Development and External Validation of a Model for Prediction of Radiation-Induced Dyspnea: an Approach combining Clinical Data with Information from Literature

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Introduction

Background

- The risk of radiation-induced dyspnea increases with higher radiation dose
- In clinical practice the radiation dose to the lung is usually restricted in order to limit the incidence of severe dyspnea
- Therefore, there is a lack of clinical data to model the relationship between mean lung dose (MLD) and dyspnea in the MLD dose region above 20 Gy

Objective of the study

- Investigate the possibility to combine dosimetric information of individual patients and published data to develop a prediction model for radiation-induced dyspnea

Methods and Materials

Study population

- Development cohort (n=407) and validation cohort (n=175)
- Lung cancer patients treated with (chemo) radiotherapy with curative intent
- Outcome: dyspnea CTC version3.0

Statistical analysis

- Multivariate logistic regression
- Relationship between MLD and dyspnea is modeled using clinical data (lower dose region) as well as a regression coefficient published by the QUANTEC group (higher dose region)
- Performance is expressed as AUC*

*The maximum value of the AUC is 1.0; indicating a perfect prediction model. A value of 0.5 indicates that patients are correctly classified in 50% of the cases, e.g. as good as chance.

Figure 1. Model Performance

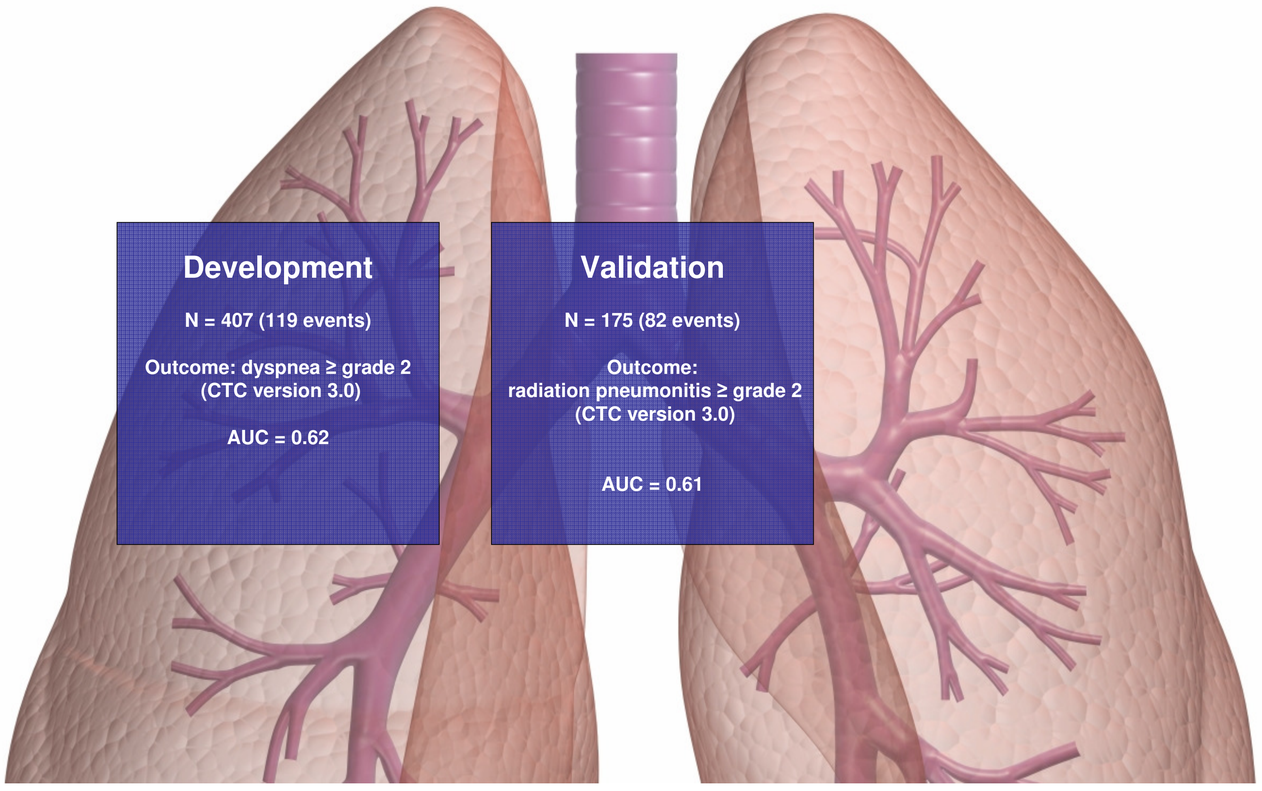
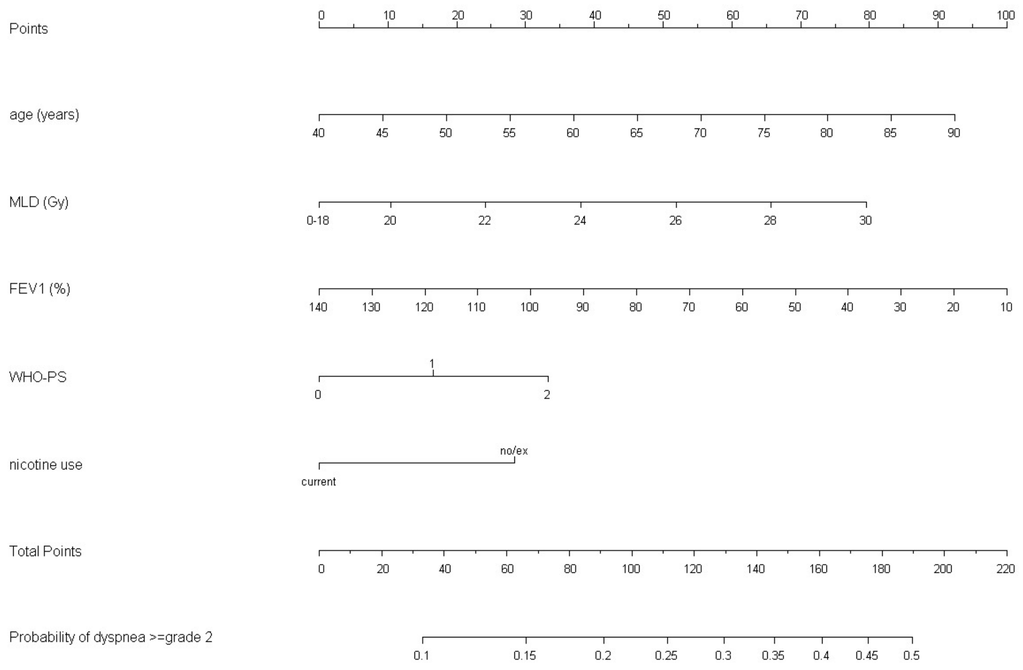


Figure 2. Nomogram for the prediction of dyspnea ≥ grade 2



Results

Multivariate model

- The model consisted of age, WHO-performance scale, forced expiratory volume in 1 s (FEV_1), nicotine use, and MLD.
- This model yielded an AUC of 0.62
- Applying the model to the external validation set resulted in an AUC of 0.61
- Performance of the models is shown in Figure 1.

Clinical application: nomogram (Figure 2)

- Obtain predicted probability for an individual lung cancer patient

Conclusion

- The final multivariate model performed significantly better than chance and the external validation was successful, but there is still a lot of room for improvement.

It is possible to combine information from individual patients and published data to develop prediction models. This approach will lead to more efficient use of data by avoiding that models are built on single institute databases, while additional information is readily available in published literature.

References
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