Master's Thesis Engineering Technology

2020-2021

The potential of radiomics with PET/CT: study of correlations with the metabolic profile and its discriminative power

Laura Deckers

Master of Nuclear Engineering Technology

Rani Truyens

Master of Nuclear Engineering Technology

Introduction

The treatment of lung cancer is still a challenging research, partly due to late-stage diagnosis of patients. This leads directly to a high mortality rate, so an **early diagnosis** is a crucial step in the treatment of patients with lung cancer. This research focusses on one of the most common types of lung cancer, more specifically, **early-stage non-small cell lung cancer (NSCLC)**. All patients included in this study underwent a **lobectomy**.

This study examines the **discriminative** potential of combining specific metabolic biomarkers from blood plasma (**metabolomics**) with features out of medical images (**radiomics**). This way metabolomics and radiomics might be at the base to develop a **more patient specific treatment plan** for lung cancer patients.

Research questions

Goals:

1. Combining **metabolomics and radiomics** datasets from NSCLC patients, to unravel the underlying **correlations**.
2. Generate a **discriminative model** between malignant and non-malignant long lesions, and between adenocarcinoma and squamous cell carcinoma based on the **radiomics** features.

Materials and method

- Metabolomics and radiomics:
  - 39 patients
  - **ACCURATE** tool (creating volumes of interest (VOIs)) and **RADIOMICS** tool (extracting radiomics features)
  - 483 radiomics parameters
  - 238 metabolic parameters obtained with proton nuclear magnetic resonance (^{1}H-NMR)
  - **Correlation test**

Figure 1: The ^{1}H-NMR spectroscopic analysis [1]

- Radiomics:
  - 85 patients
  - **ACCURATE** tool (creating VOIs) and **RADIOMICS** tool (extracting radiomics features)
  - 483 radiomics parameters out of PET-CT images
  - **Correlation** test
  - **Logistic regression** to generate discriminative model

Figure 2: The Biograph Horizon detector from Siemens [2]

Results

Table 1: Summary of the total amount of correlated radiomics features to metabolic variables related to plasma glucose and glycerol for all three segmentation methods

	↑ Glucose	↓ Glycerol
First segmentation method (PET/CT)	12 features	8 features
Second segmentation method (PET/CT)	16 features	12 features
Third segmentation method (PET)	17 features	15 features

Table 2: Summary of the sensitivity and specificity of the generated models to discriminate between malignant and non-malignant lung nodules, and between adenocarcinoma and squamous cell carcinoma

	Sensitivity	Specificity
Malignant/non-malignant	0.9474	0.0000
Adenocarcinoma/Squamous cell carcinoma	0.4000	0.9167

Conclusion

- High glucose uptake in tumor cells
- Supporting role gluconeogenesis in normal cells

→ **6** features positively correlated to **increased** plasma glucose

→ **13** features negatively correlated to **decreased** plasma glycerol

- **Discriminative** models:

→ Malignant/non-malignant and adenocarcinoma/squamous cell carcinoma

→ **Fragile** due to small patient cohort

Supervisors / Co-supervisors / Advisors

Prof. dr. Brigitte Reniers[1] , Prof. dr. Liesbet Mesotten[2,3], Mevr. Elien Derveaux[2]

[1]Faculty of Industrial Engineering Sciences, Hasselt University, Hasselt, Belgium

[2]Faculty of Medicine and Life Sciences, Hasselt University, Hasselt, Belgium

[3]Department of Nuclear Medicine, Ziekenhuis Oost-Limburg, Genk, Belgium

[1]: ProLUNG study

[2]: Siemens Healthineers