded with two EPSP components showed only a short spike afterhyperpolarisation (4.8 to 6 ms) with only one identified and found to be a stellate cell projecting out of the AVCN. The remaining eight neurones showed a long lasting spike afterhyperpolarisation (18 to 40 ms) with only one identified and found to be a bushy cell. The monosynaptic responses seen to stimulation suggests that these neurones receive direct input from ganglion cells in the cochlea. The two monosynaptic components suggest possible convergence of cochlear input on AVCN neurones. In addition, stellate cells may be involved in inhibiting local circuit stellate and bushy cells both of which show polysynaptic IPSP responses to stimulation.
Author/s:
Paolini, A. G.; Clark, Graeme M.

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