Lisa Duff

Short Biography:

My current project is based with in the NIH and Cancer Research UK Grand Challenge for Cancer Cachexia. Our team explores the tumor-patient metabolic relationship using PET Imaging. Recently, I finished my PhD which explored the utility of Image Analysis of PET imaging for the diagnosis of Large Vessel Vasculitis and Aortitis.

Throughout my academic career, I have engaged in diverse and interdisciplinary research primarily in the areas of physical sciences, data analysis, and their applications in the medical field, particularly medical imaging. My passion for working in teams comprising individuals from various backgrounds has been a constant source of excitement for me, as it provides a great opportunity to learn about new topics, and allows ideas to combine in completely novel ways.

I have always been drawn to interdisciplinary work since starting my undergraduate master's degree in chemistry and physics. During this time, I explored ways I could make a positive impact through science. Initially, I explored renewable energies, but a year-long industry experience with Merck sparked my interest in medical imaging. Upon returning to university, I chose a Master's project on using Raman Spectroscopy for medical applications.

Subsequently, I pursued a combined MSc and PhD in Tissue Engineering and Regenerative Medicine, culminating in a PhD that explored quantitative analysis of FDG PET-CT imaging of Large Vessel Vasculitis for diagnosis. Through this work, I gained proficiency in radiomics, machine learning, and image analysis.

Throughout my master's, PhD, and now post-doctoral position, I have had the privilege of working with diverse local and global research groups and attending varied conferences, enhancing my understanding of imaging techniques and their clinical uses. Collaboration has allowed me to build a more rounded knowledge of imaging techniques, as well as their uses in clinical practice, as shown by my publications co-authored with clinicians.

My short- and medium-term goals include utilizing PET image analysis to decode the mechanisms behind cancer cachexia for early detection, stratification, and treatment development. Additionally, in the long term, I aspire to make healthcare more accessible locally and globally, and I am committed to making a significant impact through scientific research, translation, collaboration, and mentoring.

Abstract:

Aortitis refers to inflammatory pathologies affecting the aortic wall, which cannot be solely ascribed to atherosclerosis. The primary type of non-infectious aortitis is referred to as Large Vessel Vasculitis (LVV), potentially impacting any of the major arteries. The diagnostic and therapeutic challenges linked to aortitis and LVV stem from multiple factors, such as vague symptoms, non-specific

diagnostic tests, diverse underlying causes, and the inherent risks associated with inaccurate or delayed interventions.

[18F]-Fluorodeoxyglucose Positron Emission Tomography-Computed Tomography (FDG PET-CT) imaging serves as a vital tool in the identification of LVV, due to its capacity for early and non-invasive detection of inflammation. However, its qualitative evaluation leaves it susceptible to subjective bias and inter-observer discrepancies. As a consequence, there is a pressing demand for more dependable imaging biomarkers, a goal attainable through radiomic analysis.

The primary objective of this project was to investigate the diagnostic efficacy of radiomic features within FDG PET-CT imaging for aortitis. A systematic automated framework was devised and validated to aid in the diagnosis of active aortitis, utilizing radiomic imaging biomarkers extrapolated from [18F]-FDG PET-CT images. Initially, a convolutional neural network (CNN) algorithm was employed to accurately and automatically delineate the aorta from FDG PET-CT scans of both aortitis-afflicted and control subjects. The FDG PET-CT dataset was subsequently divided into three distinct cohorts: training (comprising 43 aortitis and 21 control cases), testing (consisting of 12 aortitis and 5 control instances), and validation (encompassing 24 aortitis and 14 control samples). Radiomic features, including Standardized Uptake Value (SUV) metrics, were extracted from the segmented data and standardized.

Three distinct radiomic profiles were established: Profile A, which retained RFs (radiomic features) with pronounced diagnostic utility by eliminating highly correlated RFs; Profile B, leveraging principal component analysis (PCA); and Profile C, employing Random Forest intrinsic feature selection. The effectiveness of these profiles was evaluated through accuracy measurements and the area under the receiver operating characteristic curve (AUC). Numerous RFs and radiomic profiles exhibited noteworthy AUC values (AUC > 0.8), a pattern confirmed across training, testing, and externally validated datasets by means of balanced accuracy. The robust diagnostic performance demonstrated across diverse multi-center datasets suggests the potential for broad applicability of the radiomic pipeline. These findings could potentially underpin the development of an automated clinical decision support tool, fostering an objective and standardized evaluation process irrespective of observer expertise.