Breath analysis using eNose technology to diagnose inflammatory bowel disease – early results

Authors: Akira Tiele,[A] Alfian Wicaksono,[A] Jiten Kansara,[B] Ramesh Arasaradnam[B] and James Covington[A]

Aims

This study aimed to determine if exhaled volatile organic compounds (VOCs), analysed with electronic nose (eNose) and gas chromatograph – ion mobility spectrometer (GC-IMS) technology, can be used to distinguish inflammatory bowel disease (IBD) from controls and Crohn's disease (CD) from ulcerative colitis (UC).

Methods

Early diagnosis of IBD, including CD and UC, remains a clinical challenge with current tests being invasive. About 0.5–1% of people in Europe have IBD. Colonoscopy is the current gold standard for diagnosing IBD, which is uncomfortable for the patient, expensive to the NHS and has an associated morbidity. CD and UC have shown distinct patterns of VOCs, reflecting gut fermentome metabolites. VOC sampling is a non-invasive method of identifying various compounds from faecal, urine and breath samples. The development of a high throughput, non-invasive breath test, using eNose technology, could provide a real-time diagnostic tool for point-of-care clinical use.

For this pilot study, 39 subjects were recruited, including 30 established IBD (14 CD, 16 UC) and nine healthy controls. End-tidal (alveolar) breath was captured using biological-VOC breath samplers (Markes Int, Llantrisant, UK), analysed by eNose (Warwick Olfaction: Wolf). Full breath samples were captured directly and analysed by GC-IMS (BreathSpec, GAS, Dortmund, Germany). The Wolf eNose system was built in-house at the School of Engineering (University of Warwick) and the BreathSpec is a commercially available system.

Results

Analysis was conducted using five classification algorithms, including Sparse Logistic Regression, Random Forest, Gaussian Process, Support Vector Machine, and Neural Network. Both technologies consistently showed the ability to separate those with IBD and controls, eNose (AUC ±95%, sensitivity, specificity; 0.81 (0.66–0.96), 0.67, 0.89) and GC-IMS (AUC ±95%, sensitivity, specificity; 0.9 (0.8–1), 0.73, 1). Furthermore, we were able to separate CD from UC, eNose (AUC ±95%, sensitivity, specificity; 0.88 (0.76–0.99), 0.71, 0.88) and GC-IMS (AUC ±95%, sensitivity, specificity; 0.75 (0.56–0.94), 0.79, 0.75).

Conclusion

These results confirm the utility of breath VOC analysis to distinguish IBD from healthy control volunteers, and CD from UC. Moreover, this study achieved its objective of demonstrating that the Wolf eNose and BreathSpec GC-IMS instruments offer the potential of a non-invasive diagnostic tool for IBD. ■

Conflict of interest statement

None declared.

Authors: [A]School of Engineering, University of Warwick, Warwick, UK; [B]Department of Gastroenterology, University Hospitals Coventry and Warwickshire, Coventry, UK