DO NOT FEAR RESISTANCE: ASSOCIATION OF THE INTERNAL RESISTANCE OF THE INHALER AND QUALITY OF DRUG DELIVERY

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Background. The essence of dry powder inhalers' (DPI) functionality can be described in such way: a patient's inhalation energy, together with the internal characteristics of the inhaler, generates a potent turbulent airflow which de-aggregates drug particles, separates them from the carrier substance and delivers them to the airways. The DPI airflow resistance is a fixed property that determines the rate of airflow through the inhaler in response to the inspiratory effort of the patient. Total airflow energy is a key parameter for the clinical effect, so to receive the needed dose of active substance via high resistance inhaler we need quite low peak inspiratory flow (PIF). And vice versa, low resistance inhalers need higher PIF. There are many untrue interpretations of the importance of inhaler resistance level, which substantiate the need of careful studies of this problem. *The aim.* To answer the question «Is it possible for a patient with asthma or chronic obstructive pulmonary diseases (COPD) to use a high resistance DPI?» on the basis of modern literature data on this topic.
Materials and methods. Analysis of modern studies on this topic (Haughney J. Et al., 2020; Azouz W. Et al., 2015; Levy M.L. et al., 2019; Malmberg L.P. et al., 2014; Haikarinen J. et al., 2017). *Results and discussion.* To provide the needed airflow level in the inhaler, the pressure change must reach minimum 4 kPa, that's why in case of usage low resistance inhalers (Breathhaler, AerosoliserElipta) there is a need in high PIF. In turn, in case of usage of high resistance inhalers (Handihaler, Easyhaler, Turbuhaler) to provide sufficient energy of turbulent airflow we need relatively lower PIF. During inhalation with the help of Easyhaler («Orion Pharma») the air, which comes from outside, is directed into a narrow canal. As a result, the speed of airflow increases and when the air comes to the dosing chamber, it creates high turbulence. Due to the high speed of turbulent airflow drug particles start to separate, and this process continues in the inhalational canal. Such high-turbulent airflow provides stable dose delivery even in patients with low PIF. Easyhaler is a highormedium-to-highresistance DPI, which enables optimal turbulent airflow across all patient groups (children and adults with asthma, patients with COPD). The maximal pressure change in children with asthma was about 4.02 kPa, in adults with asthma – 6.67 kPa, in patients with COPD – 4.8 kPa. Easyhaler shows better dose delivery and consistency at all inhalation flows than Turbuhaler, so, the former is more effective even in case of bronchospasm or other cases of low PIF. An inspiratory flow rate of 30 L/min or above has been reported as optimal for Easyhaler mono and combination therapies. Such airflow rate creates the background for the optimal aerosolization and delivery of the drugs. According to the modern scientific data, almost all asthma and COPD patients reach the PIF of 30 L/min. This year on the European Respiratory Society Congress J. Haughney et al. (2020) were presented the results of the study of Easyhaler usage in patients with asthma. The authors showed that 93.7 % of patients reached correct PIF rate at high resistance (DPI setting), compared to 70.5 % at no resistance (metered-dose inhaler setting, $p < 0.0001$). So, the majority of patients with asthma can achieve an adequate inspiratory flow 30–90 L/min with a high resistance DPI. *Conclusions.* 1. Technical characteristics – such as internal resistance of the device – do matter when choosing the most suitable dry powder inhaler for the patient. 2. Medium-to-high and high internal resistance DPIs like Easyhaler («Orion Pharma») require lower patient inspiratory effort for the effective and accurate delivery of the drug. 3. Improved inhaler technology efficiency means that they are suitable for use by all types of patients, irrespective of PIF. 4. Regardless of the inhaler type, inhaler technique training to minimize errors is essential.

Key words: internal resistance of the inhaler, peak inspiratory flow, asthma, chronic obstructive pulmonary disease.

ISSN 2307-3373
DOI: 10.31655/2307-3373-2020-4-63-64