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Serum metabolite profiling for monitoring disease activity in patients with ulcerative colitis

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Background

Ulcerative colitis (UC) is an inflammatory bowel disease affecting the colon and rectum, characterized by alternating periods of remission and flare-ups.

Metabolomics in UC may provide insights into disease mechanisms and activity monitoring.

Nuclear magnetic resonance (NMR) spectroscopy allows profiling of serum metabolites, including inflammatory markers, lipoproteins, and organic acids.

Previous literature shows that:

- Lipid profiles are often altered in IBD patients due to systemic inflammation.
- Acetic acid, a short-chain fatty acid involved in energy metabolism, is generally reduced in UC.
- GlycA is linked to IBD activity, but Glyc/SPC has not yet been studied in IBD.
- The Glyc/SPC ratio is derived from the inflammatory markers glycoprotein A (GlycA), B (GlycB), and the lipoprotein-related marker supramolecular phospholipid composite (SPC).

Study aim

There is currently no established serum metabolite profile that distinguishes UC patients in remission from UC patients with active disease. This study aims to determine whether serum metabolite profiling may be used for monitoring disease activity in ulcerative colitis.

Method

Serum samples were collected from 47 healthy subjects (HS, 40 females), 64 UC patients in remission (UCR, 31 females), and 27 UC patients with active disease (UCA, 6 females).

Serum samples underwent targeted NMR spectroscopy (158 metabolites quantified).

Multivariate analysis with principal component analysis (PCA) and a random-forest-based MUVR algorithm was used to evaluate metabolic differences.

Results

Serum samples from HS, UCR, and UCA were analysed by targeted NMR spectroscopy.

PCA demonstrated differences between UCR vs UCA, and HS vs UCA, but not HS vs UCR.

The random forest-based model accurately distinguished UCA from UCR (sensitivity = 0.67, specificity = 0.95) based on a profile of eight metabolites.

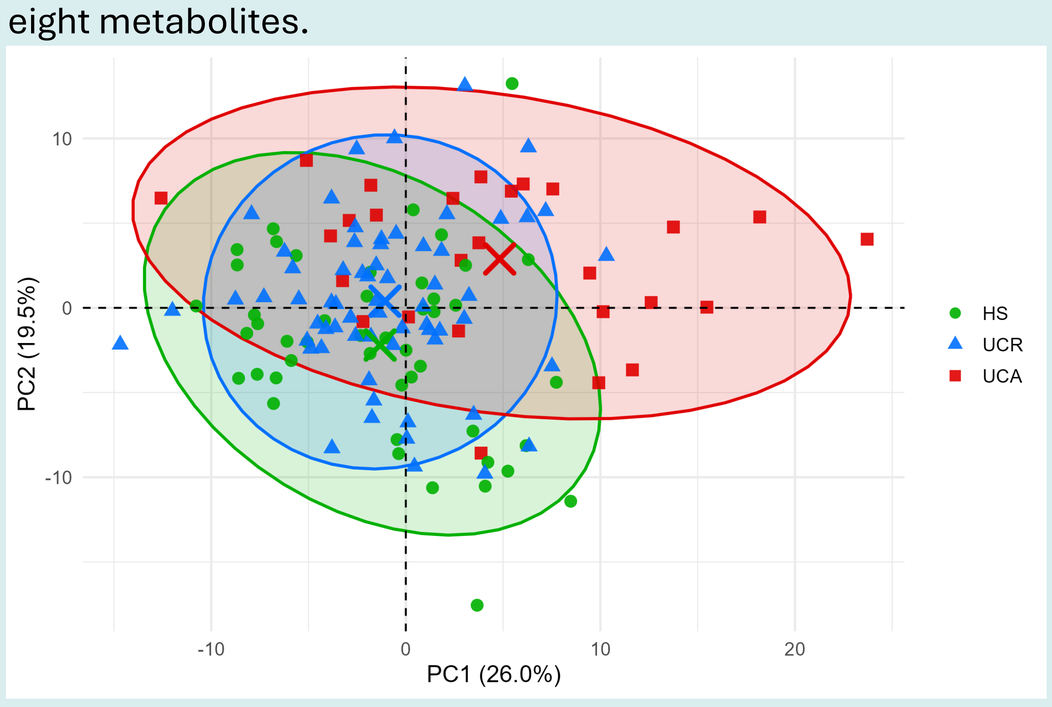

Figure 1 PCA plot on serum metabolites from HS (N = 47, green circles), UCR (N = 64, blue triangles), and UCA (N = 27, red squares) showing UCA centroid further away from HS and UCR, which cluster more closely, although overlap indicates shared characteristics.

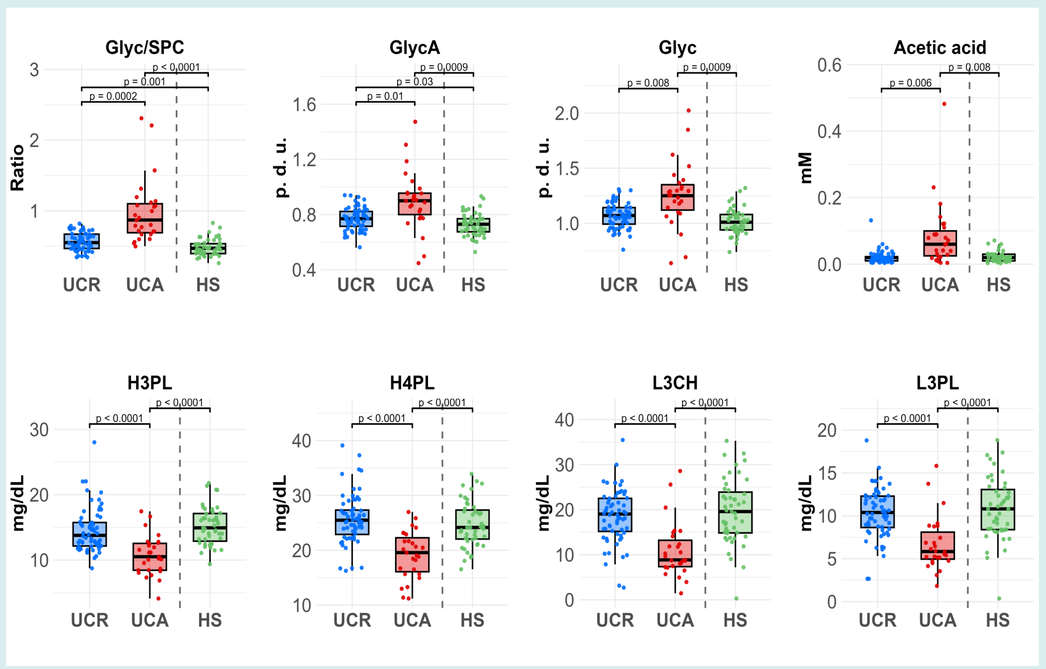

Figure 2 Boxplots of eight serum metabolites contributing to group discrimination between UCR and UCA. The Glyc/SPC, GlycA, and Glyc levels increase, while H3PL, H4PL (HDL-related), L3CH, and L3PL (LDL-related) decrease with inflammation. Results for HS are shown as a reference. P.d.u. procedure-defined units.

Conclusion

Metabolite profiles differ between patients with active UC and those in remission. NMR metabolomics shows promise for monitoring disease activity, although further validation is required to establish accuracy and diagnostic value.

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