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Trajectory analysis of asthma

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Trajectory means path that a moving object follows through space as a function of time, in which the object might be a projectile or a satellite. A familiar example of a trajectory is the path of a projectile, such as a thrown ball or rock. In order to manage asthma from the “cradle to the rocker” more effectively, it is important to assess lung function over time to define a lung trajectory. Trajectory of lung growth is proposed to enable the approach to asthma to be more proactive and less reactive.

Asthma has the potential to lead to persistent and severe loss in lung function over time. The varying patterns of lung function development over time in children with persistent asthma were depicted by McGeachie et al from 20 years of follow-up in the NHLBI Childhood Asthma Management Program (CAMP). Spirometry was measured at least annually and four distinct patterns of lung function over time were described. Two patterns included reduced lung growth from early childhood and two patterns displayed evidence of early decline in pulmonary function after age 20 years. Approximately 11% of those participants met physiologic criteria for advanced levels of COPD in early adulthood. Below age 16 years, a pattern of reduced lung growth was defined, which is characterized by a pre-bronchodilator FEV1 consistently below the 25 percentile or less than -1.67 when using a reported Z-score. After age 16 years a plateau in these measurements is likely to occur and then after about age 25 years one can assess for a decline in lung function, again either by pre-bronchodilator FEV1 percentile or z-score. Based on these observations, children with persistent asthma should have ongoing measures of lung function to classify their trajectory of lung growth/phenotype and use it to consider a potential intervention strategy, such as trigger avoidance, assessment of medication adherence, increased caregiver/provider communication, assistance with medication administration in the school setting, smoking cessation, smoking avoidance, home assessment, career counseling, reversibility testing with conventional therapy and a clinical trial of immunomodulator therapy to assess response.

Several evidences indicate that lung function development in utero, infancy, and childhood may have long

lasting effects on respiratory health throughout the life span. Most studies have addressed trajectories of lung function from childhood into adult life by focusing on FEV1 and the FEV1/FVC ratio as indices of airflow limitation. Consequently, COPD has been mostly studied spirometric pattern. Importance of a full growth to maximal lung function in childhood has been reinforced by conclusive evidence that COPD can develop in mid to late adult life through at least two main trajectories: by the classic trajectory of an accelerated FEV1 decline in adulthood following a normal lung function development in childhood ("Rapid FEV1 decline" trajectory) or alternatively by a low maximal lung function attained by the beginning of adult life without necessarily an accelerated FEV1 decline thereafter ("Low maximal FEV1" trajectory). About 50% of participants with COPD exhibited features compatible with the latter trajectory, suggesting that lung function development in childhood may play a substantially more relevant role in COPD susceptibility than traditionally thought. Recent studies showed even more advances in addition to trajectory classification of lung function. For example, reduction of childhood smoke exposure and minimisation of the risk of early-life sensitisation and wheezing exacerbations might reduce the risk of diminished lung function in early adulthood. Moreover, childhood predictors of lung function trajectories and future COPD risk could be assessed through prospective cohort study from the 1st to the 6th decade of life.

In summary, recent studies showed advances in understanding lung function development and its critical importance for lung health into adult life. Lung function deficits established by school age may track into adult life and increase the risk of adult lung obstructive diseases, such as chronic obstructive pulmonary disease. There might be a chance to modify lung function decline by environmental or personal behavior interventions.

References

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