

# Functional MRI for predicting metastatic spreading at the time of surgery after neoadjuvant radiotherapy

F.Lallemand<sup>1,2,3</sup>, N. Leroi<sup>2</sup>, M. Bahri<sup>3</sup>, E.Balteau<sup>3</sup>, A Noël<sup>2</sup>, P. Coucke, P.Martinive<sup>1,2</sup>,

A.Plenevaux<sup>3</sup>

1 Department of Radiotherapy-Oncology, CHU de Liège, ULg, Belgium  
2 Laboratory of Tumor and Development Biology, ULg, Belgium  
3 Cyclotron Research Centre, University of Liège, Liège, Belgium



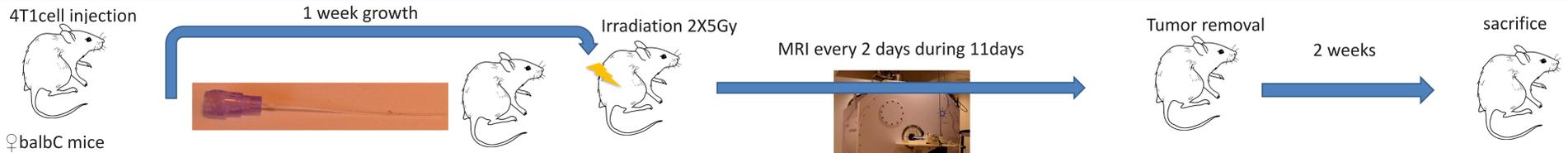
Université de Liège



## Introduction

Neoadjuvant radiotherapy (NeoRT) improves tumor local control and tumor resection in many cancers. The timing between the end of the NeoRT and surgery is driven by the occurrence of side effects or the tumor downsizing. Some studies demonstrated that the timing of surgery and the RT schedule could influence tumor dissemination and subsequently patient overall survival (1). Our aim is to evaluate with functional MRI the impact of the radiation treatment on the tumor microenvironment and subsequently to determine the best timing to perform surgery avoiding tumor spreading.

## Materials & Methods



Acquisition were made on an Agilent 9,4 T MRI with a 40mm diameter volume coil.

**Diffusion Weighted (DW) and Dynamic Contrast Enhancement (DCE)** -MRI were performed every 2 days during 11 days between neo-RT and surgery.

We developed a homemade "portacath (PAC)" specifically dedicated for mice and for repetitive IV gadolinium contrast agent injection.

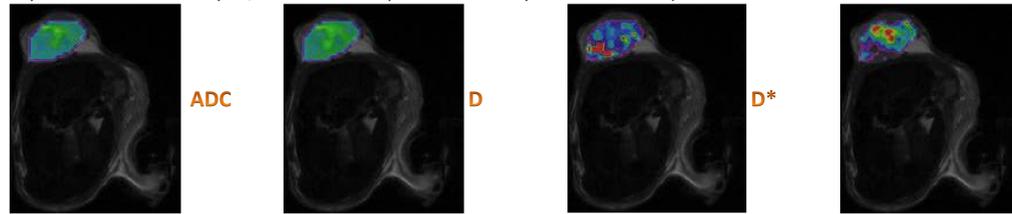
For DW-MRI, we performed FSEMS (Fast Spin Echo MultiSlice) sequences, with 10 different B-values (from 20 to 1000) and B<sub>0</sub>, in the 3 main directions.

For DCE-MRI, we used FSEMS sequence for keeping the same as with DW-MRI. After the T1 mapping, we performed DCE acquisition with a temporal resolution of 5.6 sec. After 10 repetitions, we injected 100 μl of gadopentetate dimeglumine (0.1 mmol/kg) in 5 sec. via the PAC and recorded the 190 following repetitions during 14 min. for the contrast enhancement and wash out.

For both images, we performed analysis on the entire tumor volume and we obtained the mean tumor signal.

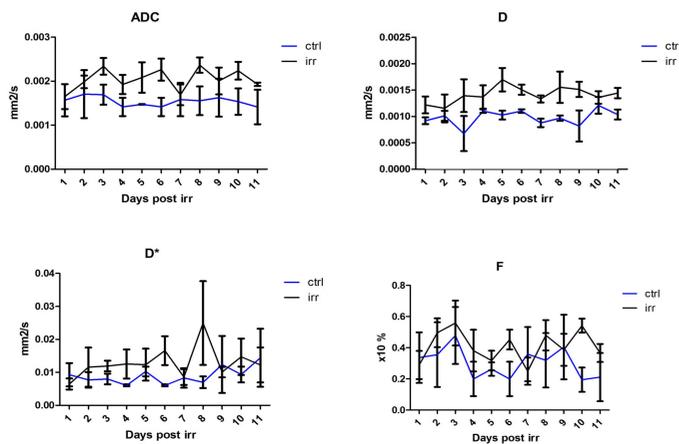
**For DW-MRI, we perform IVIM** (intra voxel incoherent motion (2)) analysis. With IVIM analysis, we use a biexponential analysis to obtain 3 parameters:

**D**, the true diffusion  
**D\***, the pseudo-diffusion  
**F**, the perfusion fraction



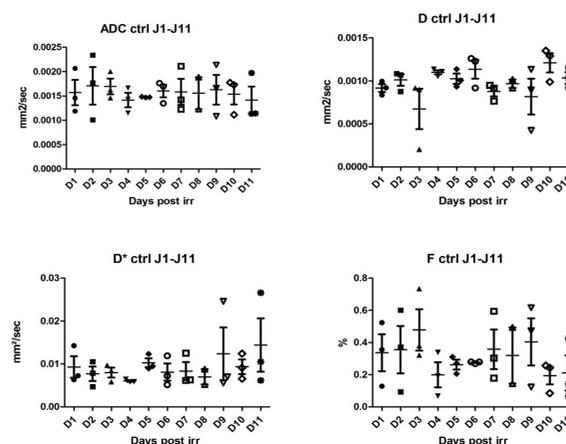
## Results

### 1) Control VS irradiated



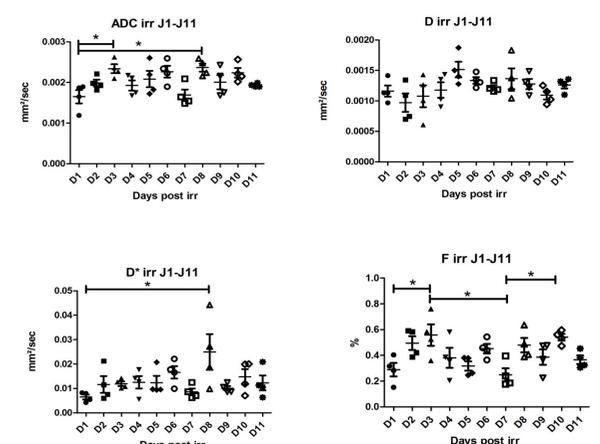
The signal intensity differences between irradiated and non irradiated mice could be due to cell death.

### 2) Signal Evolution in control mice



These graphs represent individual mice measurements in the control group. No differences between mice and no evolution in time.

### 3) Signal Evolution in irradiated mice



These graphs represent individual mice measurements in the irradiated mice. We can observe significant difference between the first days and day 8. The difference are more in relation with the perfusion (D\* and F) than the pure diffusion (D)

## Conclusion and perspectives

The first aim of the study was to demonstrate the protocol feasibility of longitudinal following of the tumor microenvironment with DW-MRI after neoadjuvant radiotherapy.

Here, we succeeded to follow irradiated mice during 11 days after irradiation with DW-MRI and demonstrates differences in DW-MRI Signal between control and irradiated mice for all the parameters (ADC, D, D\* and F). We showed in the irradiated group, significative difference in the perfusion related factor between day 1 (just after the end of radiotherapy) and day 8. These observations could be related to cell death. We failed to obtain good DCE data (data not showed).

The next step will be to correlate functional imaging study with neoadjuvant radiotherapy and the risk of tumor dissemination at the time of surgery and following the radiotherapy protocol.

### Contacts:

- Radiotherapy and radiobiology

Dr. P. Martinive: [philippe.martinive@chu.ulg.ac.be](mailto:philippe.martinive@chu.ulg.ac.be)

- Cyclotron Research Center (CRC) and Laboratory of Tumor & Development Biology (LBTD)

Dr. F. Lallemand : [f.lallemand@chu.ulg.ac.be](mailto:f.lallemand@chu.ulg.ac.be)



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### References

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