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A Novel Technique to Evaluate Skin Toxicity in Breast Cancer Radiotherapy

R Culcasi

M Vlachaki

M Snyder
Beaumont Hospital

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80.45±3.51/1.64±0.10, 162.50±7.48/2.29±0.71 and 124.19±8.88/2.11±0.50 (GGybp)−1 for 1ZBB (4_601_167 Tetranucleosome), 1bna (B-DNA DODECAMER) and 1tsr (P53 CORE DOMAIN IN COMPLEX WITH DNA), respectively. The mean SSB/DSB RBEs calculated by its respective DNA model are 1.56±0.13/2.17±0.79 (1ZBB), 1.85±0.45/3.11±1.69 (1bna), and 1.81±0.37/2.77±1.46 (1tsr) for electrons, 2.95±0.81/6.47±5.10 (1ZBB), 2.10±0.49/9.32±6.31 (1bna), and 1.92±0.37/7.26±4.76 (1tsr) for protons for concerned energies. However if the DNA models were confused by each other, there will bring differences of 2.02 /1.29 times to SSB/DSB RBEs. **Conclusion:** As far as the direct ionizing radiation is considered, the atomistic DNA model remarkably affects RBE value. It is better that RBE value labels acquisition from which type of DNA.And the precise radiobiological quantity should also consider these factors like DNA atoms number, structure and composition etc.

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PO-GePV-T-108, A Multi-Centre Multi-Omics Study of Critical Weight Loss Prediction in Nasopharyngeal Carcinoma Patients Undergoing Chemo-Radiotherapy: J SUN[1]*, S Lam[2], X Teng[3], J Zhang[4], Z Ma[5], C Liu[6], W Li[7], H Xiao[8], Y Huang[9], X Han[10], F Lee[11], W Yip[12], A Cheung[13], H Lee[14], K Au[15], J Cai16</sup>,(1) HKU/POLYU, Tko, , HK, (2) Duke Kunshan University, Kunshan, , CN, (3) The Hong Kong Polytechnic University, Hong Kong, Hong Kong, HK, (4) Duke Kunshan University, Nantong, 32, CN, (5) The Hong Kong Polytechnic University, , , (6) The Hong Kong Polytechnic University, Hong Kong, Hong Kong, (7) The Hong Kong Polytechnic University, , , (8) The Hong Kong Polytechnic University, Hong Kong, 91, CN, (9) The Hong Kong Polytechnic University, Hung Hom, Kowloon, (10) , , , (11) Queen Elizabeth Hospital, Hong Kong, , HK, (12) Queen Elizabeth Hospital, Hong Kong, , CN, (13) , , , (14) The University Of Hong Kong, , , (15) Hong Kong Queen Elizabeth Hospital, , , (16) Hong Kong Polytechnic University, Hong Kong, , CN

Purpose: To develop a clinically generalizable multi-omics model for predicting critical weight loss (CWL) in nasopharyngeal carcinoma (NPC) patients during concurrent chemoradiotherapy (CRT) via a multi-centre study**. Methods:** NPC patients from two hospitals were retrospectively collected and assigned as primary (N=64) and validation (N=59) cohort, respectively. The threshold of CWL was set to be percentage weight loss > 10% during CRT. Shape, energy, and texture feature of radiomics (Rx) and dosiomics (Dx) were extracted from computed tomographic images and dose maps, respectively, from four organ structures including primary gross-tumor-volume (GTVnp), nodal gross-tumor-volume (GTVn), bilateral parotid glands and larynx. A univariate filter (p-value < 0.1) was used, followed by forward ridge recursive feature elimination classifier to select predictive features in the primary cohort for Support Vector Machine modelling. Pre-treatment body mass index (BMI) was set as the baseline model (BMI-only), three omics-models (BMI+Rx, BMI+Rx+Dx, Rx+Dx) were then developed. Model performance was evaluated in validation cohort with Receiver-Operation-Characteristics (ROC) curve and Decision Curve Analysis (DCA)**. Results:** Four Rx features and eight Dx features were identified among the studied models. Model with BMI+Rx+Dx obtained the highest training (primary) score, achieving an area under ROC curve (AUC) = 0.91, outperforming other comparing models. This model also yielded the best validation score in validation cohort with AUC = 0.79. Compared to the BMI-only model, addition of either Rx or Dx features improved the model's predictive power (validation AUC: BMI-only= 0.42; BMI+Rx=0.61; BMI+Rx+Dx=0.79). Furthermore, the BMI+Rx+Dx model also demonstrated the highest net benefit compared to "treat-all/treat-none" patients in DCA when the threshold probability was larger than 0.35**. Conclusion:** The multi-omics model (BMI+Rx+Dx) outperformed other comparing models, demonstrating its strong capability and net benefit in differentiating the clinical heterogeneity of patients' CWL during RT. Further, external validation of the model highlighted its generalizability toward potential clinical applications.

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PO-GePV-T-109, A Novel Technique to Evaluate Skin Toxicity in Breast Cancer Radiotherapy: R Culcasi[1]*, M Vlachaki[1], M Snyder[2],(1) Ascension St John Hospital, Grosse Pointe, MI, (2) Beaumont Hospital, Huntington Woods, MI

Purpose: To evaluate skin toxicity throughout breast radiotherapy by visualizing variations in Eulerian amplified microcirculation and correlating to skin temperature as measured by a thermal camera**. Methods:** High-resolution monochrome video recordings and thermal images were acquired for four breast cancer patients prior to radiation treatment followed weekly over 3-5 weeks. During these visits, the radiation oncologist assessed the patient's skin following the CTCAE scoring system. Videos were amplified by a factor of 100 for frequencies near the patient's measured heart rate (as measured by a fingertip pulse oximeter) with a bandwidth of 0.2Hz, based on a technique developed by CSAIL at M.I.T. The amplitude of the dynamic changes during cardiac cycle were assessed as a ratio of the regions of interest (ROI's) within the treated breast compared to the contralateral breast for normalization.

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Maximum skin temperature was evaluated in the treated breast ROI each week. These metrics were compared to provide a correlation between a novel technique for assessing skin toxicity with a known surrogate of skin damage**. Results:** This computational technique was able to visualize subtle color changes due to blood flow that would have otherwise been invisible to the clinician's eye. The increasing change in amplitude between the treated and contralateral breasts was found to correlate with the changes in maximum temperature observed within the treated breast. These increasing changes were detected prior to visible skin erythema over treatment**. Conclusion:** Eulerian amplification was found to be capable of detecting non-visible changes in microcirculation based on amplification of subtle skin color changes in this feasibility study. These detected changes followed similar trends to changes in skin temperature over treatment. The measured amplitude changes provide a surrogate of skin damage and thus yield a novel technique for evaluating skin toxicity during breast radiotherapy prior to clinical manifestation.

PO-GePV-T-110, Development and Validation of Treatment-Specific Prediction Models for Critical Weight Loss in Nasopharyngeal Carcinoma Patients – A Multi-Centre Study: J SUN[1*], S Lam[2], X Teng[3], J Zhang[4], Z Ma[5], Y Huang[6], H Xiao[7], C Liu[8], W Li[9], X Han[10], F Lee[11], W Yip[12], A Cheung[13], H Lee[14], K Au[15], J Cai16</sup>,(1) HKU/POLYU, Tko, , HK, (2) Duke Kunshan University, Kunshan, , CN, (3) The Hong Kong Polytechnic University, Hong Kong, Hong Kong, HK, (4) Duke Kunshan University, Nantong, 32, CN, (5) The Hong Kong Polytechnic University, , , (6) The Hong Kong Polytechnic University, Hung Hom, Kowloon, (7) The Hong Kong Polytechnic University, Hong Kong, 91, CN, (8) The Hong Kong Polytechnic University, Hong Kong, Hong Kong, (9) The Hong Kong Polytechnic University, , , (10) , , , (11) Queen Elizabeth Hospital, Hong Kong, , HK, (12) Queen Elizabeth Hospital, Hong Kong, , CN, (13) , , , (14) The University Of Hong Kong, , , (15) Hong Kong Queen Elizabeth Hospital, , , (16) Hong Kong Polytechnic University, Hong Kong, , CN

Purpose: To develop and validate treatment-specific prediction models for critical weight loss (CWL) in nasopharyngeal carcinoma (NPC) patients during radiotherapy (RT) course via a multi-centre setting**. Methods:** A total of 303 and 146 NPC patients, retrospectively recruited from two medical centres, were allocated to a training group (n=303) and testing group (n=146), respectively, forming a Combined Cohort (CC) regardless of treatment regimens. From the CC, three treatment-specific sub-cohorts were formed according to the prescribed treatment regimen, including Concurrent Chemoradiotherapy (CRT), CRT plus Adjuvant Chemotherapy (ACR), and Induction Chemotherapy plus CRT (ICR), with a ratio of training to testing samples being 189:27, 64:59 and 51:60, respectively. Radiomics and dosiomics features were extracted from four organ structures using computed tomography images (GTVnp, GTVn, Parotids, and Larynx). Model development was performed in the training samples of each cohort separately. A filter-based recursive feature elimination method was employed for feature selection and feature dimensionality reduction. The remaining features were then passed into a Support Vector Classifier to predict CWL of >10% during the RT course. External model validation was performed in testing samples of respective cohorts. The Area under Receiver-Operating-Characteristics Curve (AUC) and Brier score (BS) were used to evaluate model discriminability and calibration, respectively**. Results:** All treatment-specific models demonstrated an improved discriminability in both training and external testing samples compared to the CC model (Training AUC: CC=0.75, CRT=0.95; ACR=0.91, ICR=0.81; Testing AUC: CC=0.57, CRT=0.79, ACR=0.79, ICR=0.78), and also displayed better probabilistic prediction accuracy (calibration) (Testing BS: CC=0.24, CRT=0.18, ACR=0.17, ICR=0.18). Besides, a smaller difference between training and testing AUC was observed in treatment-specific models, suggesting a mitigated issue of overfitting**. Conclusion:** Three treatment-specific models were developed and demonstrated satisfactory and superior model discriminability and calibration performance than the CC model in external testing samples, meanwhile showing less degree of model overfitting.

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PO-GePV-T-111, Improvements On Acute Gastrointestinal Toxicity Modeling by Using Deep-Learning Auto-Segmentation: R Salazar*, J Duryea, A Leone, S Nair, R Mumme, H Baroudi, T Netherton, E Holliday, T Whitaker, K Hoffman, L Court, J Niedzielski, UT MD Anderson Cancer Center, Houston, TX

Purpose: To test the hypothesis that, compared with the use of manual contours, the increase in consistency provided by deep learning segmentation will lead to improved NTCP models**. Methods:** An auto-segmentation model (nnU-Net) of bowel bag contours was trained and tested on 32 and 8 patients, respectively, using consistently drawn contours approved by a GI radiation oncologist. The bowel bag was then auto-contoured on 195 anal cancer patients CTs, and DVH metrics were extracted on their manually delineated clinical contours (manual-DVHs) as well as those generated automatically (auto-DVHs). Random forest NTCP models for an endpoint of ≥ grade 2, acute, GI tract, CTCAE toxicity were trained with clinicopathological factors and DVH metrics as model predictors. Using the auto-DVHs, 100 models were built following a 10 times 3-fold cross-validation approach on distinct training sets each consisting of 146

