Central CO_2/pH Chemosensitivity Influence on Respiration in both Early and Late Staged Tadpoles

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Abstract

We test the hypothesis that central respiratory CO_2/pH chemosensitivity, recorded from isolated brainstems, remains consistent throughout tadpole development. Results indicate that tadpoles at all developmental stages respond to CO_2/pH, and that the sensitivity of these responses does not change with development.

Introduction

As the tadpole develops into a frog, arterial pH decreases (acidosis) due to an accumulation of CO_2 associated with the transition from aquatic to terrestrial environments. This study aims to determine consistency or change in CO_2/pH sensitivity over development.

With tadpole development lung ventilation increases, and eventually replaces gill (buccal) respiration as the primary mechanism for gas exchange.

Potential transitions in CO_2/pH sensitivity are inconclusive.

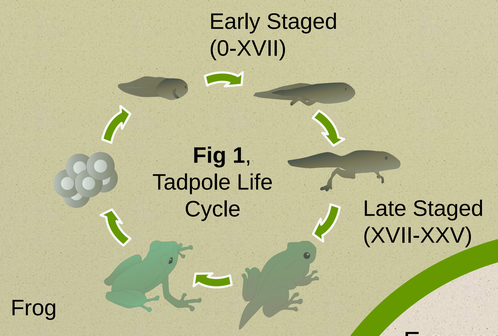

Fig 1, Tadpole Life Cycle

Methods

Tadpole brain stems where isolated *en bloc and* transferred to a recording superfusion chamber (**Fig 2.)** where activities of nerves normally controlling ventilation were recorded generating neurograms **(Fig 3.)**

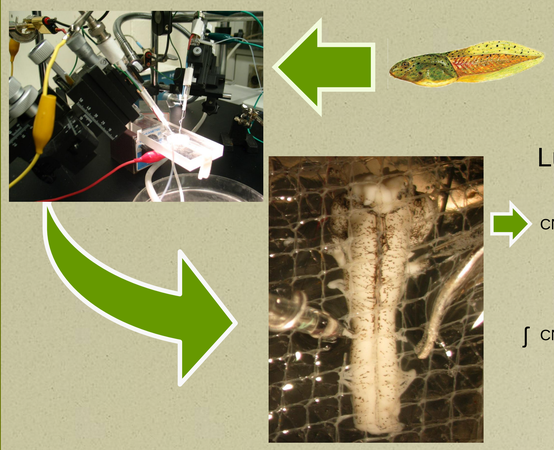

Fig 2. Recording superfusion chamber

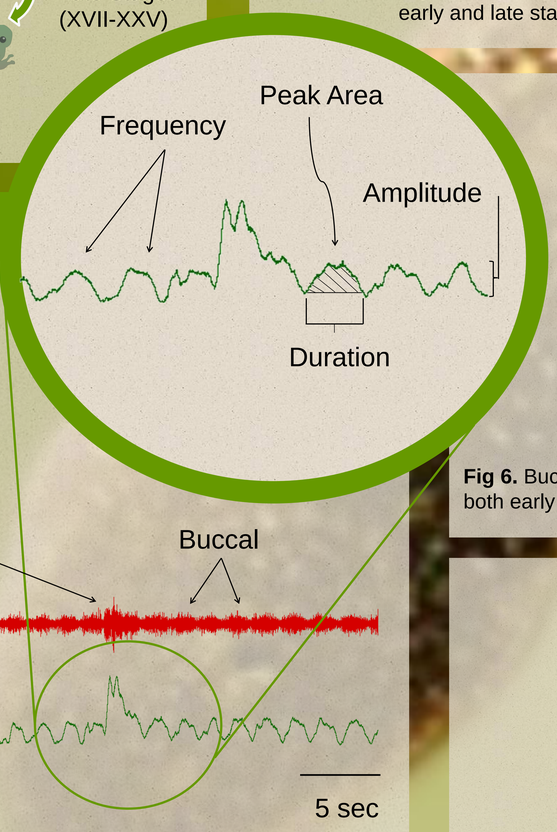

Fig 3. Respiratory neurograms.

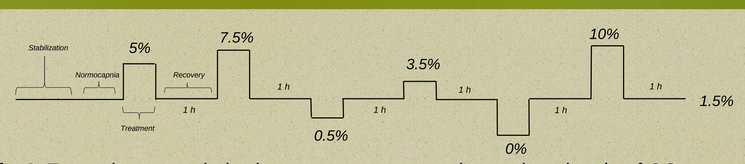

***Fig 4**. Example protocol: brainstems were exposed to various levels of CO_2.*

Results

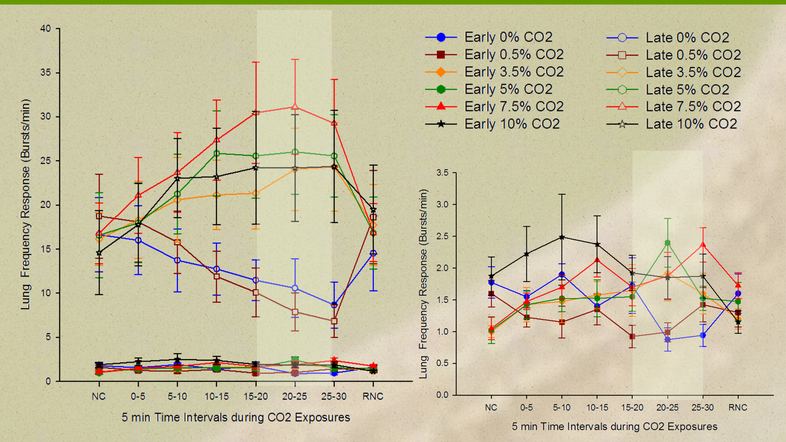

Fig 5. Lung frequency response to 30 min CO_2 treatments in both early and late staged tadpoles.

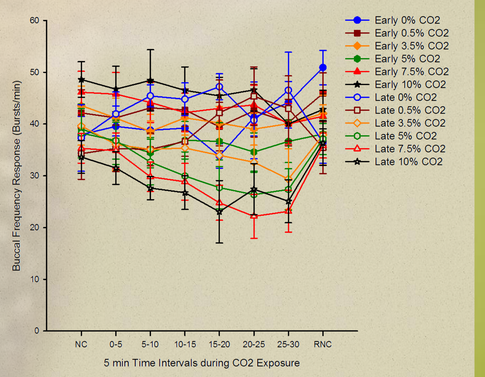

Fig 6. Buccal frequency response to 30 min CO_2 treatments in both early and late staged tadpoles.

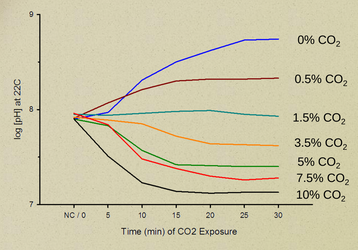

Fig 7 Time dynamic of the change in recording chamber pH, over 30 min for each of the CO_2 concentrations used (from point of initiation).

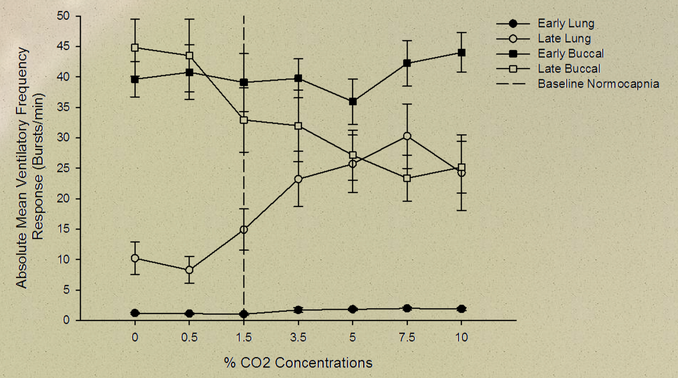

***Fig 8**. Average absolute respiratory frequency at each CO_2 treatments, for both early and late staged tadpoles (average over final 15 min of gas treatment).*

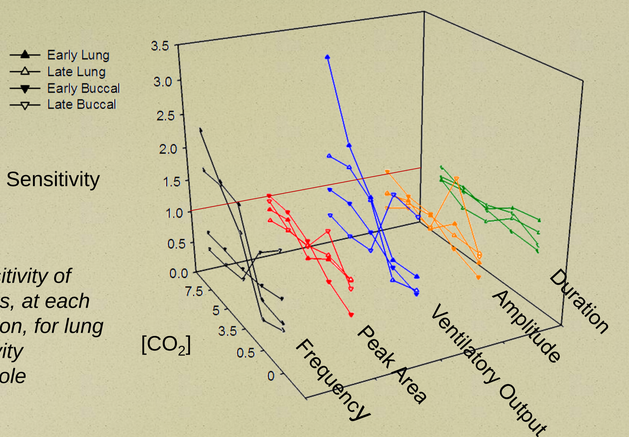

***Fig 9**. CO_2 sensitivity of burst parameters, at each CO_2 concentration, for lung and buccal activity throughout tadpole development.*

Discussion

This study demonstrates that isolated brain stems exposed to various CO_2 concentrations generated a fictive respiratory response, and that the sensitivity of this remains consistent throughout tadpole development.

References

Milsom, W.K. Phylogeny of Central CO_2/pH Chemoreception in Vertebrates. Department of Zoology, University of British Columbia, Canada. 2010. (1)

Taylor BE, Harris MB, Leiter JC and Gdovin MJ. Ontogeny of Central CO_2 Chemoreception: Chemosensitivity in the Ventral Medulla of Developing Bullfrogs. Am J Physiol Regul Integr Comp Physiol, December, 1 2003; 285 (6): R1461-R1472. (2)

Torgerson CS, Gdovin MJ, and Remmers JE. Ontogeny of Central Chemoreception during Fictive Gill and Lung Ventilation in an in vitro Brainstem Preparation of Rana Catesbeiana. J Exp Biol 200: 2063-2072, 1997. (3)

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