Automated Analysis of FDG-PET/CT Imaging to Monitor Heterogeneous Disease Response in Metastatic Castration-Resistant Prostate Cancer

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Background & Introduction

- **Heterogeneity of individual sites of disease** in prostate cancer is well recognized and can increase over time as the therapies administered promote divergent evolution
- Often depicted in PET scan reports as a **mixed-response**; wherein some lesions improve and others progress or emerge
- **Individualizing management is challenging**, especially in patients with high volume disease for whom inability to concisely and effectively assess overall disease status may mask **emerging resistance that could benefit from early focal intervention and/or a change in therapy**

Methods

Response Analysis

- Thirty-one sets of serial baseline and on-treatment FDG-PET scans from patients with mCRPC were analyzed using **TRAQinform IQ software (AIQ Solutions)**
- Individual **regions of interest (ROI) were identified, quantified, matched across multiple images, and analyzed** for a range of quantitative and spatial features (fig 1)

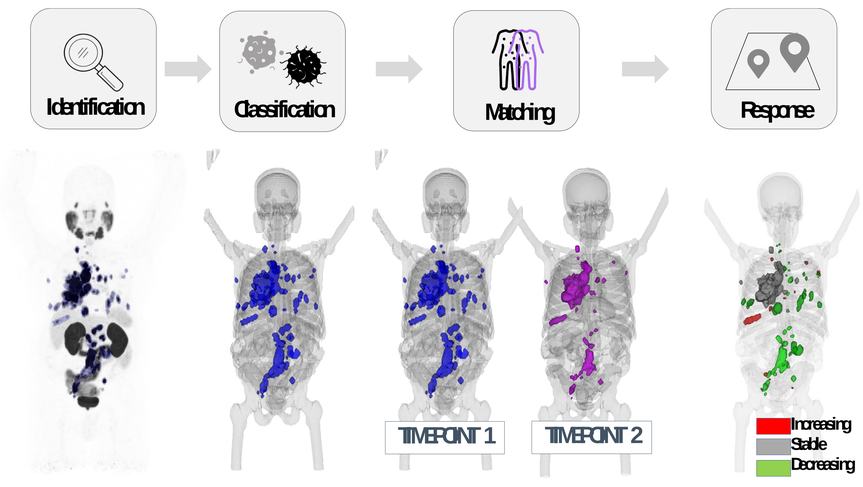

Figure 1.

Methods

Prognostic Biomarker

- Single time-point and dynamic **imaging features (output of TRAQinform IQ: see fig 3) and PSA values/dynamics were assessed in Cox regression model to develop a prognostic model for overall survival (OS)**
- **3-fold cross validation** of a random survival forest was performed to train the model **for predicting OS** using the **TRAQinform Profile software**
- **TRAQinform Profile** reports were reviewed for individual cases to **characterize progression** and to evaluate the potential impact on **patient management**

Results

- Significant **inter-lesion response heterogeneity was observed across the population**, with nearly all patients demonstrating mixed response (fig 2)

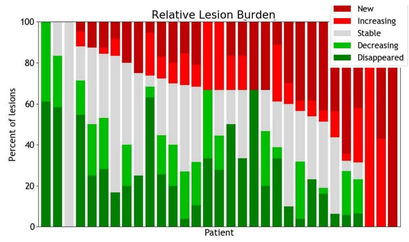

Figure 2.

- **Imaging features were more closely correlated with OS** than PSA in univariate Cox regression models (fig 3)
- Best performing model included the baseline total lesion glycolysis (**TLG**), number of new/increasing lesions ($\mathbf{N_{red}}$), and **three PSA variables**
- **Low Score group had significantly longer median OS** than those in the High Score group (630 days vs 1326 days; $p < 0.01$, c-index = 0.744) (fig 4)

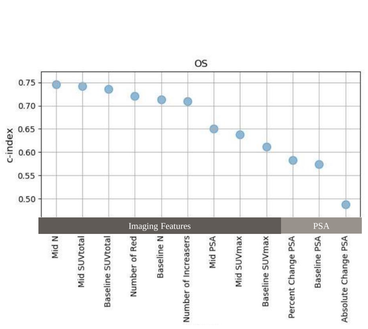

Figure 3.

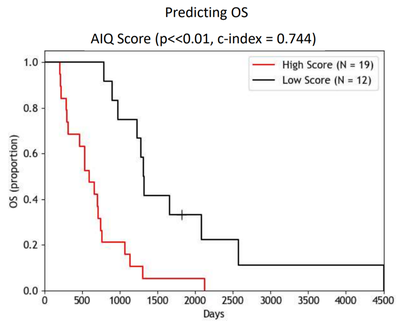

Figure 4.

Case Report: Oligoprogression

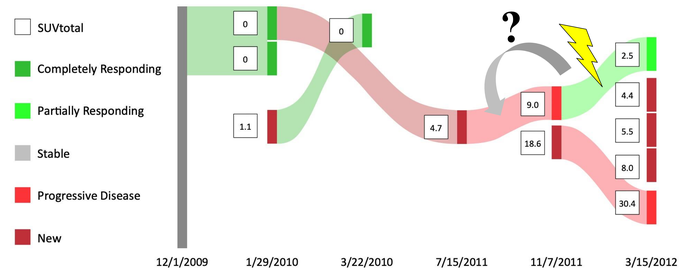

Figure 5.

- TRAQinform IQ reports **clearly identify oligo-progression** months prior to the emergence of more widespread progression (fig 5)
- Focal RT was eventually administered, but **earlier intervention based on the TRAQinform IQ report could have potentially further delayed systemic progression** and prolonged the benefit of the therapeutic regimen

Case Report: Diffuse Progression

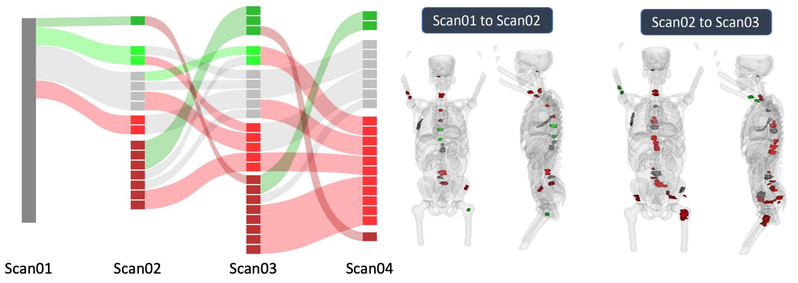

Figure 6.

- Conversely, TRAQinform IQ reports can **identify patients with more diffuse progression (higher $\mathbf{N_{red}}$ & TLG)** for which focal treatment may not be suitable (fig 6)

Conclusions

- TRAQinform Profile software can be used on FDG PET/CT scans to accurately stratify patients into good and poor prognostic groups
- TRAQinform IQ reports can potentially serve as a valuable resource in the clinic to help evaluate the extent of progression and determine the appropriate intervention

References

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