Robust radiomic feature selection in magnetic resonance apparent diffusion coefficient maps of rectal cancer

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Purpose. Changes in Apparent Diffusion Coefficient (ADC) intensities derived from Magnetic Resonance (MR) imaging have been shown to be potentially predictive of (chemo) radiotherapy response in rectal cancer. Radiomics is a non-invasive, computer-assisted extraction of image-based biomarkers that assist in characterization of tumour phenotype. This study concerns the identification and selection of robust (i.e. repeatable and reproducible) radiomic features in MR-ADC across independent scanners in The Netherlands and Denmark.

Methods. Retrospective datasets (23 cases from the THUNDER clinical trial and 34 cases from a Danish watchful-waiting protocol) were independently manually delineated. Radiomic features were extracted using public open source software. Repeatability was examined using concordance and intra-class correlation coefficients for sensitivity to inter-observer disagreement, image re-processing and effect of image filters.

Results. Significant intra-class correlations were observed between related sets of features. Histogram-based features were least sensitive to variations with respect to resampling and quantization (78% and 89% of features, respectively, exceeding the highest reproducibility criterion). Global robustness was adversely affected by image pre-processing. Textural features exhibited the highest sensitivity to processing steps, for all of the examined options. A number of radiomic features were found to be correlated with tumour volume, which should be a noted as a potential confounder for future radiomics studies.

Conclusions. This study showed that radiomic features were differentially affected by specific choices made along the processing pathway. In general, histogram features were least sensitive to details of processing, while shape metrics and textural features are more susceptible to heterogeneity in delineation, slice thickness and filtration. The latter was most likely due to its reliance on subtly nuanced properties within the image. Identification and selection of robust radiomic metrics are essential for development of clinically actionable prognostic models for rectal cancer incorporating image-based biomarkers.

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Tumour segmentation in longitudinal diffusion weighted MRI of rectal cancer patients receiving radiotherapy

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Purpose. Target volume delineation is a fundamental step in radiotherapy and is subject to considerable inter-observer variation. Diffusion weighted magnetic resonance imaging (DW-MRI) is being investigated for tumour definition in locally advanced rectal cancer (LARC), offering high contrast between volumes with different diffusion characteristics. Segmentation algorithms such as k-means clustering have the potential to improve consistency of target delineation. In this study we have evaluated the performance of two segmentation algorithms for target definition by comparing them to expert delineations on longitudinal DW-MRIs for patients with LARC.

Methods. Weekly repeat DW-MRI scans (b-values: 0, 150, 1000 s/mm²) were recorded on a 1.5T Philips Ingenia MR scanner (Best,