

Application of novel AI-assisted technology in ¹⁸F-FDG PET-CT scan analysis – Predicting disease response in metastatic melanoma patients undergoing immunotherapy

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The patient population included 25 male and 19 females, average age 66 (range 23-85). First line immunotherapy included pembrolizumab (n= 28), ipilimumab (n= 3), nivolumab (n= 5) and ipilimumab + nivolumab (n= 8).

Heterogeneity (based on total lesion glycolysis) was observed in 12/44 patients (Figure 1).

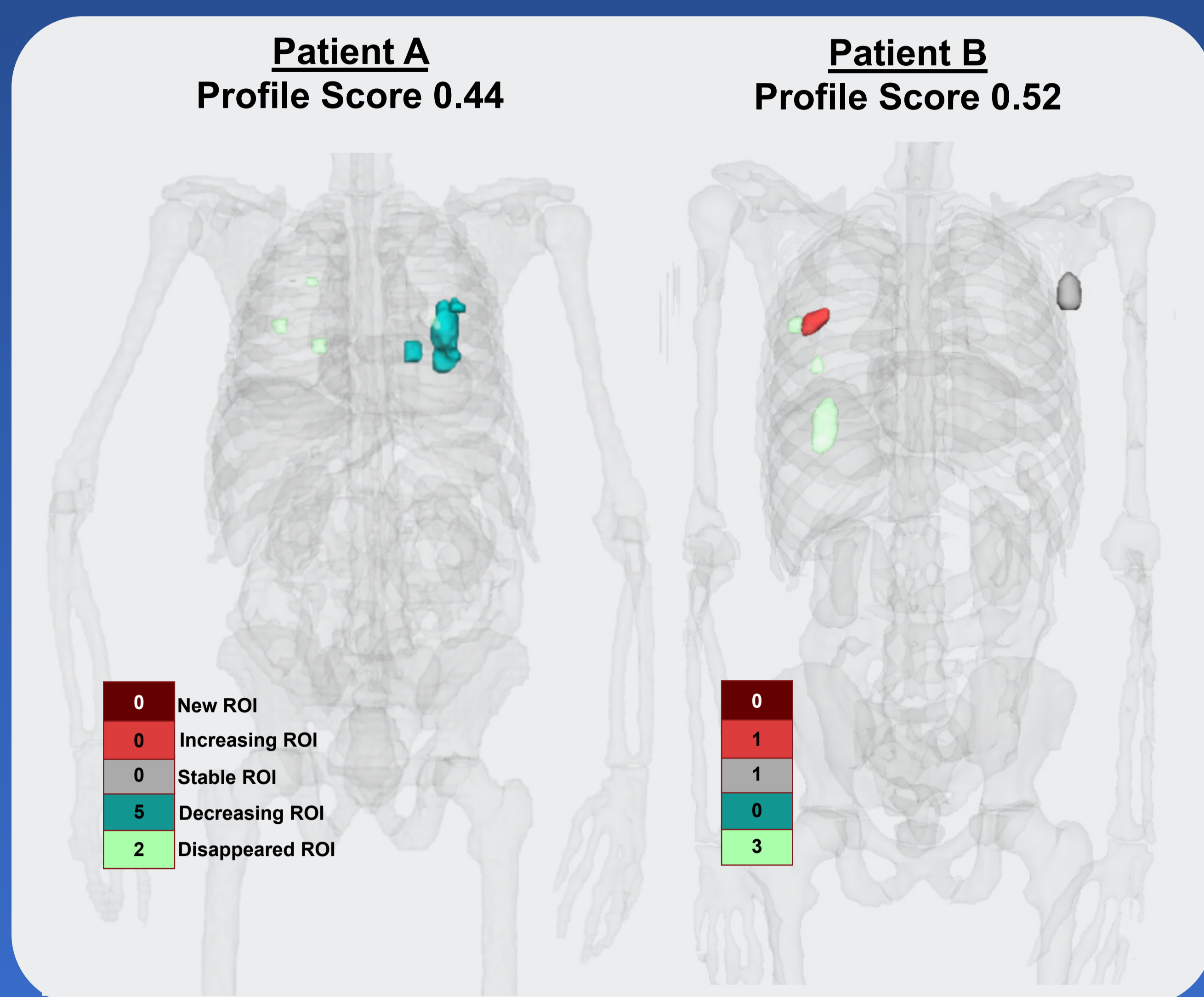


Figure 2. Quantification of change maps demonstrating a higher TRAQinform profile score for patient A who had a better outcome compared to patient B.

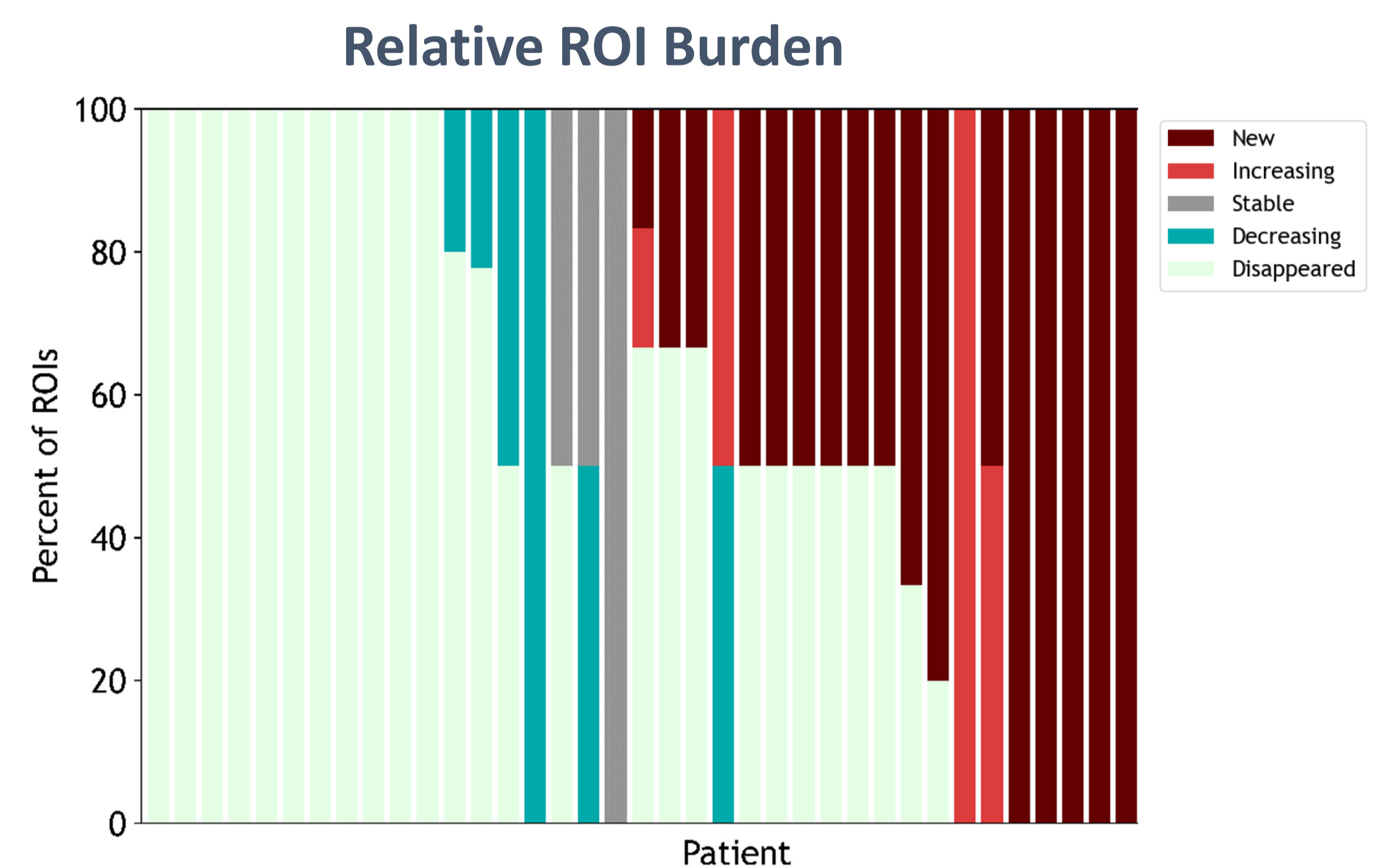


Figure 1. Heterogeneity assessment of 37 patients' images with ¹⁸F-FDG PET-CT (7 patients had no ROI detected and therefore were excluded). Each patient is a column divided into colors representing % of ROI each response category.

The top univariate predictors of response to immunotherapy based on time to progression were change in uptake heterogeneity (defined as standard deviation of all ROI SUV_{mean}) (c-index= 0.73), heterogeneity of uptake at baseline (c-index= 0.69), SUV_{total} at baseline (c-index= 0.68), number of decreasing ROI (c-index= 0.68) and number of ROI at baseline (c-index= 0.68).

TRAQinform Profile resulted in the highest predictive power (c-index= 0.75).

Figure 2 shows an example of quantification of change maps for individual patients.

Background

- Immunotherapy has proven its ability to yield durable responses in patients with metastatic melanoma (MM), as evidenced by the findings from ¹⁸F-FDG PET-CT medical imaging ¹.
- By leveraging the valuable information embedded in scans conducted early in the treatment process, there is potential to predict treatment effectiveness based on biomarkers of responding disease ².
- This study applied novel AI-assisted technology to automatically extract features from ¹⁸F-FDG PET-CT images in patients receiving first line immunotherapy in order to evaluate heterogeneity.

Conclusion

This study demonstrates that an AI-assisted analysis can help predict disease response using quantitative features from ¹⁸F-FDG PET-CT imaging of patients with metastatic melanoma undergoing immunotherapy. These results support further investigation into individual outcomes, type of immunotherapy and warrants future studies to validate these findings in a prospective cohort.

Methods

- Baseline (pre-immunotherapy) and follow up ¹⁸F-FDG PET-CT scans from 44 patients with MM were collected retrospectively. These scans were taken between 2013 and 2022 for patients treated with immunotherapy.
- Progression free survival was defined as the start date of immunotherapy to the date of clinical progression or last cycle of immunotherapy.
- TRAQinform IQ software (AIQ Solutions, Madison, WI) was used to analyse ¹⁸F-FDG PET-CT scans and identify regions of interest (ROI) and evaluate change across the two timepoints.
- Imaging features were input into the TRAQinform Profile (AIQ Solutions), which used 5-fold cross-validation of a random survival forest to predict time on immunotherapy.
- Univariate metrics were assessed using Cox proportional hazards regression.
- Predictive power of individual metrics and TRAQinform Profile were evaluated using the c-index.

References

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CONFLICT OF INTEREST: NR, DH, RMG, and TP are employed by AIQ Solutions (Madison, WI, USA). AIQ Australia Pty Ltd in collaboration with UWA have established AIQ Research Fellows - full time research fellowships in medical imaging. Dr Dell'Oro holds one of these Fellowships.