

The cancer microbiome produces distinct volatile organic compounds

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Summary:

Oesophagogastric cancer harbours a distinct microbiome that produces volatile short chain fatty acids. Bacterial headspace VOCs were characterised using an optimised, reliable, high-throughput TD-GC-ToF-MS and two-dimensional GC-MS with quality-controlled protocols.

Keywords: cancer, bacteria, VOC, GC-MS

Title

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approaches, enabling high-throughput dynamic sampling.

Headlines

This study utilises an optimised and reliable method for headspace VOC sampling of liquid bacterial cultures, using a thermal desorption-gas chromatography-time of flight-mass spectrometer.

Background, Motivation and Objective

The detection of bacterial volatile organic compounds (VOCs) has established utility in healthcare. [1,2] VOCs produced by the cancer microbiome offers a novel non-invasive platform for early disease detection. Our previous work identified volatile short chain fatty acids (SCFAs) in the exhaled breath of patients with oesophagogastric cancer, demonstrating the potential for a breath-based diagnostic test in a cancer of unmet clinical need. [3,4] This research aims to investigate the differential oesophagogastric cancer-related microbiome as the source of VOCs detected in exhaled breath.

Description of the New Method or System

Bacterial headspace VOCs were extracted using an automated sampling device onto thermal desorption tubes and analysed by mid-polar TD-gas chromatography-time of flight-mass spectrometry (TD-GC-ToF-MS) and two-dimensional GC-MS for structural identification. Stringent quality control and a robust analytical pipeline supported both untargeted and targeted

Results

Bacteria from cancer tissue and saliva were cultured and underwent whole genome sequencing demonstrating an abundance of *Lactobacillus*, *Prevotella*, *Veillonella*, *Fusobacterium*, and *Streptococcus*. Liquid bacterial cultures were established under anaerobic conditions, with growth curves to identify peak metabolic activity for VOC production. Bacteria cultured from oesophagogastric cancer patients demonstrated significantly higher volatile SCFA production, with responsible metabolic pathways identified through metagenomic sequencing. This proof-of-concept study supports a novel breath test based on the cancer's distinct bacterial VOC profile. The breath test will offer a cost-effective, non-invasive, and patient-friendly approach to identifying high-risk individuals presenting with non-specific upper gastrointestinal symptoms.



Fig. 1. Automated headspace sampling of volatile organic compounds produced by liquid bacterial cultures onto thermal desorption tubes.

References

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