



Early variation of FDG-PET  
Radiomics features in NSCLC is  
related to overall survival

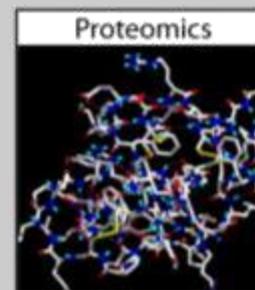
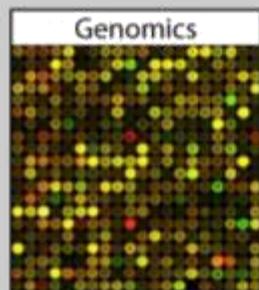
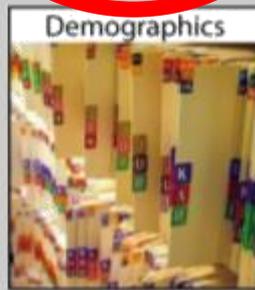
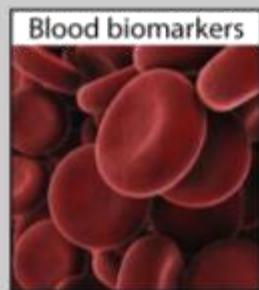
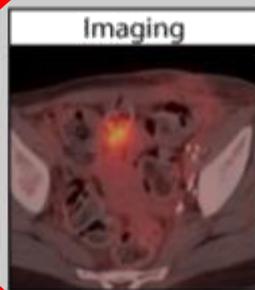
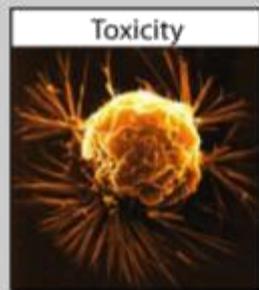
## The “Delta Radiomics” concept

Sara Carvalho, Ralph Leijenaar  
Session 2 – Nuclear Medicine

15<sup>th</sup> February 2016

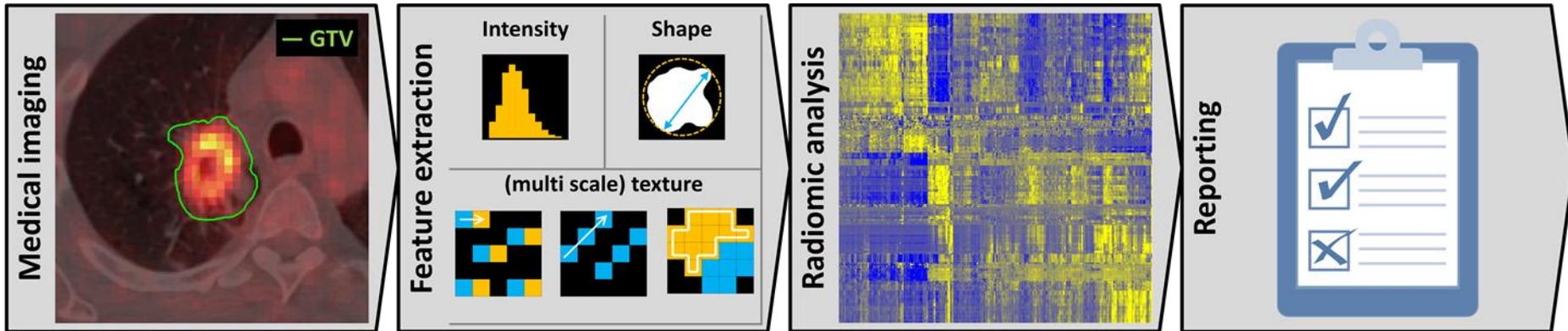
# Radiomics

Retrieving extra information from medical imaging



- Imaging – source of complementary and **interchangeable** information
- ***Radiomics Hypothesis***: advanced image analysis could capture additional information
- Potential “Imaging biomarkers” → individualized treatment selection and monitoring

# The Radiomics workflow in a nutshell



**A high-throughput approach**

**The analysis extracts diagnostic, prognostic and predictive Radiomics signatures**



### 1. Tumor image intensity

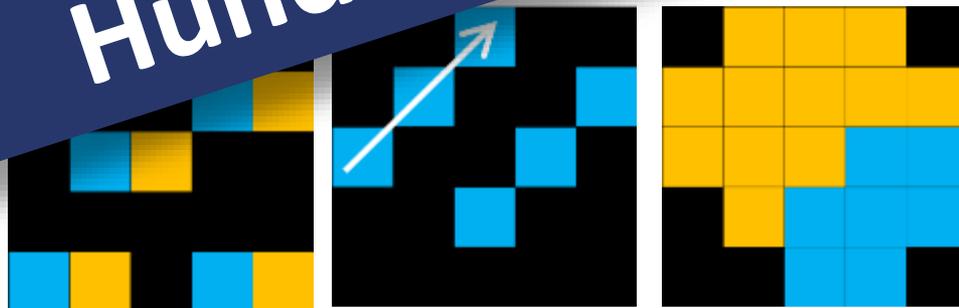


### 2. Shape



**Hundreds of features → omics**

### 4. Multi-scale filtering



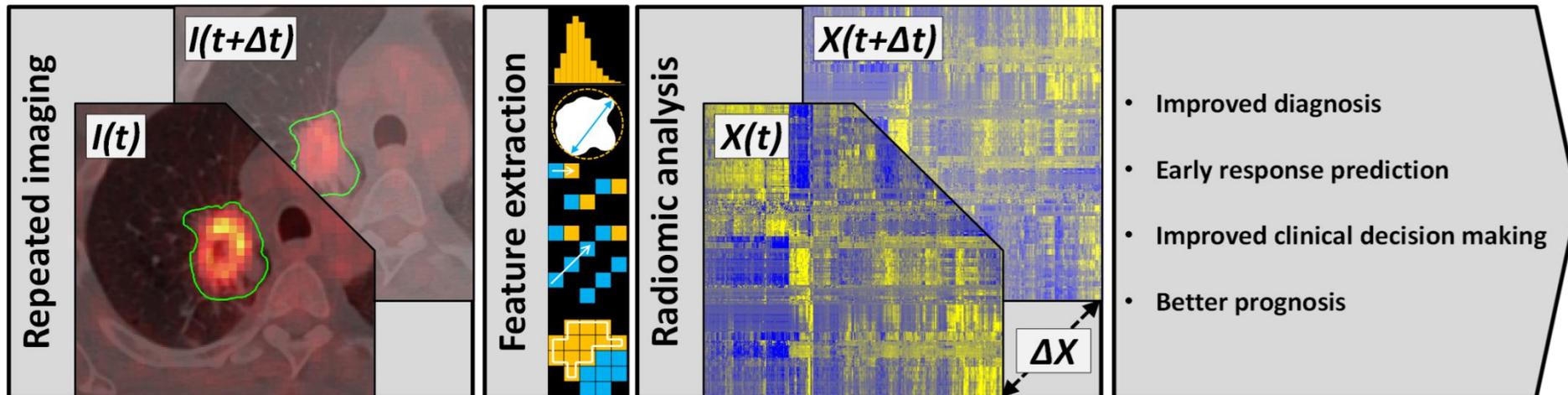
# “Delta Radiomics”

## Materials and Methods



Radiomics studies mainly look at one time point (baseline)...

**AIM:** To develop and validate a **Delta Radiomics** predictive model for NSCLC based on variation of PET features early during treatment

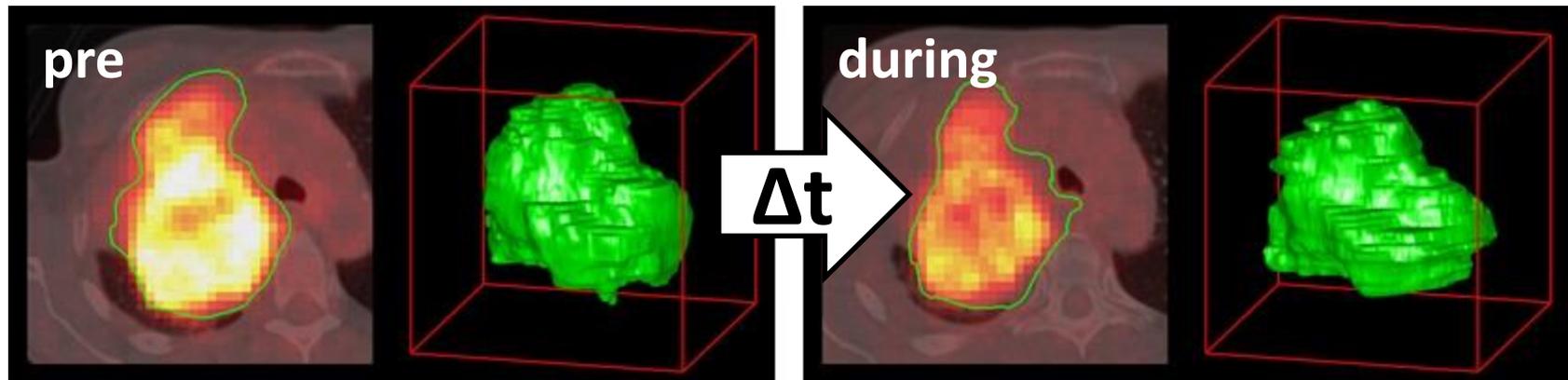


# “Delta Radiomics”

## Materials and Methods



- **Development dataset:** 52 stage IIIa-IV NSCLC with PET before and during second week of RT

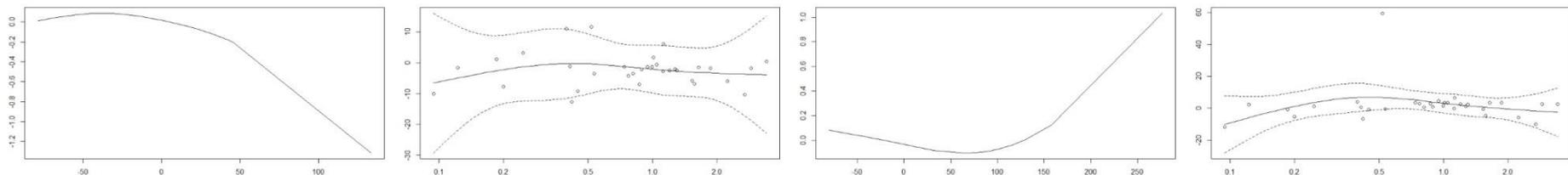


- **Δ features:** 
$$\frac{(During_{treatment} - Pre_{treatment})}{Pre_{treatment}} \times 100\%$$
- Cox proportional hazards model
- Automatic feature selection with LASSO



## Model:

- 6 features
- At least one feature from each category selected, except for first order statistics
- All features met the proportional hazards assumption
- Features not verifying the log-linearity assumption were entered in the derived model by a piecewise linear approach - intervals were verified visually on the fitted smoothing splines



# Results



Features in the model	HR	95% CI	p-value	c-index
Shape – Volume				<b>0.66</b>
< 50%	0.98	0.96 – 1.01	0.29	
≥ 50%	0.88	0 – 1.22e <sup>34</sup>	0.99	
RLGL – Grey level non-uniformity				
< 150%	1.02	1.00 – 1.03	0.07	
≥ 150%	1.01	1.00 – 1.02	0.19	
RLGL – Long run emphasis	0.97	0.94 – 1.00	0.06	
GLCM – Sum entropy				
< 0%	0.97	0.93 – 1.02	0.30	
≥ 0%	0.99	0.96 – 1.02	0.59	
GLSZM – High intensity large area emphasis	1.00	1.00 – 1.00	0.41	
IVH – AVRI <sub>60%</sub>				
< 40%	1.00	0.99 – 1.02	0.76	
≥ 40%	1.00	0.98 – 1.01	0.42	



## Two validation datasets:

### 1) 32 stage IIb-IV NSCLC

**van Elmpt W. et. al**, *Response assessment using 18F-FDG PET early in the course of radiotherapy correlates with survival in advanced-stage non-small cell lung cancer*

### 2) 26 stage II-IIIb NSCLC

**Yossi S et. al**, *Early assessment of metabolic response by 18F-FDG PET during concomitant radiochemotherapy of non-small cell lung carcinoma is associated with survival: a retrospective single-center study.*

# External validation



Features in the model	HR	95% CI	p-value	c-index	External Validation	
					Dataset 1	Dataset 2
<b>Shape – Volume</b>				0.66	0.64	0.57
< 50%	0.98	0.96 – 1.01	0.29			
≥ 50%	0.88	0 – 1.22e <sup>34</sup>	0.99			
<b>RLGL – Grey level non-uniformity</b>						
< 150%	1.02	1.00 – 1.03	0.07			
≥ 150%	1.01	1.00 – 1.02	0.19			
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<b>IVH – AVRI<sub>60%</sub></b>						
< 40%	1.00	0.99 – 1.02	0.76			
≥ 40%	1.00	0.98 – 1.01	0.42			

# To conclude



- A model based on percentage variation of Radiomics features was developed and validated
- $\Delta$  of commonly analysed features (e.g., maximum, peak and mean SUV) were not associated with overall survival in the multivariable approach here shown
- Uniformity of imaging acquisition, including time of scanning repetition, should thoroughly be considered in future studies for more reliable validation procedures

# Acknowledgments



Esther Troost  
Cary Oberije  
Wouter van Elmpt  
Philippe Lambin  
Dirk De Ruyscher  
Hugo J.W.L. Aerts

Centre **Jean Bernard**  
Oncologie - Hématologie - Radiothérapie - Scintigraphie

Jean-Pierre Muratet  
Fabrice Denis

Next Radiomics talk  
Janita van Timmeren  
Thursday, Room 4, 14:30h



# Thank you for your attention!

Look for research details @

[www.radiomics.org](http://www.radiomics.org)

[www.maastro.nl](http://www.maastro.nl)

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