QUANTIFICATION OF OXYGENATION BY DCE MRI AND RELATIONSHIP BETWEEN FUNCTIONAL IMAGES OF HEAD AN NECK CANCER

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MOTIVATION :

This work is part of a research project named "Adaptive Radiation and Prediction of Tumor Response based on Functional Studies of MRI and PET / CT in Head and Neck Cancer"' funded by a FIS (IP: PI11/02035) grant. The overall objective of the project is to establish an integrated information network from which predictive models of tumor response can be developed, and the effects to critical organs for patients with head and neck tumors based on functional data in vivo can be assessed. Our research focuses on quantifying tissue oxygenation

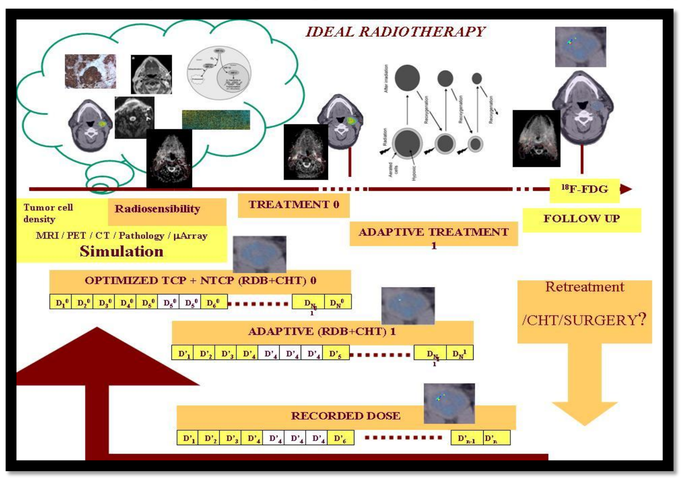

Fig. 1. Ideal Radiation: The radiation planning should be tailored to the individual patient's response to treatment, based on functional images.

THESIS OBJECTIVES:

Dynamic Contrast Enhance MRI has been proposed by several authors for treatment monitoring [1] and measurement of oxygenation distribution [2]. The main problem is the complex data analysis and the correspondence between measurement and biological parameters. The parameter k_{trans} is related to vascularization, and then to hypoxia [3].

Our objective is explore the relationship between ADC, SUV, and DCEMRI related parameters (like k_{trans}) to evaluate their influence in tumor response.

RESULTS:

We explored the relationship between ADC, SUV, and DCEMRI related parameters (like k_{trans}) to evaluate their influence in tumor response in a case where we have, in the same slice, a necrotic volume, a hypoxic area and a well vascularized tumor volume (Fig.2). In november 2014 we published a paper [5] with more details about this relationships.

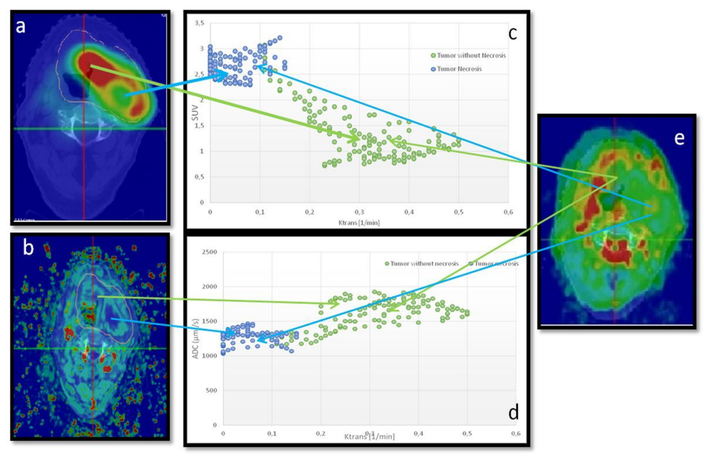

Fig.2 In this figure SUV versus K_{trans} and ADC is represented. (a) PET/CT. (b) K_{trans} map overlapped to simulation CT (c) In the hypoxic area (excluding necrotic area), high SUV values are obtained independently for all low K_{trans} values, because of the addition of the Warburg effect and the Pasteur effect. (d) In the well vascularized area, SUV values are decreasing with K_{trans}, as expected, because a reduction in ADC implies an increase in tumor cell density. (e) ADC map overlaped to simulation CT.

Data analysis was performed with an own home software developed for this project [5]. Partial validation of the deformable registration was made using a commercial software and introduced in the ESTRO 2015 Congress. A total validation we hope to present a paper soon.

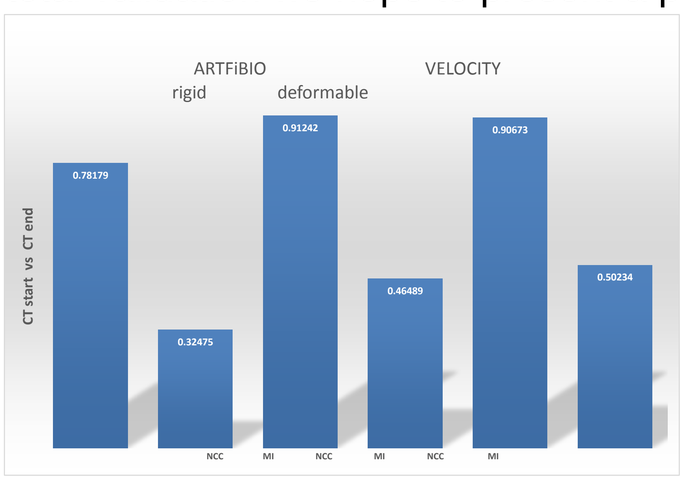

Fig.3 This figure shows the comparasion between registration of 2 X-ray CT performed whit our home software (ARTFIBIO) versus the commercial software Velocity©. We have use NCC and Mutual Information metrics

RESEARCH PLAN

		2014				2015				2016	
TASK	DESCRIPTION	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
1.	LITERATURE REVIEW										
2.	COLLECTING DATA										
3.	DATA ANALYSIS										
4.	SOFTWARE VALIDATION										
5.	PUBLICATION										
6.	THESIS										

The research plan schedule is shown in the timetable:

- Green color indicates completed work
- Yellow color indicates future assignments

Our in-home software and our imaging protocol are explained in [4] and [5], respectively.

PLANNING FOR 2015-2016:

Next year we expect to publish a second paper including the register validation and thesis redaction.

REFERENCES:

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[2] Elliott JT, Wright EA, Tichauer KM, Diop M, Morrison LB, Pogue BW, Lee TY, St Lawrence K., «Arterial input function of an optical tracer for dynamic contrast enhanced imaging can be determined from pulse oximetry oxygen saturation measurements,» *Phys. Med. Biol.,* p. 57 8285, 2012.

[3] Zahra MA, Hollingsworth KG, Sala E, Lomas DJ, Tan LT., «Dynamic contrat-enhanced MRI as predictor of tumour response to radiotherapy,» Lancet Oncol. 2007 Jan;8(1):63-74.

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[5] Mera Iglesias, M., Aramburu Núñez, D., del Olmo Claudio, J. L., López Medina, A., Landesa-Vázquez, I., Salvador Gómez, F., ... & Muñoz, V. (2015). Multimodality functional imaging in radiation therapy planning: relationships between Dynamic Contrast-Enhanced MRI, Diffusion-Weighted MRI, and 18F-FDG PET. *Computational and mathematical methods in medicine*, *2015*