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Immunologic and Infectious Reactions in the Lung

edited by
Charles H. Kirkpatrick
and
Herbert Y. Reynolds

IMMUNOLOGIC AND INFECTIOUS REACTIONS IN THE LUNG

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Charles H. Kirkpatrick
Herbert Y. Reynolds

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and Infectious Disease
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FOREWORD

Many techniques for updating and assimilating new information in medicine have been proposed. As scientific reports proliferate, we hear shrill complaints about the amount of material that must be covered by the scientist and the physician in order to "keep up" with the latest and best information. There is no substitute for review by an expert to help others interpret the significance of new data and concepts.

This series of monographs is both expert and timely. There has been an expansion of research on respiratory and pulmonary problems. This expansion reflects a renewed public awareness of the importance of lung disease and a new awareness by researchers of opportunity to apply modern biological techniques to the study of the lung in health and disease.

It is my view that this series makes a comprehensive contribution to the science and practice of medicine and to the hopes we have for more effective concepts of preventive medicine.

Theodore Cooper, M. D.
Assistant Secretary for Health
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and Welfare

PREFACE

One of the principal contacts the human organism has with his environment is the 10,000 or so liters of ambient air that enters and leaves the respiratory tract during normal daily activities. Inspired air, which has so many essential ingredients for survival, also contains noxious gases and a variety of particulate materials which must be cleared or excluded from the lungs to maintain good health. To accomplish this the respiratory tract is equipped with a variety of physical and cellular mechanisms for defense against the hostile elements in air. Green has described this complex system as an umbrella of defense.*

Deposition of large particles in the lungs is prevented by anatomic filtration in the nose and the turbidity imparted to the air stream in the pharynx and tracheobronchial passages. Particles larger than 2-3μm in diameter are deposited on the mucus and cleared from the airways by ciliary action and coughing.

The smaller inhaled particles (0.5-3μm) include many infectious agents, and may be deposited distal to the ciliated epithelial portions of the respiratory tract in the alveolar spaces. Here a different clearance apparatus is present in which fluid components in the alveoli—a mixture of lipids, immunoglobulins and enzymes, and phagocytic cells interact to inactivate and remove particles either by way of the respiratory tract or through lymphatic channels to the hilar and mediastinal lymph nodes. When the local defenses fail, components of the inflammatory response recruit polymorphonuclear cells and other cellular and humoral factors from the intravascular compartment and systemic mobilization of the hosts' immune defenses is accomplished.

The purpose of this monograph, "Immunologic and Infectious Reactions in the Lung" is to explore the various immunologic components of host-defense that operate in the lungs. The presentation is divided into three parts. First, the anatomic and functional components of the lungs defenses are reviewed and the responses to challenges with antigens and certain infectious

*G. M. Green, The J. Burns Amberson Lecture—In defense of the lung, *Am. Rev. Respir. Dis.*, 102:691-703 (1970).

agents are considered. Part II concerns the disease states that occur as a consequence of deficiencies in the defense mechanisms or aberrant responses to drugs and environmental or unidentified antigens.

The third section dwells on techniques and phenomena, both conventional and projected, that enhance or reconstitute the hosts' defenses and thereby either prevent disease or have direct therapeutic effects. These therapies were reviewed from the rationale of their specific interactions with the immunologic processes.

Charles H. Kirkpatrick, M.D.
Herbert Y. Reynolds, M.D.
Bethesda, Maryland

INTRODUCTION

This monograph, *Immunologic and Infectious Reactions in the Lung,* marks the initiation of a series that will cover various aspects of modern *Lung Biology in Health and Disease.* Conceived late in 1972, the series has been made possible through the enthusiastic support of the many scientists who were approached. Until now, nearly 200 researchers from several countries have been involved in the twelve titles that are already in production or planned.

This series clearly reflects the remarkable blossoming of pulmonary investigation during the last decade, a decade during which investigators have become aware that nonrespiratory metabolic and "defense" functions of the lung are as important as the respiratory functions. There is now abundant evidence that all of these functions are closely related and interdependent. Alterations in the processes of gas exchange will be followed by impairment of the other functions; and conversely, disorders of the nonrespiratory functions will eventually lead to disturbances in the respiratory functions. While numerous research efforts are directed toward defining this interdependence more precisely, others are uncovering the fundamental processes that underlie all aspects of lung function. New approaches and new disciplines are being brought to bear on explorations of the lung as a whole, its cells and even its cellular components. The enormous body of new knowledge that has emerged from these new approaches to lung biology is addressed by the editors and authors of this series of monographs.

Special tribute should be paid to the editors to, and contributors of, this monograph, the first to appear. Through their unrelenting effort, Drs. C. H. Kirkpatrick and H. Y. Reynolds managed to complete the manuscript for this volume in about one year.

The volumes that soon will follow will cover topics in basic molecular biology applied to the lung, various aspects of lung development, the evolution of the respiratory system as it is reflected in different species, and various facets of pulmonary medicine, from early detection and pathogenesis to treatment.

Claude Lenfant, M.D.
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