Dorsolateral Periaqueductal Grey Matter in the control of laryngeal activity and subglottic pressure in spontaneously breathing anaesthetized rats

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ABSTRACT

Background

The stimulation of the Periaqueductal Gray matter (PAG) produces vocalization. The nucleus retroambiguus (nRA) turn passive into active expiration modifying the activity of laryngeal motoneurons located in the nucleus ambiguous (nA). We have shown that Parabrachial complex and A5 Region are involved in changes of laryngeal caliber. A high expression of FOXP2 protein (transcription factor closely related to vocalization) at mesencephalic and pontine regions involved in cardiorespiratory control has been described.

Objectives

To characterize the role of the dlPAG in modulating laryngeal activity and their effects on vocalization.

Methods

Experimental studies were carried out with male Sprague-Dawley rats (n=25) (250-300g). Animals were anesthetized with sodium pentobarbitone (60 mg/kg i.p., initial dose, supplemented 2 mg/kg, i.v.). The pattern of staining for c-Fos and FOXP2 protein immunoreactivity were examinated throughout the rostrocaudal extent of the nRa/nA region during electrical stimulation of the dlPAG. Electrical stimulations (n=7) (1ms pulses, 20-40µA, 100Hz for 5s), microinjections of PBS-Evans Blue (250nl, pH 7.4±0.1, 5-s duration) (n=7) or glutamate (0,25M, 250nl) (n=7) were performed. Respiratory flow, pleural pressure, subglottic pressure, blood pressure and heart rate were recorded.

Results

Activation of the dlPAG elicited a selective increase in c-Fos-ir with an ipsilateral predominance in nRA/nA somatas ($p<0.01$) and confirm the expression of FOXP2 bilaterally in both nuclei. dlPAG PBS-Evans Blue microinjections did not produce any significant changes in any of the cardiorespiratory variables recorded. dlPAG electrical and chemical (glutamate) stimulations evoked a decrease of laryngeal resistance (subglottal pressure) ($p<0,001$) accompanied with an inspiratory facilitatory response consisted of an increase in respiratory rate ($p<0,001$), together with a pressor ($p<0,001$) and tachycardic response ($p<0,001$).

Conclusions

Our study contributes with new data on the role of the mesencephalic neuronal circuits in the control mechanisms of subglottic pressure and laryngeal activity.

Keywords: Subglottic Pressure, Laryngeal Motoneurons, dlPAG, Nucleus Ambiguus