MULTIMODAL CONVERGENCE OF SENSORY PATHWAYS ON MOTONEURONS OF FLIGHT MUSCLES IN THE FLY (*Calliphora*).

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The flight motor of flies consists of indirect flight muscles, which generate the basic wingbeat pattern during flight, and direct flight muscles, which control the flight course by altering differentially the pitch and beat amplitudes of the wings. The spike-activity in direct flight muscles is phase-coupled to the wing beat-cycle. Visual inputs modulating the activity of the muscles are gated by mechanosensory afferences of the wing-nerve and the halteres, both monitoring the wing-oscillations (Heide,G. in: Nachtigall,W (ed.) Biona-report 2, Fischer, Stuttgart, 1983, pp 35-52).

In order to analyze the neural circuit mediating these interactions, we studied the motoneurons of direct flight muscles and sensory projections in the thoracic ganglion using the cobalt-technique. We employed, in particular, cobalt-infusions of different durations in order to produce selectively first-order stainings, which are due to direct uptake of cobalt into injured neurons, and higher-order stainings of neurons, which are assumed to be caused by cobalt-diffusion through gap junctions from directly stained neurons and which, thus, can demonstrate functional pathways in the nervous System (Strausfeld,N.J. and Bassemir,U., J.Neurocytol.,12:971, 1983).

The motoneurons (Mn) of the direct flight muscles bl, b2, I1, III1, psl, ps2 were identified and studied light microscopically. All of them show large dendritic domains in the dorsal part of the mesothoracic ganglion and additional dendrites in ventral layers of the ganglion. The axons of Mnbl, Mnb2, and Mnl1 project through the anterior dorsal mesothoracic nerve, those of MnIIIl and Mnpsl-2 run through the mesothoracic accessory nerve to their target muscles. The dendritic main trunks of Mnbl, Mnb2, and MnIIIl were found to be cobalt-coupled to large interneurons, which constitute a prominent commissure in the dorsal mesothoracic ganglion.

The mechanosensory projections of each haltere form a dense tract in the ipsilateral half of the thoracic ganglion. Prolonged cobalt-infusions into halteres resulted in higher order stainings of axonal bundles and single large interneurons, which terminate in the contralateral parts of the meso- and prothoracic ganglion, in impregnations of the above described neurons of the mesothoracic commissure and in stainings of the Mnbl, Mnb2 and MnIIIl.

Impregnations of the wing-nerve revealed terminal arborizations mainly in the mesothoracic ganglion. Second order stainings after wing-nerve infusions did not occur. Dense appositions of wingnerve terminals and the ventral dendrites of Mnbl and Mnb2 were, however, frequently observed. Preliminary observations an descending neurons derived from the optic foci of the deutocerebrum and the antennal lobes indicate that these neurons terminate also in close vicinity to the dendrites of the described motoneurons.

The results indicate strongly that the motoneurons of the direct flight muscles are synaptically coupled to interneurons of the dorsal mesothoracic commissure and to different types of sensory interneurons.This suggests that multimodal convergence and gating as described above takes place directly at the dendrites of the motoneurons.

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