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Modulation of the lamprey respiratory activity through inhibit ion of glutamatergic neurons projecting to the respiratory rhythm generator

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We have previously reported that bicuculline (10 μM) but not strychnine (10 μM) applied to the bath restores the respiratory rhythm during apnea induced by blockade of ionotropic glutamate receptors in the in vitro brainstem preparation of the adult lamprey. This effect was also obtained by bicuculline (1 mM) or gabazine (0.2 mM) microinjected into the paratrigeminal respiratory group (pTRG), the proposed respiratory central pattern generator. Here we show that a blockade of GABA and glycine receptors within the vagal region strongly increases the respiratory frequency through disinhibition of neurons projecting to the pTRG from the vagal region. These ascending excitatory projections to the pTRG are confirmed by retrogradely labelled neurons within the vagal area following a neurobiotin injection into the pTRG. Retrogradely labelled neurons are identified in the ipsilateral and contralateral vagal motoneuron region either intermingled with vagal motoneurons or in close vicinity to them. Retrogradely labelled neurons are surrounded by GABA immunoreactive structures and also display glutamate immunoreactivity. The present study provides details on the localization of retrogradely labelled neurons within the vagal region and on related neurochemical markers. Not only GABA receptors within the pTRG, but also GABA and glycine receptors within the vagal area mediate tonic modulation of lamprey respiratory frequency and may represent suitable substrates for the adaptive control of respiratory network excitability.