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Airflow limitation and airway dimensions assessed per bronchial generation in older asthmatics

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METHODS

Pulmonary function tests

We used the rolling seal type of spirometer, the CHESTAC-33 (CHEST MI, Inc., Tokyo, Japan). The procedures and results of pulmonary function tests met the requirements of the pulmonary function test guidelines of the Japanese Respiratory Society Guidelines,[E1] which are similar to those of the American Thoracic Society. The diffusing capacity of the lung for carbon monoxide (DLco), based on the single-breath method, was also measured in all subjects according to the pulmonary function test guidelines of the Japanese Respiratory Society. DLco divided by alveolar volume (V_A) was expressed as percentage of predicted values according to the prediction equations of Burrows.[E2] Lung volumes (total lung capacity (TLC), functional residual capacity (FRC), and residual volume (RV)) were measured by the helium closed-circuit method. Lung volumes were expressed as a percentage of predicted values according to the prediction equations of Nishida.[E3]

CT Data Acquisition and Analysis

First, a three-dimensional bronchial skeleton was automatically reconstructed using a certain threshold level, determined on an individual basis (-950HU to -980 HU) to obtain airway images as distal as possible. Any portions of lung parenchyma remaining with the skeleton were manually removed to prevent analysis error. Finally, we obtained a bronchial skeleton and were able to identify any bronchus in the source images of axial, sagittal, and coronal slices. The selected bronchial pathway in the bronchial skeleton could be manually extended to at least the 6th generation of bronchi, when necessary, and be automatically converted to a curved multiplanar reconstruction image. The bronchial long-axis image appears as if it was a straight pathway. Of note, we were able to the long axis at any site, and to identify which

generation of airway was actually picked up. Identification of the generation of bronchi must be relied on careful inspection of any bifurcation while proceeding longitudinally in the airway.

Figure E1. Relationships of the mean Ai/BSA of all the bronchi among the 3rd to the 6th generation.

There were excellent correlations of inter-subjects variations on Ai/BSA among the generations.

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