Multimodality Imaging Approach to Predict Antineoplastic Therapy Induced Cardiotoxicity

Sarah Herbert[1], Sonia-Frida Ndifon[1], Axel Schon[1], Raafay Uqaily[1,2], Srinivas Palanki[1], Brijesh Patel[2]

[1] Department of Chemical and Biomedical Engineering, West Virginia University, Morgantown, WV, USA
[2] Heart and Vascular Institute, Division of Cardiology, West Virginia University, Morgantown, WV, USA

Background

- Cardiotoxicity, which is heart damage caused as a result of chemotherapeutic treatment, is the second leading cause of death in cancer-surviving patients.
- Utilizing available biomarkers from routine surveillance imaging like CT scans can be cost-effective and prognostically important.
- **Objective:** Develop an artificial intelligence (AI) model that can isolate the aortic wall and extract radiomic features to predict the risk of cardiotoxicity.

Central Illustration

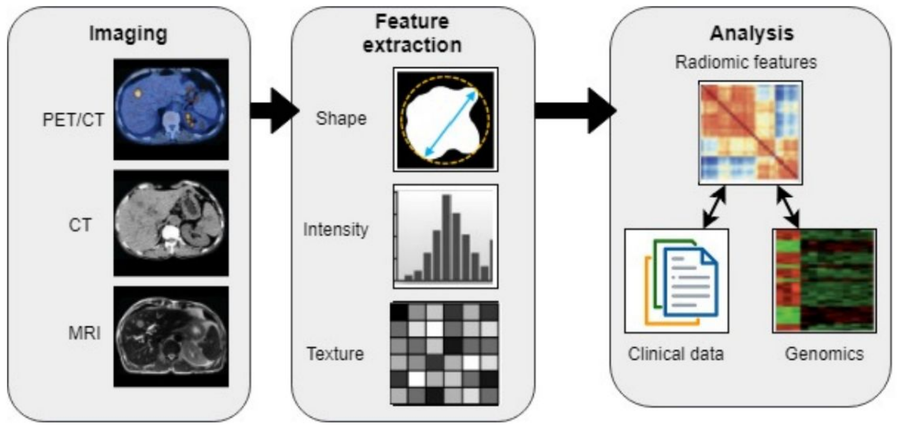

Figure 1. *Central Illustration of the Project[1].*

Methods

- CT scans of 20 patients were obtained from electronic medical records.
- Images were classified as *contrast* and *non-contrast* based on pixel values at the center of the aorta.
- Images were blurred to average out rapid changes in pixel intensity using a Gaussian blur with a five by five kernel size.
- Images were thresholded using built-in algorithms in Python like *Binary* and *Otsu.*
- The thresholded images were combined to produce a final mask.
- File pathways for the original images and final masks were exported as a csv file.
- PyRadiomics was utilized to extract radiomic data for all images in the csv file.

Python & PyRadiomics Output

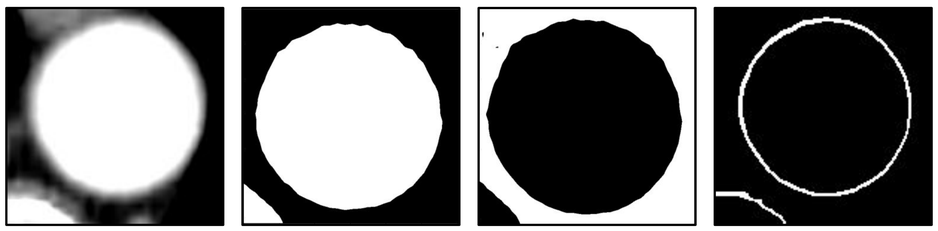

Figure 2. *Image Thresholding Sequence for Patient #1.*

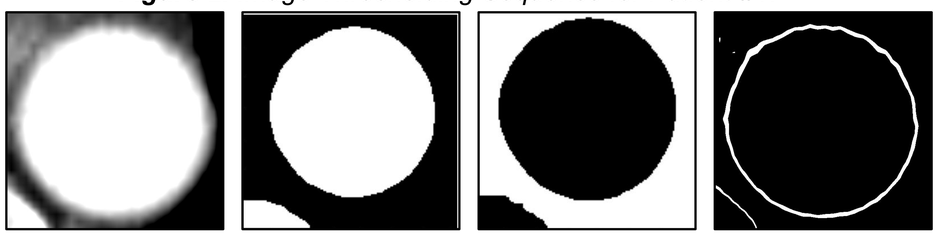

Figure 3. *Image Thresholding Sequence for Patient #2*

Table 1. Sample PyRadiomics Output.

Patient	Contrast	Complexity	Cluster Shade	Gray Level Variance	Coarseness	Busyness
#1	0.051	2.814	-0.218	0.611	0.007	20.375
#2	0.012	0.354	-0.080	0.302	0.001	226.819

Clinical Implications

- Wall inflammation is a common indication of cardiovascular disease (CVD).
- AI models can aid in the early detection of CVD like cardiotoxicity.
- Early detection allows for cardio-protection and formulation of monitoring strategies.

Conclusion

- Using built-in image thresholding algorithms within Python, the aortic wall was successfully isolated in contrast CT scans.
- Through PyRadiomics' batch processing,120 unique radiomic features were extracted for all input images.

Future Works

- Improve image thresholding methods for non-contrast CT scans.
- Enhance program functionality to remove unwanted artifacts in the final masks.
- Analyze radiomic features in conjunction with clinical data to develop a predictive machine learning model that can predict cardiotoxicity risk.

References

[1] K.M. Meijer, "Accuracy and stability of radiomic features for characterising tumour heterogeneity using multimodality imaging: a phantom study," M.A. thesis, Department of Technical Medicine, University of Twente, Enschede, Netherlands, 2019