



香港城市大學  
City University of Hong Kong

專業 創新 胸懷全球  
Professional · Creative  
For The World

## CityU Scholars

### Roles of nitric oxide in adaptive response induced in zebrafish embryos *in vivo* by microbeam protons

Choi, Viann Wing Yan; NG, Candy Yuen Ping; KOBAYASHI, Alisa; KONISHI, Teruaki; OIKAWA, Masakazu; CHENG, Shuk Han; YU, Kwan Ngok

**Published in:**

Journal of Radiation Research

**Published:** 01/03/2014

**Document Version:**

Final Published version, also known as Publisher's PDF, Publisher's Final version or Version of Record

**License:**

CC BY

**Publication record in CityU Scholars:**

[Go to record](#)

**Published version (DOI):**

[10.1093/jrr/rrt161](https://doi.org/10.1093/jrr/rrt161)

**Publication details:**

Choi, V. W. Y., NG, C. Y. P., KOBAYASHI, A., KONISHI, T., OIKAWA, M., CHENG, S. H., & YU, K. N. (2014). Roles of nitric oxide in adaptive response induced in zebrafish embryos *in vivo* by microbeam protons. *Journal of Radiation Research*, 55(suppl\_1), i114. <https://doi.org/10.1093/jrr/rrt161>

**Citing this paper**

Please note that where the full-text provided on CityU Scholars is the Post-print version (also known as Accepted Author Manuscript, Peer-reviewed or Author Final version), it may differ from the Final Published version. When citing, ensure that you check and use the publisher's definitive version for pagination and other details.

**General rights**

Copyright for the publications made accessible via the CityU Scholars portal is retained by the author(s) and/or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights. Users may not further distribute the material or use it for any profit-making activity or commercial gain.

**Publisher permission**

Permission for previously published items are in accordance with publisher's copyright policies sourced from the SHERPA RoMEO database. Links to full text versions (either Published or Post-print) are only available if corresponding publishers allow open access.

**Take down policy**

Contact [lbscholars@cityu.edu.hk](mailto:lbscholars@cityu.edu.hk) if you believe that this document breaches copyright and provide us with details. We will remove access to the work immediately and investigate your claim.

## Poster Session 08: Bystander and other Low Dose Effect

### Roles of nitric oxide in adaptive response induced in zebrafish embryos *in vivo* by microbeam protons

Viann Wing Yan CHOI<sup>1</sup>, Candy Yuen Ping NG<sup>1</sup>, Alisa KOBAYASHI<sup>2</sup>, Teruaki KONISHI<sup>2,\*</sup>, Masakazu OIKAWA<sup>2</sup>, Shuk Han CHENG<sup>3,4</sup> and Peter Kwan Ngok YU<sup>1,4,\*</sup>

<sup>1</sup>Department of Physics and Materials Science, City University of Hong Kong, Hong Kong

<sup>2</sup>Department of Technical Support and Development, National Institute of Radiological Sciences, 4-9-1 Anagawa, Inage, Chiba 263-8555, Japan

<sup>3</sup>Department of Biology and Chemistry, City University of Hong Kong, Hong Kong

<sup>4</sup>State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong

\*Corresponding author. Email: tkonishi@nirs.go.jp (T.K.); peter.yu@cityu.edu.hk (P.K.N.Y.)

Radioadaptive response (RAR) was successfully induced in dechorionated (5 h post-fertilization, hpf) embryos of the zebrafish, *Danio rerio*, by 3.4 MeV protons from the microbeam irradiation facility (Single-Particle Irradiation System to Cell, acronym as SPICE) [1] at the National Institute of Radiological Sciences (NIRS), against a challenging exposure of 2 Gy of X-ray irradiation at 10 hpf. The RAR induction was corroborated by reduced apoptotic signals at 25 hpf revealed through terminal dUTP transferase-mediated nick end-labeling assay. If *de novo* synthesis of factors was required for RAR induction, these should have already been synthesized at 5 h after the priming dose.

Application of a nitric oxide scavenger 2-(4-Carboxyphenyl)-4,4,5,5-tetramethylimidazoline-1-oxyl-3-oxide (cPTIO) to the medium at 0, 1, 2, 3 or 5 h after application of priming exposure significantly suppressed RAR. The suppression of RAR with the application of cPTIO to the medium at 5 h after the priming dose irradiation, where *de novo* synthesis of factors should have been completed, suggested that NO scavenging impaired the repair machineries in the bystander cells. The suppression of RAR with the application of cPTIO to the medium at earlier than 5 h after the priming dose irradiation could be explained by the scavenging of bystander NO signals in the medium and thus deterring the *de novo* synthesis of factors.

**Keywords:** protons; adaptive response; nitric oxide; zebrafish embryos

#### REFERENCE

1. Konishi T, Oikawa M, Suya N *et al.* SPICE-NIRS microbeam: a focused vertical system for proton irradiation of a single cell for radiobiological research. *J Radiat Res* 2013;**54**:736–47.