Summary

The aim of this thesis was to contribute to the standardization and validation of expiratory flow parameters independent of NO testing, particularly alveolar concentration (CANO) and bronchial NO flux ($J_{aw}NO$) in children and adolescents with allergic respiratory diseases. The thesis was created in the time of increased interest of medicine professionals in non-invasive examination methods and targeted therapeutic influence of inflammation in small airways in asthmatics.

After the standardization and validation of clinical benefits, the measurement of concentrations of nitric oxide (FENO) in the air exhaled through the mouth with the speed of 50 ml/s was validated for the evaluation of eosinophilic airway inflammation in patients with asthma and started to be widely used in clinical practice. Currently, there is an ongoing research focused on a new method for FENO measurement at several flow rates, which uses physiological models of NO transfer in exhaled air, allowing to quantify the amount of NO in an indirect way and to monitor the intensity of the inflammatory processes in distal and proximal airways non-invasively.

In groups of children and adolescents with allergic rhinitis and / or bronchial asthma and their healthy peers (aged 6 -19 years), the concentration of FENO was examined using online chemiluminescence NO analyzer during exhalation at a constant speed in the range of 50-250 ml/s. Then, two mathematical methods of linear regression analysis were applied, the authors Pietropaoli et al (the P method) and Tsoukias et al (the T method), which are based on a two-compartment model.

The results confirmed that the P and T methods give comparable values of CANO and $J_{aw}NO$ only under the condition that measurement and calculation are within a range allowing for the linearity dependence of the monitored values on the expiratory flow. In our sample, it represented the range between 100 ml to 250 ml /s. Measuring at very low flow rates results in 1 / CANO overestimation and $J_{aw}NO$ underestimation and 2 / the rise of systematic differences between the results obtained by the Tsoukias and Pietropaoli methods which are larger in estimating CANO as compared to $J_{aw}NO$. The effect of non-linearity in our study was higher in children with bronchial asthma than in children with allergic rhinitis.

Thus, the results of comparing parameters CawNO and $J_{aw}NO$ between groups of patients may be misleading if the condition of linearity is not respected. For this reason, we have proposed an iterative method to verify linearity and a selection of individually appropriate range of flow rates. The values of expiratory flow independent parameters $J_{aw}NO$ and $C_{aw}NO$ (concentration of NO in the wall of the bronchus) calculated using the Högman algorithm (expiratory flow

rates of 30, 100 and 250 ml /s) depended on the level of asthma control and were significantly higher in patients with poor asthma control over patients with good asthma control, while CANO concentration was similar. According to the results of ROC analysis, the sensitivity and specificity of $J_{aw}NO$ and $C_{aw}NO$ parameters for the detection of poor asthma control is comparable to FENO measurement. The area under the AUC curve close to 0.70 corresponds to the diagnostic value bordering on the clinical applicability level of this test. Expiratory flow independent parameters for transfer of NO in exhaled air in our study did not produce better information than FENO testing using a standardized method during exhalation rate of 50 ml / s.