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Metabolomics reveals distinctive local and systemic metabolic alterations in experimental asthma

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Abstract

Metabolomics is the comprehensive investigation of metabolites in biological systems and is employed to study asthmatic patients based on their urinary metabolite profile. Currently, metabolomics has not been employed to investigate for metabolism changes directly in asthmatic lungs or serum. We hypothesize that allergic asthma would affect metabolism locally and systemically, and could be detected in bronchoalveolar lavage fluid (BALF) and serum using an integrated liquid chromatography and gas chromatography mass spectrometry (LC/MS and GC/MS) platform. BALB/c mice were sensitized and challenged with ovalbumin to develop experimental asthma. Dexamethasone was administered to study the metabolic effects of clinical corticosteroids. Metabolites were measured using LC-MS and GC-MS, and multivariate statistical analysis was performed by orthogonal projections to latent structures discriminant analysis. Metabolomic analysis of BALF and serum from asthmatic mice revealed novel changes in metabolic pathways in the lungs and serum as compared to controls. Local metabolic changes in the BALF implicate the alteration of carbohydrate, energy, sterols and lipids metabolism in experimental asthma. Corresponding downstream metabolic changes in sterols and amino acids metabolism were detected in the asthmatic serum. Significant correlations were observed between asthmatic BALF and serum metabolites versus inflammatory cells, suggesting they may be disease-relevant metabolite alterations. Dexamethasone effectively reverse most disease-related metabolism shifts, but also induced extensive metabolite changes locally and systemically. Integrated metabolomic analysis of BALF and serum offered a promising approach to investigate allergic asthma. Our overall findings revealed distinctive localised and systemic metabolic pathway changes and biomarkers in experimental asthma.

Biography

Wanxing Eugene Ho was awarded the Singapore-Massachusetts Institute of Technology Alliance (SMA) Graduate Fellowship in 2010 for his Ph.D studies in the National University of Singapore (NUS), jointly co-supervised by Prof OngChoon Nam (NUS), A/Prof Wong Wai-Shiu Fred (NUS) and Prof Steven R. Tannenbaum (MIT). He was recently awarded the 13th FAOBMB Young Scientist Program Travel Fellowship and outstanding poster presentation in the 13th FAOBMB Congress 2012. His aptitude for multidisciplinary fields of biomedical and biochemical sciences, has been proved by over six successive invitations to review scientific manuscripts, by premium scientific journal, Antioxidants & Redox Signaling.