Inhibitory synaptic transmission in mouse type A and B medial vestibular nucleus neurones *in vitro*

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The precise roles played by the neurotransmitters GABA and glycine in the maintenance of posture and balance are poorly understood. In the medial vestibular nucleus (MVN) fast inhibitory drive is known to be mediated by $GABA_A$ receptors ($GABA_AR$) and indirect evidence suggests that glycine also plays a role. To directly assess the contribution of $GABA_AR$-mediated and glycine receptor (GlyR) mediated synaptic transmission we recorded miniature inhibitory synaptic currents (mIPSC) in the two major physiological classes (Type A and Type B) of MVN neurones. All experimental procedures were approved by the University of Newcastle Animal Care and Ethics Committee. Transverse brainstem slices (300 μm thick) were prepared from 21-28 day-old mice overdosed with Ketamine (100 mg/kg, i.p.). Whole-cell recordings (-70 mV holding potential) were made at room temperature (23°C) from infra-red visualised MVN neurones using patch electrodes with a CsCl-based internal solution. $GABA_AR$-mediated mIPSCs were isolated in TTX (1 μM), CNQX (10 μM), strychnine (1 μM) and were blocked by bicuculline (10 μM). GlyR-mediated mIPSCs were isolated in CNQX (10 μM), TTX (1 μM), bicuculline (10 μM) and were blocked by strychnine (1 μM). MVN neurones (24/29) received exclusively $GABA_A$ergic, exclusively glycinergic, or mixed mIPSCs (both types). Of the 24 MVN neurones displaying inhibitory events, 10 (42%) received purely $GABA_A$ergic inputs, 3 (12%) received purely glycinergic inputs, and 11 (46%) received Mixed mIPSCs. The rise times of $GABA_A$- and GlyR-mediated mIPSCs were similar for both types of mIPSC (0.7 ± 0.1 ms vs. 0.9 ± 0.5 ms), however the decay time constants for $GABA_A$-mediated events were significantly slower than those for GlyR-mediated events (9.6 ± 1.2 ms vs. 4.3 ± 0.9 ms). Having established that both GABA and glycine are involved in fast inhibitory synaptic transmission in MVN neurones, we next examined if inhibitory drive differed for Type A and Type B neurones. MVN neurones receiving mixed ($GABA_A$ergic and glycinergic) and exclusively glycinergic inputs had higher background discharge rates than those receiving exclusively $GABA_A$ergic inputs (24.1 ± 8.9 Hz n=4 and 9.4 ± 3.4 Hz n=2, respectively vs. 5.4 ± 1.0 Hz n=6). The type of inhibitory input was also correlated with the MVN neurone's physiological class. Using a combination of voltage- and current-clamp recording techniques, our initial results suggest that Type A neurones, which have a monophasic AHP, receive both glycinergic and mixed inhibitory inputs. Type B neurones, which have a biphasic AHP, receive only $GABA_A$ergic inhibitory inputs. These findings show that both GABA and glycine contribute to inhibitory synaptic processing in MVN neurones. Furthermore, inhibition mediated by $GABA_A$Rs and GlyRs may differ in Type A and Type B MVN neurones.

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