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# The Role of Brain Injury in Neural Proliferation and Neuronal Migration in Adult Zebrafish

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# The role of brain injury in neural proliferation and neuronal migration in adult zebrafish


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## Introduction

### *Background:*

- Traumatic brain injury (TBI) is increasing in prevalence
  - Neuronal death following TBI leads to dysfunction
  - Many TBI patients report olfactory dysfunction
- Adult zebrafish (*Danio rerio*) serve as a unique model due to their ability to regenerate neurons following a brain lesion
- By studying zebrafish we hope to better understand mechanisms of neurogenesis
- It is known that the zebrafish ventricular zone (VZ) is a site of cell proliferation, but it is unknown if the migration of the cells is associated in neuronal repair following TBI
- We aimed to further investigate the migration of newly proliferated neurons from the VZ following a lesion to the adult zebrafish olfactory bulb (OB).

### *Hypotheses:*

- There will be increased cell proliferation in the lesioned side of the OB, as compared to the undamaged side of the OB
- There will be increased migration of new neurons to the lesioned side of the OB from the VZ

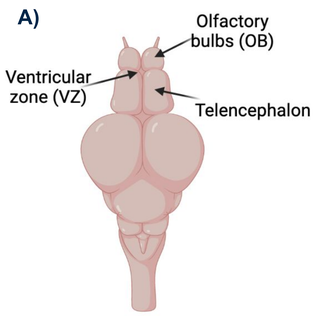


**Fig. 1** A) Diagram of the zebrafish brain. The olfactory bulbs (OB) and telencephalic ventricular zone (VZ) are shown. B) Degeneration and regeneration of the OB following a lesion on the OB.

## Results

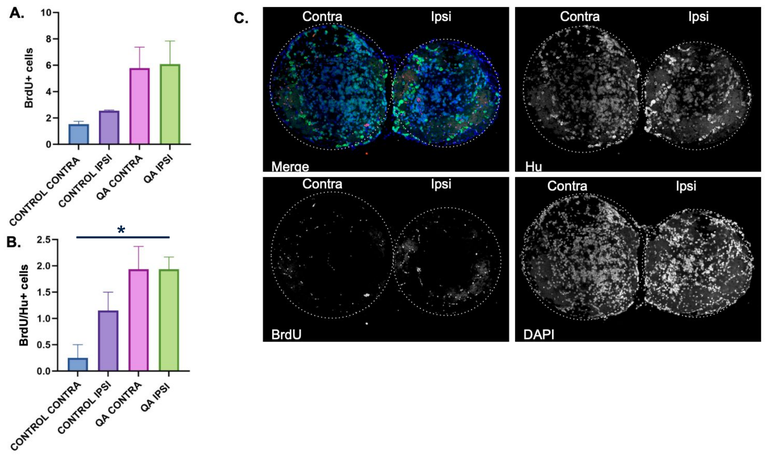


**Fig 2.** Counts for BrdU+ and BrdU/Hu+ cells in the zebrafish olfactory bulb (OB). (A.) BrdU+ cell counts for the OB in 21 dpl control and QA lesioned fish. There was no significant difference between groups on either side of the OB. (B.) BrdU/Hu+ cell counts for the OB in 21 dpl control and QA lesioned fish. There was a significant difference between groups ($p < .05$) (C.) Zebrafish OB with images of each channel: BrdU (red) and Hu (green).

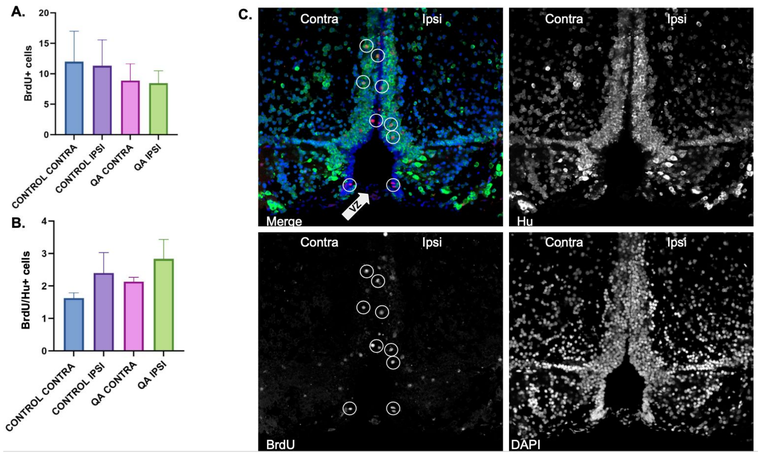


**Fig 3.** Counts for BrdU+ and BrdU/Hu+ cells in the zebrafish ventricular zone (VZ). (A.) BrdU+ cell counts for the VZ in 21 dpl control and QA lesioned fish. There was no significant difference between the two groups on either side of the VZ. (B.) BrdU/Hu+ cell counts for the VZ in 21 dpl control and QA lesioned fish. There was no significant difference between the two groups on either side of the VZ. (C.) Zebrafish VZ showing BrdU (red) and Hu (green).

## Methods

- Adult wild-type zebrafish (n = 8)
- Fish were anesthetized, then the right olfactory bulb was subject to an exotocic lesion using quinolinic acid (QA)
  - The left OB of each fish served as controls
- Fish received BrdU injections an hour after OB lesions
  - 21 dpl fish received five injections 0, 1, 2, 3, and 4 days post-lesion
- Fish recovered for 21 days, were sacrificed, dissected, and prepared for immunohistochemistry
- Prepared tissue of the OB and VZ were sectioned and photographed using confocal microscopy

## Discussion

This work aims to demonstrate the regenerative properties of the zebrafish CNS by observing the migration of new neurons following brain injury.

### *Conclusions*:

- Compared to the control, there was significantly more staining of BrdU and Hu in the lesioned OBs
- This indicates that there was increased migration of newly proliferated cells to the OB in fish lesioned with QA

### *Implications*:

- Future research should explore how cell proliferation in zebrafish might has implications for human treatment following TBI


### *Acknowledgements:*

- Hope College Biology Department and Neuroscience Program
- Dr. Calvo-Ochoa & Ted Lockett


**A haiku about zebrafish brain injury**

Zebrafish bonk head.
Ouch! TBI! must repair
Regeneration.