Reduction of radiotoxicity by ultra-high dose rate protontherapy

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1- Introduction

- Electron beams are widely used for Ultra-High Dose Rate Radiotherapy (UHDR-RT) studies.
- The novelty of UHDR-RT using protons still requires a lot of knowledge of the parameters involved in its response.
- **Protons** : -Spread a little along the trajectory.
  -Have a precise targeting.

What are the requirements that allow obtaining a protective effect using proton UHDR-RT ?

2- Materials and Methods

Zebrafish embryos

No experimental authorization is required

Statistical power

Fast beam structure investigations

Irradiation at 28 hpf

Plateau of 68 MeV protons

Conventional dose-rate **12 Gy/min**

Ultra-high dose-rate **8-9 kGy/sec**

Protocol

Sorting viable eggs → IR 32 eggs in 0.1 mL E3 medium → Culture and fixation at 5dpf → Microscopy

0.5 mL 2% agarose

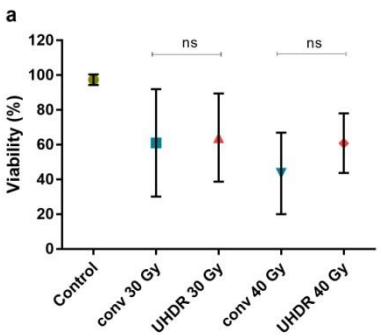
Morphometric measurements

a: Distance (from head to tail)
b: Length of the body
b/a: Curvature of the tail

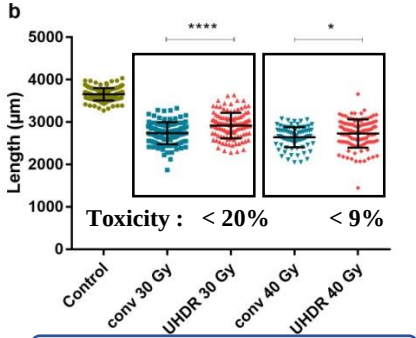
Scoring pericardial edema

3-Results

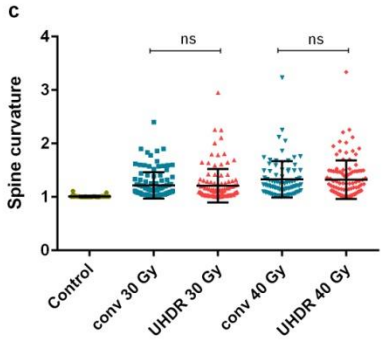
Effect of proton UHDR-RT on the morphology of zebrafish embryos vs conv RT :



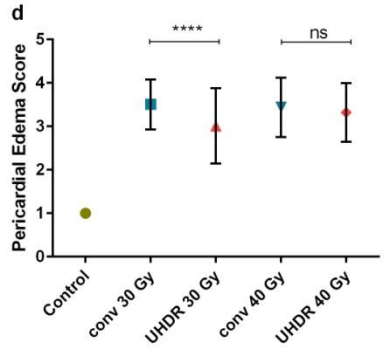
Stable viability



Less toxicity on the length

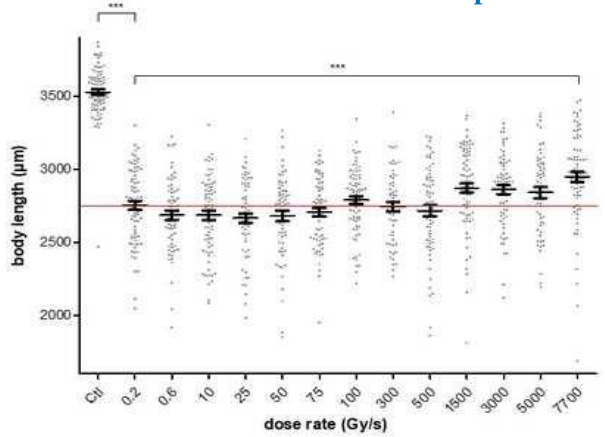


No difference of the curvature



Decrease of pericardial edema at 30 Gy

Effect of the mean dose-rate on the protection of zebrafish embryos :



Significant protection at 7700 Gy/s.

4- Conclusion

- A protection in body length after proton UHDR-RT was demonstrated with the zebrafish embryonic model.
- This model allows to study rapidly several parameters allowing a better understanding of proton UHDR-RT.