THE ANESTHETIC PLAN:

FROM PHYSIOLOGIC PRINCIPLES TO CLINICAL STRATEGIES

STANLEY MURAVCHICK

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This book is dedicated to my mother, Rebecca, and to the memory of my father, Harry: they taught me to love scholarship and to respect knowledge, values that led me to this undertaking; and to my wife, Dr. Arlene Olson, and my daughter, Rose: they gave me the gentle encouragement and consistent support that sustained my enthusiasm during three difficult years.

PREFACE

This book is a direct result of questions asked of me by my residents, many of which I was simply unable to answer immediately. It also became apparent to me that many fundamental physiologic mechanisms and pharmacologic relationships are not adequately described in standard textbooks, even though I believe them to be essential for the formulation of a rational anesthetic plan. Clinical experience, of course, can be a wonderful teacher, but the lessons are often obscure and misinterpreted until they are refashioned in the context of current scientific concepts of applied physiology and pharmacology. That is the objective of this book; in an environment as complex as that of the operating room, a little bit of knowledge can truly be a dangerous thing.

Throughout the first half of this century, anesthesiology was largely an empirical discipline taught by a process of apprenticeship. One learned directly from the clinical master; when things went wrong without apparent reason, the patient was assumed to "have taken a bad anesthetic." Some anesthetic protocols usually worked well, but others did not and were eventually discarded. Although still young enough to have a distinct genealogy, the specialty has expanded its scientific knowledge base exponentially since the end of World War II. With rapid application and acceptance of complex physiologic monitoring into daily practice, the transformation of anesthesiology into a controlled, daily exercise of the principles of applied physiology and pharmacology is nearly complete.

Virtually every anesthetic plan can be derived directly from our understanding of how these drugs alter end-organ and integrated organ-system functions, our recognition of the various expressions of anesthetic toxicity, and epidemiologic data regarding the demographic, technical, and judgmental factors that influence perioperative risk and anesthetic outcome. These are the primary issues to which this book is addressed, although this is obviously not a complete textbook of anesthesia. Nor does it have the authority or critical detail needed to satisfy serious researchers or career academicians. The references chosen are meant to be representative and not comprehensive. Wherever possible,

I have referred to widely distributed journals rather than to obscure texts, subspecialty publications, or symposia proceedings.

The reader is expected to be conversant with general medical terminology; it is also assumed that the prerequisite of a reasonably sound medical education has been met. All of the figures, to the best of my knowledge, are original in general visual presentation or in specific detail or context, although the reader undoubtedly may find similar representations elsewhere. Their purpose is to convey concisely the complex relationships difficult to describe completely in text. Some artistic license has been exercised to illustrate and integrate widely accepted concepts, although the most idiosyncratic or obscure data are referenced. The various tables summarize and condense the "conventional wisdom" for different topics, but the reader is cautioned that time may prove some of it to be seriously flawed.

In summary, this book is an overview of the essential interrelationships that make anesthesiology comprehensible, predictable, and intellectually satisfying for intelligent and well-trained practitioners. It is a companion to the textbooks of basic and clinical science and of subspecialty medicine needed for comprehensive understanding. *The Anesthetic Plan: From Physiologic Principles to Clinical Strategies* is to a three-volume, multi-authored textbook of anesthesiology what a blueprint is to a completed edifice: a schematic for the essential conceptual relationships as I see them.

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CONTENTS

1

Formulating a Plan

No plan for anesthetic management can guarantee a satisfactory perioperative course, although appropriate selection of anesthetic techniques and agents should, at the very least, minimize patient discomfort and facilitate surgery. Can an appropriate anesthetic plan reduce perioperative morbidity or influence anesthetic-related mortality? To establish this hypothesis definitively would require subjecting a large number of patients, in a randomized fashion, to various anesthetic protocols. Contemporary standards for clinical evaluation, choice of anesthetic agents, and the details of intraoperative management would thus have to be deliberately ignored, and a study of this sort could not be ethically, morally, or legally condoned. It may never be possible to prove conclusively, therefore, that a sound anesthetic plan and an optimal perioperative course are related in cause-and-effect fashion, but two indirect lines of evidence, one epidemiologic and the other empirical, support this hypothesis.

First, there has been a progressive decline in anesthetic-related morbidity and mortality (Chapter 11) coincident with the dramatic growth of the knowledge base for applied physiology and pharmacology that forms the foundation for virtually all modern concepts in anesthesiology. Second, the traditional "contraindications" to general anesthesia such as extremes of age or debilitating disease, once invoked because some patients were believed to be intrinsically unfit to "endure" general anesthesia, have virtually disappeared. This chapter describes a general, fundamental approach to patient assessment and a preliminary approach to general concepts important in the design of an anesthetic plan. Specific considerations and risk factors related to disease of individual organ systems will be discussed in subsequent chapters.

PREANESTHETIC ASSESSMENT

Traditional Approach

The time-honored, traditional medical "workup" requires a detailed medical history followed, in sequence, by a physical examination of the patient and subsequent review of laboratory data.[1] It serves well for purposes of screening and general diagnosis, but it is unwieldy and inefficient as a system for preoperative anesthetic evaluation because it is constructed to consider all possible diagnoses, and, in particular, those with multiple organ system involvement.[2] Diagnosis rests on a stack of informational strata, each of which represents a technique of inquiry applied across all major organ systems (Fig 1–1).

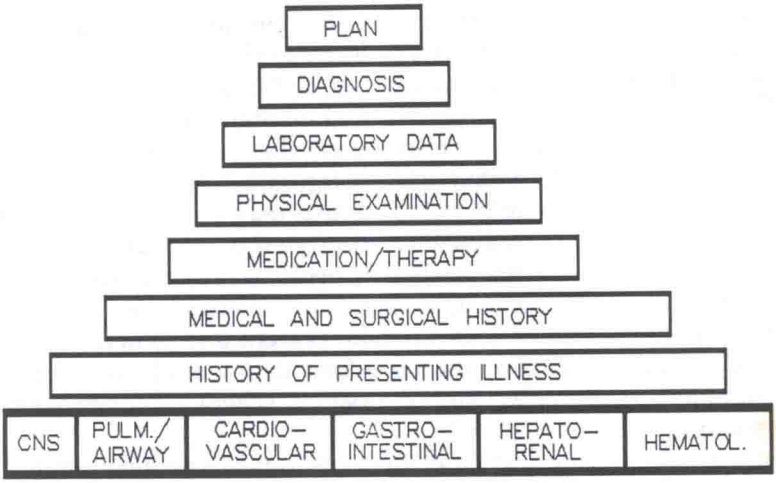

FIG 1–1.
Traditional stratified or "horizontal" medical approach to preoperative evaluation, shown schematically. It is designed to consolidate signs, symptoms, laboratory and physical findings, and other data derived from a variety of organ systems into a unifying diagnostic entity and plan for medical therapy.

This "horizontal" approach initially gives each major organ system equal weight. Excluding no details, it ultimately defines a particular organ system as the locus of one or a number of potential disease processes, which must then be distinguished by a process of differential diagnosis. The chronology and the symptoms and signs of the admitting diagnosis derived from this technique of evaluation may be highly relevant to the formulation of a plan for anesthetic management: fever accompanied by 24 hours of nausea and vomiting may lead not only to a diagnosis of appendicitis but will also significantly alter anesthetic management. On the other hand, the natural history of the discovery of an asymptomatic colonic lesion, in and of itself, rarely influences the anesthetic plan for elective hemicolectomy.

Vertical Integration

An organ system approach to preoperative anesthetic assessment differs from the traditional, horizontally integrated concept by focusing on the current functional level and the degree of functional reserve retained by each major organ system. In this approach, defining the underlying disease process itself is less important than the assessment of the functional level of the major organ systems. Since each organ sys-

tem is thoroughly evaluated from history through laboratory data, in sequence, the analysis is "vertically integrated" up through techniques of inquiry (Fig 1–2), in contrast to the traditional approach, in which techniques of inquiry are applied across all organ systems in turn.

An organ system approach to preanesthetic assessment is also easily modified by the designation of appropriate vertical columns to give special attention to a number of areas that may be critical to the mechanism of anesthetic management, although they may be of little interest for purposes of medical diagnosis because they are not part of the presenting illness. For example, a marked overbite and large tongue may compromise ease of airway management and generate difficulty during tracheal intubation, but this information would have no place in the traditional surgical workup of a patient scheduled for excision of a melanoma on a lower extremity.

Other unique anesthetic perspectives that can be incorporated into an organ system approach include general body habitus, ease of vascular access, and physical or psychologic factors that influence the relative risk of regurgitation or reflux of gastric contents. A vertical ap-

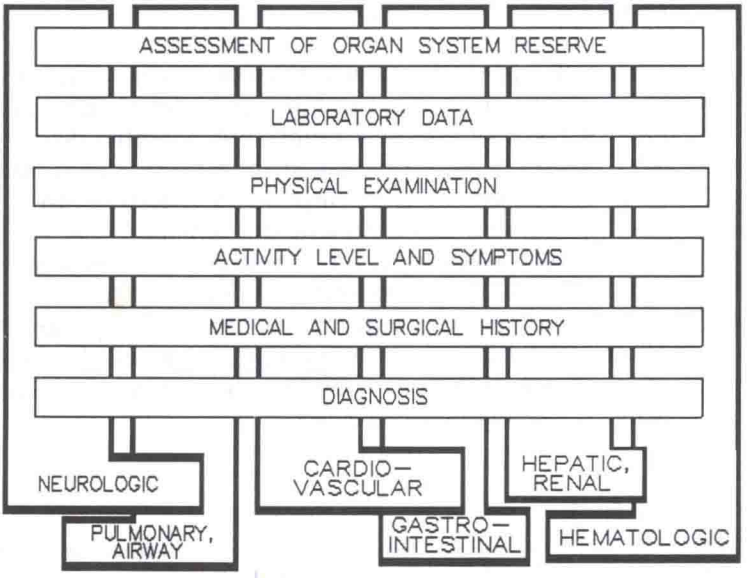

FIG 1–2.

Organ system approach to preanesthetic assessment of physical status, shown schematically. Function and functional reserve of critical organ systems and physical factors that may modify the design of the anesthetic plan are evaluated by a process of vertical integration of all available data for each organ system.

proach also applies the details of a history of specific adverse reactions to prior anesthetics to the appropriate organ system. Rarely do any, and virtually never do all, of these factors become a focal point in the horizontally integrated, traditional approach to medical assessment. They can, however, be given appropriate priority in an organ system approach to preanesthetic assessment.

Application of the organ system approach begins with a general, overall analysis of the patient's activity level and vigor; it then determines, system by system, evidence of dysfunction and the need for current therapy.[3] In this approach, some diagnostic perspective for the possibilities of common etiology may be sacrificed to provide a clear identification of those organ systems that make up the "weak link" in the chain of vital organ system interdependence.

This form of assessment cannot, however, be successfully utilized without the application of clinical judgment: there must be a relative weighting of the available data for each organ system, as well as subjective assessment of the degree to which the dysfunction compromises not just basal levels of function but also functional reserve. Clinical experience is also required to permit a judgment to be made as to whether the dysfunction is *compensated* or *decompensated* (i.e., whether the findings and symptomatology are proportional to the severity of the underlying disease or whether the dysfunction is masked or minimized by compensatory changes in other organ systems). Is the patient as sick, or sicker, than he would appear "on paper?"

Physical Status

Because the "vertical" approach to preanesthetic assessment requires organization of available data and subsequent integration of this information with the anesthesiologist's own estimate of functional level, it leads directly and efficiently to formulation of an American Society of Anesthesiologists (ASA) physical status classification. Formally defined (Table 1–1) and adopted in 1963,[4] assignment of ASA physical status is now a required component of every preanesthetic assessment. It is an act of clinical judgment based exclusively on identification of organ system disease and evaluation of the extent to which that disease impairs normal function or incapacitates the patient.

ASA physical status assignment does not, and should not, consider age per se, the nature of surgery required, or the duration of preexisting disease. It is a clinician's tool for preanesthetic assessment of the presence of pathology that compromises organ system function and functional reserve. Originally conceived by Saklad[5] more than 40

TABLE 1–1.
Original Definition of ASA Physical Status Categories

Class 1	A normally healthy patient
Class 2	A patient with mild systemic disease
Class 3	A patient with moderate to severe disease that is not incapacitating
Class 4	A patient with incapacitating disease that is a constant threat to life
Class 5	A moribund patient who is not expected to survive 24 hours with or without operation

years ago to facilitate statistical evaluation of anesthetic risk, it was subsequently refined and popularized to assist in the determination of the role of anesthesia in perioperative mortality.[6] Although some inconsistency is unavoidable,[7] this system is now universally accepted in anesthesia and widely utilized in other specialties as well because it has fulfilled the original expectation that it would correlate with the perioperative mortality[8, 9] (Fig 1–3).

There is also evidence to support the obvious corollary that preoperative diagnosis and treatment of some forms of organ system dysfunction can improve postoperative outcome.[10] Other attempts at defining more specific multifactorial risk indices[11] have done little more than reconfirm what has long been clinically evident: that the extent of preoperative organ system impairment determines both perioperative mortality[12] and the incidence and severity of postoperative complications.[13] In contemporary anesthetic practice, therefore, regardless of the type of surgery or hospital facility, healthy patients having elective surgery should do well unless they become the victims of human error.[14, 15] Patients with disease severe enough to limit activity, however, are subject to a progressively higher incidence of perioperative complications and death.[6, 13, 16, 17]

Organ System Functional Reserve

The chapters that follow discuss the interactions between individual anesthetic agents and specific organ systems. The general principles of compensation and decompensation, however, are applicable to all organ systems. Virtually without exception, every form of general or regional anesthesia is associated with cardiovascular or respiratory depression, interruption of sympathetic nervous system activity, or a combination of these effects. In the absence of disease, no compensation is needed, and even an organ system depressed by anesthetic agents would have not only adequate basal function but also sufficient