

ABSTRACT TEMPLATE

NanoInnovation 2025

SERS analysis of saliva by portable Raman for diagnosis and management of patients with Chronic Obstructive Pulmonary disease

Forleo L (1,2), Gualerzi A (1), Picciolini S (1), Mangolini V (1,3), Mangolini A (1), Gerli M (1), Compalati E (1), Tirzite M (4,5), Bueno Freire L (6), Soler N (6), Banfi PI (1), Bedoni M (1)

1 IRCCS Fondazione Don Carlo Gnocchi Onlus, Milan, Italy

2 University of Milan, Milan, Italy

3 University of Brescia, Brescia, Italy

4 Riga Stradiņš University, Riga, Latvia

5 Riga East University Hospital clinical centre Gailezers, Riga, Latvia

6 Hospital Clínic, Cellex Laboratory, CIBERES - Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), University of Barcelona, Barcelona, Spain

Chronic obstructive pulmonary disease (COPD) is a debilitating respiratory condition and a multifactorial disease estimated to become the third leading cause of death worldwide by 2030. The coexistence of COPD with other comorbidities (i.e. asthma) and the lack of specific biomarkers for diagnosis and stratification, hinders the implementation of adequate and personalized therapy while also complicating disease monitoring.

In this context, the use of a portable Raman spectroscope for saliva samples analysis could represent a breakthrough in the optimized and personalized management of COPD patients (pwCOPD). The high sensitivity of this technology, enhanced by silver nanoparticles (sNPs) that amplify the Raman signal via the SERS effect, enables the identification of a molecular fingerprint reflecting the unique biochemical composition of the biological sample, serving as a potential biomarker.

This study evaluated the potential of SERS-based saliva analysis as a diagnostic and stratification tool. Saliva samples were collected from 50 subjects with COPD, 49 with asthma (pathological controls) and 50 healthy controls. sNPs were synthesized following Lee-Meisel protocol, deposited on a calcium fluoride (CaF₂) substrate, and air-dried at room temperature before adding the saliva.

Raman spectra were collected using iRaman Plus (BW&Tek). Raman spectra revealed significant differences between the experimental groups, in specific spectral regions corresponding to bands related to nucleotides (600-800 cm⁻¹), proteins (1100-1375 cm⁻¹) and lipids (1447 cm⁻¹). Multivariate analysis was used to assess the classification model accuracy (77%) in discriminating subjects across different groups and to evaluate its ability to stratify pwCOPD by clinical phenotype.

In conclusion, our results demonstrate that the SERS-based saliva analysis is a promising and non-invasive tool for the diagnosis and monitoring of pwCOPD and the portable Raman enables easy, personalized COPD diagnosis in clinics, pharmacies and hospitals.

Acknowledgement

This work is part of the CORSAI project, registered in Clinicaltrials.gov (ID: NCT04628962), supported by ERA PerMed - JTC 2021 and Fondazione Regionale per la Ricerca Biomedica (FRRB).

Corresponding author's contact:

- labion@dongnocchi.it / lforleo@dongnocchi.it
- 0240308533

Billing information:

- FONDAZIONE DON CARLO GNOCCHI ONLUS
- Via Carlo Girola, 30
- 20162 – MILANO
- P.IVA 12520870150 / C.F. 04793650583
- fatture.mi@pec.dongnocchi.eu