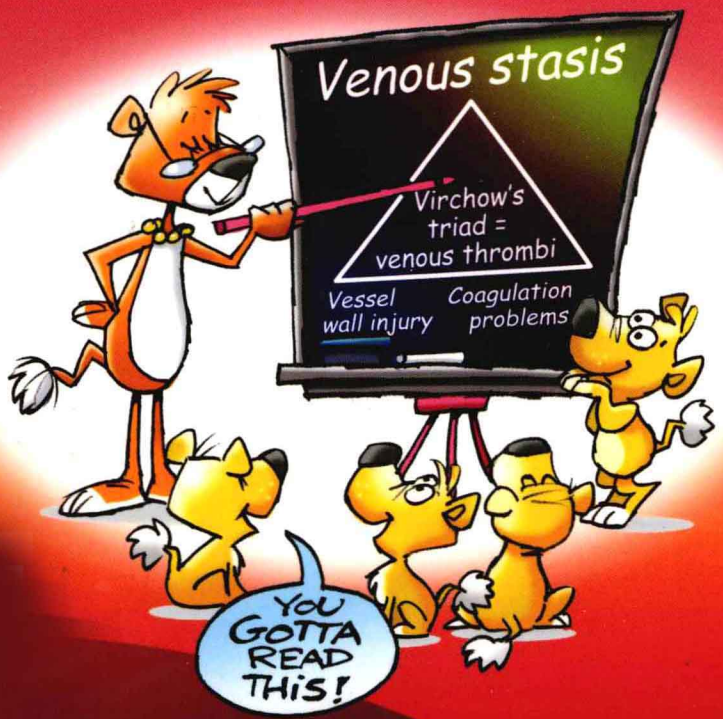
Second Edition

Saunders Nursing Survival Guide

Critical Care & Emergency Nursing



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Saunders Nursing Survival Guide: *Critical Care & Emergency Nursing*

Second Edition

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Dr. Cynthia Chernecky earned her degrees at the Case Western Reserve University (PhD), the University of Pittsburgh (MN), and the University of Connecticut (BSN). She also earned an NCI fellowship at Yale University and a postdoctorate visiting scholarship at UCLA. Her clinical areas of expertise are critical care oncology and vascular access. She has more than 30 published books as editor and author with five having won prestigious awards, among them *Laboratory Tests and Diagnostic Procedures* (fifth edition), *Advanced and Critical Care Oncology Nursing: Managing Primary Complications, ECG & the Heart, Fluid and Electrolytes, IV Therapy and Acute Care Oncology Nursing.* She is a national and international speaker, researcher, and published scholar. She is also active in the Orthodox Church, is supportive of Saints Mary & Martha Orthodox Monastery, and enjoys life with family, friends, colleagues, and a West Highland white terrier.

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Preface

The Saunders Nursing Survival Guide series was created with your input. Nursing students told us about topics they found difficult to master, such as critical care and emergency and hemodynamics. Based on information from focus groups at the National Student Nurses Association meeting, this series was developed on your recommendations. You said to keep the text to a minimum; to use an engaging, fun approach; to provide enough space to write on the pages; to include a variety of activities to appeal to the different learning styles of students; to make the content visually appealing; and to provide NCLEX review questions so you could check your understanding of key topics and review as necessary. This series is a result of your ideas!

Understanding the concepts and principles of critical care and emergency nursing provides a solid foundation for the nurse who works with critically ill patients to guide drug therapy, who monitors hemodynamic parameters, and who is expected to make sound clinical decisions. It is essential for any nurse working in critical care and emergency nursing to be aware of the assessment and technical skills and nursing knowledge associated with the nursing management for these types of patients.

Critical Care & Emergency Nursing in the *Saunders Nursing Survival Guide Series* was developed to explain difficult concepts in an easy-to-understand manner and to assist nursing students in the mastery of these concepts. A basic understanding of pathophysiology, anatomy, and physiology is assumed because the content in this text builds on previous nursing knowledge and provides the fundamental introduction to critical care and emergency nursing. *Critical Care & Emergency Nursing* can also serve as a valuable guide and resource for the novice and the experienced nurse who want to review concepts and principles of critical care and emergency nursing.

We include many features in the margins to help you focus on the vital information you will need to succeed in the classroom and in the clinical setting. **TAKE HOME POINTS** are made up of both study tips for classroom tests and "pearls of wisdom" to assist you in caring for patients. Both are drawn from our many years of combined academic and clinical experience. Content marked with a **Caution icon** is vital and usually involves nursing actions that may have life-threatening consequences or may significantly affect patient outcomes. The **Lifespan icon** and the **Culture icon** highlight variations in treatment that may be necessary for specific age or ethnic groups. A **Calculator icon** will draw your eye to important formulas. A **Web Links icon** will direct you to sites on the Internet that will give more detailed information on a given topic. Each of these icons is designed to help you focus on real-world patient care, the nursing process, and positive patient outcomes.

We also use consistent headings that emphasize specific nursing actions. **What It IS** provides a definition of a topic. **What You NEED TO KNOW** provides the explanation of the topic. **What You DO** explains what you do as a practicing nurse. **Do You UNDERSTAND?** provides questions and exercises that are both entertaining and useful to reinforce the topic's concepts. This four-step approach provides you with information and helps you learn how to apply it to the clinical setting.

Our inspirations and goals for *Critical Care & Emergency Nursing* were to make difficult topics easier. We have used real-world clinical experiences and expertise to bring you a text that will help you understand critical care and emergency nursing to facilitate better patient care. The art and science of nursing is based on understanding, which is the key to critical thinking and clinical decision making. Our hope is for you to share your new insights and understanding with others and apply this information to affect nursing care positively.

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I would like to extend grateful appreciation to my family, colleagues, and students who have provided me with continuous support and encouragement through this endeavor. To my students, who, without them and their desire to learn critical care nursing, none of this would have been possible. I also want to express special thanks to the doctoral faculty at Duquesne University, especially Dr. Joannie Lockhart and Dr. Gladys Husted, for their inspiration and encouragement through my doctoral studies and the publishing of this book. I especially wish to extend my deepest gratitude to my family. To my sister, Julie, and my father and mother, Stan and Sandy, who have continually inspired me in all my nursing endeavors. I wish to dedicate this book to them. Thank you to all the critical care and emergency nurses at Buffalo General Hospital, Medical College of Georgia Health Inc., and WCA Hospital for your diligence and care that you provided to my father during his numerous visits to your nursing units—without you, great things would not be possible! I appreciate and will never forget all the encouragement that Dad gave me through the writing and editing process of this book, although he was ill and not feeling his best. Through his illness, he always strived and was determined to make life better and to live to the best of his abilities.

Dad, it is your determination, strength, love, wisdom, and encouragement that I will always cherish and will attempt to foster in my nursing endeavors and those of my students.

Lori Schumacher

The added strengths of this edition could not have been accomplished without the true professionalism of editors, contributors, reviewers, students, and publication team. Vision and unselfishness are qualities of all of these professionals. We could not have completed this book from idea to present edition without a professional environment that encouraged and supported us in our educational efforts, both in our jobs and from the many experts at Elsevier.

Special thanks for the support and continuous encouragement of my mother, Olga, the nuns of Saints Mary and Martha Orthodox Monastery, and Peter and Katya McNeill. Professional thanks to Drs. Linda Sarna, Ann Kolanowski, Jean Brown, Geri Padilla, Mary Cooley, Leda Danao, Rich Haas, Fred Lupien, Georgia Narsavage, and to Denise Macklin, Paula T. Rieger, Jennifer Edmunds, Kitty Garrett, Becki Hodges, Nancy Stark, Rebecca Rule, and Ingrid Porter for their support and encouragement.

And, finally, to my dog, who gave up long walks and play time so I could write and edit.

Cynthia (Cinda) Chernecky

Contents

Review of Hemodynamics

Chapter 1

What You WILL LEARN

After reading this chapter, you will know how to do the following:

- ✔ Describe the physiologic basis for hemodynamic monitoring in critically ill patients.
- ✔ Discuss factors that influence cardiac performance and hemodynamic values.
- ✔ Identify normal values for intraarterial, right atrial, left atrial, and pulmonary artery pressure monitoring.
- ✔ Identify appropriate nursing interventions when caring for a patient with hemodynamic monitoring.

What IS Hemodynamics?

Hemodynamics is the study of forces involved in the flow of blood through the cardiovascular and circulatory systems. Components of hemodynamics are blood pressure (BP) or cardiac output (CO) × systemic vascular resistance, central venous pressure (CVP), and right and left heart pressures.

The physiologic principles of hemodynamics include factors that affect myocardial function, regulate BP, and determine cardiac performance and CO. Understanding the basic concepts of pressure, flow, and resistance provides an insight into the understanding of hemodynamic values. Assessing ventricular function through the evaluation of hemodynamic variables enables the nurse to identify cardiovascular problems and to determine appropriate interventions. This chapter

provides a basis for the interpretation of hemodynamic values and clinical application.

What IS the Circulatory System?

The body has a complex network of veins and arteries within a continuous circuit that makes up the *circulatory system.* The heart pumps a constant volume of blood through this system to maintain balance between oxygen delivery and demand.

What You NEED TO KNOW

Several mechanisms regulate the flow of blood through the system. When the body's metabolic demands increase, the blood vessels constrict in an attempt to force blood back to the heart. When the metabolic demand decreases, the veins dilate. This dilation causes pooling of blood in the periphery and reduces venous return to the heart. Other mechanisms that control flow are the result of the ability of the heart to increase or decrease heart rate (HR) and strength of contraction.

How Does the Heart Work?

The function of the heart is to pump blood through the body. The heart is composed of two upper chambers called the *atria* and two lower chambers called the *ventricles.* The atria serve as reservoirs for incoming blood, and the ventricles are the main pumping chambers of the heart. The atria are separated from the ventricles by **atrioventricular valves (AV valves).** The tricuspid valve separates the right atrium from the right ventricle, and the mitral valve separates the left atrium from the left ventricle. Two other valves, the **pulmonic** semilunar and the **aortic** semilunar, help control the flow of blood from the ventricles to the lungs and systemic circulation. The pulmonic semilunar valve controls the flow of blood from the right ventricle to the lungs, and the aortic semilunar valve controls the flow of blood from the left ventricle to the aorta.

The electrical conduction system is specialized tissue that allows electrical impulses to travel very efficiently from the atria to the ventricles. **Depolarization** is the electrical activation of the muscle cells of the

heart and stimulates cellular contraction. Once the cells are depolarized, they return to their original state of electrolyte balance, which is called **repolarization**.

Atria contract.

Cardiac Cycle

The right atrium receives venous blood from the systemic circulation while the left atrium receives reoxygenated blood from the lungs. While both atria are filling with blood, the sinoatrial (SA) node in the electrical conduction system fires and starts the process of depolarization. As the atria fill with blood, the pressure within the atria increases, forcing the AV valves to open. The majority of ventricular filling **(diastole)** passively occurs when the AV valves open. After atrial depolarization, the atria contract, forcing the remaining atrial blood into the ventricles. This contraction is referred to as the **atrial kick** and is responsible for as much as a 30% contribution to CO.

After atrial contraction, the atria begin to relax and atrial pressure decreases. The electrical impulses from the atria now travel through the remainder of the conduction system and cause ventricular depolarization, which is the beginning of ventricular contraction. Ventricular pressure now exceeds atrial pressure, and the AV valves close and the semilunar valves open. Desaturated blood is ejected from the right ventricle into the lungs, where it drops off carbon dioxide and picks up oxygen. Oxygenated blood from the left ventricle is ejected into the systemic circulation via the aorta. The ejection of blood from the ventricles is referred to as **systole**.

Stroke volume (SV) is the volume of blood that is ejected during systole. Left ventricular end *systolic* volume (LVESV) is the amount of blood that remains in the left ventricle at the end of systole. Left ventricular end *diastolic* volume (LVEDV) is the amount of blood that is in the ventricle just before ejection occurs. The left ventricle never ejects the entire volume it receives during diastole. The portion of the volume it does eject is referred to as **ejection fraction** (EF), which is approximately 70% of the total volume at the end of diastole.

Do You UNDERSTAND?

DIRECTIONS: **Fill in the blanks to complete the following statements.**

1. The cardiac conduction system provides electrical activation to cause the heart to _____ _____.