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Radiomics: Medical Imaging Can Predict Pancreatic Cancer Patient Outcome

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Radiomics: Medical Imaging Can Predict Pancreatic Cancer Patient Outcome

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Abstract

Radiomics is a process that mines quantitative data from imaging techniques, including MRIs, CTs, and PET scans. In this study, radiomics is used to find associations between clinical factors such as the number of metastases in pancreatic ductal adenocarcinoma (PDAC) patients from their preoperative CT scans. PDAC patients have a five-year survival rate only barely above 10%. By the time of diagnosis over half of pancreatic cancers are metastasized, and when that is the case the five-year survival rate is only 3%. It is hypothesized that radiomics can help predict clinical factors such as the number of metastases in pancreatic patients. These predictions can lead to improved treatment plans by risk stratification. Patients with a higher risk of metastases would adopt more aggressive treatment than patients with lower risk. This study included 87 patients diagnosed with PDAC who consented to a Rapid Autopsy Program. Although results have not yet been processed, future work would include finishing developing a model to use to predict PDAC metastases.

Background

Radiomics
- Process of mining medical images for quantitative data **(Figure 1.)**
- Gain features from high-throughput extraction to construct models
- Goals:
  - Use predictive models alongside clinical practices
  - Non-invasive and personalized medicine
  - Longitudinal monitoring

Pancreatic ductal adenocarcinoma (PDAC)
- Most common type of pancreatic cancer
- Treatment: surgical resection of tumor, if possible, followed by radiation and chemotherapy
- Prognosis: many patients are diagnosed late-stage and have a survival rate of about 1 year on average

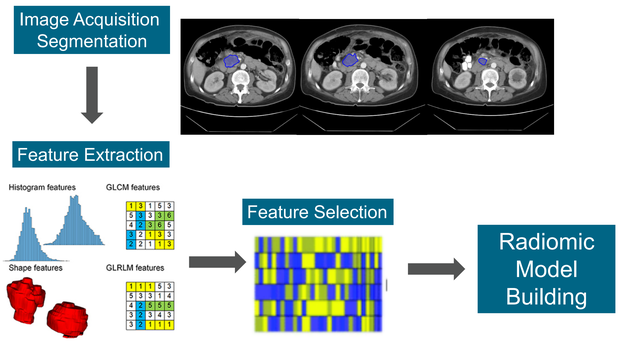

Figure 1. Radiomic workflow including image acquisition, segmentation, feature extraction, feature selection, and model building.

Background (cont.)

Clinical Data from PDAC Patients: (**Figure 2**)
- Average number of metastases per patient within cohort is 5
  - Most patients had between 0-5 metastases (69 patients)
- Most patients were stage IV at diagnosis (60 patients)
- Most patients had between 1-400 survival days after diagnosis (67 patients)

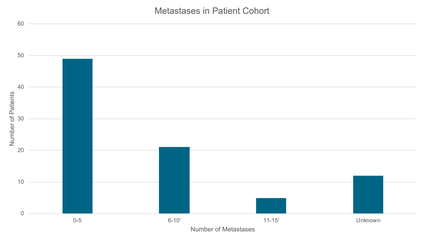

Figure 2. Number of patients per number of metastases.

Materials and Methods

Image Acquisition
- 87 patients with PDAC
- Abdominal and Pelvic CTs

Contouring
- Highlight pancreatic tumor on each CT slice to later extract features from this region of interest (**Figure 3.**)
- Programs used: Velocity for contour, 3D slicer for 3D model

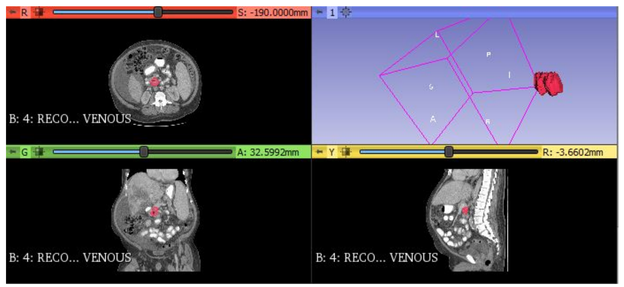

Figure 3. CT image of PDAC patient with pink contour and 3D model

Materials and Methods (cont.)

Feature Extraction
- 982 features extracted
- Examples: shape of tumor, intensity of tumor, smooth/rough
- Program used: Slicer Radiomics

Analysis
- Involves feature selection and modeling
- Use machine learning to identify significant features
- Usually about 3 – 15 features are selected
- 70% of data is used to make a model, 30% of data is used to test the model
- After adjustment of the model, it can be verified on new outside data

Results

Feature Extraction Results
- Most features extracted were texture analysis features **(Figure 4.)**
  - Texture feature categories included: Glcm, gldm, glrlm, glszm, ngtdm, etc.
  - Often pancreatic cancer radiomic studies find texture features significant in prediction models
- 2,2,2 kernel size applied, and log and wavelet features extracted in Slicer Radiomics parameters

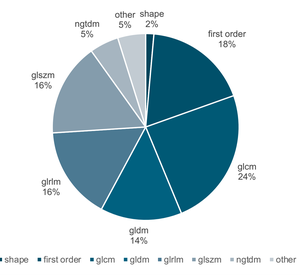

Figure 4. Pie chart of extracted feature categories.

Future Work

The next steps for the project include feature selection and model building. If radiomics would be able to predict metastases, it would be more cost-effective, easily accessible, and could be used for non-invasive prognosis and optimal treatment prediction. Our model could provide a quick way for clinicians to risk assess PDAC patients.

References

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