1269P Machine Learning Model for Predicting Lung Cancer Recurrence after Surgical Treatment: A Retrospective Study Using NLST and European Hospital Data

Ann Valter[1], Tanel Kordemets[2], Aydan Gasimova[3], Noah Waterfield Price[3], Lutz Freitag[3], Tõnu Vanakesa[4], Ingemar Almre[4], Kersti Oselin[1]

[1]Department of Chemotherapy, Clinic of Oncology and Hematology, North Estonia Medical Centre, Tallinn, Estonia, [2]Department of Radiology, Clinic of Diagnostics, North Estonia Medical Centre, Tallinn, Estonia, Research Department, Optellum, Ltd., Oxford, United Kingdom, [4]Department of Cardiothoracic surgery, Clinic of Surgery, North Estonia Medical Centre

Background

The rate of lung cancer recurrence following curative surgical resection is 30-55%[cite] and remains a significant challenge in patients´ management.

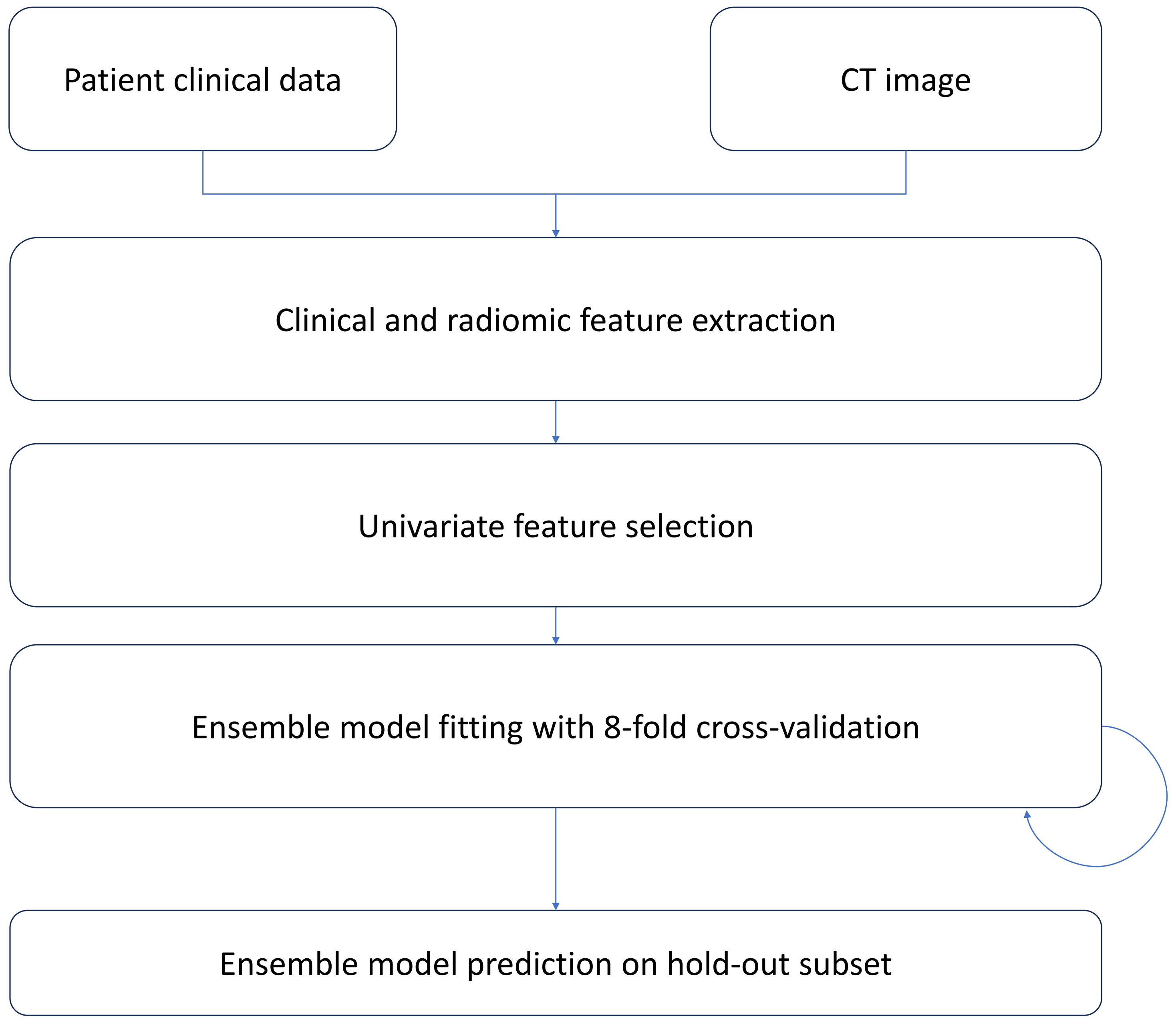
Accurate prediction of recurrence risk is crucial for guiding treatment decisions, such as the use of (neo-) adjuvant chemo- or immunotherapy, the extent of lung resection, and follow-up strategies.

We present a preoperative machine learning (ML) model that uses patient computed tomography (CT) images and demographic features to predict lung cancer recurrence.

Methods: Training and validation

The model was trained to predict the likelihood of recurrence on a diverse set of preoperative features, including radiomic features extracted from CT images and relevant clinical factors.

As a baseline, we compare the model to ranked clinical staging. Performance was evaluated using the Area-Under-the-ROC-Curve (AUC), sensitivity, and specificity.



Machine learning tool outperforms clinical staging prediction of lung cancer recurrence in a preoperative setting

Methods: Data

We collected a dataset of 588 clinical stage I-IIIA lung (pathologically confirmed) cancer patients who underwent surgical treatment from the US National Lung Screening Trial (NLST) [cite] and the North Estonia Medical Centre (NEMC) (Table 1).

	NLST		NEMC	
	Progressed	**No progression**	**Progressed**	**No progression**
N	100	326	47	115
Sex				
Male	58 (58.0%))	179 (54.9%)	35 (74.5%)	66 (57.4%)
Female	42 (42.0%)	147 (45.1%)	12 (25.5%)	49 (42.6%)
Age (mean, std)	64.41, 5.55	64.74, 5.28	68.04, 9.42	67.01, 10.69
Nodule size (mean, std)	20.35, 10.89	18.58, 9.41	35.53, 13.81	30.65, 14.25
Lobe				
Upper	63 (63.0%)	215 (66.0%)	29 (61.7%)	70 (60.9%)
Lower	37 (37.0%)	111 (34.0%)	18 (38.3%)	45 (39.1%)
Attenuation				
Solid	75 (75.0%)	208 (63.8%)	45 (95.7%)	93 (80.9%)
Part-solid	25 (25.0%)	88 (27.0%)	0 (0%)	10 (8.7%)
GGO	0 (0%)	30 (9.2%)	0 (0%)	2 (1.7%)
Other			2 (4.3%)	10 (8.7%)

Table 1. Patients' characteristics.

Results: Classification performance

Lung cancer recurrence prediction results are tabulated in table 2. We find that our model performs significantly better (AUC=61.4, sensitivity=18.2) than preoperative staging alone (AUC=56.1, sensitivity=16.4, p=0.035). The most important features, in addition to staging, were nodule size, location, and sub-solidity, and patient age.

Predictors	AUC	Sensitivity	Specificity
TNM	56.1 (51.1, 61.2)	16.4 (10.1, 23.6)	90.0
ML model	61.4 (56.7, 66.3)	18.2 (10.2, 24.5)	90.0

Table 2. AUC, sensitivity and specificity performance of our machine learning model compared with ranked TNM staging. The specificity is set to 90.0 for a rule-in context.

Results: ROC

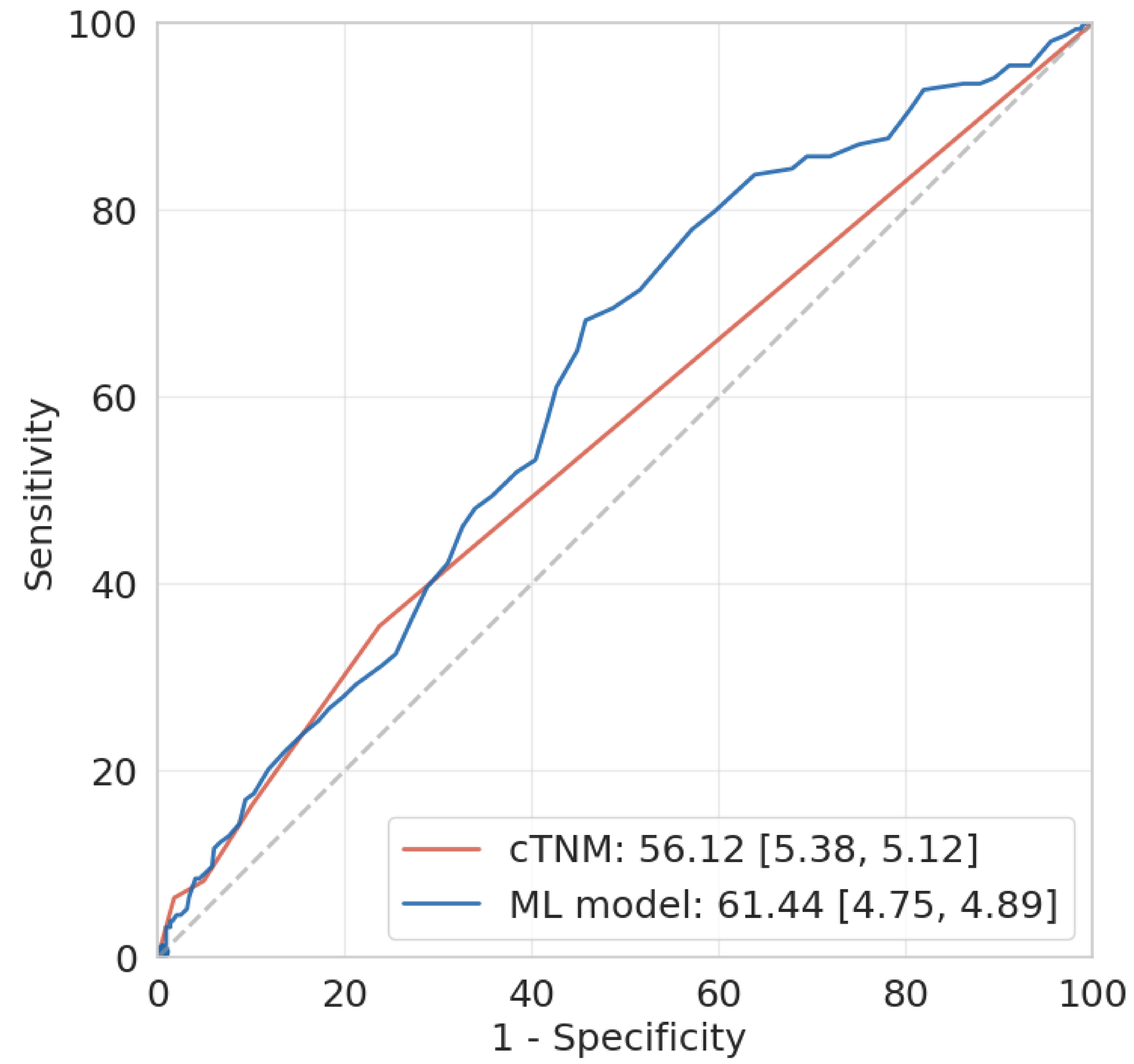


Figure 1. ROC of cTNM vs our machine learning model with AUC and 5% confidence internals (bootstrapped). Evaluated on the combined validation subsets of NLST and NEMC.

Conclusions

Based on this retrospective analysis, we find that our model outperforms clinical staging prediction of lung cancer recurrence in preoperative settings. With further development, this algorithm could prove a valuable tool to aid the management of lung cancer patients.

References

Acknowledgements

Ann Valter declares no conflict of interest with this work.
This study was sponsored by Optellum.

Corresponding author e-mail: ann.valter@regionaalhaigla.ee