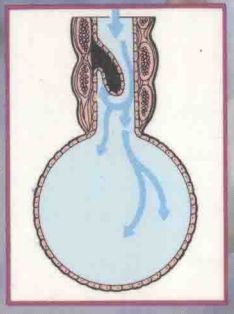
Pulmonary Nursing Care



Patricia A. Dettenmeier

Pulmonary Nursing Care

Patricia A. Dettenmeier, M.S.N., R.N., CCRN
Clinical Nurse Specialist
Division of Pulmonology and Pulmonary Occupational Medicine
Assistant Clinical Professor of Nursing
St. Louis University Medical Center
St. Louis, Missouri

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Consultants

Patricia Carroll, *C.,C.E.N., R.R.T., M.S., R.N.*
Owner, Educational Medical Consultants
Per Diem Staff Nurse
Emergency Department
Manchester Memorial Hospital
Manchester, Connecticut

Patti Coughlin Dalleske, *M.S.N., CCRN, R.N.*
Instructor
Youngstown State University
Youngstown, Ohio

Susan Donckers, *Ed.D., R.N.*
Associate Professor of Nursing
Radford University
Radford, Virginia

Margaret Eberts, *M.S.N., CCRN, R.N.*
Clinical Nurse Specialist
Ohio State University Hospitals
Columbus, Ohio

Clydia Frazier, *M.S.N.*
Clinical Specialist, Certified
Baltimore Veterans Administration Medical Center
Baltimore, Maryland

Cheri Howard, *M.S.N., R.N.*
Unit Director
Indiana University Hospital
Indianapolis, Indiana

Janet Larson, *Ph.D., R.N.*
Assistant Professor
College of Nursing
University of Illinois at Chicago
Chicago, Illinois

Colleen Mall, *M.N.*
Director
Nursing Education
Research Medical Center and Trinity Lutheran Hospital
Kansas City, Missouri

Edwina McConnell, *Ph.D., R.N.*
Independent Nurse Consultant
Madison, Wisconsin

Virginia L. Norman, *M.A., M.S., R.N.*
Associate Professor
College of Nursing
University of North Dakota
Grand Forks, North Dakota

Barbara Ogden, *M.S.N., R.N.C.*
College of Nursing
University of Florida/GVAMC
Gainesville, Florida

Tracy Riley, *B.S.N., R.N.*
Instructor
Aultman Hospital School of Nursing
Canton, Ohio

Carol M. Ruscin, *B.S., R.N.*
Level I Faculty
Baptist Medical System School of Nursing
Little Rock, Arkansas

Robert E. St. John, *R.R.T., B.S.N., B.A., R.N.*
Cardiopulmonary Nurse Clinician
Department of Nursing Administration
Jewish Hospital at the Washington University Medical Center
St. Louis, Missouri

Carol Thompson, *Ph.D.*
Assistant Professor
College of Nursing
University of Tennessee at Memphis
Memphis, Tennessee

Nancy Townsend, *M.N., CCRN, C.S., R.N.*
Program Director
Nursing Knowledge, Inc.
Metairie, Louisiana

Mary Wallace, *R.N.C., M.S.N.*
Assistant Professor
Northern Michigan University
Marquette, Michigan

Pamela Becker Weilitz, *M.S.N.(R), R.N.*
Pulmonary Clinical Nurse Specialist
Barnes Hospital at the Washington University Medical Center
St. Louis, Missouri

Preface

What do nurses and other health care professionals need to know in order to care for patients, primarily adults, with lung dysfunction? This is the objective of *Pulmonary Nursing Care* which is organized into 5 units based on clinically-functional components of the nursing process: assessment, diagnosis, and intervention.

Organization. To understand what happens in the patient (pathophysiology) and why treatments appropriate for one disorder are not appropriate for another, the nurse needs a foundation in what is normal. Therefore, Unit 1, Foundations of Pulmonary Nursing, includes the most important concepts of pulmonary anatomy and physiology, divided into 3 chapters.

Given this knowledge, the nurse is prepared to gather data. Unit 2, Methods of Assessing Pulmonary Function, is designed to provide the nurse with information about gathering and interpreting data specific to patients with lung dysfunction. This process begins with taking a history and performing a physical examination. Pertinent information about other body systems as they relate to the pulmonary system are also included. Other chapters in Unit 2 focus on analysis of arterial blood gases, chest x-rays, and pulmonary function tests. Components specific to critically ill patients are included throughout with additional specific concerns addressed in Chapter 9 Bedside Monitoring of Acutely Ill Patients. Some nurses might argue that they do not need to know how to interpret chest x-rays. Although it is true that a physician is ultimately responsible for "reading" a chest x-ray, it is important for nurses to understand abnormalities on chest x-rays to effectively direct nursing care. I have therefore included numerous examples of x-rays in this unit.

Unit 3, Diagnosis of Respiratory Dysfunction, discusses major lung diseases, of which there are basically two types: obstructive and restrictive. Some lung diseases, such as adult respiratory distress syndrome or chest trauma, traditionally cause acute respiratory failure and are discussed separately in Chapter 12 Respiratory Failure. In Chapter 12, I have tried to help the nurse separate basic ventilatory and oxygenation failure, which is critical for treatment.

Unit 4 Methods of Intervention discusses interventions applied in patients with respiratory dysfunction. Main interventions are classified into noninvasive and invasive, although noninvasive and invasive mechanical ventilation and weaning are covered in a subsequent chapter. Similarly, medications are discussed separately and not integrated into the treatment of diseases or with other interventions.

The final section—Unit 5, Home Care of Patients with Respiratory Dysfunction—is directed toward home discharge of patients with pulmonary dysfunction. This area has developed markedly in the past 2 decades. Patients are being sent home sooner, and with more technology for them to manage in the home. There is also a trend toward improving functional capabilities and quality of life in patients with chronic pulmonary diseases through rehabilitation. Unfortunately, reimbursement for pulmonary rehabilitation is not always optimal, and patients may need direction from the home health nurse.

A comprehensive patient education program, complete with reproducible patient education guides, is presented in Chapter 19 Pulmonary Rehabilitation.

Features. Each unit contains an introduction to focus the reader on important content. Each chapter begins with general learning objectives applicable to the student or practicing nurse to promote learning. This book is well illustrated—it includes over 100 illustrations to reinforce content visually. In addition, numerous tables and boxes are provided to help the nurse provide complete care for patients with pulmonary dysfunction.

Acknowledgements. I have many people to thank for their contributions over the years. First, there are the patients who helped me realize that I wanted to be a pulmonary nurse. Then, there are the nurses, therapists, social workers, and physicians who asked the questions that helped direct the content of this book. I am indebted to my colleagues, the pulmonologists and intensivists, who helped me to understand pulmonary medicine, which is critical for being an effective pulmonary nurse. I appreciate all the support and cooperation from family and friends. I also want to thank the staff at Mosby–Year Book, including Robin Carter, Don Ladig, Mark Spann, Jeanne Wolfgeher, and Linda Woodard. It is difficult to place a value on the advice I have received from a friend and colleague Anne Perry, who gave me my first opportunity to write in a major textbook. I am pleased that members of my COPD support group, the Breathers For Life, were able to demonstrate different types of oxygen devices. These people include John Cox, Daisy Dodson, Howard and Millie Jennings, Charles and Cedona Kendall, and Charles Peterson. I gratefully recognize Thomas M. Hyers for his thoughtful Foreword to this edition. Finally, I would like to thank you, the reader. I have tried to write an accurate, easy-to-understand book. I would appreciate any positive or negative comments you have. You can write to me at St. Louis University or through Mosby-Year Book.

Patricia Dettenmeier

For my boys
ROGER, DAVID, NICHOLAS, and MATTHEW
who charge my life and dreams

Foreword

It is a pleasure to write this Foreword to a new pulmonary book for nurses and other health care professionals. An understanding of lung function and lung diseases is increasingly important because these diseases continue to escalate in prevalence in western society; they now constitute the fourth leading cause of death in the United States. Although cigarette smoking has a great deal to do with this increase, other conditions, such as asthma and occupational health hazards, which are not directly related to cigarette smoking, also appear to be increasing. However, at a time when the prevalence of lung diseases is increasing, our understanding of them and our ability to intervene are also improving. Consequently, the pulmonary practitioner or student must constantly update knowledge and experience to care for these patients.

Diagnosis and treatment of lung diseases has increasingly become dependent on high technology. However, a basic understanding of anatomy and physiology must be coupled with a clear history and competent physical examination before high technology can be effectively applied. In my opinion, the three greatest advances in the diagnosis of lung disease in the last 20 years have been the widespread application of arterial blood gas technology, fiberoptic bronchoscopy, and computed tomographic scanning. These techniques have allowed for understanding of the pathophysiology of hypoxic-induced acute and chronic lung injury, and for widespread diagnostic approaches to the interior of the lung without resort to invasive surgical procedures. Each technology has already produced numerous spin-offs. Arterial blood gas measurements have lead to intravascular and cutaneous monitoring of oxyhemoglobin saturation. Fiberoptic bronchoscopy has led to a wealth of diagnostic and therapeutic techniques, which include transbronchial lung biopsy and needle aspiration and laser and brachytherapy for endobronchial neoplasms. Understanding the rationale and application of these techniques is essential in the approach to the modern day diagnosis of lung disease.

Similarly, in my opinion, the three greatest treatment advances in the last 20 years have been the widespread use of reliable mechanical ventilation in acute respiratory failure, the recognition that oxygen prolongs life in hypoxemic patients with chronic obstructive pulmonary disease, and the use of inhaled medications, particularly beta-2 adrenergic agonists and glucocorticoids, in the treatment of asthma. Again, to understand and apply these therapeutic advances, the student or practitioner must understand the basic pathophysiology of lung disease, the principles of gas exchange, and the mechanics of airway function.

Finally, the reader is reminded that the lung offers a much larger surface to the environment than does the skin. This gas exchange surface is constantly interacting with respirable environmental hazards. These hazards include dust, such as asbestos; noxious gases; and other particulates. The most important environmental hazard, however, remains a self-induced one. Cigarette smoke still accounts for the great majority of cases of lung disease, principally emphysema and lung cancer. In this regard, it is never too late to stop smoking. When a heavy smoker stops, the risk for lung cancer begins to de-

cline immediately and returns to the risk of a non-smoker within 10 to 15 years. After smoking cessation, the accelerated rate of decline in airway function (decrease in FEV_1) in the emphysema patient rapidly returns to the rate associated with the non-smoking individual. Consequently, it is imperative that nurses and other healthcare givers understand and be able to explain to the patient the nature of lung diseases caused by cigarette smoking. Furthermore, the care-giver must be able to counsel individuals on the steps to smoking cessation. These steps are well outlined in the book and will prove useful in smoking intervention. This intervention is the most important therapy any care-giver can give a patient.

In summary, the book offers a basic summary of pulmonary interventions as appropriate for nurses and other care-givers. In addition to providing a physiological theoretical foundation, the book addresses assessment and treatment of the patient with lung diseases. Care-givers who understand the book and can apply its principles will render large benefits to their patients.

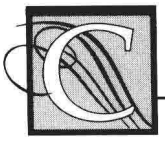
Thomas M. Hyers, M.D.
James and Ethel Miller Professor of Medicine
Director, Division of Pulmonology and Occupational Medicine
St. Louis University Medical Center
National Institutes of Health Clinical Trials Review Committee

Contents

UNIT ONE

Foundations of Pulmonary Nursing

In Chapter 1 anatomy and physiology are studied by monitoring air as it moves through the pulmonary system. Concepts follow the path of air from entry through the upper airway into the lower airway and finally into the bloodstream. With this understanding, the nurse is prepared to examine special properties of lung function in Chapter 2, titled "Ventilation/perfusion relationships." Ventilation depends on the compliance and resistance properties of the lung. Blood flow, or perfusion, in the lung is altered by many factors, including cardiac output and hypoxemia. The balance of ventilation and perfusion affects gas exchange. Understanding *ventilation/perfusion matching*, the final section in Chapter 2, is critical in recognizing gas exchange abnormalities common in respiratory dysfunction. Chapter 3 reviews the transport of oxygen and carbon dioxide across the alveolar-capillary membrane and discusses acid-base concepts. These concepts are a prelude to interpreting abnormalities in arterial blood gases and to applying appropriate interventions.



CHAPTER 1

Anatomy and Physiology

Objectives:

- Identify upper airway structures on a diagram.
- State the functions of each upper airway structure.
- Identify lower airway structures on a diagram.
- State the functions of each lower airway structure.
- Discuss defense mechanisms of the upper and lower airways.
- Describe pulmonary circulation.
- Describe diaphragmatic function.

Respiration is the process of gas exchange in the lungs. Oxygen is diffused into the blood at the same time that carbon dioxide is removed from the blood. Air is directed to the gas-exchanging units through a complex system of upper and lower airways. These gas-exchanging units approximate in the pulmonary capillaries. This relationship allows for exchange of oxygen and carbon dioxide. Inhalation and exhalation of air are facilitated by the muscles of the thoracic cage. This chapter is designed to review fundamental concepts of the anatomy and physiology of respiration.

UPPER AIRWAY

Nose

The respiratory tract is divided into the upper airway and the lower airway. The upper airway is composed of the nose, pharynx, and larynx (Fig. 1-1). In the normal individual, air enters through the nares and passes into the nasal cavity. The nasal cavity is lined with a mucous membrane that contains serous glands and goblet cells. The serous glands and goblet cells secrete a thin layer of watery mucus over the mucous membrane. Also protruding from the mucous membrane are hairlike projections that beat in a waving motion to propel particulate matter for removal.

The primary respiratory functions of the nose are to warm, moisturize, and filter the inhaled air. Upon inhalation, air is warmed almost to body temperature by the time it reaches the trachea. This occurs because of the rich supply of blood vessels lying under the mucous membrane. Heat from these blood vessels warms incoming air.

Air is also moisturized by the nose as it is inhaled. The nose supplies mois-

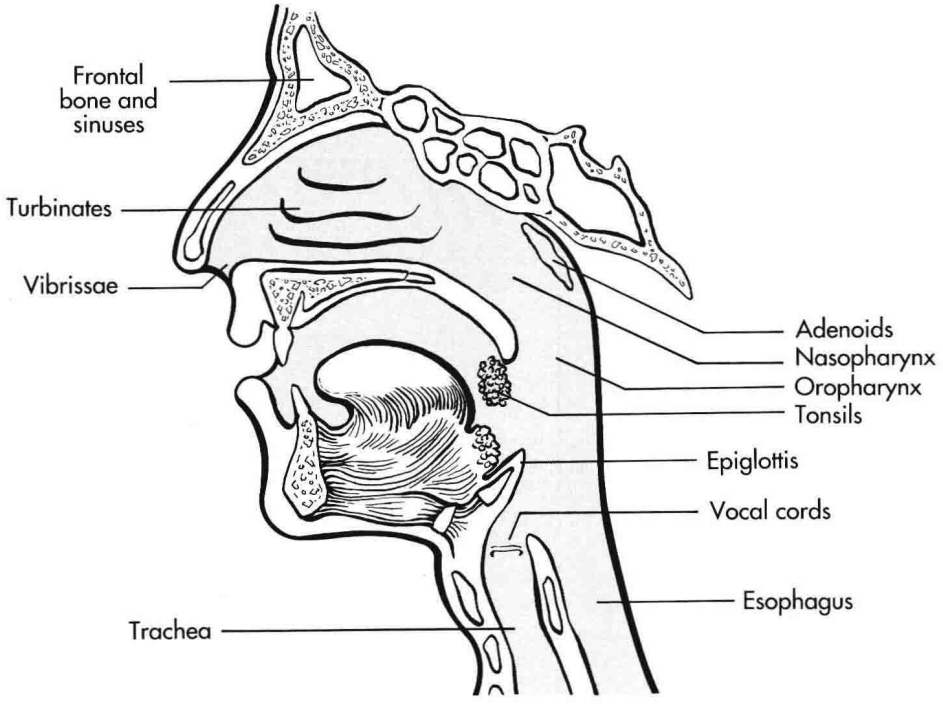


Fig. 1-1. Upper airway.

ture to inhaled air depending on the ambient temperature and humidity. When the temperature and humidity are elevated, as may occur in summer months, the nose supplies less moisture than when the temperature and humidity are lower, as may occur in winter months. The goal of 100% saturation of the air with water vapor is achieved by the time air reaches the alveoli. Most humidification of inhaled air occurs in the nose. To humidify inhaled air, the body loses approximately 250 ml of water in a 24-hour day.

Filtration of inhaled air is another very important function of the nose. Nasal hairs, or vibrissae, are responsible for filtering large particles of dust, germs, and other matter. Particles exceeding 10 μm are efficiently filtered by the vibrissae. This function can be appreciated on dusty days or days when particulate air-pollution levels are very high. For example, when the nose is blown, trapped dust or coal or hay particles are evident in the tissue. Smaller particulate matter is trapped by the mucus layer in the nasal cavity. Air flowing through the nasal cavity frequently changes direction, creating turbulent air flow, and causes impaction of particulate matter on the walls of the turbinate bones. The particulate matter lands on the mucus layer and is swept to the pharynx for expulsion. In some instances a sneeze will be generated to clear nasal passages.

Sinuses

Four sinuses surround and drain into the nasal cavity. They are the frontal, maxillary, ethmoid, and sphenoid sinuses. The ethmoid sinuses are associated closely with inspired air; they are also the smallest and most likely to be obstructed with mucus. Because of their posterior position, problems in the

sphenoid sinuses are associated with vision impairment. The sinuses lighten the weight of the skull, produce mucus for the nasal cavity, and contribute to an individual's resonant voice characteristics.

Pharynx

After passing through the nose and nasal cavity, inhaled air reaches the pharynx, or throat. The pharynx has three anatomic divisions: the nasal pharynx, the oral pharynx, and the laryngeal pharynx. The nasal pharynx, also called the nasopharynx, is located posterior to the nose and above the soft palate at the rear of the mouth. The adenoids and eustachian tube openings are located in the nasal pharynx.

The oral pharynx, also called oropharynx, is located in the mouth. The boundaries of the oral pharynx are the soft palate superiorly, the base of the tongue inferiorly, and the palatine arches laterally. The tonsils are located in the oral pharynx.

The laryngeal pharynx, also called laryngopharynx or hypopharynx, is located posterior to the larynx from the hyoid bone to the esophagus. The epiglottis, arytenoid cartilages, piriform sinuses, and valleculae are located in the laryngeal pharynx.

The pharynx functions as a passageway for air into the lungs and for food into the esophagus. The pharynx, particularly the nasal pharynx, is also involved in filtering and humidifying the inhaled air.

Larynx

The larynx is the final portion of the upper airway. Another name commonly used to refer to the larynx is *voice box* because the vocal cords are located in the larynx. The larynx is located inferior to the pharynx and connects the pharynx to the trachea. The lower border of the larynx is about the level of the sixth cervical vertebrae. The glottis is the entrance to the larynx. During swallowing, the glottis is covered in a lidlike manner by the epiglottis. The thyroid, cricoid, and arytenoid cartilages are other essential components of the larynx.

The larynx has multiple functions, including separation of food and air, phonation, or voice production, and initiation of cough from the upper airway. The larynx is responsible for separating inhaled air from food that is being swallowed. Failure of the epiglottis to cover the larynx during swallowing results in aspiration of solid or liquid material into the lung. Because solids move through the larynx by propulsion instead of falling by gravity like liquids, they usually are aspirated less easily.

The vocal cords are located between the thyroid and arytenoid cartilages. They form the V-shaped opening of the glottis. Movement of the arytenoid cartilages by muscle contraction allows inhalation and exhalation of air and controls sound production. Sound is produced when the arytenoid cartilages pull together forcing exhaled air through a closed glottis and vibrating the vocal cords. Intubated patients cannot talk because of impaired vocal cord movement and because air does not pass over the vocal cords. Some patients with tracheostomy tubes can talk because vocal cord movement is not altered.

Cough from the upper airway is initiated by many irritants, including dust, smoke, pressure, chemicals, cold, and dry mucous membranes. Cough itself can initiate another cough. The physiology of cough is discussed as a lower airway defense mechanism later in this chapter.