Title of Research:

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Development of high sensitivity in vitro assessment system of chemical-mediated hypersensitivity by using serine protease inhibitor-deficient cells
Subtitle: Analysis of in vitro assessment for respiratory allergy

Principal Investigator:

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Summary of Research:

The allergic disorders triggered by various chemicals are separated into two types of diseases, IgE-dependent immediate allergy and IgE-independent chronic allergy. Mast cells, basophils and eosinophils act as the effector cells in both allergic reactions. In particular, basophils and eosinophils rapidly infiltrate into respiratory tissue, and cause airway hyper-responsiveness and airway obstruction. These cells secrete abundant serine proteases as well as chemical mediators and cytokines. Serine proteases, such as elastases, disrupt the basement membrane, leading to the infiltration of inflammatory cells. The serine proteases are repressed by the serine protease inhibitors. Because we found that basophils and eosinophils lacking a secretory leukoprotease inhibitor SLPI produced more cytokines than wild type cells after stimulation with IgE or LPS. Therefore, we have planned to generate the highly sensitive cell line by the deletion of serine protease inhibitors using a human basophilic cell line, KU812-F. Because KU812-F expresses high levels of Serpin b1 and b6, and we have generated stable Serpin b1 knockdown KU812-F cell lines by using lentiviral-delivered sh (short hairpin) RNA. The knockdown KU812-F cells (KD cells) produced IL-6 about 2 times higher than KU812-F after administration with toluene diisocyanate (TDI). KD cells also secreted IL-13 upon stimulation with TDI. In contrast, scramble and wild type KU812-F cells did not produce IL-13. We investigated gene alteration between KD cells and scramble KU812-F cells in responses to TDI by mRNA sequencing analysis. We found significant elevation of three genes as follows: CD69 (T cell activation marker), a chemokine receptor, CXCR4, and sphingosine-1-phosphate receptor 4. We evaluated the relative fluorescence intensities (RFI) in accordance with human Cell Line Activation Test (H-CLAT). KU812-F and KD cells showed higher RFI of CD69 than scramble cells upon TDI and formaldehyde stimulation, whereas all cell lines did not display any alteration of CD69 expression after DNCB and Methyl Salicilate. We also found that the levels of CD69 mRNA are significantly augmented in KD cells after TDI stimulation. In the present LRI research, we confirmed the high level of CD69 expression in KD cells. Moreover, to establish a simpler method for the screening, we analyzed the CD69 expression using wild type KU812-F cells in response to 12 kinds of chemicals since wild type cells are also sensitive to chemical stimulation. The RFI values displayed more than 150% in WT cells after administration with TDI and *p*-phenylenediamine. Collectively, our data suggested that the analysis of CD69 expression is a suitable application for the detection of respiratory sensitizes by using KU812-F cells in addition to Serpin b1 knockdown KU812-F cells.

Timeline:

April 1, 2018 – March 31, 2019

Topics:

Poster presentation entitled “Development of high sensitivity *in vitro* assessment system of chemical-mediated hypersensitivity by using serine protease inhibitor-deficient cells.” at the annual conference of 2018 LRI, Tokyo, Japan, August 2018