Contributors, Reviewers, Illustrators, and Graphic Designers

CONTRIBUTORS
Robert Blumm, MA, RPA-C, DFAAPA
Adjunct Instructor, Surgery and Emergency Medicine,
Physician Assistant Studies
Hofstra University
Hempstead, NY

Nancy Davis, RN, NP (Retired)
Cascade, ID

Jeanne K. LaFountain, RN, MBA, CNOR, CRNFA
Nursing Program Manager/Perioperative Clinical Educator
Perioperative Services, Richard M. Ross Heart Hospital at the Ohio State University Columbus, OH

Russell R. Lynn, MSN, CRNA
Associate Program Director,
Nurse Anesthesia Program
University of PA School of Nursing
Philadelphia, PA

James R. McCarthy, RN, CNOR, CRNFA
Perioperative Nursing Services
Temple University Hospital
Philadelphia, PA

Rose Moss, RN, MN, CNOR
Perioperative Nurse Consultant
Del Norte, CO

Julie Mower, RN, MSN, CNS, CNOR
Credentialing and Education Project Manager
CCI
Denver, CO

Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN
Clinical Nurse Specialist, Perianesthesia Care Areas
University of Michigan Health System
Ann Arbor, MI

John T. Paige, MD, FACS
Assistant Professor of Clinical Surgery
Louisiana State University School of Medicine
New Orleans, LA

Jane C. Rothrock, PhD, RN, CNOR, FAAN
Professor and Director, Perioperative Programs
Delaware County Community College
Media, PA
Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN
Education Coordinator
Cardiovascular Operating Room
Inova Heart and Vascular Institute
Falls Church, VA
and
Editor-in-Chief
AORN Journal

Tim Snider
Editorial Director
BookMasters, Inc.
Ashland, OH

Elizabeth A. P. Vane, LTC, AN, RN, MS, CNOR
Assistant Professor, Perioperative Clinical Nursing Specialist Program
Graduate School of Nursing, Uniformed Services, University of the Health Sciences
Bethesda, MD

Linda J. Wanzer, RN, MSN, CNOR
Assistant Professor
Director, Perioperative Clinical Nurse Specialist Program
Graduate School of Nursing, Uniformed Services, University of the Health Sciences
Bethesda, MD

Mary K. Weis, RN, MSN, ACNS-BC, CNOR, CRNFA
Clinical Nurse Specialist
Department of Surgery, Centracare Clinic
St. Cloud, MN

Jennifer Welsch
Senior Full Service Project Director
BookMasters, Inc.
Ashland, OH

**REVIEWERS**

Brian Campbell, BSN, CRNA
Staff Nurse Anesthetist
Winchester Anesthesia Associates
Winchester Hospital
Winchester, MA

Susan Carzo, RN, CNOR, RNFA
Staff Nurse
Winchester Hospital
Winchester, MA

Beverly A. Kirchner, RN, CNOR, CASC
President, Genesee Associates, Inc.
Southlake, TX

Charles Moss, RN, CRNA
Director, Anesthesia Services
San Luis Valley Regional Medical Center
Alamosa, CO

Janette M. Parsons, RN, MSN, RNFA, CNOR
Family Nurse Practitioner
Marjorie K. Unterberg School of Nursing and Health Studies
Monmouth University
West Long Branch, NJ

Joseph H. Viveiros, RN, RNFA, CNOR
Staff Nurse
Winchester Hospital
Winchester, MA

Jennifer L. Zinn, RN, MSN, CNOR
Clinical Nurse Specialist for Operative Services
Moses Cone Health System
Greensboro, NC

**ILLUSTRATORS AND GRAPHIC DESIGNERS**

Molly Borman
Biomedical Illustrations
Fort Collins, CO

Larin Zamora
Graphics Designer
Littleton, CO
To Sean, nephew and new high school graduate who has expressed an interest in a nursing career: We need bright, tenacious, bold-thinking young men like you in nursing. Much love to you from Aunt Jane.

—Jane C. Rothrock

To my assisting colleagues—RNs, MDs, PAs, and Technologists: Thank you for all that you have taught me, not the least of which is that there is always so much more to learn.

—Patricia C. Seifert
1 Patient Positioning ................................................................. 1
   Rose Moss, RN, MN, CNOR

2 Prepping and Draping ............................................................ 38
   Linda J. Wanzer, RN, MSN, CNOR
   and Elizabeth A.P. Vane, LTC, AN, RN, MS, CNOR

3 Tissue Handling ................................................................. 74
   John T. Paige, MD, FACS

4 Providing Exposure: Retractors and Retraction ....................... 107
   Nancy B. Davis, RN, NP (emeritus)

5 Methods for Assuring Surgical Hemostasis ............................. 137
   James R. McCarthy, RN, CNOR, CRNFA

6 Suturing Materials and Techniques ........................................ 195
   Nancy B. Davis, RN, NP (emeritus)

7 The Assessment and Diagnostic Process ................................. 243
   Robert M. Blumm, MA, RPA-C, DFAAPA

8 Planning and Providing Care .................................................. 280
   Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN,
   and Julie Mower, RN, MSN, CNS, CNOR

9 Patient Education .............................................................. 338
   Denise O’Brien, MSN, RN, ACNS-BC, CPAN, CAPA, FAAN

10 Anesthesia .................................................................. 361
    Russell R. Lynn, MSN, CRNA
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>The First Assistant and Collaborative Practice</td>
<td>387</td>
</tr>
<tr>
<td></td>
<td>Mary K. Weis, RN, MSN, ACNS-BC, CNOR, CRNFA</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Credentialing</td>
<td>406</td>
</tr>
<tr>
<td></td>
<td>Jeanne K. LaFountain, RN, MBA, CNOR, CRNFA</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Resources</td>
<td>449</td>
</tr>
<tr>
<td></td>
<td>Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Appendix I: Laboratory Studies and Their Clinical Significance</td>
<td>467</td>
</tr>
<tr>
<td></td>
<td>Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Appendix II: Diagnostic Imaging and Testing Procedures</td>
<td>497</td>
</tr>
<tr>
<td></td>
<td>Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Index</td>
<td>505</td>
</tr>
</tbody>
</table>
Assisting in Surgery: Patient-Centered Care is specifically designed for healthcare professionals who assist in surgery. The focus of the book—as the title states—is patient-centered care. It is that focus that facilitates achieving positive patient outcomes, a goal embraced by all members of the surgical team.

This book's proud ancestry includes the 1987 textbook, The RN First Assistant—An Expanded Perioperative Nursing Role, written by the current book’s first editor. Subsequent editions of this groundbreaking textbook reflected the value and exemplary practice of the assistant in surgery.

The current text has been expanded to include a multidisciplinary approach that includes nurses, physicians, physician assistants, and surgical technology assistants. It is appropriate not only that the “real world” of surgery be reflected but also that the importance of communication, collaboration, sharing and improvement of surgical skills, and leadership be highlighted. The book covers a broad spectrum of surgical information which can be used by practicing clinicians as well as students learning the clinical skills of the assistant at surgery.

The editors’ personal and professional careers have been enriched by our association with colleagues: nurses, physicians, surgical technologists, and physician assistants. Their generosity in sharing knowledge and experience in the current book illustrates the teamwork exemplified in producing a book and in achieving optimal patient outcomes. Surgery is a team effort, and the contributions of each member of the surgical team produce a whole greater than the sum of its parts. The same can be said for this book. While each chapter focuses on a topic essential to assisting in surgery, the whole of the book focuses on the patient and protecting
him or her from vulnerabilities. It may fairly be said that patients undergoing a surgical or other invasive procedure feel vulnerable. It is our intent that the assistant in surgery, whether in an educational program or practicing in a surgical setting, assist in alleviating those vulnerabilities in a manner marked by clinical talent, cognitive acumen, and an approach that is humanistic and caring.
INTRODUCTION
Facilitating access to the structures undergoing surgical repair is one of the primary responsibilities of the First Assistant (FA) for achieving a successful patient outcome. This is accomplished by positioning the patient in a manner that promotes patient safety and creates optimal exposure to the surgical site for the operators.

Patient positioning, the art and science of moving and securing the human body into place, is an interdisciplinary task performed in the operating room (OR) suite on a daily basis. The FA recognizes that positioning is a collaborative effort by all members of the surgical team (i.e., surgeon, anesthesia provider, circulating nurse, FA, surgical technologist, nursing assistant), therefore, everyone must be aware that positioning can profoundly affect the patient in many ways. The patient undergoing surgery presents special concerns, including the inability to relate sensations of discomfort or pain; the need for strange and/or unnatural posturing for various procedures; and the effects of anesthetic agents and other drugs that affect normal physiologic functions. Prevention of injury to the patient (and to staff) is paramount; care must be taken to protect the patient and ensure that his or her physiological status remains as close to preoperative values as possible. While positioning a patient, the FA and other team members need to understand the relationship between certain positions and risks for injuries specific to those positions. It is also important that the FA understand the physiological changes that occur with a change in position.

PATIENT SAFETY
Patient positioning during surgery must provide optimal exposure of the surgical site, while simultaneously allowing access to the patient’s airway, intravenous lines, and monitoring devices. Optimal positioning also prevents any
potential complications related to the selected surgical position, such as compromise in physiological functions and mechanical stresses of the body parts. The FA knows that a surgical position should not compromise the cardiovascular, integumentary, musculoskeletal, nervous, or respiratory systems, or other vulnerable areas.

One of the expected outcomes related to safety is that the patient is free from signs and symptoms of injury from positioning (Petersen, 2007). Potential position-related injuries range from minor skin abrasions and backache to serious morbidity (Table 1-1); the injuries that may occur may be permanent or only temporary (Seibert, 2009). Complications from these injuries can lead to infection, tissue necrosis, paralysis, loss of limbs, and even loss of life. While most patients recover from minor positioning-related injuries, more

<table>
<thead>
<tr>
<th>System</th>
<th>Potential Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular system</td>
<td>Deep vein thrombosis (DVT)</td>
</tr>
<tr>
<td></td>
<td>Ischemic injuries</td>
</tr>
<tr>
<td></td>
<td>Vascular occlusion</td>
</tr>
<tr>
<td>Head, eyes, ears, nose, throat</td>
<td>Blindness</td>
</tr>
<tr>
<td></td>
<td>Corneal abrasion</td>
</tr>
<tr>
<td></td>
<td>Facial edema</td>
</tr>
<tr>
<td></td>
<td>Vocal cord edema</td>
</tr>
<tr>
<td>Integumentary system</td>
<td>Abrasions</td>
</tr>
<tr>
<td></td>
<td>Alopecia</td>
</tr>
<tr>
<td></td>
<td>Decubitus ulcers</td>
</tr>
<tr>
<td>Musculoskeletal system</td>
<td>Amputation</td>
</tr>
<tr>
<td></td>
<td>Backache</td>
</tr>
<tr>
<td></td>
<td>Compartment syndrome</td>
</tr>
<tr>
<td></td>
<td>Rhabdomyolysis</td>
</tr>
<tr>
<td>Nervous system</td>
<td>Decreased cerebral blood flow</td>
</tr>
<tr>
<td></td>
<td>Increased intracranial pressure</td>
</tr>
<tr>
<td></td>
<td>Peripheral neuropathy</td>
</tr>
<tr>
<td></td>
<td>Quadriplegia</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>Atelectasis</td>
</tr>
<tr>
<td></td>
<td>Endobronchial intubation</td>
</tr>
</tbody>
</table>

SKIN PREPARATION

Postoperative surgical site infections (SSIs) are the third most commonly reported hospital-acquired infections in the United States (APIC, 2002; Barnard, 2002). However, Medicare no longer reimburses costs associated with SSIs as of October 1, 2008; thus health care institutions are taking a critical look at practices that place the patient at risk for infections. According to the Deficit Reduction Act of 2005 Section 6081 (USHHS, 2008), the costs associated with hospital-acquired infections or SSIs will now be absorbed solely by the health care institutions. This legislative act places strategic importance on practices supporting aseptic technique, basic infection control, and prevention strategies for the entire surgical team. Identifying factors that place the surgical patient at risk for a surgical site infection forms a focal point for the First Assistant (FA) to implement interventions aimed at preventing infections within the perioperative setting (Akridge, 2004; Vaiden, 2005).

All surgical patients are at risk for infection from endogenous and exogenous sources of contaminants. Adherence to strict aseptic technique while preparing the patient’s skin for surgery can minimize this risk and support the goal of reducing the risk of postoperative surgical site infections. When the surgical incision is made or mucous membranes are breached, tissue is exposed and at risk for contamination. Because endogenous microbes (e.g., the patient’s own microbial flora) are associated with most wound infections, preparing the patient’s skin before surgery is essential to ensuring successful surgical outcomes (APIC, 2002; Gruendemann & Stonehocker, 2001; Mangram et al., 1999). Exogenous microbes (e.g., contaminates from the environment including members of the surgical team, operating room environment, and surgical instruments) also place the patient at risk for surgical site...
infection (Gruendemann & Stonehocker, 2001; Mangram et al., 1999). Protecting the patient from serious SSI complications requires that the FA has knowledge of the contaminate origin as well as containment strategies for endogenous and exogenous microorganisms.

Vitalized (intact) tissue has enormous resistance to infection and creates a protective barrier for disease prevention, requiring a significant microbial deposit in the tissue to cause an infection (Phillips, 2007). Moist areas of the axilla, mouth, and perineum are ideal incubators for microbial growth. Body areas such as the trunk and extremities have negligible numbers of microbes; however, exposed body parts such as the face, hands, and feet can routinely harbor up to $10^3$ microorganisms per gram. As long as the skin surfaces in these regions remain intact, the skin should provide a sufficient barrier to prevent disease at these levels of microbial growth. However, when bioburdens (microbial counts) on the skin surface greater than $10^5$ microorganisms per gram are introduced into wounds (through breaches in the skin or surgical incisions), wound infection rates increase dramatically (Mangram et al., 1999; Meakins, 2008). Therefore an effective antimicrobial chemical agent for surgical skin preparation is critical to ensure that microbial destruction occurs on the skin before surgery. Through proper skin antisepsis, the FA can minimize the microbial count of superficial (endogenous) microorganisms (Gruendemann & Stonehocker, 2001).

**Anatomy and Physiology of the Skin**

Intact skin and mucous membranes form the body’s first line of defense against infection by providing the following barriers of protection: (1) anatomical—intact epithelium; (2) chemical—stratified epithelium [sweat (sudoriferous) and oil (sebaceous) glands] that possess a natural biochemical substance with bactericidal properties; and (3) desquamation process and low pH properties—inhibits bacterial colonization (Phillips, 2007). The skin has two distinct layers: the outer epidermis and the deeper dermis (Figure 2-1).

Microorganisms are prevalent on all skin layers and are categorized as either transient or resident flora. The transient flora are those microorganisms that are in loose contact with the skin, such as those in grease, sweat, and oil particles. Because they are in loose contact with the skin, these organisms are easily removed by gentle mechanical friction. Resident flora, on the other hand, usually colonize around a particular body site (e.g., around the glands and hair follicles). They are carried to the surface layer of the skin and shed with perspiration and dead skin cells. Examples of resident flora include *Staphylococcus epidermidis*, aerobic and anaerobic diphtheroid bacilli, aerobic spore-forming bacilli, aerobic and anaerobic...
Tissue Handling

John T. Paige

INTRODUCTION

In the late 19th Century, two major advances in the field of surgery occurred, laying the foundation for modern practice: the discovery of anesthesia and the adoption of principles of asepsis. William Steward Halsted, a legendary figure in American surgery, was one of the first surgeons to recognize the immense benefits that could arise from these innovations when they were combined with precise surgical technique. In doing so, he helped create a “school for safety in surgery” that emphasized gentle tissue handling, meticulous hemostasis, sharp dissection, aseptic practice, and attention to detail. His theories eventually won out over the then popular concept of completing a procedure as speedily as possible. His success in lowering surgical infection rates and improving patient outcomes demonstrated the merits of this “safety in surgery” approach. Today, many of the surgical principles he advocated are still commonly employed.

Just as in Halsted’s era, the contemporary surgical assistant (referred to in this book as “first assistant,” or FA) is an integral member of the operating room (OR) team. In the highly complex, dynamic environment of the modern OR, the FA plays a crucial role in providing safe, effective care to the patient. A well-prepared, knowledgeable, technically dexterous FA who has a firm grasp of the operative plan and can anticipate the next step in the procedure can enhance a surgeon’s abilities, making a good surgeon look great. By contrast, an unprepared, naive, technically challenged FA with a poor understanding of the operative plan can hamper a surgeon, causing even a gifted surgeon to struggle. A talented FA is able to provide exposure effectively, handle tissues appropriately, and attain hemostasis efficiently in close coordination with the surgeon and without impeding the progress of the
Chapter 3: Tissue Handling

operation. He or she makes possible the safe, efficient completion of the procedure and works to help the team as a whole function more effectively. To do so, the FA must master important teamwork skills. He or she must know each team member’s role, communicate openly and clearly, maintain constant awareness of the overall situation, manage resources, and monitor continually for potential problems. Although complex, these interactive skills contribute to optimal teamwork, improving both efficiency and safety (Halverson et al., 2009).

This chapter focuses on tissue handling techniques commonly used in the surgical care of the patient. It begins with a brief overview of the wound healing process, which is also discussed in Chapter 8. Next, it discusses fundamental surgical principles important to the proper handling of tissues in surgery, followed by a brief discussion of patient positioning (see also Chapter 1) and preparation. It then reviews five essential tissue handling techniques (i.e., incision, dissection, retraction, hemostasis, and suturing/stapling), discussing principles and instruments. Finally, it discusses the challenges and special considerations of tissue handling in the setting of laparoscopic surgery.

OVERVIEW OF WOUND HEALING

From the moment of injury to any tissue, the healing process begins, initiating a cascade of biochemical and microscopic events invisible to the naked eye (Table 3-1). This first phase of wound healing, known as the inflammatory phase, involves the release of vasoactive substances such as serotonin, histamine, and bradykinin to promote initial capillary constriction and hemostasis, followed by dilation to increase blood flow to the injured tissue. The body mobilizes platelets and initiates the coagulation cascade to promote hemostasis and seal the wound through the deposition of fibrin and clot. Next, waves of white blood cells (i.e., polymorphonuclear leukocytes, monocytes, and then macrophages) enter the wound to clean it of cellular debris and foreign material. During this process, the wound appears red, edematous, and warm to the touch. Finally, fibroblasts migrate to the wound in preparation for the next phase of healing. The inflammatory phase may last up to five days.

The proliferative phase is the subsequent phase in wound healing. In this phase the fibroblasts that have migrated into the wound begin to produce collagen, rapidly increasing the wound’s tensile strength. Fibrin and fibronectin are released to create the substance to which the fibroblasts adhere. In addition, new blood vessels are created, which help to nourish the fibroblasts. The squamous epithelium begins to restore the surface anatomy of the skin through
A major function of the surgical first assistant (FA) is to expose the operative site. Exposure is necessary to visualize organs and tissues that are being inspected, dissected, repaired, or sutured. Exposure is also necessary to prevent injury to tissues and other structures that are adjacent to the operative area. When there is bleeding, exposure is critical to identifying the site of the bleeding and controlling it.

Providing exposure is usually the first function the FA performs. An experienced FA makes this activity appear easy. However, the FA must be knowledgeable about the operative procedure, anatomy of related structures, and the potential for injury to tissues and their underlying and surrounding structures. Proper selection and utilization of exposure methods are essential. As the FA becomes more skilled at providing exposure, the surgeon can provide less direction.

Unfortunately, the act of providing exposure sometimes appears to be a simple task, merely requiring “an extra pair of hands” that are positioned by the surgeon. Some institutions may even permit the use of unlicensed assistive personnel to act as “retractor holders.” As the shortage of surgeons in the United States increases and surgical residents’ duty hours are limited (Iglehart, 2008), such “retractor holders” may become the norm as fewer trained staff are available to provide exposure. However, institutions cannot ignore their corporate responsibility, part of which is to ensure that there are adequate numbers of qualified perioperative personnel, appropriately educated and trained to carry out the tasks to which they are assigned (Box 4-1).
Box 4-1  **Legal Brief: What Are the Consequences if a Surgeon “Drafts” a Hospital Orderly to Hold Retractors?**

Assume first that the patient suffers serious injury as a result of improper retraction, for example, a sciatic nerve impingement causes serious injury. The patient will likely initiate a lawsuit as a result. Let’s review the potential consequences for each of the possible parties in our hypothetical lawsuit.

The “drafted” orderly, a hospital employee, is probably uninsured and judgment proof. Therefore although, he or she may be named as a defendant, the orderly will probably obtain defense counsel and indemnity from the hospital’s insurance carrier. The orderly would not need to worry much.

Likewise, our surgeon—a deep pockets target and insured—will bear direct liability for all untoward consequences to his patient, including those suffered at the hands of the orderly—controlled in all ways—by the drafting surgeon. The orderly’s lack of training will prove of no benefit to the surgeon. It will be assumed by the court and jury that orderlies normally are wholly untrained in the many arts and sciences represented by health care practitioners in the OR.

As for the hospital itself, depending on the jurisdiction, the days when there was any judicial reluctance to impose liability on charitable institutions are gone. The scope of potential hospital liability appears very near boundless. Some questions about the injury would no doubt be painful for our hospital to answer.

Did the hospital’s OR director, for example, know or have reason to know that this defendant surgeon was liable to draft this orderly (and had he or she done so previously, using this orderly or others)? Was the use of the orderly seen as a cost-saving measure that enjoyed the unspoken blessing of the hospital administration? Did the surgeon or his practice enjoy any economic benefit as a result of keeping hospital *per diem* costs minimized?

Those kinds of questions, if answered “yes,” bode ill for the hospital, given the developing thrust of the doctrine of hospital corporate liability. By it, a hospital can be deemed directly responsible for what happens in the OR if it bills itself to the public as a *best provider of quality surgery and hospital care* within its community. When it does so, some courts have become quite willing to hold a hospital liable for what happens within the walls of its OR. See, e.g., *Thomson v. Nason Hospital*, 527 Pa. 330, 591 A.2d 703 (1991).

The Pennsylvania Supreme Court in *Welsh v. Bulger*, 548 Pa. 504, 698 A.2d 581 (1997), quoted approvingly from *Thomson, supra*, to expound on what is an adequate *prima facie* or “first glance” case of a hospital’s direct corporate liability, needed to move a lawsuit further toward trial and a jury:

Corporate negligence is a doctrine under which the hospital is liable if it fails to uphold the proper standard of care owed the patient, which is to ensure the patient’s safety and well-being while at the hospital. This theory of liability creates a nondelegable duty which the hospital owes directly to a patient. *Thompson*, 527 Pa. at 339, 591 A.2d at 707. Under *Thompson*, a hospital has the following duties:

“(1) a duty to use reasonable care in the maintenance of safe and adequate facilities and equipment; (2) a duty to select and retain only competent physicians; (3) a duty to oversee all persons who practice medicine within its walls as to patient care; and
Hemostasis is the process of controlling or stopping the flow of blood from a vessel or organ. The control of such bleeding is necessary to preserve physiologic function for the patient and to provide clear visualization of anatomic structures for the surgeon and the surgical first assistant (FA) (Villanueva, 2008). The alleviation of vulnerabilities, like bleeding, is considered a part of patient-centered care (PCC) (Hobbs, 2009). Alleviating vulnerability such as bleeding by achieving hemostasis is essential to the role of the FA. Effective hemostasis not only provides a clear surgical field, but also results in fewer transfusions, reduced surgical time, and decreased morbidity and mortality (Samudrala, 2008).

During surgery, the patient’s usual clotting mechanisms are often insufficient to provide adequate hemostasis, necessitating the use of surgical hemostatic techniques. A primary expectation and responsibility of the FA is to provide and assure hemostasis. Thus, the FA must not only be technically skilled, but must have a functional understanding of the physiologic and mechanical aspects of coagulation, bleeding, and methods to achieve hemostasis. Application of the appropriate method depends on the type of bleeding, its location, and the structures involved.

Physiologic, or “natural,” processes may be used to achieve hemostasis. Natural physiologic responses may be inhibited by preexisting medical conditions. Thus, an artificial process may be used, employing mechanical strategies such as sutures, ties, pressure, instruments, surgical staples, ligating clips, or bonewax; chemical hemostatic adjuncts; tourniquets; electrosurgical devices; ultrasonic energy devices; argon beam-enhanced electrosurgery; or any combination of the above. The physiologic response to bleeding is a series of interactions represented by the coagulation cascade (Figure 5-1). Bleeding during or after a surgical intervention
Chapter 5: Methods for Assuring Surgical Hemostasis

is influenced by multiple factors, including the type of procedure, anatomy, certain medications, coagulopathies, fibrinolytic activity, patient position, and the patient’s medical condition and nutritional status, all of which can have a profound impact on expected outcomes.

Figure 5-1

In the coagulation sequence, the intrinsic pathway is initiated by surface contact, whereas the extrinsic pathway is initiated by the release of tissue factor from injured tissues. The pathways are interrelated and operate in tandem to achieve hemostasis.

For a surgical first assistant (FA) suturing aptitude is a fundamental clinical skill during operative and other invasive procedures. As with any skill acquisition, learning and performing the techniques of suturing means graduating from basic competency to excellence in skill performance.

The FA first learns about the types of sutures and various suturing techniques in his/her basic educational program (Physician Assistant [PA], Surgical Assistant [SA], Registered Nurse First Assistant [RNFA], Certified First Assistant [CFA], medical internship, or residency). Further information is obtained by observing the surgeon, engaging in clinical discussions about suture characteristics and suturing techniques, taking professional continuing education, and reviewing manufacturer’s literature. In the interest of patient safety, practice by novices should initially be done in a simulated setting. Laboratory practice is especially helpful when learning more complex suturing techniques, such as those used in microsurgery. After practice and initial skill evaluation, suturing skills are refined in the operating room under the direction and supervision of the surgeon. The application of this skill varies depending on the clinical privileges awarded by the credentialing body and is based on scope of practice, practice setting, and any legal constraints.

Although the choice of suture materials and techniques is primarily determined by the operating surgeon, many factors must be considered. The patient's condition and age, the presence of infection, and the type of tissue being sutured are some important factors. Preoperative assessment of the patient provides data that can help the assistant to identify potential complications. Suture materials are foreign substances; therefore, in selecting the type of suture and suturing techniques, the FA should consider patient risk factors and the potential for wound infection, inadequate or delayed wound healing, wound dehiscence, and excessive scarring. The goal
is to leave minimal foreign material in the wound. This result is achieved, in part, by selecting the suture with the highest tensile strength, the smallest diameter (size), and one that holds knots well, requiring fewer turns and throws during tying.

USES AND SELECTION OF SUTURES

The three common uses for sutures during operative procedures are as follows:

1. Hemostasis: strands of sutures are used as ligatures to tie off blood vessels and control bleeding.
2. Wound closure: sutures are used to sew tissues together and to hold the tissues securely until healing occurs.
3. Wound exposure: sutures are used to retract tissues and expose the operative site for the surgeon, when tension is applied to the sutures.

Sutures are medical devices and must meet certain standards established by the Federal Food and Drug Administration (FDA, 2003). Government regulations have established criteria for ensuring the safety and effectiveness of sutures. Sterility, tensile strength, size, dyes, needle attachments, coating or impregnation of suture material with other substances, biocompatibility, absorption profile, packaging and labeling are some of the areas addressed in these regulations.

The three main characteristics of sutures are physical characteristics, handling characteristics, and tissue-reaction characteristics. Physical characteristics include physical configuration (single- or multistrand), capillarity, diameter (size), tensile strength, knot strength, elasticity, and memory. Handling characteristics include pliability, tissue drag, knot tying, and knot slippage. Tissue-reaction characteristics include inflammatory and fibrous cell reaction, absorption, potentiation of infection, and allergic reaction (Rothrock, 2007). Allergic reactions to sutures have been reported (Woo, 2008) in the scientific literature and must be anticipated by the surgical team. Patients with known allergies to certain suture materials should inform their health care providers and should wear a medical-alert identification bracelet with information about any allergies. The FA should always check any patient’s arm for a wristband noting an allergy. In some states, wristband standardization initiatives require the use of a red-colored wristband for allergies (Texas Hospital Association, 2008). Any patient allergies should be communicated during the preop briefing or time-out, which are designed to improve teamwork and communication (Nundy et al., 2008).

The FA should consider the type of tissue when selecting a suture. The suture must be as strong as the tissue it is holding, and the strength of the suture must last until the tissue is healed. Thus, the rate of suture absorption should correspond to the rate
There is an organized process by which the history and physical examination (H&P) and other assessment data contribute to the identification of a diagnosis. The word process also indicates a procedure that utilizes the points under discussion every time the clinician examines a patient (Figure 7-1). There is a beginning to this type of patient encounter, and there is a conclusion. A process implies that we will utilize the same steps, in the same sequence, regardless of the patient’s demographic variables. The goal of using a process is to avert errors that can possibly harm the patient and to inform the other members of the surgical team about conditions that require special consideration in the perioperative period. Regardless of one’s clinical title, this approach has been tested and will provide the first assistant (FA), surgeon, anesthesia provider, and nursing staff with essential personalized patient information.

PATIENT ADMISSION
The patient’s admission to a health care facility begins with an assessment of the patient’s status. The initial assessment may be brief (major problem, airway, hemodynamic status, level of consciousness). As more is learned about the patient, the new information is integrated into the patient’s record and directs the clinician to more and more specific questions about the nature of the patient’s problem. An admission note will include as much of the following information as available:

- Patient identification, date, and time
- Admission note (e.g., problem causing patient to seek care)
- Medical record/computer number
- Condition on admission
Chapter 7: The Assessment and Diagnostic Process

Preliminary diagnosis

- Vital signs (when taken?)
- Labs, special procedures indicated (e.g., x-ray films, ECG)
- Medications the patient is currently taking
- Diet (nothing by mouth [NPO]?)
- Oxygen requirement

In categorizing and organizing information, the clinician may use the SOAP format to document what is important to the patient’s situation:

- S (subjective): How does the patient describe the condition in his/her own words?
- O (objective data): Refers to the physical examination, lab results, radiology, pathology, or results of other diagnostic studies.
- A (assessment): Includes a summary of the patient’s condition, progress, or problems. If there are additional problems such as chronic obstructive
In Chapter 7, the patient interview, history, review of systems, and physical examination were discussed as sources of subjective and objective information. Additional data provided by laboratory tests and imaging studies (see Appendices I and II) provide a foundation for the diagnosis and subsequent plan of treatment to achieve the therapeutic goal (Rothrock, 1999a).

The plan of care includes:

- Priorities
- Establishment of goals
- Identification of desired outcomes
- Specific actions and interventions

Planning saves time and resources and enhances multidisciplinary collaboration. A plan of care should be communicated to other members of the surgical team.

**PRIORITIES**

Setting priorities enables the first assistant (FA) to identify life-threatening or potentially harmful events. For example, managing the patient’s airway has a higher priority than inserting an intravenous (IV) line during an emergency situation, although both airway and IV procedures may be conducted simultaneously with sufficient personnel. Setting priorities requires an understanding of the “normal” chronological progression of a procedure (e.g., the actions and instrumentation needed for each step of a given procedure) as well as knowledge and experience in dealing with unexpected events (e.g., sudden hemorrhage).
ESTABLISHMENT OF GOALS
Goals may be subjective (patient’s goals) or objective (surgical goals), and the patient and the surgeon may share the same goal(s). Goals may be related to improved psychosocial status (e.g., cosmetic surgery), improved ability to engage in activities of daily living (e.g., coronary artery bypass graft [CABG]), or improved functional status (e.g., hip replacement). It is important that the FA discuss goals and identify those goals desired by the patient (Epstein et al., 2008).

IDENTIFICATION OF DESIRED OUTCOMES
Goals and outcomes may be similar, particularly from the patient’s perspective. However, in addition to patient-specific desired results, outcomes also refer to specific and general results. For example, specific results for a particular patient may include improved functional status, removal of a life-threatening lesion, or cessation of chronic pain. General outcomes may relate not only to a “successful” surgical result (e.g., heart valve replacement) but also to achieving national benchmarks and performance standards such as infection rates, ventilator-assisted pneumonia, stroke, and other morbidity/mortality statistics. Outcomes may also include cost considerations (cost per case), regulatory compliance, and quality improvement initiatives. FAs can play a leading role in achieving desired outcomes, given their familiarity with the patient, staff, environment, and procedures. Facilitating a collaborative environment promotes positive outcomes and increases staff satisfaction.

SPECIFIC ACTIONS
The manner in which goals and outcomes are achieved for each patient depends on the needs of that patient (biopsychosocial), the skill of the team, the knowledge and experience necessary to accomplish the selected procedure, and the resources available. The FA should understand the reasons for each action, its intended effect, and potential hazards. Keeping the procedure as simple as possible by minimizing unnecessary and wasteful actions should be the goal of each member of the surgical team (Oram, 2006).

FORMING A PLAN
Novice FAs typically develop the patient plan according to a structured methodology: by body system (neurologic, cardiac), surgery type (craniotomy), or underlying disease/pathology (tumor). The plan is not static, but a dynamic process
Preparing patients for surgical, diagnostic, and interventional procedures requires assessment of patient educational needs, knowledge of teaching/learning principles, the information needed by the patient, and educational resources. Quality care includes providing patients and families with appropriate information for decision making. When patients are adequately prepared for procedures, benefits to the patient include shorter stays, less anxiety, fewer complications, as well as improved knowledge, compliance, satisfaction, and discharge preparation (Stern & Lockwood, 2005). Patient education is a multidisciplinary effort that uses the knowledge and expertise of FAs, physicians, nurses, and other health care providers to improve outcomes for surgical patients.

GOALS, PURPOSE, AND BENEFITS OF PATIENT EDUCATION IN THE PERIOPERATIVE SETTING

Increasing the patient’s sense of self-worth, decreasing anxiety, and reducing facility and provider liability are all goals of patient education (O’Brien, 2008). Patients and their families/caregivers need information provided in a form that they can understand and use. In addition, they are empowered when the focus is on the patient instead of on the provider or facility. Patient-centered care views the patient as a partner, engages the patient in interactions that identify and alleviate vulnerabilities, and allows shared authority over care decisions (Hobbs, 2009). The intended result is an educated surgical patient who understands and complies with preoperative regimens, discharge instructions, and overall health management.

The Joint Commission (TJC) in its 2008 report on Healthcare at the Crossroads (TJC 2008b) aptly notes that the patient has an enormous stake in his or her care
and should be respected as an equal partner. The notion of “patient as partner” has significant implications for the quality and safety of patient care. Family members or others to whom the patient is emotionally tied are also part of this health care partnership. According to the report, adopting patient-centered care values is essential for improving patient safety and patient and staff satisfaction. When patient-centered care values are adopted, barriers to patient and family engagement, such as low health literacy and personal and cultural preferences, are identified and addressed.

Positive effects of preoperative patient education include less anxiety and fear, shorter recovery time, decreased length of stay (LOS) by 1.5 days, fewer postoperative complications, less analgesia use, increased patient satisfaction, and improved compliance with treatment regimens (Joanna Briggs Institute, 2000; Kiyohara et al., 2004; Roach, Tremblay, & Bowers, 1995; Shuldman, 1999; Sjöling et al., 2003). Other positive effects are lower levels of psychological distress and physical pain. Various patient outcomes measures have been studied; they include knowledge of preoperative, intraoperative, and postoperative procedures, compliance, satisfaction, skills, physical coping, mobility, independence, and discharge preparedness (Joanna Briggs Institute, 2000).

By definition, patient education focuses on patients and their families/caregivers. They need adequate information and support for successful navigation of the perioperative experience. Johansson et al. (2007) promote a model of empowering patient education within a patient-centered model of care. Consisting of an individually tailored amount of knowledge, their model of empowering education includes biophysiological (signs, symptoms), functional (activities of daily living), experiential (feeling, experiences), social (social network), ethical (individual rights), and financial (payments, benefits) issues. Their research with orthopedic patients suggests that preadmission counseling that focuses on empowering patients with knowledge and uses appropriate methods to achieve empowerment were highly effective in patient education. Another example of a patient-centered care model empowers elderly patients through choice, again focusing care on the patient instead of the usual provider or system (Merriman, 2008). Patient-centered models such as these promote discharge readiness that is grounded in both patient knowledge and preferences.

Compliance—The Joint Commission Requirements
TJC accreditation standards underscore the requirement that patients receive both oral and written information about their care, treatment, and services in a comprehensible form. Understanding information through effective
Many patients feel vulnerable about undergoing anesthesia, which can be described as a state in which one experiences a loss of sensation and awareness. Patient-centered care can alleviate patient vulnerabilities (Hobbs, 2009). Generally, the state of anesthesia is achieved by pharmacologic agents that provide amnesia, analgesia, and muscle relaxation. The delivery of anesthetic agents requires the anesthesia provider to formulate a patient-specific anesthetic plan, to monitor and assess the patient’s physiologic response to the anesthetic and surgical procedure, and to manipulate the administration of anesthetic as needed. The safety of present-day anesthetic practice can be directly attributed to the ability to safely monitor critical parameters of a patient’s ventilation, oxygenation, perfusion, and temperature (Bankert, 2000) (Table 10-1).

**HISTORY OF MODERN ANESTHESIA**

Considered one of the three most significant advances in health care in the 19th century, the discovery of ether’s anesthetic property 150 years ago dramatically changed the practice of surgery (Garde, 1996). Before the development of anesthesia, only procedures deemed life-saving, such as amputations of gangrenous limbs or drainage of an abscess, were performed, and often speed mattered more than did the surgeon’s skill. Patients were prepared for surgery using ice, whiskey, hashish, opioids, a blow to the head, and even strangulation. Often surgeons used “muscle men” to restrain and gag the patient during a procedure (Kaul, 2006). As one can imagine, mortality was quite high before the advent of anesthesia.
Table 10-1  Monitors Used to Assess the Anesthetized Patient

Oxygenation
- Pulse oximetry
- Direct observation of patient’s skin color
- Oxygen monitors within anesthesia equipment
- Arterial blood gas sampling

Ventilation
- Auscultation of breath sounds
- Precordial stethoscope
- Esophageal stethoscope
- Capnography (identification of expired carbon dioxide)
- Direct observation of the patient’s chest
- Arterial blood gas sampling
- Ventilation pressure and spirometry monitoring

Perfusion
- Electrocardiogram tracing
- Esophageal stethoscope
- Auscultation of heart sounds
- Pulse oximetry
- Blood pressure (noninvasive or arterial line)
- Urine output
- Central venous pressure monitoring
- Evaluation of surgical blood loss (suction and sponges)

Temperature
- Esophageal stethoscope
- Skin temperature monitoring
- Central core temperature

Neuromuscular Function
- Nerve stimulation (when neuromuscular blocking drugs [NMBDs] have been administered)

Positioning
- Continued monitoring and assessment

Note: This document mandates continued clinical observation and vigilance throughout anesthesia care that applies to all patients. The standards also dictate that the means for monitoring shall be immediately available and, if omitted, must be documented by the anesthesia provider.


PREANESTHESIA EVALUATION

Before the administration of any anesthetic agent, a thorough preanesthesia assessment takes place. While a routine in-hospital evaluation is usually conducted by an anesthesia provider on the day before or the morning of surgery, preoperative anesthesia
New strategies, policy initiatives, delivery models, and payment methods are changing the way health care is delivered. The successful transformation of the health care system depends, in part, on effective collaboration among members of the health care team. In today’s health care system, delivery processes involve numerous interfaces and patient handoffs among multiple patient care providers who possess varying levels of education and occupational training. In addition, the patient care environment offers an ever-broadening range of treatment options and complex care strategies. Too often, however, care is fragmented, and there is evidence of overreliance on physicians directing care, lack of patient/family participation in setting health care goals, wasted resources, diminished effectiveness, and dissatisfaction among providers and patients (Markus et al., 1995; McEwen, 1994). Moreover, research on patient outcomes has demonstrated that physician behavior alone cannot produce quality patient care in hospitals: quality outcomes are more closely linked to teamwork (Fagin, 1992; Prescott, 1993; The Joint Commission, 2005).

OVERVIEW: DEVELOPMENT OF MULTIPLE PROVIDERS OF FIRST ASSISTING SERVICES
In 1894, an operating room (OR) team consisting of surgeons, nurses, and assistants was recommended and introduced at the Johns Hopkins Hospital in Baltimore (Kneedler, 1994). At about the same time, in Rochester, Minnesota, the Mayo brothers were among the first to provide an opportunity to expand the role of nurses in the OR and to include them in patient care by training them to provide anesthesia to their patients (Clapesattle, 1941). Although the operating room
nurse’s duties at that time centered mainly on maintaining instruments, supplies, and equipment; managing the sterilizing room; preparing dressings; and passing instruments, the team concept fostered shared responsibilities and a growing mutual respect.

By World War I, OR nursing had evolved into a distinct specialty with formal education programs and specialized training. The nurse’s focus shifted from technical concerns to more patient-centered activities. Their additional responsibilities included maintaining an aseptic environment, supervising non-nursing personnel, and preparing the surgical patient for the procedure. First assisting services were performed and became increasingly more common as the war progressed. A shortage of qualified first assistants (FAs) influenced the decision to train nurses for this role.

First assisting by non-physicians was further promoted during World War II, when the demand for assistants became so great that even non-nursing technicians were trained to assist. After the war, the shortage of nurses forced hospitals to hire technicians trained in the armed forces. In 1962, former Navy hospital corpsmen were hired to assist with operative procedures and were classified as “physician assistants” (PA).

The role of the PA became established in the 1960s. In 1965, the first four PA students, all ex-Navy hospital corpsmen, began training in the first PA program at Duke University. In 1969, the American Hospital Association and Joint Commission on Hospital Accreditation released a report on the “Utilization of Physician’s Assistants in the Hospital” (Physician Assistant History Center, 2004). In 1971, the American Medical Association (AMA) began work on national PA certification and delineated educational standards. A PA certification exam was developed in 1973, and in 1974, the American College of Surgeons published the “Essentials of an Approved Educational Program for the Surgeon’s Assistant” (Physician Assistant History Center, 2004). The curriculum of PA programs includes a surgical rotation to prepare the PA student for the role. In addition to their broad medical care training, PAs may enhance their education through postgraduate surgical programs (see Chapter 13 for a list of resources for PAs).

Over the years, the Association of periOperative Registered Nurses (AORN) has issued position statements clarifying the role responsibilities of registered nurses as first assistant (RNFA) in surgery and defined standards for their educational programs (see Chapter 13 for a list of resources for RNFAs). The Association has also fostered the RNFA role by creating the RNFA Specialty Assembly to serve as a forum for the discussion of issues, to provide educational opportunities, and to act as a representative in regulatory and legislative arenas. Professional recognition
INTRODUCTION

Health care services, organizations, delivery systems, and providers are changing at a rapid pace. Today, health care is provided in venues that range from ambulatory to hospital settings. In addition, health care services are provided by numerous specialized practitioners including those who assist in surgery. As health care has changed, so too has the process of credentialing.

Credentialing for these specialized practitioners, hereafter referred to as allied health professionals (AHP), is important for patient safety and to ensure that services are provided by individuals who are qualified and competent. Hospitals are obligated to protect patients from incompetent practitioners. Credentialing of AHPs is influenced by state regulation, scopes of practice, institutional policy, medical bylaws, and regulatory compliance (Pybus & Cairns, 2004). This is not a simple task and varies greatly from organization to organization and from state to state.

WHO NEEDS TO BE CREDENTIALED?

All AHPs allowed to provide patient care services within an organization should go through some type of credentialing process. This includes hospital employees, physician-employed AHPs, and contract AHPs. The extent of credentialing depends on the role of the individual and may be done through the human resources department (utilizing job descriptions) or the medical staff office (approval of clinical privileges). The scope of medical and legal risk to the patient and organization generally determines the extent of the credentialing process (Pybus & Cairns, 2004).

To guide the credentialing process, it is important to examine state laws to establish which AHPs can function as licensed independent practitioners...
(LIP); credentialing of LIPs usually parallels that of the medical staff. State law and health care organization policy will determine whether the health care provider can practice independently. As with medical staff credentialing, qualification validation should be an objective evaluation of the applicant’s current licensure, training and experience, competence, and ability to perform the services requested. Ultimately, each individual health care facility will determine the best method of properly credentialing applicants classified as AHPs. It is to the health care organization's advantage to standardize the credentialing process for all AHPs to mirror that of the medical staff credentialing process, thus setting the standard of patient care within the institution to ensure quality patient care (Hospital Peer Review, 2002).

**WHAT IS CREDENTIALING?**

As defined by the Joint Commission (2007), credentialing is the process by which an organization obtains, evaluates, and certifies qualifications of health care professionals who provide patient care services in or for a health care organization. The process, based on predetermined and standardized criteria, focuses on verification of training, experience, licensure, competence, and the validation of the credentials collected to determine if the practitioner is qualified to render the patient care services requested. Credentialing is not complete until the information is reviewed and approved by the health care organization’s governing body (Deutsch & Mobley, 1999).

**HISTORY OF HOSPITAL CREDENTIALING**

The hospital credentialing process was instituted for the purpose of granting hospital privileges to physicians. This process became necessary as increasing numbers of physicians began using hospitals. In the early 1900s, there was a growing acceptance of hospitals as centers for treating patients with acute illnesses and for performing surgical interventions. More and more physicians wanted to use the hospital facility as a “workshop.” Hospitals were eager for physicians to admit their patients, especially those patients able to pay the hospital for their care. Because physicians determined which patients were to be admitted, they were powerful in influencing how hospitals were managed and controlled.

Physicians who had obtained hospital privileges soon controlled the “credentialing process.” Occasionally, other physicians were not granted hospital privileges and were unable to use the hospital for their patients. In 1907, a survey of New York physicians in the Bronx and in Manhattan found that only 10% had hospital privileges. Those physicians who had been excluded began establishing their own hospitals, and increasing competition forced hospitals to open their staff privileges.
NOTE: All references were current and correct as of June 2009.

CHAPTER 1. PATIENT POSITIONING

• INJURY

• PRESSURE INJURY
  Institute for Healthcare Improvement. Relieve the pressure and reduce harm. www.ihi.org/IHI/Topics/PatientSafety/SafetyGeneral/ImprovementStories/FSRelievethethePressureandReduceHarm.htm

- **PRODUCTS**
  

**CHAPTER 2. PREPPING AND DRAPING**

- **DRAPE STANDARDS**
  


  Association for the Advancement of Medical Instrumentation. (2009). *Sterilization in Health Care Facilities. New guidance on processing of*
# Laboratory Studies and Their Clinical Significance

## TABLE OF CONTENTS:

A. Abbreviations  
B. Hematology  
   1. Complete Blood Count with Differential  
   2. Platelets  
   3. Blood Gases  
   4. Coagulation Factors  
   5. Coagulation Tests  
C. Basic Metabolic Panel  
D. Cardiac/Skeletal Muscle, Brain Enzymes  
E. Kidney (Renal) Function Studies  
F. Liver Function Studies  
G. Urine Studies  
H. Cerebrospinal Fluid (CSF)  
I. Genetic Testing  
J. Pulmonary Function Testing  

**Note:** The values listed provide an overview of some common laboratory studies. First Assistants (FAs) and other clinicians should consult their institutional laboratory manual for values which may be affected by the reagents used and the specific testing procedures performed.
### A. ABBREVIATIONS

<table>
<thead>
<tr>
<th><strong>Conventional Units</strong></th>
<th><strong>SI Units</strong> (International System of Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg = kilogram</td>
<td>kM = millimole</td>
</tr>
<tr>
<td>g = gram</td>
<td>nM = nanomole</td>
</tr>
<tr>
<td>mg = milligram</td>
<td>mOsm = milliosmole</td>
</tr>
<tr>
<td>μg = microgram</td>
<td>mm = millimeter</td>
</tr>
<tr>
<td>μμg = micromicrogram</td>
<td>μ = micron or micrometer</td>
</tr>
<tr>
<td>ng = nanogram</td>
<td>mm Hg = millimeter mercury</td>
</tr>
<tr>
<td>pg = picogram</td>
<td>mU = milliunit</td>
</tr>
<tr>
<td>dl = 1 deciliter or 100 milliliters</td>
<td>µU = microunit</td>
</tr>
<tr>
<td>ml = milliliter</td>
<td>mEq = milliequivalent</td>
</tr>
<tr>
<td>cu mm = cubic millimeter</td>
<td>IU = International Unit</td>
</tr>
<tr>
<td>fL = femtoliter</td>
<td>ImU = International milliunit</td>
</tr>
</tbody>
</table>

- g = gram
- L = liter
- d = day
- h = hour
- mol = mole
- mmol = millimole
- μmol = micromole
- nmol = nanomole
- pmol = picomole
## B. HEMATOLOGY*

<table>
<thead>
<tr>
<th>Determination</th>
<th>Conventional Units</th>
<th>SI Units</th>
<th>Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red Blood Cell Count (RBC)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RBC ( \times 10^6 / \mu l )</td>
<td>RBC ( \times 10^{12} / L )</td>
<td></td>
</tr>
<tr>
<td><strong>Increased</strong> in severe diarrhea and dehydration, polycythemia vera, acute poisoning, pulmonary fibrosis. <strong>Decreased</strong> in all anemias, in leukemia, and after hemorrhage when blood volume has been restored.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male: 4.7–6.1 ( \times 10^6 ) / ( \mu l )</td>
<td>4.7–6.1 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female: 4.2–5.4 ( \times 10^6 ) / ( \mu l )</td>
<td>4.2–5.4 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newborn: 4.8–7.1 ( \times 10^6 ) / ( \mu l )</td>
<td>4.8–7.1 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–8 weeks: 4.0–6.0 ( \times 10^6 ) / ( \mu l )</td>
<td>4.0–6.0 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–6 months: 3.5–5.5 ( \times 10^6 ) / ( \mu l )</td>
<td>3.5–5.5 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months – 1 year: 3.5–5.2 ( \times 10^6 ) / ( \mu l )</td>
<td>3.5–5.2 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–6 years: 4.0–5.5 ( \times 10^6 ) / ( \mu l )</td>
<td>4.0–5.5 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6–18 years: 4.0–5.5 ( \times 10^6 ) / ( \mu l )</td>
<td>4.0–5.5 ( \times 10^{12} ) / ( L )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Continued*
### Appendix I: Laboratory Studies and Their Clinical Significance

<table>
<thead>
<tr>
<th>Determination</th>
<th>Conventional Units</th>
<th>SI Units</th>
<th>Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (Hgb)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Possible critical values: &lt;5.0 g/dl or &gt;20 g/dl</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased in polycythemia vera, chronic obstructive pulmonary disease, congenital heart disease, dehydration.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decreased in anemia, hemorrhage, hemolysis, lymphoma, kidney disease.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Adult:**
  - Male: 14–18 g/dl
  - Female 12–16 g/dl
  - Pregnant female >11g/dl

- **Elderly:** Values may be slightly decreased

- **Children:**
  - Newborn: 14–24 g/dl
  - 0–2 weeks: 12–20 g/dl
  - 2–6 months: 10–17 d/dl
  - 6 months-1 year: 9.5–14 g/dl
  - 1–6 years: 9.5–14 g/dl
  - 6–18 years: 10–15.5 g/dl

- **Values:**
  - Adult: 8.7–11.2 mmol/L
  - Elderly: Values may be slightly decreased
  - Children: 7.4–9.9 mmol/L
### Hematocrit (Hct)

<table>
<thead>
<tr>
<th>Determination</th>
<th>Conventional Units</th>
<th>SI Units</th>
<th>Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Possible Critical Values:</strong></td>
<td></td>
<td></td>
<td>&lt;15% or &gt;60%</td>
</tr>
<tr>
<td><strong>Increased</strong></td>
<td></td>
<td></td>
<td>in polycythemia vera,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>chronic obstructive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pulmonary disease,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>congenital heart disease,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>severe dehydration,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>eclampsia, burns.</td>
</tr>
<tr>
<td><strong>Decreased</strong></td>
<td></td>
<td></td>
<td>in anemia, hemorrhage,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hyperthyroidism,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>hemolysis, leukemia,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>kidney disease, normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>pregnancy.</td>
</tr>
</tbody>
</table>

**Adult:**
- Male: 42%–52%
- Female: 37%–47%

**Pregnant female:**
- >33%

**Elderly:** Values may be slightly decreased

**Children:**
- Newborn: 44–64%
- 2–8 weeks: 39–59%
- 2–6 months: 35–50%
- 6 months-1 year: 29–43%
- 1–6 years: 30–40%
- 6–18 years: 32–44%

(continued)
### Appendix I: Laboratory Studies and Their Clinical Significance

<table>
<thead>
<tr>
<th>Determination</th>
<th>Conventional Units</th>
<th>SI Units</th>
<th>Clinical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red Blood Cell Indices</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Mean Corpuscular Volume (MCV)</em></td>
<td>Adult/elderly/child: 80–95 μg³</td>
<td>80–90 fL</td>
<td><em>Increased</em> in liver disease, alcoholism, pernicious anemia.</td>
</tr>
<tr>
<td></td>
<td>Newborn: 96–108 μg³</td>
<td></td>
<td><em>Decreased</em> in iron deficiency anemia, Thalassemia.</td>
</tr>
<tr>
<td><em>Mean Corpuscular Hemoglobin (MCH)</em></td>
<td>Adult/elderly/child: 27–31 pg</td>
<td>27–32 pg</td>
<td><em>Increased</em> in macrocytic anemia.</td>
</tr>
<tr>
<td></td>
<td>Newborn: 32–34 pg</td>
<td></td>
<td><em>Decreased</em> in microcytic anemia.</td>
</tr>
<tr>
<td><em>Mean Corpuscular Hemoglobin Concentration (MCHC)</em></td>
<td>Adult/elderly/child: 32–36 g/dl (or 32%–36%)</td>
<td>Concentration fraction: 0.33–0.38</td>
<td><em>Increased</em> in intravascular hemolysis, cold agglutinins.</td>
</tr>
<tr>
<td></td>
<td>Newborn: 32–33 g/dl (or 32%–33%)</td>
<td></td>
<td><em>Decreased</em> in iron deficiency anemia.</td>
</tr>
<tr>
<td><em>Red Blood Cell Distribution Width (RDW)</em></td>
<td>Adult: 11%–14.5%</td>
<td></td>
<td><em>Increased</em> in iron deficiency anemia, folate deficiency anemia, hemolytic anemias.</td>
</tr>
<tr>
<td><em>Reticulocytes</em></td>
<td>Adult/elderly/child: 0.5%–2%</td>
<td></td>
<td>Immature red blood cell; normally few cells in bloodstream.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Increased</em> levels seen in hemolytic anemia, sickle cell anemia, leukemias.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Decreased</em> levels seen in pernicious anemia, aplastic anemia, bone marrow failure, anterior pituitary hypofunction.</td>
</tr>
</tbody>
</table>
The following list reviews common diagnostic imaging procedures and testing examples with which the First Assistant should be familiar.

**Arteriogram (Angiogram):** Serial x-ray imaging of the vascular system utilizing a contrast media. With the use of digital subtraction angiography, bony structures can be removed from the picture.

*Examples:* Abdominal aortogram, carotid arteriogram, renal angiography, lower extremity arteriography.

**Arthrogram:** X-ray study involving injection of contrast medium into a joint cavity allowing visualization of joint structures.

*Example:* Arthrogram of knee.

**Barium enema:** X-ray study of the colon involving injection of barium into the colon allowing visualization of tumors, polyps, and diverticula.

*Example:* Barium enema of the terminal ileum for Crohn’s disease or colonic tumors.

**Barium swallow:** X-ray study of the esophagus involving injection of barium into the upper gastrointestinal tract allowing visualization of tumors, polyps, and diverticula.

*Examples:* Barium swallow to visualize esophageal tumors, reflux, or strictures.

**Bone densitometry:** Accurate means of measuring bone mass and predicting risk of fracture. Utilizes low-dose x-ray.

*Example:* Bone density study.
**Bone scan**: See *Nuclear imaging*.

**Bone x-ray**: Single exposure radiographic film to evaluate bone. Films vary by density and anatomic location. Films may be taken from different angles: anterior, posterior, lateral, or oblique.  
*Examples*: Fracture, tumor, infection, or congenital bone abnormalities.

**Breast scintigraphy**: Nuclear scan of breast with sestamibi in patients whose tissue is too dense for conventional mammography studies.  
*Example*: Cancer lesions in patients with dense breast tissue.

**Breast sonogram**: Ultrasound examination of breast useful for differentiating cystic from solid tumors.  
*Example*: Monitor changes in size of breast cyst.

**Capsule endoscopy (Virtual endoscopy)**: Endoscopy uses scopes to visualize the interior aspects of an organ. Capsule endoscopy employs a vitamin pill-sized camera containing a radiofrequency transmitter and batteries that records images of the entire digestive tract, especially the small intestine. The capsule is swallowed and expelled after 6 to 10 hours (the capsule does not need to be retrieved).  
*Examples*: Bleeding from the small intestine, polyps, Crohn's disease, tumors.

**Cardiac catheterization**: Method of studying and diagnosing defects in heart chambers, valves, and blood vessels. Utilizes fluoroscopy and arterial and venous catheters that deliver contrast material into chambers and vessels of the heart.  
*Examples*: Coronary arteriography, left ventriculogram, mitral valve regurgitation.

**Cardiac Stress Test**: The heart is stressed (with exercise or drugs) and electrocardiographically monitored to evaluate heart function. A treadmill or bicycle may be used if the patient is able to perform physical exercise.  
*Examples*: Monitor for coronary occlusive disease, heart rate, blood pressure.

**Carotid artery duplex scanning**: Test employing both Doppler and B-mode (“duplex”) ultrasound to study vertebral and extracranial carotid artery stenoses or occlusions. Color Doppler may be added.  
*Example*: Monitor for transient ischemic attacks (TIAs), hemiparesis, and speech or visual deficits.

**Chromosome karotyping**: Analysis of the chromosomal arrangement of cells.  
*Examples*: Determination of fetal sex, prenatal chromosomal disorders. (See *Genetic Testing* in Appendix I, H.)
A
Abdomen, incisional approaches to, 84–87
midline, 85
oblique, 86
paramedian, 85–86
transverse, 87
infraumbilical, 87
Pfannenstiel 87
wound closure, 100
Abscess, 290, 331
Absorbable collagen sponges, 191
Absorbable sutures, 197–200
commonly used in surgery, 198
polymers, 200
surgical gut, 197, 200
synthetic, 200
Accreditation, 411, 433
Accreditation Review Commission for Education of the Physician Assistant (ARC-PA), 447
Acellular blood substitutes, 148
Activated coagulation time (ACT), 145
Activated partial thromboplastin time (APTT), 145
Adhesive tapes, 232–234
Adson forceps, 90–91
Advanced Practice Nurses (APN), 389
Agency for Healthcare Research & Quality (AHRQ), 288, 305, 394
Allergies, 299–300
Allied health professionals (AHP), 406, 408, 433
Allis clamp, 90, 124
Alternating current (AC), 173
American Academy of Physician Assistants (AAPA), 447
American Association of Nurse Anesthetists (AANA), 382
American Association of Surgical Physician Assistants (AASPA), 410
American College of Physicians, 411
American College of Surgeons (ACS), 214, 238, 294, 410, 441–442
American Hospital Association, 388, 411
American Medical Association (AMA), 388, 411
American National Standards Institute (ANSI), 180
American Nurses Association (ANA), 7, 410
American Society of Anesthesiologists (ASA), 146, 147, 294, 363–364
Physical Status Classification System, 262–263
Amide locals, 370
Amperes, 173
Anastomosis, 98–99, 105
Anesthesia
anesthetic agents, 369
awareness during, 382, 383
general, 372–376
handoff report, 376–377
history of, 361
intraoperative emergencies, 377–379
laparoscopic considerations, 373–375
patient safety, 379–384
physical classification system, 363
postanesthesia evaluation, 377
preanesthesia assessment, 362–372
Anesthesia Patient Safety Foundation, 380
Anesthetic agents, 369
Anesthetized patient monitors, 362
Antibiotic prophylaxis, 300
Antimicrobial agents, 47–48 considerations for, 49–51
AORN. See Association of periOperative Registered Nurses (AORN)
Argon-enhanced coagulation (AEC), 183–184
Army-navy retractor, 92
Arterial venous malformations (AVM), 143
Aseptic technique, draping, 67–68
Assessment and diagnostic process
American Society of Anesthesiology scale, 262–263
diagnostic examination, 258–260
informed consent, 260–262
obtaining history, 248–254
patient admission, 243–245
patient history, 245–248
physical examination, 255–258, 273–279
review of systems, 254–255, 269–272
Association for the
Advancement of Medical Instrumentation (AAMI), 180
Association of periOperative Registered Nurses (AORN), 7–8, 40, 238, 294, 380, 388, 410
official statement on RN first assistants, 437–440
clinical privileging for RNFA, 439–440
definition of RN first assistant, 437
preparation of RNFA, 438–439
qualifications for entry into RNFA practice, 439
scope of practice, 437–438
perioperative nursing credentialing model, 413, 414
Position Statement on Ergonomically Healthy Workplace Practices, 7
Recommended Practices for Preoperative Patient Skin Antisepsis, 40, 43
Recommended Practices for Selection and Use of Surgical Gowns and Drapes, 53
Association of Physician Assistant Programs (APAP), 443
Association of Surgical Technologists (AST), 389, 448
Atelectasis, 367–368, 384
Atraumatic needle, 209
Auscultation, 256
B
Babcock clamp, 90, 123
Balfour retractor, 93, 94
Barrier protection of drapes, 69
of skin, 39
Bipolar electro surgery, 181, 182
Blended mode, 174
Blood transfusions, 147–148
Blunt needle, 213–214, 238
Bookwalter retractor, 94, 118–120
C
Canadian Medical Association, 411
Capacitative coupling, 180–181
Catheter-associated urinary tract infections (CAUTI), 288
Cellulitis, 291, 331
Centers for Disease Control and Prevention (CDC), 42, 288
Centers for Medicare and Medicaid Services (CMS), 12, 93, 149, 294, 412
Central nervous system (CNS), 14
Central venous catheter-related bloodstream infections (CRBSI), 288
Central venous pressure (CVP), 23–24
Certification, 413, 414, 415, 422, 433
Certified First Assistant (CFA), 389
Certified nurse operating room (CNOR), 413, 438, 439
Checklists for patient safety, 379–380
Chemical hemostasis, 184–192 absorbable collagen sponges, 191
epinephrine, 190
fibrin gel, 191
gelatin sponges, 189–190
microfibrillar collagen, 190
Microporous Polysaccharide Hemosphere, 192
oxidized cellulose, 191
synthetic adhesives, 192
thrombin, 189
topical agents for, 184–189
Chlorhexidine gluconate (CHG), 42–43, 50
Cholinesterase-inhibiting agent, 375, 384
Christmas Disease, 140
Chromic sutures, 200
Circumoral numbness, 370, 384
Clamps, 80–90, 122–124
Clean-contaminated wounds, 77, 78, 289
Clean wounds, 77, 78, 289
Clinical competence, 427, 429, 433, 434