

Images in Allergy and Immunology

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Airway remodeling in asthma

Editor's note: This new feature, Images in allergy and immunology, is designed to highlight the current concepts of immunopathology of allergic diseases and other common immunologically mediated diseases. The presentation takes the form of sets of images that involve cross-pathology, histopathology, and molecular pathology.

In the first few Journal issues in which it appears, this feature will focus on asthma. Other topics to be addressed (in subsequent issues) include allergic rhinitis, sinusitis, atopic dermatitis, food allergy, and immune deficiency.

Structural changes within asthmatic airways include goblet cell and mucous gland hyperplasia, extracellular matrix protein deposition, changes in the epithelium, inflammatory cell infiltration, smooth muscle hypertrophy and hyperplasia, vascular changes, and changes in the cartilage. Epithelial detachment is a characteristic feature of airway remodeling (Fig 1); however, it is not uncommon to also find epithelial detachment in bronchial biopsy



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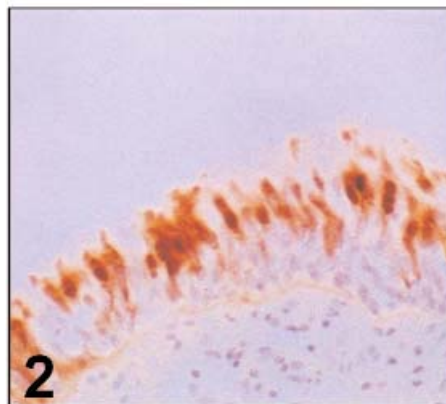
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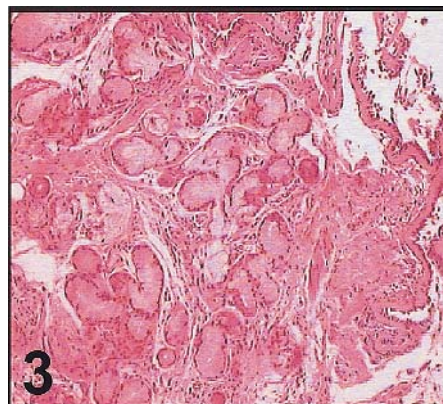
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specimens from healthy subjects. Recent studies suggest a change in the phenotype of the epithelial cells in an asthmatic subject and an increase in the ability of these cells to produce cytokines, chemokines, and profibrotic growth factors. Fig 2 demonstrates an example of IL-11 immunostaining in a biopsy speci-

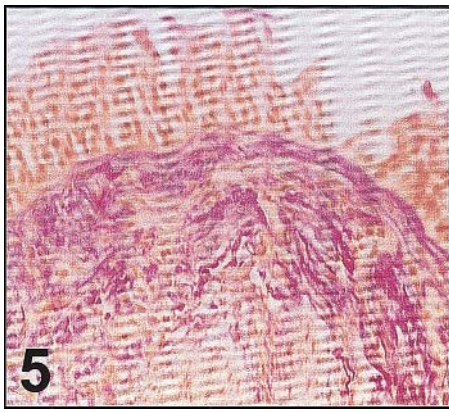


men from a patient with moderately severe asthma. Fig 3 is an example of goblet cell hyperplasia in biopsy specimens from asthmatic subjects. As shown in Fig 3, mucus gland hyperplasia is also a common fea-

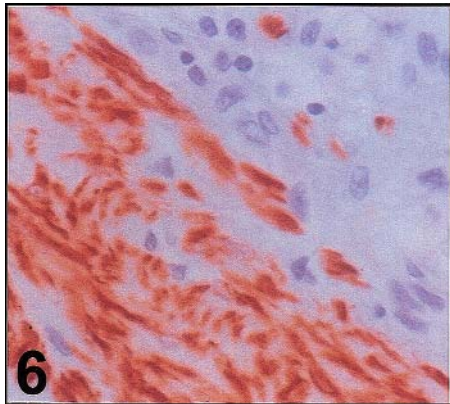


ture of asthmatic biopsy specimens. Subepithelial fibrosis is an important feature of airway remodeling that could range from simple thickening (Fig 4) to

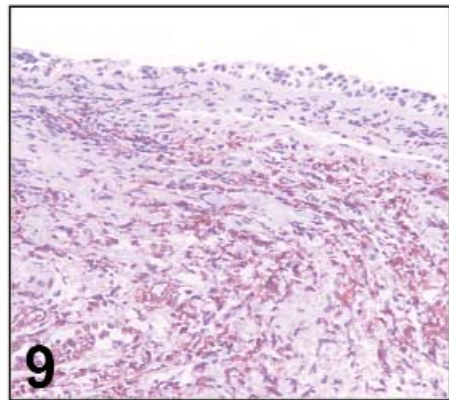
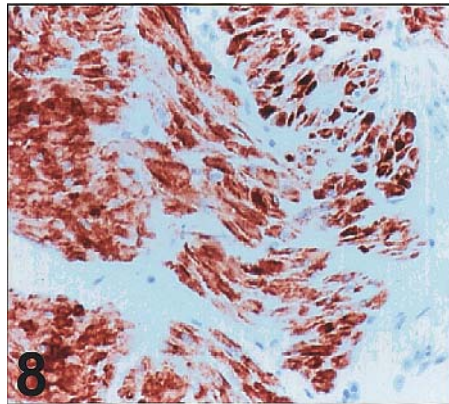
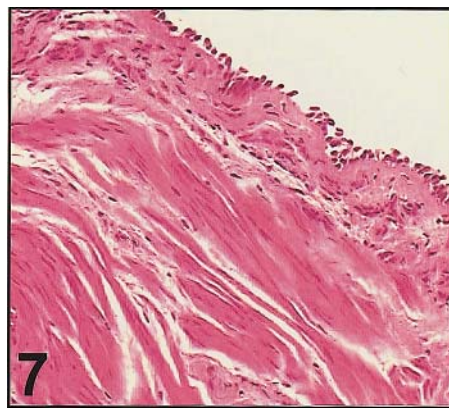




extensive fibrosis (Fig 5). Figs 4 and 5 are examples of Van Gieson staining of biopsy sections from patients with mild and severe asthma, respectively. Fibrosis is due to the increased deposition of extracellular matrix, particularly collagen type I and III (Fig 6), fibronectin, and proteoglycans. The increased deposition of extracellular matrix is due to the upregulation of a number of cytokines and growth factors, such as transforming growth factor β and IL-11, which are produced by structural cells (Fig 2) and inflamed cells, particularly eosinophils.



Increases in smooth muscle mass could be demonstrated in endoscopic biopsy specimens, particularly in those from patients with severe asthma. Smooth muscle cells could be demonstrated in close proximity to epithelial cells (Fig 7). There is strong evidence to suggest that smooth muscle cells in asthma can act as inflammatory cells and have an increased capacity to produce chemokines and cytokines. Fig 8 is an example of eotaxin immunoreactivity in smooth muscle from an asthmatic airway. An increase in vascularity has been described in asthma. Fig 9 is an example of factor VIII immunoreactivity in biopsy specimens of asthmatic subjects.



SUGGESTED READING LIST

- Holgate ST, Golden MP, Panettieri RA, Henderson WR. Roles of cysteinyl leukotrienes in airway inflammation, smooth muscle function, and remodeling. *J Allergy Clin Immunol* 2003;111:S18-36.
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- Molet S, Hamid Q, Davoine F, Nutku E, Taha R, Page N, et al. IL-17 is increased in asthmatic airways and induces human bronchial fibroblasts to produce cytokines. *J Allergy Clin Immunol* 2001;108:430-8.

Next in the series *Images in allergy and immunology*: Effect of steroids on asthma pathology