Cardiopulmonary resuscitation

PROCEDURES FOR BASIC AND ADVANCED LIFE SUPPORT

Patricia Diane Ellis
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Foreword

It has been estimated that as many as 10 million citizens of the United States became critically ill or injured in the year 1978. More than 1 million such individuals lose their lives each year from the effects of cardiovascular disease and accidental death alone. Many lives could be saved and disabilities reduced or prevented if appropriate emergency medical care were implemented at the site of the emergency as well as en route to and following arrival at the hospital.

In many metropolitan areas ambulance services respond to between 50,000 and 100,000 emergencies per year. No matter what the emergency, most life-threatening situations necessitate a thorough understanding of the management of both the airway and circulation in these critically ill patients.

Cardiopulmonary resuscitation has come a long way since 1956, when Dr. W. B. Kouwenhoven and his assistant, Mr. G. G. Knickerbocker, first observed that, by pressing on the chest of a laboratory animal attached to strain gauges and flowmeters, circulation could be achieved. Shortly thereafter, in the late 1950s, the first attempts at closed-chest cardiopulmonary resuscitation (CPR) were undertaken. It is interesting to note that the medical profession in Baltimore remained somewhat skeptical, and it was the Baltimore City Fire Department that was instrumental in introducing CPR.

Since the late 1950s a real explosion of interest in the delivery of emergency care has occurred in the United States. With the advent of emergency medical technicians, paramedics, and other sophisticated paramedical providers in the late 1960s and 1970s, the interest and rebirth of interest in resuscitation and airway management have continued. Unfortunately we in the health profession sometimes lose sight of the fact that our goals should be the elimination of certain problems, not the treatment of these problems after they happen. For instance, we have found that with the training of citizen CPR rescuers and with the advent of advanced life support units, we can initially salvage a number of individuals who suffer myocardial infarctions. The long-term survival of these individuals, however, still remains to be adequately improved. In other words, conquering heart disease does not necessarily rest with CPR.

One of the great positive spin-offs from the emphasis on advanced life support and mobile intensive care units has been a general improvement in the delivery of emergency medical care in all areas. Certainly the ability to clear an obstructed

airway in a small child who has aspirated a piece of food is a great and significant saving and has profound, long-term implications.

This fine textbook is a "nuts and bolts," in-depth evaluation of both basic and advanced life support. The public generally expects all health professionals to have some basic life support capability and expects many health professionals to have advanced life support capabilities. This textbook goes a long way toward helping one achieve those goals. One should be cautioned, however, that reading and studying a textbook such as this does not make one proficient or even qualified to deliver basic or advanced life support. However, it can be useful in improving one's overall knowledge. CPR is a skill that can be improved and practiced only through drill and actual experience.

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Preface

Procedures for cardiopulmonary resuscitation (CPR) include recognition of cardiopulmonary emergencies, prompt restoration of ventilation and circulation, and definitive therapy with adjunctive procedures. These procedures for basic and advanced life support are performed in hospital and community settings, contributing to lower death rates and enhanced quality of life for victims of unforeseen cardiopulmonary arrests.

The acceptance of procedures for life support has mandated training personnel who can consistently provide quality health care during cardiopulmonary emergencies. Through the efforts of voluntary agencies, governmental agencies, and professional organizations, standards for training personnel for cardiopulmonary rescue have been developed to assure continuity of practice for physicians, nurses, emergency medical technicians (paramedics), respiratory therapists, and other allied health team members. The purpose of this text is to provide a resource for rescuers acquiring and maintaining CPR skills. Although not all team members may be qualified to initiate each procedure, all should be familiar with intervention and equipment used during CPR.

This text is designed for learning or reviewing the life support procedures for recognition of a cardiopulmonary emergency and for treatment during and immediately after the cardiopulmonary emergency. The content is arranged with a discussion of anatomy and physiology of the respiratory and cardiovascular systems and etiology and pathophysiology of cardiopulmonary arrest, followed by chapters that describe procedures for assessment of cardiopulmonary emergencies, basic life support, and advanced life support including restoration of ventilation, restoration of circulation, and parenteral therapy. Those procedures that may be performed by nurses, emergency medical technicians, and respiratory therapists are described in depth. Other procedures not performed by these persons are summarized. The final chapters describe the organization of an emergency medical system in the community and hospital and provide perspectives of the historical, legal, ethical, and psychological aspects of CPR. Suggested emergency protocols for basic and advanced life support procedures are included as an appendix. Illustrations, tables, and flow charts are used liberally throughout to amplify descriptions of procedures.

We recognize that procedures and policies vary in clinical settings, and cir-

cumstances surrounding a cardiopulmonary emergency are often less than ideal. The procedures are therefore written as guidelines and it is expected that the rescuer adapt these for practical use according to the age and size of the victim, the setting and situation, the availability of equipment and supplies, as well as the policies of the employing agency.

We wish to extend our appreciation to our colleagues and friends, Linda Abels, R.N., Henry C. Bock, M.D., Beverly Brown, R.N., Claudia Chavis, Peter Dillman, Suzanne Ellis, Christine Gelb, R.N., Philip Gibbs, M.D., Sr. Mary Paul Grove, R.N., Jeanne Hawkins, R.Ph., Charles E. James, M.D., Daniel K. Lowe, M.D., Peg McIntosh, R.N., Carol Miller, R.N., S. S. Moorthy, M.D., Elizabeth Scales, R.N., R. Brian Smith, M.D., Rosalyn Smith, R.N., Gordon Tabor, L.L.D., and Lyman H. Wolfla II for their manuscript critique; to Marita Bitans, Paul McGrey, and Philip Stock for artwork; and to Henry C. Bock, M.D., for photography.

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CHAPTER ONE

Anatomy and physiology of the respiratory and cardiovascular systems

Knowledge of anatomy and physiology of the respiratory and cardiovascular systems provides a framework for rescuers who may be instituting either basic life support or advanced life support. This chapter provides a brief synopsis of these subjects to facilitate assessment of cardiopulmonary emergencies, implementation of cardiopulmonary resuscitation (CPR) maneuvers, and evaluation of the effectiveness of these maneuvers to restore life to the victim. If a more detailed review of anatomy and physiology is desired, the rescuer should seek a suitable text of anatomy and physiology. The chapter describes the anatomy and physiology of the respiratory and cardiovascular systems.

RESPIRATORY SYSTEM

Structures of the respiratory system include the nose, pharynx, larynx, trachea, bronchi, bronchioles, alveoli, and thorax. The oral cavity is not considered technically a part of the respiratory system; however, it is included here since many individuals are "mouth breathers" and many procedures and devices utilized to restore ventilation during CPR may involve manipulation of the oral cavity. The respiratory system serves not only to facilitate metabolism of the tissue cells through the exchange of oxygen for carbon dioxide but also to participate in the regulation of acid-base balance.

Anatomy

Nose. Structures of the nose include the nares, nasal cavity, several small bones, and hard palate (Fig. 1-1). The external openings of the nose, the nares (singular, naris), communicate with the nasal cavity, which is separated by a cartilagenous structure, the nasal septum, to form the nasal passageways. Lining the nasal cavity is a ciliated (hair-like) mucous membrane, which serves not only to filter airborne debris but also to warm, cool, and humidify air during inspiration; bypass of the nasal cavity, such as with insertion of some types of artificial air-

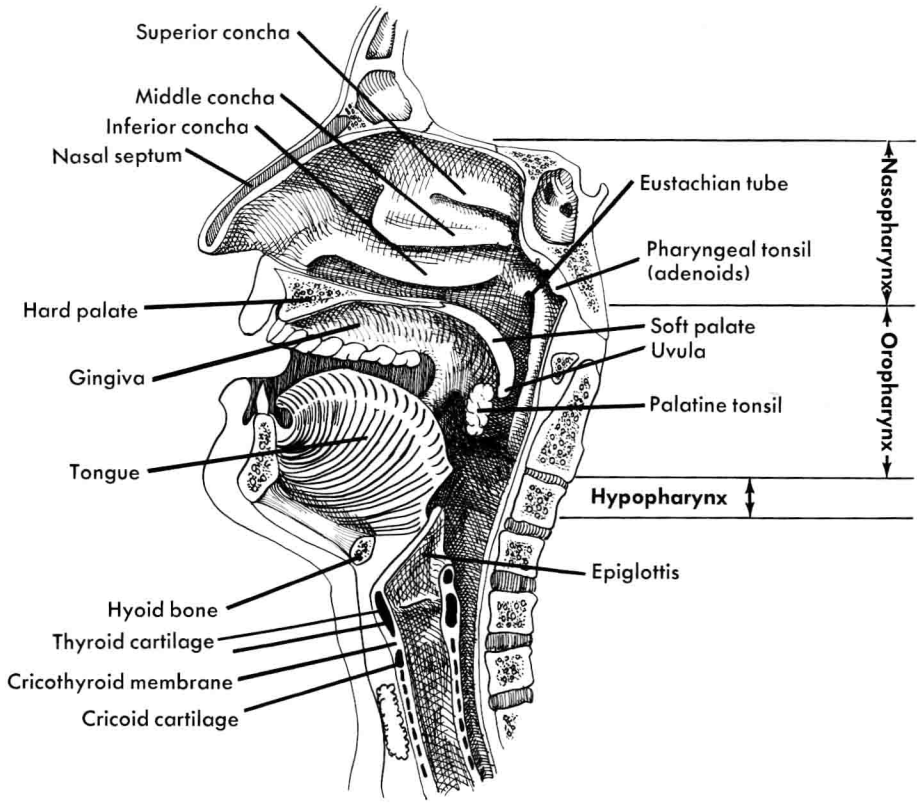

Fig. 1-1. Structures of upper airway and oral cavity. Larynx is the landmark for separation of upper and lower airway.

ways during CPR, hinders these protective mechanisms. Each side of the nasal cavity has three bones—the superior concha, the middle concha, and the inferior concha—which project from the lateral wall, and several small openings for drainage of sinuses. The hard palate, composed of the palatine bones, separates the oral cavity from the nasal cavity.

Oral cavity. The oral cavity includes the cheeks, tongue, soft and hard palates, gingiva, teeth, and salivary glands (Fig. 1-1). The cheeks form the lateral walls of the oral cavity. A musculomembranous structure, the tongue, is located at the midline and is attached to the floor of the oral cavity by a fold called the frenulum. The anterior portion of the roof of the oral cavity is the hard palate; the posterior portion is the musculomembranous soft palate, which has a midline projection called the uvula. The gingivae (singular, gingiva) secure the necks of the teeth. Several salivary glands empty mucous and serous secretions into the oral cavity.

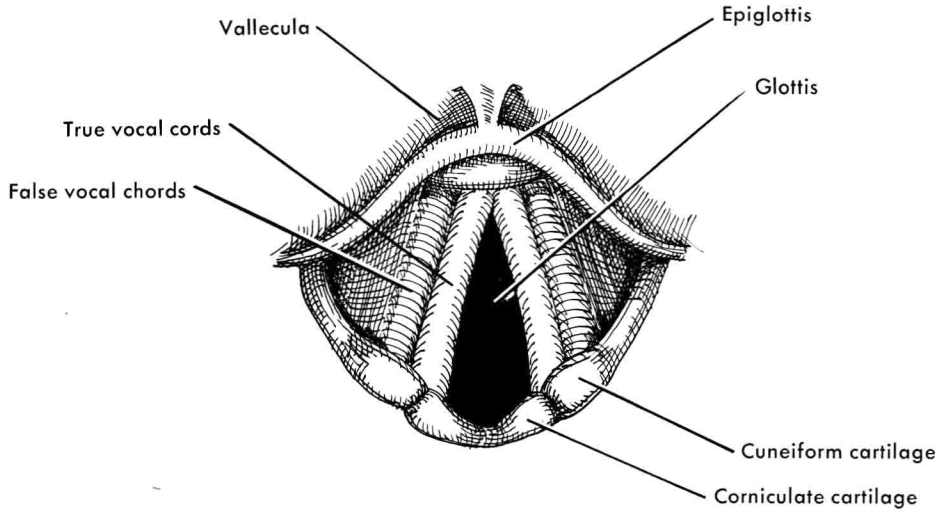

Fig. 1-2. Interior of larynx.

Pharynx. The pharynx is a musculomembranous tube extending from the base of the skull to the esophagus; the pharynx serves as a passageway not only for air but also for food and fluid from the oral cavity to the esophagus. There are three distinct areas of the pharynx: the nasopharynx, oropharynx, and hypopharynx (Fig. 1-1). The nasopharynx extends from the nasal cavity to the soft palate. Positioned in the posterior wall of the nasopharynx are the pharyngeal tonsils, also referred to as adenoids. The right and left eustachian tubes, which connect the middle ear to the pharynx, have their openings in the lateral walls of the nasopharynx. Extending from the soft palate to the hyoid bone is the oropharynx, which connects with the oral cavity. Contained in the oropharynx are the palatine tonsils. The hypopharynx extends from the hyoid bone to the opening of the larynx.

Larynx. The larynx serves not only as a passageway for air to and from the lungs but also as the landmark for separation of the upper and lower airway. It is positioned between the pharynx and the trachea (Fig. 1-1) and is composed of several cartilages and muscles (Fig. 1-2). The epiglottis, which normally prevents the entry of fluid and food into the lower airway, is positioned just below the vallecula and just posterior and superior to the thyroid cartilage. The thyroid cartilage, sometimes called the Adam's apple, is the largest cartilage of the larynx, generally being larger in the male than the female. Below the thyroid cartilage is the cricothyroid membrane, which is connected to the signet-shaped cricoid cartilage. Just posterior to the thyroid cartilage are three paired cartilages, the arytenoids, corniculates, and cuneiforms. There are two pairs of mucous membrane folds that pass across the opening of the larynx. One pair is called the false vocal cords; the

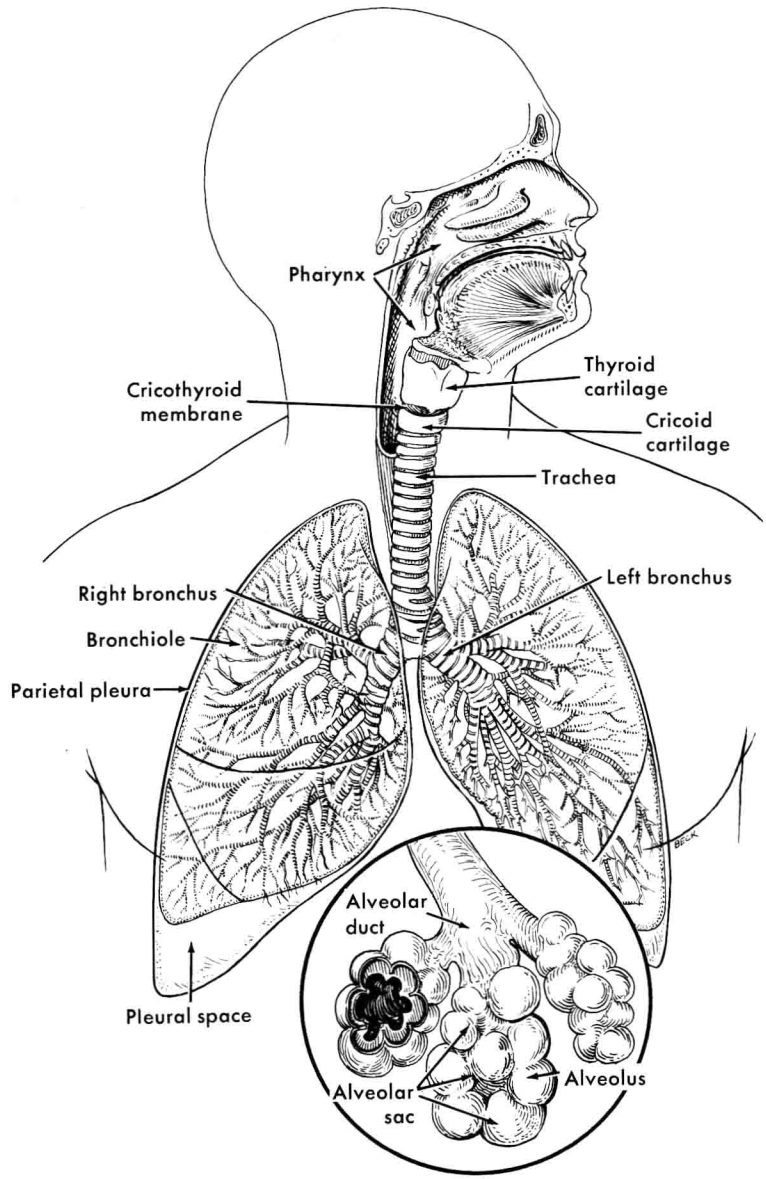

Fig. 1-3. Pharynx, trachea, bronchi, bronchioles, alveoli, and related structures. (From Anthony, C. P., and Thibodeau, G. A.: Textbook of anatomy and physiology, ed. 10, St. Louis, 1978, The C. V. Mosby Co.)