DETECTION, DIFFERENTIATION, AND MONITORING OF INFLAMMATORY RHEUMATIC DISEASES VIA VOLATILE ORGANIC COMPOUND (VOC)-BASED BREATH ANALYSIS

Demy Gerritsen (MST, BMS-HIB-PHT) Mirjam Hegeman (MST), Manouk Vrielink (UT), Marloes Leentjens (VU), Silvie van Grotel (UT), Peter ten Klooster (BMS-HIB-PHT), Harald Vonkeman (BMS-HIB-PHT)

Introduction

Early diagnosis of inflammatory rheumatic diseases, such as rheumatoid arthritis (RA), spondyloarthritis (SpA), and psoriatic arthritis (PsA) is critical for preventing joint damage. Current diagnostic methods can be invasive, expensive, and time-consuming. Exhaled breath analysis, which detects volatile organic compounds (VOCs) reflecting physiological processes, offers a non-invasive alternative.

Objectives

This study examined whether RA, PsA, and SpA patients can be distinguished from healthy controls using an electronic nose. The impact of adding clinical variables on diagnostic performance was also assessed. For PsA, different thresholds were explored for optimal clinical applicability.

Methods

Breath samples were collected from RA (N = 215), PsA (N = 57), SpA (N = 59) patients, and healthy controls (RA: N=205, PSA/SPA: N = 180). Data were analysed using machine learning algorithms with cross-validation. Breath-based models were compared to logistic regression models incorporating clinical variables.

Results

The RA model demonstrated modest accuracy, with an area under the receiver operating characteristic curve (AUC-ROC) of 0.6, improving to 0.75 with the addition of age and gender. The SpA model performed exceptionally, with an AUC-ROC of 0.95, remaining at 0.96 after adding age and gender. The PsA model achieved an AUCROC of 0.87, sensitivity of 0.81, specificity of 0.79, and positive predictive value (PPV) of 0.55. Adjusting the threshold increased specificity to 0.91 and PPV to 0.72.

Conclusion

VOC-based breath analysis is a promising non-invasive tool for detecting different rheumatic diseases. While performance varies, this method may serve as a valuable screening tool, especially when combined with clinical data.

References

1. Kort, S., Tiggeloven, M. M., Brusse-Keizer, M., Gerritsen, J. W., Schouwink, J. H., Citgez, E., ... & van der Palen, J. (2018). Multi-centre prospective study on diagnosing subtypes of lung cancer by exhaled-breath analysis. Lung Cancer, 125, 223-229.
2. Kort, S., Brusse-Keizer, M., Gerritsen, J. W., Schouwink, H., Citgez, E., de Jongh, F., ... & van der Palen, J. (2020). Improving lung cancer diagnosis by combining exhaled-breath data and clinical parameters. ERJ open research, 6(1).