From signals to insights: NMR-based metabolomics as a tool for lung cancer biomarker research

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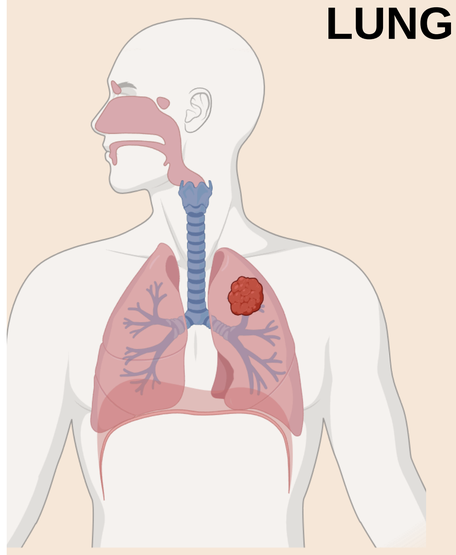
Background



LUNG CANCER

2.5 million new cases in 2022

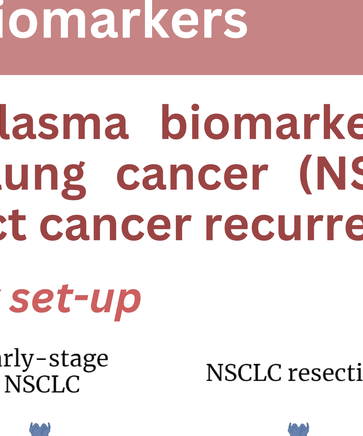
1.8 million deaths in 2022

Decrease in mortality

Screening for early-disease detection

CURRENT METHOD

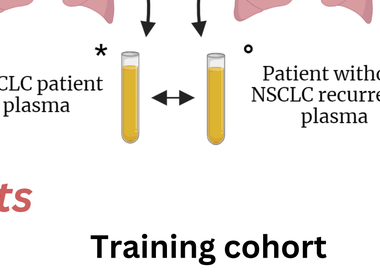
Low-dose computed tomography (LDCT)



LDCT is effective in the reduction of lung cancer mortality in high-risk patients but lacks the ability to distinguish **benign from malignant lesions**. This leads to a high false-positive rate and unnecessary invasive procedures.

FUTURE ALTERNATIVE

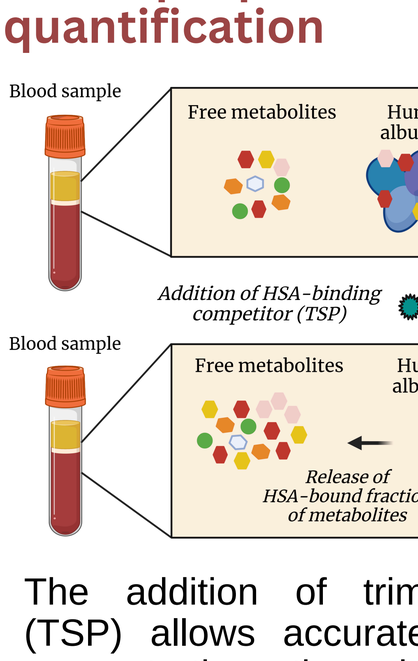
Plasma metabolite biomarkers

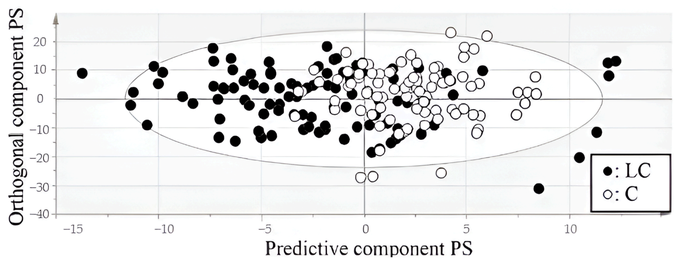


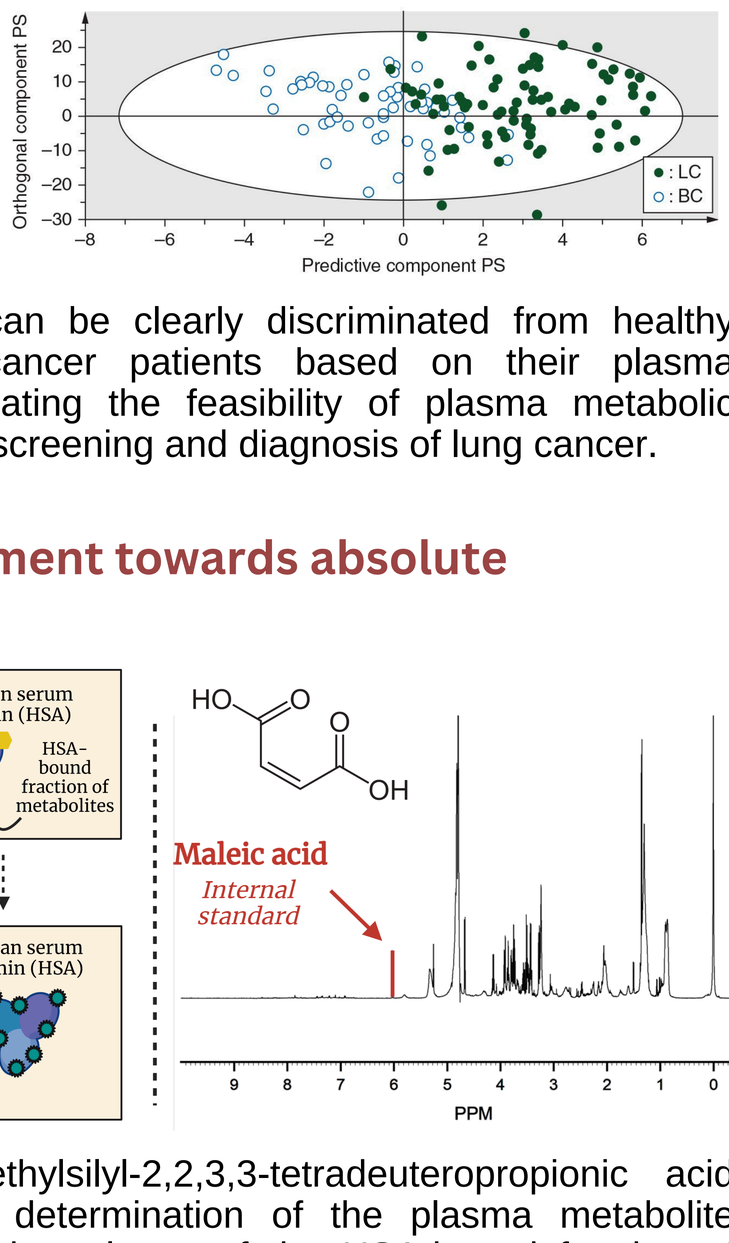
As lung cancer arises, metabolic alterations occur leading to altered plasma metabolite levels. These altered levels can be measured using ^{1}H-NMR to identify potential biomarkers for early-stage lung cancer detection.

Overview of breakthroughs using ^{1}H-NMR as a tool for the identification of plasma metabolite biomarkers

I. Feasibility of ^{1}H-NMR







Lung cancer patients can be clearly discriminated from healthy controls and breast cancer patients based on their plasma metabolite profile, indicating the feasibility of plasma metabolic biomarkers as a tool for screening and diagnosis of lung cancer.

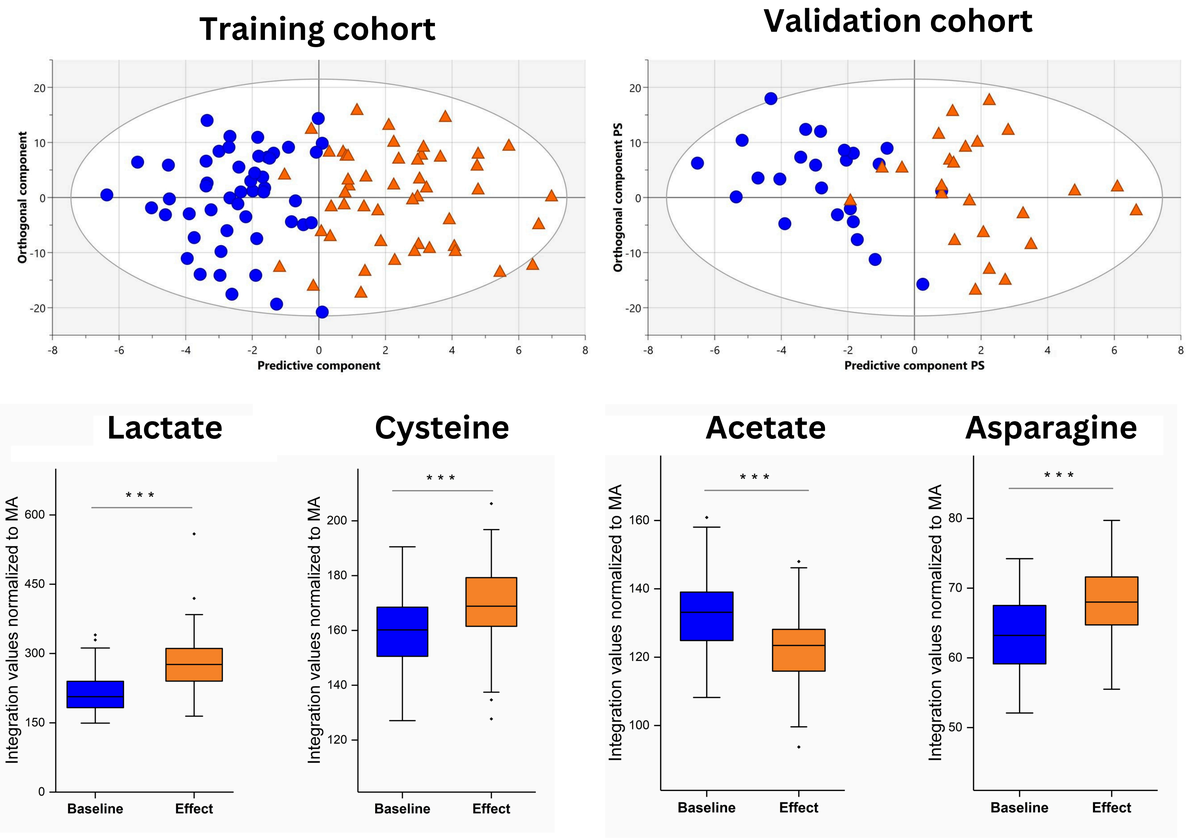
II. Sample pretreatment towards absolute quantification

The addition of trimethylsilyl-2,2,3,3-tetradeuteropropionic acid (TSP) allows accurate determination of the plasma metabolite concentrations through the release of the HSA-bound fraction of some plasma metabolites. Absolute metabolite quantification was achieved using maleic acid as an internal standard.

III. Plasma biomarkers for early-stage non-small cell lung cancer (NSCLC) and their potential to detect cancer recurrence

Study set-up

Results



There is a clear shift between the pre- and postoperative plasma metabolite profiles (96% specificity and 92% sensitivity). Lactate, cysteine, acetate, and asparagine were the key contributors to this metabolic shift and could therefore potentially serve as **biomarkers** for lung cancer screening, diagnosis, and follow-up.

CURRENT RESEARCH

The metabolic profiles of four additional postoperative time points (1, 4, 6, and 52 weeks after surgery) are currently being compared with the two preoperative time points. This will provide insights into the potential of this method to monitor and detect early cancer recurrence in a non-invasive manner.