

DESIGN AND IMPLEMENTATION OF A METHOD TO STUDY LARYNGEAL RESISTANCE DURING THE STIMULATION OF DORSOLATERAL PERIAQUEDUCTAL GREY (dlPAG) IN SPONTANEOUSLY BREATHING ANAESTHETIZED RATS

M. Gonzalez-Garcia^{1,2}, M.V. Lopez-Gonzalez^{1,2}, C. Carrillo-Franco³, L. Carrillo-Franco³, M.A. Barbancho¹, A. Díaz-Casares^{1,2} and M.S. Dawid-Milner^{1,2}

(1) Facultad de Medicina, Universidad de Málaga, Málaga (Spain).

(2) Unidad de Neurofisiología del Sistema Nervioso Autónomo (CIMES), Universidad de Málaga, Málaga (Spain).

(3) Facultad de Psicología y Logopedia, Universidad de Málaga, Málaga (Spain)

ABSTRACT

Background: Stimulation of the dorsolateral periaqueductal gray matter (dl-PAG) in rats evokes a cardiorespiratory response characterised by an increase of blood pressure, heart rate and respiratory frequency. In previous studies we have demonstrated a functional interaction between dlPAG and the pontine A5 region (Peinado-Aragonés C.A., 2016). A5 region modulates the cardiorespiratory response evoked from the dlPAG and it is also involved in the changes of laryngeal caliber (Lara et al., 2002). The aim of this study was to characterise the relationship between mesencephalic-pontine neuronal circuits to understand their role in laryngeal control and its effect on vocalization.

Methods: Experimental studies were carried out with non-inbred male rats (n=7), SPF, Sprague-Dawley (250-300 g) housed under standard conditions. Animals were anesthetized with sodium pentobarbitone (60 mg/kg i.p., initial dose, supplemented 2 mg/kg, i.v., as necessary). A double tracheal cannulation (upwards in direction of the glottis for the “glottis isolated in situ” technique, and downwards in the direction of the carina) was performed. Subglottic pressure was recorded with an aneroid transducer (Hugo Sachs Elektronik D-7801, $\pm 0,1$ psi) by passing a stream of humidified medical air upwards through the larynx at a constant rate of 30-70 ml/min with a thermal mass digital air flow meter controller (Bronkhorst Hi-Tec F-201CV-AGD-22-V). Electrical stimulation of the dlPAG using concentric bipolar electrodes (1 ms pulses, 20-40 μ A, 100 Hz for 5 s) was performed. Respiratory flow, pleural pressure, blood pressure, heart rate and ECG activity were also recorded.

Results: dlPAG stimulation 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 a tachycardic response ($p < 0,001$).

Conclusions: Our variation of the classical technique for the recording of the “isolated glottis in situ” in rats shows good dynamic responses and can be perfectly used as an index of subglottic pressure and laryngeal activity, thus our results contribute with new data on the role of the dlPAG in the control mechanisms of subglottic pressure and laryngeal activity.

Keywords

Subglottic Pressure, Laryngeal Motoneurons, Periaqueductal Gray, Rat.

Funding information: The study was supported by a program grant Junta de Andalucía, Grupo Consolidado nº CTS156, Spain. Part of the final study was supported with a grant from the University of Málaga.