Characterization Of Exhaled Particles From The Human Lung In Airway Obstruction

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Background

The human breath contains small droplets generated during the reopening of collapsed terminal airways. The properties of the exhaled aerosols are determined from the conditions in the lung periphery. Therefore, characterization of exhaled particles might be useful for non-invasive diagnosis of lung disease.

In this study, the impact of peripheral and central airway obstruction on particle emission characteristics was investigated.

Methods

Exhaled aerosol properties were recorded for healthy non-smokers (n = 16), healthy smokers (n = 13), patients with chronic obstructive pulmonary disease (COPD, n = 28, GOLD-stage I – IV), as well as patients with asthma following methacholine challenge (n = 10) in order to assess the influence of airway obstruction on particle emission characteristics.

Particle number flux was assessed by means of a condensation nucleus counter (TSI 3760), and particle size distribution was determined by a laser spectrometer (PMT LASAIR II-110).

Results

Particle number per breath showed high intra-subject reproducibility and rose exponentially with increasing tidal volume, as shown in Fig.1.

However, there was a large inter-subject variability of emitted particle number in the order of about two magnitudes, with no influence of airway obstruction on emission level (Fig.2).

Similarly, methacholine-induced airway obstruction in subjects with allergic asthma did not change the exhaled particle number when compared to pre-challenge values, as shown in Figure 3.

Conclusion

- Airway obstruction did not have an impact on number and size of endogenously generated exhaled particles.
- Determination of particle number flux during breath condensate sampling would allow for a normalization procedure to improve the validity of biochemical analysis.
- The individual particle emission pattern, which is highly reproducible, serves as a fingerprint of the actual status of the lung. The usefulness of more complex physical parameters of breath aerosols as a biomarker for detection of airway disease is currently investigated (see separate poster J106).

Acknowledgements

Supported by Deutsche Forschungsgemeinschaft (Ho 2158/1-2).

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