Lung Cancer Detection: Analysis of Trace Volatile Organic Compounds in Exhaled Breath Using Silicon Microreactor Technology

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Introduction

Studies¹-² have shown that certain volatile organic compounds present in the breath can serve as metabolic biomarkers for the detection of lung cancer. This implies that by accurately identifying and quantifying biomarkers in exhaled breath that are specific to lung cancer, a minimally invasive, safer, and more cost-effective screening and diagnostic tool for the detection of lung cancer can be developed that has the potential to improve long-term survival rates.

Methods (cont.)

HTM coated microreactors show much higher capture efficiencies than ATM. As a result, HTM coated microreactors for breath analysis provided higher concentration ranges of acrolein (0.09-0.34 nmol/L), crotonaldehyde (0.20-1.19 nmol/L), pentenal (0.003-0.005 nmol/L), 4-HHE (0.12-0.36 nmol/L) in the breath of patients with pulmonary nodules. The preliminary results indicate that 4-HHE in exhaled breath samples of a small number (n=2) of patients with indeterminate pulmonary nodules show higher concentrations than that in exhaled breath samples of healthy controls (0.18-0.21 nmol/L). Also, pentenal in healthy controls is in the range of 0.006-0.014 nmol/L higher than the range of patients with pulmonary nodules.

Results (cont.)

Table 1: Comparative analysis of HTM (top; N=4) vs. ATM (bottom; N=34) coated silicon microreactors for capture of unsaturated aldehydes in exhaled breath of patients with pulmonary nodules

Table 2: Comparison of concentration of unsaturated aldehydes in patients with pulmonary nodules (top; N=2) vs. healthy controls (bottom; N=5) using HTM-coated silicon microreactors.

HTM coated microreactors show much higher capture efficiencies than ATM. As a result, HTM coated microreactors for breath analysis provided higher concentration ranges of acrolein (0.09-0.34 nmol/L), crotonaldehyde (0.20-1.19 nmol/L), pentenal (0.003-0.005 nmol/L), 4-HHE (0.12-0.36 nmol/L) in the breath of patients with pulmonary nodules. The preliminary results indicate that 4-HHE in exhaled breath samples of a small number (n=2) of patients with indeterminate pulmonary nodules show higher concentrations than that in exhaled breath samples of healthy controls (0.18-0.21 nmol/L). Also, pentenal in healthy controls is in the range of 0.006-0.014 nmol/L higher than the range of patients with pulmonary nodules.

Conclusion

The preliminary results support the hypothesis that quantitative analysis of unsaturated aldehydes in exhaled breath is promising for developing a noninvasive diagnostic tool for lung cancer screening. More patients for breath analysis are required for statistical analysis to validate specific unsaturated aldehydes as lung cancer biomarkers.

References


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