

Blood Biomarkers and Machine Learning in Prognosis of Nasopharyngeal Carcinoma

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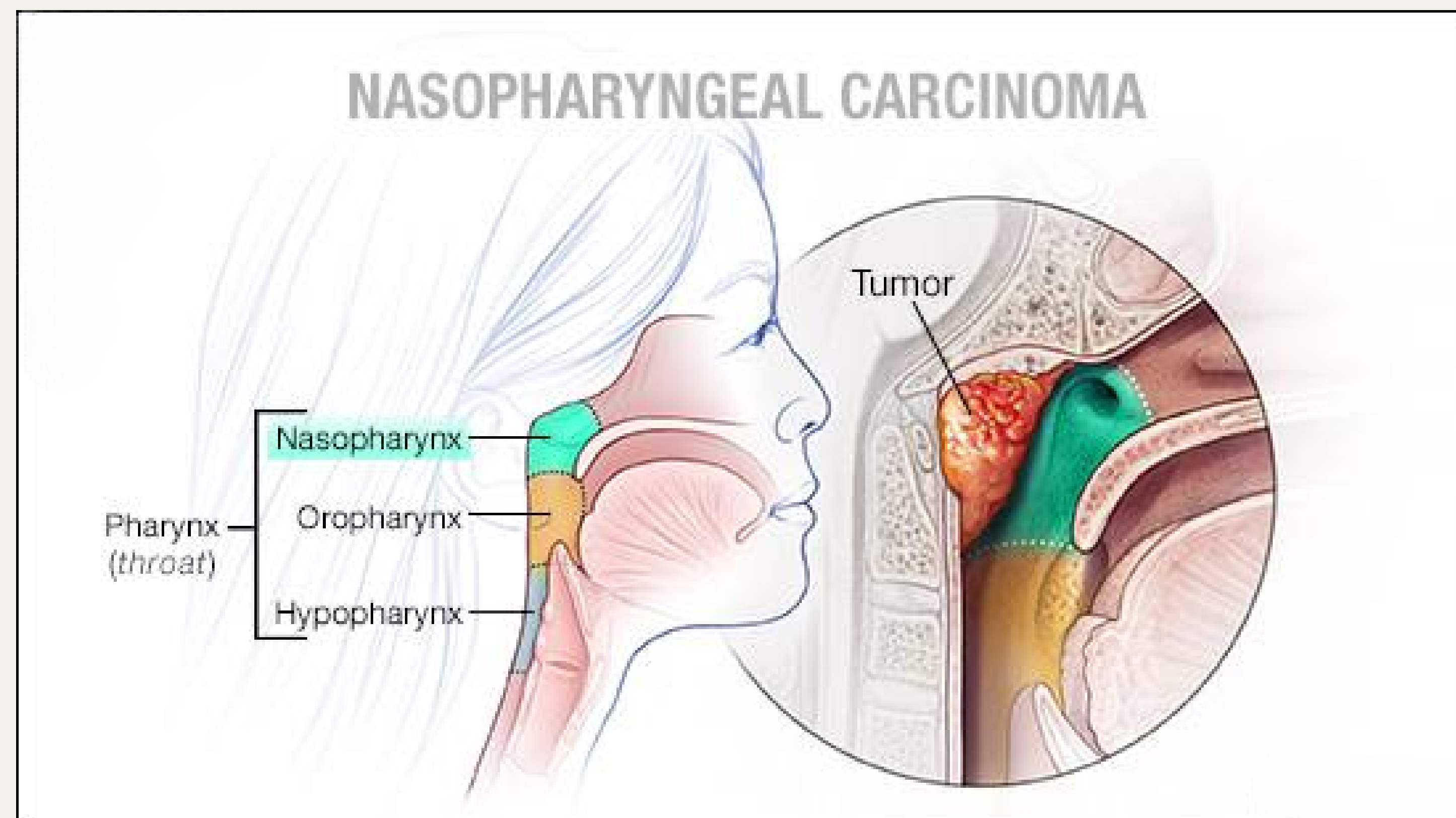
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Introduction

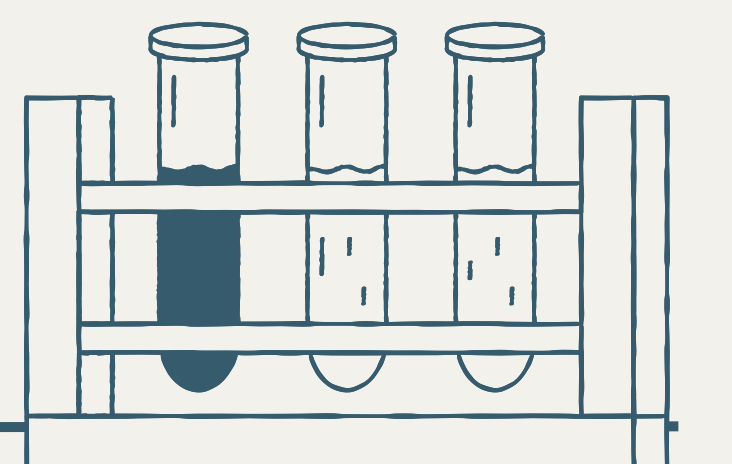
Nasopharyngeal carcinoma (NPC) is a highly aggressive head and neck cancer. Despite standard staging, prognosis varies widely. Blood-based inflammatory markers (e.g., NLR, PLR, SII) show potential as low-cost, non-invasive predictors of outcomes in NPC.



Objective

This study aims to develop predictive models for overall survival and the risk of second malignancies in nasopharyngeal carcinoma using clinical, pathological, and hematological parameters, particularly systemic inflammatory markers.

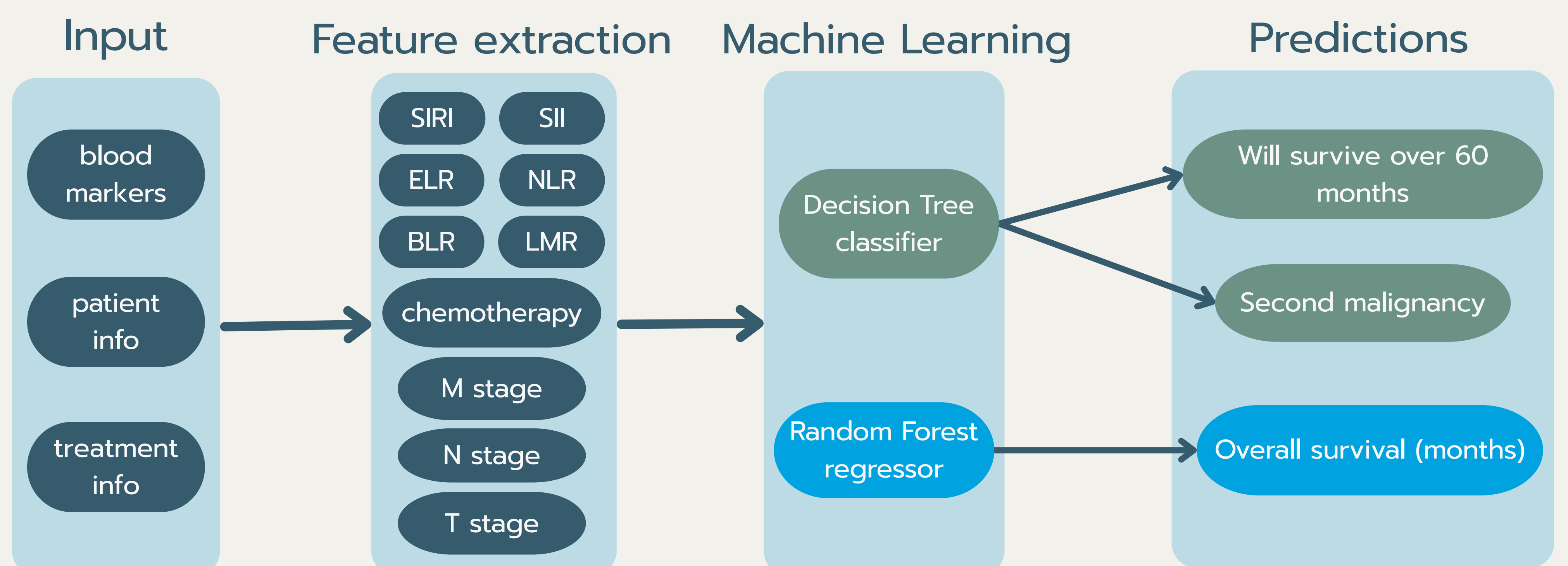
- ? Will the patient survive over 60 months?
- ? How many months will the patient survive?
- ? Will the patient develop a second malignancy?



Methodology

We analysed anonymised data from NPC patients treated at IOCN (Cluj-Napoca, Romania) and other treatment centres. Using systemic inflammatory markers (e.g., NLR, LMR, PLR) and haematological parameters, we developed:

- A Random Forest regressor to estimate survival time (in months)
- Decision Tree classifiers to predict:
 - Survival beyond 60 months
 - Risk of second malignancy



Results

The Random Forest classifier showed strong performance in identifying patients at risk of developing second malignancies and those likely to survive beyond five years, underscoring the prognostic value of systemic inflammatory markers.

In contrast, the regression models struggled to accurately predict exact survival time, likely due to the wide variability in patient outcomes. To improve this, future analyses will focus on patients with survival times of less than 60 months to narrow the prediction range and enhance model accuracy.

Feature	Importance
BLR	0.1349
SIRI	0.1235
NLR	0.1234
ELR	0.1223
PLR	0.1212
LMR	0.1050
SII	0.0967
T Stage	0.0475
N Stage	0.0310
Chemotherapy	0.0242
Histology	0.0204
Sex	0.0167
Smoking Y/N	0.0118
Race	0.0110
Lymphnode excision	0.0071
Radiotherapy	0.0021
M Stage	0.0003

Conclusions

Systemic inflammatory markers—including NLR, LMR, and PLR - demonstrated significant predictive value for survival outcomes in nasopharyngeal carcinoma. Integrating these blood-based biomarkers with machine learning models can enhance prognostic accuracy and aid clinical decision-making.

These haematological markers represent promising, noninvasive tools for NPC prognosis. However, further multicenter validation is needed to confirm their utility and facilitate integration into personalised treatment strategies.

