Radiomic analysis of salivary glands and its role for predicting xerostomia in irradiated head and neck cancer patients

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Purpose/Objectives

- To determine the radiomic predictors for xerostomia (dry mouth)
- Hypothesis: Imaging features of pretreatment images can quantify the baseline salivary gland function for predicting xerostomia.

Materials/Methods

- **Primary endpoint:** prediction of grade ≥ 2 xerostomia during 3 to 6 month post-RT
- **Algorithm**: LASSO logistic regression
  - Three models were developed with
    (1) both imaging features and DVH
    (2) only DVH
    (3) only imaging features.
- **Data**: 87 head and neck IMRT patients
  - **Imaging**: from planning CT
    - 5,000 imaging features for each ROI (L/R parotid/submandibular gland)
    - intensity, volumetry, shape, texture
  - **Dosimetry**: DVH of parotid and submandibular glands
  - **Clinical**: xerostomia

Table 1. Demographic data (N=87)

Variable	N (%)
Age ≥ 60	33 (38%)
Male	71 (82%)
Caucasian	43 (49%)
Chemotherapy	69 (79%)
T stage ≥ T3	27 (31%)
N Stage ≥ N2	52 (60%)
Site, pharynx	37 (43%)
Xerostomia ≥ 2	42 (48%)

Results

- Imaging features combined with DVH improved AUC of predicting xerostomia ($p < 0.05$)

Table 2. AUC of the prediction models

Variables in the Prediction Model	AUC
(1) Both imaging features and DVH	**0.81**
(2) Only DVH data	0.70
(3) Only imaging features	0.63

Table 3. Odds ratio of the prediction model (1)

	Predictive Factor	odds ratio
Texture	NGTDM (ipsilateral parotid)	0.58
	GLCM (ipsilateral parotid)	0.45
	RLE (ipsilateral parotid)	2.05
Shape	aspect ratio (ipsilateral submandibular)	0.51
DVH	combo parotid D95 [Gy]	1.19
	combo submandibular D50 [Gy]	1.09

NGTDM: Neighborhood Gray-Tone Difference Matrix
GLCM: Grey Level Co-occurrence Matrix
RLE: grey level Run Length Encoding

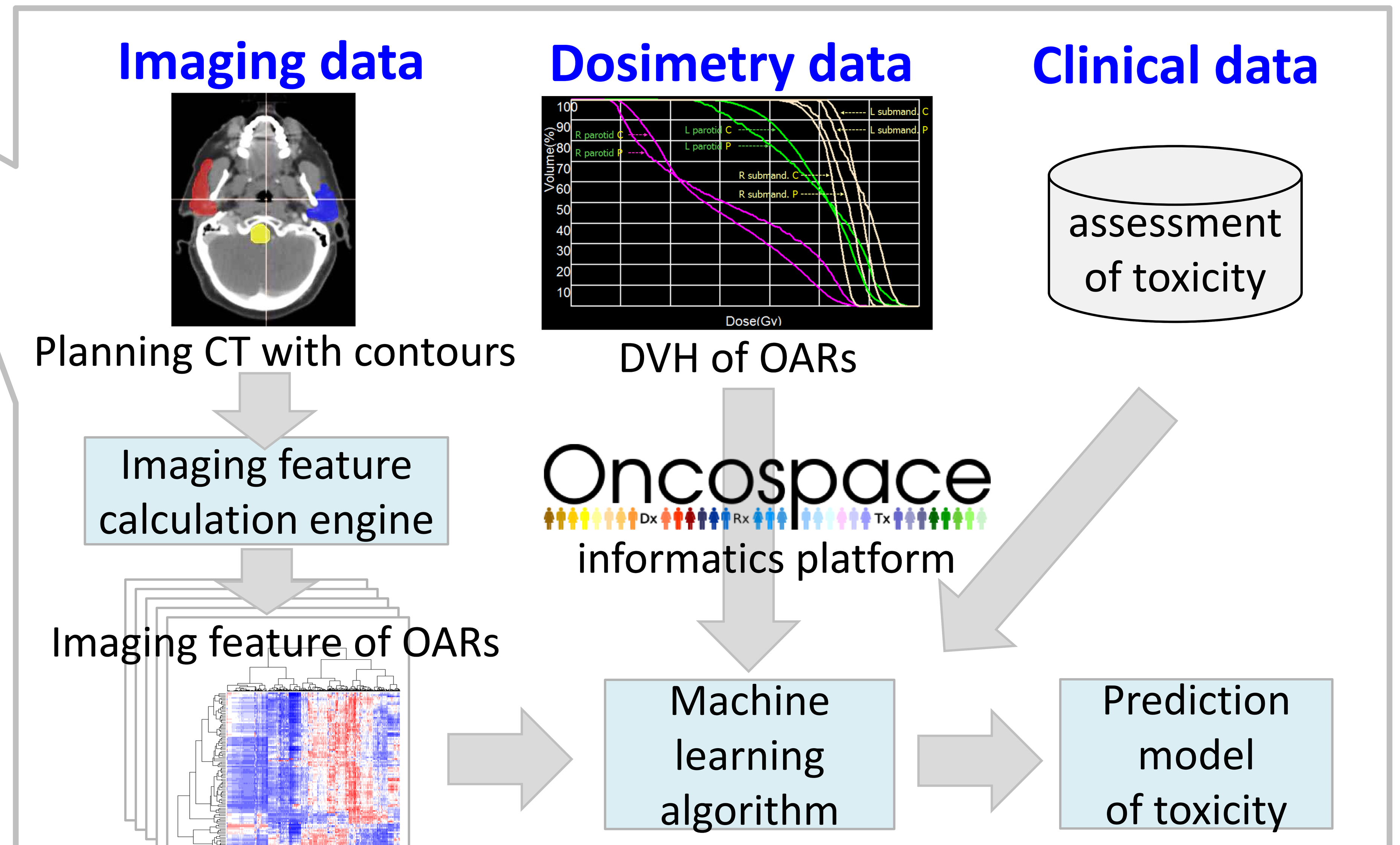

Figure 1. Radiomic analysis of OARs for toxicity prediction

- Texture predictors showed changing trends against age (parotid RLE, $p < 0.05$).
  - Decrease of density and increase of heterogeneity in parotid glands are reflected.
  - Xerostomia risk is high when parotid RLE is large.
  - Some patients have older parotid gland than actual age.

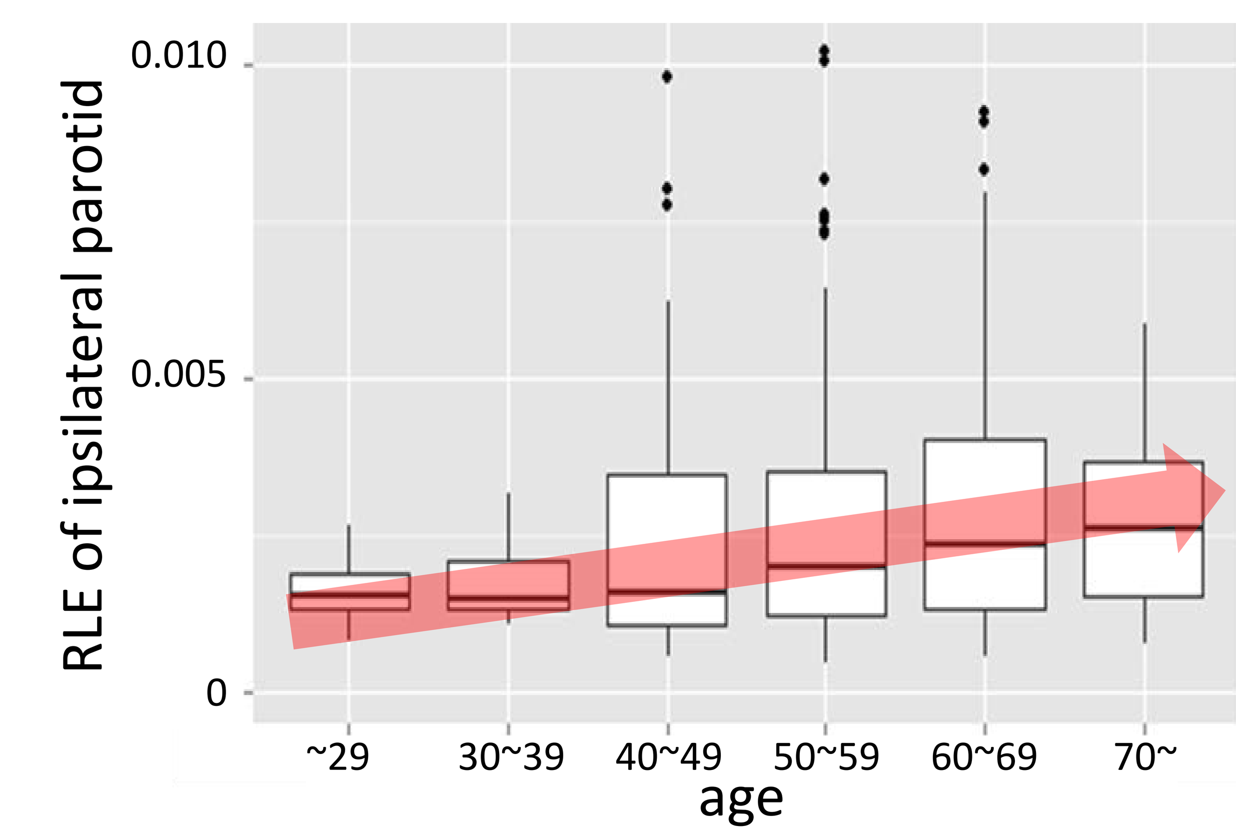

Figure 2. Trend of grey-level run length of the ipsilateral parotid gland against age

Conclusions

- Pre-RT radiomics is associated with the risk of xerostomia. This may reflect personalized baseline function of salivary glands.
- A potentially novel finding that imaging features of organs at risk (normal tissue) have a prognostic role for toxicity.
- Prediction of xerostomia can support clinical decision for RT-planning and toxicity management.