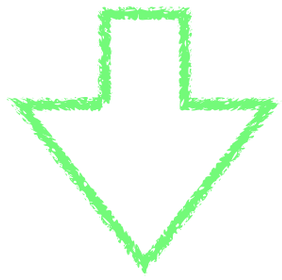
Analisi NMR

Riunione presentazione progetti per i bandi della regione Lazio - Lunedì 16 gennaio 2017 ore 10:00 - Aula Direzione LNF

Introduction

- The therapy for locally advanced rectal cancers is:
  - neoadjuvant chemo-radiotherapy (CRT)
  - followed by radical surgery



- local pelvic recurrence to rate lower than 10%

However...

- This therapeutic approach is an **over-treatment** of many patients:

- those who do not respond to the treatment (non-responders)

  - whose early identification (2–3 weeks after the start of neoadjuvant CRT) might help clinicians in referring them to alternative treatments;

- patients with pathological complete response

  - who could benefit from either less invasive surgery (ie, transanal endoscopic microsurgery) or "wait-and-watch" strategy

The purpose

- Recognize non-responders and complete responder patients during the CRT (before surgery)

The dataset

- 75 patients with histologically confirmed colorectal adenocarcinoma and locally advanced tumor stages II (cT3-4, N0, M0) and III (cT1-4, N+, M0)
- Images acquired in three stages:
  - just after diagnosis (pre-CRT)
  - CRT response evaluation at early phase: CRT treatment was day 40 and tumor response was assessed with MRI at day 21
  - post-surgical analysis: 6 to 8 weeks after the end of CRT
- gross specimen was analyzed by pathologist

The dataset

- Three kind of NMR images acquired:
  - T2-weighted
  - diffusion-weighted imaging (DWI) or apparent diffusion coefficient (ADC)
  - and perfusion MRI (pMRI)
- Two acquisition per NMR kind:
  - axial oblique (planes orthogonal to the rectum)
  - coronal oblique (planes parallel to the rectum)
- The images acquired at the same time have a common reference system

The project

- Analyze the available images and find observables that allow to categorize the patients
- Increase the patient database
- Automatically define the Region Of Interest (ROI)

Possible tools

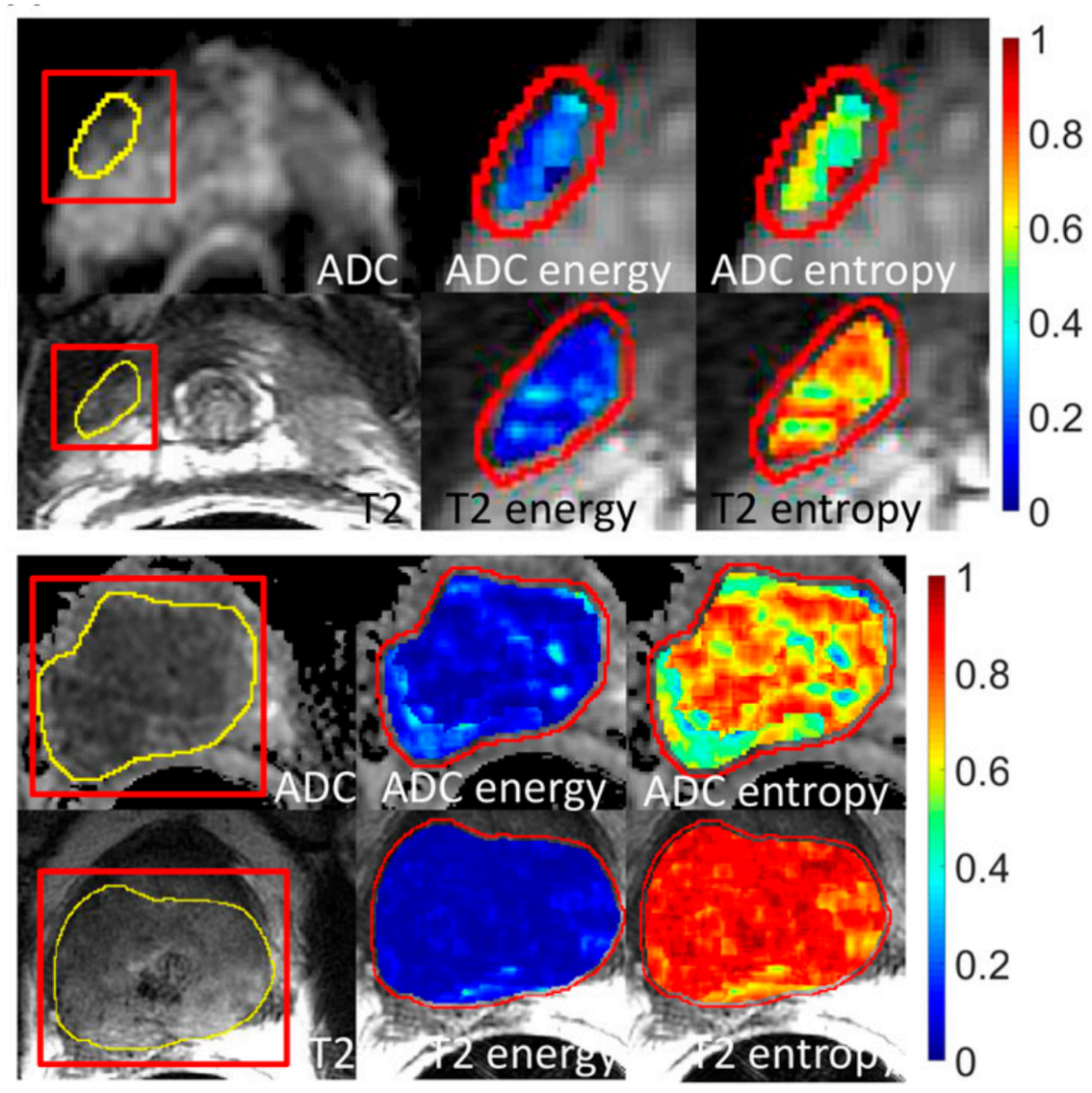
- Texture analysis
  - Structural methods
    - useful for the synthesis of an image than for its analysis
  - Transform methods
    - Fourier, Gabor or Wavelet transform
  - Statistical methods
- Neural networks
- Deep learning neural networks
  - H. Greenspan, B. van Ginneken, and R. M. Summers, “Guest Editorial Deep Learning in Medical Imaging: Overview and Future Promise of an Exciting New Technique,” IEEE Trans. Med. Imaging, vol. 35, no. 5, pp. 1153–1159, Dec. 2016.

Application on prostate cancer

- machine learning-based automatic classification of prostate cancer aggressiveness

- combining apparent diffusion coefficient (ADC) and T2-weighted (T2-w) MRI-based texture features

- achieved an accuracy greater than 90%



D. Fehr et al. “Automatic classification of prostate cancer Gleason scores from multiparametric magnetic resonance images,” Proc Natl Acad Sci USA, vol. 112, no. 46, pp. E6265–E6273, Nov. 2015.

People involved

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