Multi-omics models can predict prostate specific membrane antigen (PSMA) avidity for computed tomography lesions in oligo-metastatic castration sensitive prostate cancer

Ritesh Kumar, Chengzhu Zhang, Jongmyung Kim, Lara Hathout, Salma K Jabbour, Ke Nie, Matthew P Deek

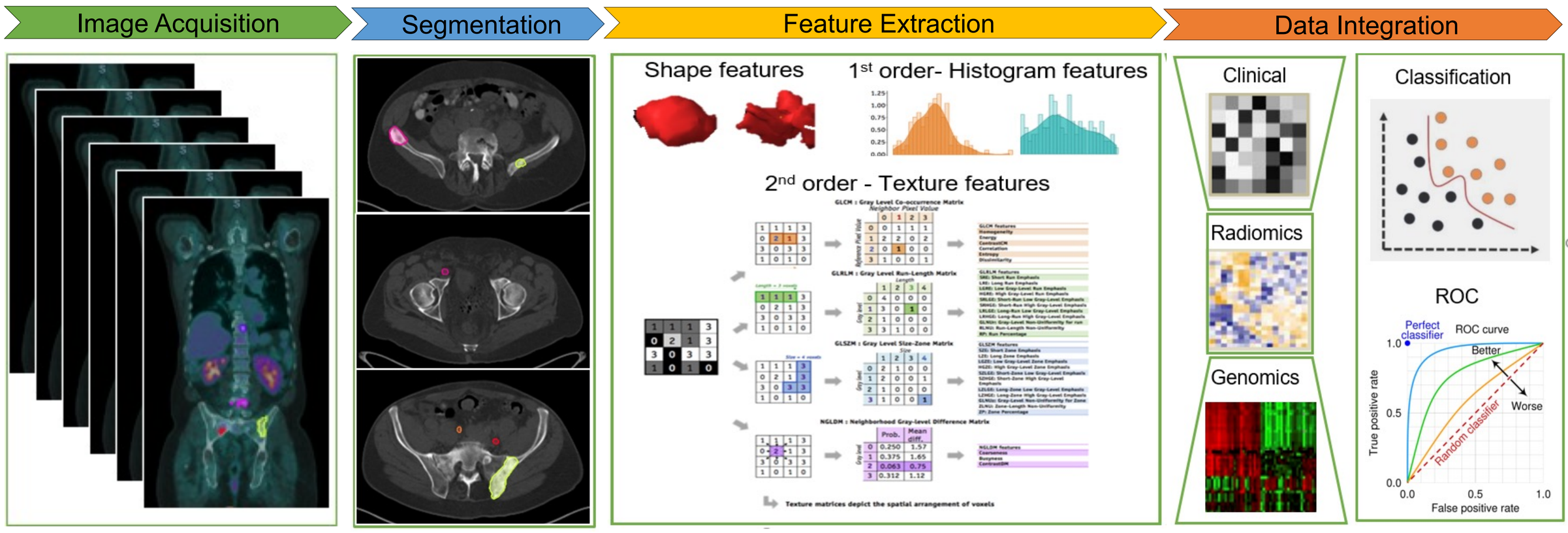
Department of Radiation Oncology, Rutgers Cancer Institute of New Jersey, Rutgers University, NJ

Introduction

- PSMA PET imaging is a sensitive modality for detection of early metastases in prostate cancer (PC)
- Optimal integration of PSMA scans in routine follow-up is unknown
- Hypothesis: Multi-omics (Radiomics + genomics + clinical details) could predict PSMA avidity in lesions seen on CT imaging

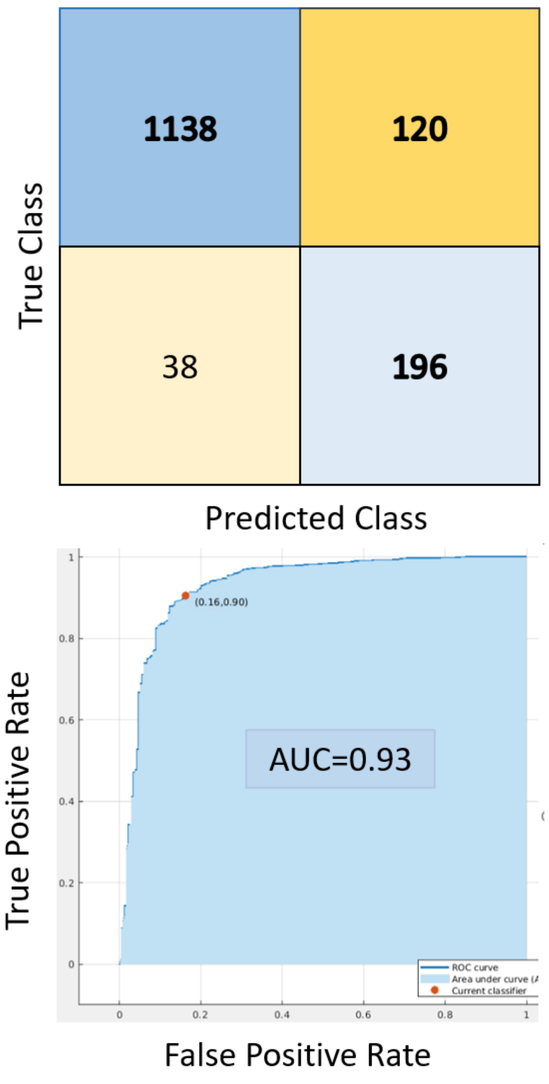
Material and Methods

- Oligometastatic castrate-sensitive PC patients with PSMA PET, genomic mutational analysis and clinical details (n=84)
- High-risk mutations was defined as pathogenic mutations in ATM, BRCA1/2, Rb1 or TP53)
- Both PSMA avid and non-avid lesions in lymph node and bone were contoured on CT images.
- Radiomic features were extracted for all lesions using PyRadiomics.
- ML algorithms [support vector machine (SVM) and decision trees] were used to predict PSMA avidity in CT anatomic correlates
- Five-fold cross validation



Results

Patient and Lesion Characteristics	
Total Number of patients	84
Total Lesions • PSMA + (avid) • PSMA - (non-avid)	1492 • 234 • 1258
LN Lesions • PSMA + (avid) • PSMA - (non-avid)	1016 • 164 **(16.14%)** • 852
Bone Lesions • PSMA + (avid) • PSMA - (non-avid)	332 • 47 **(14.2%)** • 285
Lesion per pt (Median / IQR)	2(1 - 3)
Low volume disease	96.4%
High Risk Mutations • TP53 • PTEN • BRCA 2 • ATM • BRCA 1 • CHEK2 • ATRX • RB1	**34.5%** • 20.2% • 14.3% • 8.3% • 4.8% • 2.4% • 2.4% • 2.4% • 1.3%



Best Predictive Model	
Top 5 Features	• Site of lesion • Volume of lesion • Total number of lesions seen on CT • Gray level non-uniformity • High Risk mutation
Other Features	• Large area Gray level emphasis • Coarseness • Non-uniformity • CHEK2 mutation • FANCD2 mutation • Pre-metastatic PSA.
Sensitivity	• **83.7%** • 196 of 234 lesions
Specificity	• **90.4%** • 1138 of 1258 lesions
AUC	• **0.88 – 0.93**

Conclusions

- Multi-omics including radiomics, genomics and clinical factors can predict PSMA avidity in early metastatic lesions in LN and bones on CT imaging in oligometastatic castrate-sensitive Prostate Cancer
- This approach can be applied for better personalization and decision-making regarding PSMA surveillance imaging.
- This multi-omics model needs to be further validated in a larger independent cohort.