

Cambridge University Press
978-1-107-00916-5 - Medical Management of the Surgical Patient: A Textbook of Perioperative Medicine: Fifth Edition
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Perioperative Care of the Surgical Patient

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Section 1

Chapter

1

General

Anesthesia management of the surgical patient

L. Reuven Pasternak

Few aspects of healthcare involve as much simultaneous interaction by different physicians as the management of the patient undergoing surgery. At a minimum, the primary care provider, surgeon, and anesthesiologist form a team of physicians, all of whom bring a different perspective and expertise to the care of the patient. As the medical intensity of patients increases, there is also an expanding number of community-based and hospital-based specialty physicians and hospitalists actively involved in this process.

The intersection of the primary care provider and the anesthesiologist first occurs when the surgeon schedules a patient for surgery. At that point the series of events that culminates in medical evaluation, anesthetic assessment, and perioperative management starts. This chapter will begin with that aspect of preparation of the patient for elective surgery. The greatest detail is spent in this area as this is where, by far, the greatest overlap of expertise and communication occurs. The remainder of the chapter will then briefly cover the standard issues involved in perioperative management. These comments are not so much geared to make the primary care provider an expert in the field but are more designed to provide some familiarity with the environment into which the patient is going. It is assumed that detailed information about anesthesia care is provided directly to the patient by the anesthesia provider and/or preoperative systems.

Preoperative evaluation: preparation for surgery

The importance of this phase of clinical management is indicated by its global nature. As the administration of anesthesia may involve a risk for the patient that equals or even exceeds that of the surgery itself, the preoperative evaluation is a crucial first step that may affect the clinical safety and organizational integrity of the entire surgical system. The preoperative assessment of the surgical patient for surgery poses a formidable challenge. While the relative merits of alternative surgical and anesthetic techniques have been extensively

studied and reviewed in the literature and other forums, the issue of appropriate preoperative assessment has often remained ambiguous.

Several issues have combined to cause this previously simple process to become more complex.

- While the surgeon has retained the opportunity to examine and assess the patient before the scheduling of surgery, the anesthesiologist often does not have the same access to the patient that had previously existed with routine preoperative admissions.
- The selection of procedures by third-party payers to be done on an outpatient and same-day admission basis is generally determined on the presumed complexity of the procedure and not the patient's other underlying medical problems or potential issues associated with anesthesia. Consequently, the anesthesiologist is often asked to manage patients with complex medical conditions undergoing less complex surgery with little prior information.
- Organized health plans often seek to retain as much of the control of the process as possible, including determining when and where tests and consultations are to be done.
- Many hospitals and surgical units have yet to organize and develop preoperative evaluation units due to the expense of staff and space at a time when financial constraints are increasingly severe.
- There has been no consistent system for risk assessment to determine appropriate preoperative management.
- Multiple professional societies have developed specific and often contradictory guidelines on preoperative evaluation for their members.

To further compound the issues there are multiple strategies and guidelines for assessment of the patient undergoing surgery, often from organizations outside of the anesthesia community and, at times, with little input from anesthesiologists or consideration of anesthesia-related issues.

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Philosophy

The purpose of the preoperative evaluation is to identify and reduce the risks associated with anesthesia and surgery. The preoperative evaluation is that portion of the general process that is designed to address issues related to the perioperative management of the surgical patient by anesthesiologists. All preoperative activities, including evaluation prior to the day of surgery, testing, and consultation, should be undertaken only on the reasonable expectation that they will enhance the safety, comfort, and efficiency of the process for the patient, clinical staff, and overall system. Decisions concerning preoperative management should be associated with a consideration of how any aspect of the evaluation will affect the management and outcome of the perioperative process. Evaluations and interventions that do not have a demonstrated beneficial effect do not have value to the patient, clinician, or manager and should not be undertaken on the basis of custom or convenience.

The preoperative evaluation is therefore a focused assessment to address issues relevant to the safe administration of anesthesia and performance of surgery. The use of this event to perform unrelated general medical screening and intervention should be undertaken only in association with appropriate primary and specialty care support. Only anesthesia staff may determine a patient's fitness for administration of anesthesia and appropriate anesthesia technique. The performance of a history and physical examination by other healthcare providers does not constitute a clearance for administration of anesthesia but provides information to the anesthesia staff to make that determination. Thus, internists and other specialists do not "clear" patients for surgery. Rather, they provide an assessment of the current health status of the patient, including whether the patient is as optimally managed as possible.

When evaluating patients for surgery, it should be remembered that the anesthesiologist has only a temporary but important relationship with the patient. Patients' continuing care, including assessment of new or acute exacerbations of chronic conditions, should be done by their primary care providers and associated consultants with whom they will have long-term relationships. Patients should be apprised of the fact that the preoperative evaluation is not a substitute for regular primary care. Requests by patients for performance of tests not deemed necessary for the performance of surgery or administration of surgery should also be referred to their primary healthcare source.

Risk classification

While the purpose of the preoperative evaluation is to reduce risk, current risk classification systems are ill-equipped to provide assistance with patient classification. The first attempt to quantify risks associated with surgery was undertaken by Meyer Saklad in 1941 at the request of the American Society of Anesthesiology (ASA) [1]. This effort was the first by any

medical specialty to stratify risk for its patients. Saklad's system did so based on mortality secondary to the associated preoperative medical condition. Type of anesthesia and nature of surgery were not considerations in this system and the divisions were based on empirical experience rather than on specific sets of data and reflect the techniques and standards of practice as of 50 years ago. Four preoperative risk categories were established ranging from category 1 (least likely to die) to category 4 (highest expectation of mortality).

The current ASA classification system is a modification of this work, adding an additional fifth category for moribund patients undergoing surgery in a desperate attempt to preserve life. Numerous studies have demonstrated an association of mortality with ASA Classification independent of anesthetic technique [2–13]. However, these data have limited application as it relates to mortality as its sole outcome and are based on anesthetic techniques as practiced more than 20 years ago. Apfelbaum [14] and Meridy [15] for example, have noted a lack of correlation between ASA status and cancellations, unplanned admissions, and other perioperative complications in outpatient surgery. In a 2004 review of 564,267 procedures done through the Medicare program, Fleischer *et al.* [16] found that advanced age, prior admission within the past 6 months, and, most important, invasiveness of procedure were the best predictors of admission.

Thus, while useful as a broad assessment of preoperative medical status, the current ASA classification is limited in its ability to truly establish risk or serve as a basis for formulating clinical guidelines without an associated risk index for the surgical procedure. In addition, while concerning itself with the identification of risk, there is a remarkable lack of data delineating outcomes in ambulatory surgery and anesthesia. When the ASA Task Force on Preoperative Evaluation recently issued its recommendations for all preoperative assessment, it initially tried to do so using an evidence-based approach linking specific tests and interventions with designated outcomes. The literature in this area for all of anesthesia was such that, of over 1,200 articles identified in this area, fewer than 30 fit the criteria for use. Lack of information of sufficient scientific validity mandated that the guideline development had to yield to an advisory that was based on consensus opinion subject to further scientific investigation and validation using evidence-based studies at a future date. For purposes of risk stratification, the ASA advisory adopted a modification of the risk index system for patient medical severity and surgical severity as used by the other most commonly used algorithm for patient preoperative assessment, the AHA/ACC guidelines for preoperative assessment of the cardiac patient for non-cardiac surgery [17].

Patient and procedure selection

The nature of patient and procedure selection is a function of medical status, surgical procedure, and availability of appropriate postoperative assistance, ranging from home care to

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intensive care support. While elective surgical procedures are by definition not emergencies, many are nonetheless relatively urgent in nature. The delay of some procedures, such as biopsies for staging of oncology treatments, may unnecessarily delay and inappropriately compromise the care of the patient. Surgeons and anesthesiologists must make a judgment if delay will truly reduce the risk for the patient or merely postpone the inevitable task of dealing with a potentially difficult challenge in the operating room. Finally, while mandates for early discharge by regulatory and managed care groups are based almost wholly on postoperative physiologic status, patient comfort and availability of appropriate assistance at home should be a major consideration in this process. In these circumstances, it is anticipated that the primary care provider will provide insight about the medical status of the patient and assist with optimal stabilization prior to surgery. Advice as to type of anesthesia technique should be deferred to the anesthesia team, who will tailor their technique to the special needs of the patient.

Time of the evaluation

At the current time, over 60% of surgery performed in the USA is outpatient and another 10–15% is performed on a same-day admission basis. For this 70% of the nearly 40 million surgical procedures performed each year, the challenge of appropriate timing and content of the assessment is important and sometimes difficult. Initially, it was a common assumption that a preoperative visit prior to the day of surgery confers some added measure of safety and comfort for patients. On the basis of this assumption, patients were often asked to take the time and expense required to comply with such requirements while hospitals and anesthesiologists had to staff centers able to handle this demand.

Eventually, the literature called this practice into question. Fischer’s study [18] demonstrated for outpatients and inpatients that prior preoperative evaluation by anesthesia staff reduced cancellations, tests, and consultations. This study was thus useful in demonstrating the need for a screening mechanism that allowed for patient assessment prior to the day of surgery. However, the assertion that these benefits could be obtained only in a system where all patients visited a preoperative evaluation center was not demonstrated. Some studies demonstrated that no preoperative evaluation visit prior to the day of surgery was necessary for healthy patients undergoing minor procedures [19,20]. Some of the most comprehensive work in this area has been by Twersky *et al.* [21] which indicates that patient evaluations on the day of surgery may be performed in a manner that is safe and effective. However, even in these studies, patients were not stratified by medical status or surgical procedure and were not relevant for the larger patient population managed by most anesthesiologists.

In discussions with major academic and private practice medical center directors, it has been observed by this author

that the percentage of patients who required having an onsite visit prior averages about 25–33%. The preoperative assessment must be a balance between patient convenience and the need to have information available in a timely fashion to allow for planning appropriate preoperative and perioperative management. While the ideal system may include a preoperative evaluation prior to the day of surgery for all patients, the logistics of patient schedules and their often otherwise healthy status makes this ideal impractical and, at times, unnecessary. This point is of significant concern to hospital preoperative evaluation staff who believe that resources may be inappropriately committed to patients with little need of those services to the detriment of others with more extensive medical and surgical issues and with waste of resources needed elsewhere.

The algorithm adopted by the ASA for preoperative evaluation [22] recognizes that there are categories of patients (health individuals for low-risk surgical procedures) for whom a preoperative assessment (consisting of information made available prior to the day of surgery for review) is sufficient. Similarly, there are some individuals for whom assessment prior to the day of surgery is mandated by their medical condition and/or planned surgery. It is difficult to provide a standard recommendation for how ambulatory surgical centers should place its patients into these categories; much depends on the ease of availability and validity of data provided prior to the day of surgery. What is uniformly recommended is that appropriate information should be made available to anesthesia staff prior to the day of surgery to allow for review and appropriate action.

It is increasingly recognized that the role of the primary care provider is critical in this process. That individual is most familiar with the health status of the patient. Thus, while they are not in a position to “clear for anesthesia,” they are in a position to provide the pertinent medical information prior to the day of surgery that would allow surgical systems staff to determine the need for any additional information or consultation.

Laboratory testing

Laboratory and other diagnostic tests associated with preoperative evaluations represent one of the most costly issues associated with surgery. It is difficult to attach a precise dollar cost on this activity. However, it is conservatively estimated that at least 10% of the over \$30 billion spent on laboratory testing each year is for preoperative evaluation. The traditional system of the protocol “battery of tests” evolved from a lack of clear definition of their role in preoperative screening, insufficient information on their utility, and a mistaken belief that voluminous information, no matter how irrelevant, enhanced the safety of care and reduced physician liability for adverse events. Protocol testing relieved physicians and their associates of the responsibility of decision making as an easier, though

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more costly, alternative to selective tests based on patients' individual health profiles.

At a time when the cost of care and the convenience of patients is a major concern, the role of tests as a screening device is rightfully diminishing. The patient history, physical examination, and judgment of the physician are replacing protocols as the basis for testing. While information about other aspects of the preoperative evaluation may be ambiguous, there is extensive literature and experience to support the selective use of testing which also confirms that the use of broad testing panels has a strong tendency to result in excessive testing. Laboratory testing, like all areas of medical intervention, should be undertaken on a "value-added" basis: a reasonable expectation that a potential issue exists that is relevant to anesthesia.

The utility of the preoperative test is based on several key considerations. The first issue is relevance. While some abnormalities are clearly of concern (e.g., cardiac and respiratory), others may have little or no effect on anesthetic plan and outcome and thus do not warrant thorough investigation in this format. The second issue is the prevalence of the condition in both symptomatic and asymptomatic patients. A low prevalence in asymptomatic patients indicates that screening is of little use. The third issue is that of test sensitivity and specificity. Low sensitivity permits false-negative results and patients at risk undergo anesthesia without appropriate preparation. Low specificity causes a large number of false-positives subjecting patients to additional testing, with coincident inconvenience, costs, and potential morbidity. Testing should therefore be done for conditions that are medically relevant using tests of high sensitivity and specificity. A final consideration is cost. Selection of alternative testing modalities should also take into consideration the financial and non-financial costs of testing with selection of the less costly approach where it does not compromise the quality of the information desired. Testing in the asymptomatic population should only be done in patients for whom the potential condition is significant and of reasonable prevalence with tests of reasonable sensitivity and specificity.

Attaching precise numbers to the above caveats is difficult and is the subject of cost-benefit and cost-effectiveness analysis for each of the tests concerned. While this has not been established for many of the routine diagnostic tests that we employ, it has been established in the medical, surgical, and anesthesia literature that the use of screening tests without specific indication is not appropriate. In a study of 19,980 tests on 1,000 patients, Korvin *et al.* [23] encountered 2,223 abnormal values of which 993 were initially considered to be unanticipated. Of these, 223 led to further evaluation and new diagnoses and in only one case was the diagnosis unrelated to other known medical issues and resulted in new patient care. This involved elevated liver studies in a male who had received halothane anesthesia and for whom the recommendation was made that this agent be avoided.

Robbins and Mushlin [24] in evaluating preoperative testing from a medical perspective, provide an excellent review of the sensitivity, specificity, and consequent utility of a wide range of tests. Kaplan *et al.* [25] reviewed the records of 2,000 patients undergoing elective surgery who received a routine battery of complete blood cell count, differential cell count, prothrombin time, partial thromboplastin time, platelet count, glucose level, and six channel chemistries. They found that 60% of these tests would not have been performed had they been done only on the basis of clinical indication and that, of these, only 0.22% revealed abnormalities that might have affected perioperative management. These findings were replicated by Turnbull and Buck [26] in a review of 1,010 otherwise healthy patients undergoing cholecystectomy, who discovered 225 abnormal results in 5,003 tests of which 104 were judged to be important and for whom only four patients might have derived some benefit.

In addition to protocols lacking critical review, another reason for excess testing often relates to a lack of communication between medical colleagues. A retrospective study by Kitz *et al.* [27] compared the use of chest X-rays, electrocardiograms, and chemistry panels in patients undergoing knee arthroscopy and diagnostic laparoscopy or laparoscopic tubal ligation. The groups were divided into patients electively admitted prior to the day of surgery and those who were outpatients. Both patient groups were healthy ASA I and II with tests ordered in the first group by the admitting surgeon and in the second by the anesthesiologist. Though medically similar, the groups had significantly different rates of testing with the higher test rate by surgeons attributable to their desire to not have cases canceled and lack of information from anesthesia staff about test indications.

Additional studies of specific tests have also confirmed the use of the history and physical as a basis for specific tests. Urinalysis, long a mainstay of testing and still required by law in some states, has been found to be of extremely limited use in patients without a preexisting medical condition or positive physical findings [28]. Their use for prevention of postoperative surgical problems outside the realm of genitourinary surgery was addressed by Lawrence *et al.* [29]. In a classic application of cost-benefit analysis, it was determined that routine urinalysis for all knee replacement surgery in the USA would cost \$1,500,000 per wound prevented and not add to the safety or effectiveness of the surgery. Rucker *et al.* [30] in a review of 905 routine chest X-rays for elective surgical procedures, determined that 368 had no risk factors by history and physical and that only one had a minor abnormality. Of the remaining 504 patients, 22% (114) had serious abnormalities, virtually all of which would have been anticipated by the history and physical examination. Charpak *et al.* [31] in a retrospective review of postoperative complications, found no circumstances in which absence of a chest X-ray in patients without prior pulmonary disease would have altered outcome or management, even when the complications were respiratory in nature. In both studies, no correlation was

established between age and occurrence of positive chest X-rays in patients independent of coexisting positive history or physical examination. Similar findings are available for hemoglobin determinations [32,33], serum chemistries [34], and pulmonary function testing [35].

In accordance with the philosophy that a test is undertaken because of a realistic possibility of adding valuable information, protocol screening without specific indication is not appropriate. In addition to lack of utility for the physician, such testing may, in fact, do harm to patients through unnecessary and potentially invasive interventions, heightened anxieties, and markedly increased costs that may place the physician in a position of having to explain proceeding with surgery in the face of incomplete or irrelevant data. As observed in the literature, there is little rationale for testing other than on the basis of specific indicators. Testing should be done only on an expectation of a finding that might have reasonable relevance for anesthesia and surgery based on:

- Presence of a positive finding on the history and physical examination.
- Need of the surgeon or other clinician for baseline values in anticipation of significant changes due to surgery or other medical interventions (e.g., chemotherapy).
- Patient's inclusion in a population at higher risk for the presence of a relevant condition even though they may exhibit no individual signs of that condition themselves.

By this standard, patients less than 50 years of age without coexisting medical disease would require no preoperative testing, while patients greater than 50 years of age would require an electrocardiogram as per the anesthesiologist. Further testing is done on an individualized basis as indicated by history, physical, and nature of the surgical procedure. It is estimated conservatively that such testing at our institution could reduce preoperative testing by 70%.

Consultations

Specialty consultations should not be obtained on an automatic basis because of organ-specific problems but because there is a specific issue that remains to be addressed. For example, in some centers it is routine to require all patients with any cardiac risk factor to be seen by a cardiologist prior to surgery. These consultations often provide no new information or insight other than that which can be obtained by a review of existing records and a basic history and physical examination. At worst, these requests for consultation are at times taken as a request for suggestions concerning the perioperative management with recommendations made that are based on erroneous assumptions concerning the risks associated with anesthetic techniques. When indicated, requests for consultations should be specifically and narrowly worded to request the specialist's evaluation of the patient's clinical condition, and not to "clear for anesthesia."

Preparation of the patient on the day of surgery

Preoperative fasting (NPO)

Preoperative fasting is aimed at reducing the risk of aspiration on induction of anesthesia and the risk of postoperative emesis. It had long been assumed that any gastric intake prior to surgery posed a major risk to the patient. This standard assumption, however, has been shown to be misleading. Some recent studies in adults demonstrate reduced and less acidic gastric contents when patients are given 150 mL of clear fluid 2 hours before surgery. Schreiner *et al.* [36] evaluated this same issue in pediatric patients, comparing those with routine NPO status with those allowed to take clear liquids up to 2 hours before surgery, with the only limitation in volume being the last intake (240 mL). The study group taking oral fluids was found to be less anxious and less irritable at the time of induction, while not having any statistically significant difference in gastric volume or pH. Similarly, Sandhar *et al.* [37] evaluated oral intake of liquids (5 mL/kg) with and without ranitidine (2 mg/kg) and ranitidine alone up to 2–3 hours before surgery in patients 1–14 years of age. The use of fluids alone did not appear to place patients at risk, and the combination with ranitidine was found to be beneficial.

These findings increasingly suggest that the 8-hour NPO rule for outpatients may be subjecting many low-risk individuals, especially children and the elderly, to unwarranted discomfort and that allowing clear liquids up to 2–3 hours before surgery may be preferable. Current recommendations retain the 8-hour NPO rule for solids, but allow up to 150–200 mL of liquid 2 hours before surgery. From a practical standpoint, however, the ability to convey this in instructions is sometimes difficult for the patient to follow, and it sometimes remains simpler to require a full 8-hour NPO period prior to surgery except for sips of liquids required for medication or for special circumstances on an individualized basis.

Preoperative medication

It is generally recommended that patients take their routine medications prior to, and on the day of, surgery. Exceptions to this recommendation include diuretics, oral hypoglycemic agents, anticoagulants, and insulin. Anticoagulants will usually need to be withheld per instructions of the surgeon. Insulin should be brought by the patient to the hospital or surgical facility on the day of surgery with one-third to one-half of the usual dose administered after testing for blood glucose levels and the start of an IV to prevent hypoglycemia. For this reason, it is strongly recommended that insulin-dependent diabetics be placed as early in the schedule as possible to protect against wide swings in their glucose levels prior to surgery. One area of special interest has been the use of beta-blockers prior to surgery. Early management called for discontinuation of these drugs with deference to management by anesthesiologists on the day of surgery. However, recent

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analysis by the American Heart Association and the American College of Cardiology [38,39] has determined that the weight of evidence supports continuing administration of beta-blockers prior to and on the day of surgery.

At times, a compassionate primary care physician may prescribe sedation to be taken by the patient prior to arrival for an outpatient or same-day admission procedure. This practice should be discouraged as the patient may not be in an appropriate condition to work with the anesthesiologist who must also then cope with an exogenous agent in determining and obtaining informed consent for an appropriate anesthetic plan.

Perioperative management

As with all other aspects of management, the perioperative care of the ambulatory surgery patient requires scrupulous attention to issues of safety, comfort, convenience, and efficiency. Selection of anesthetic technique must thus ensure a cooperative patient for the surgeon. The anesthesiologist must use a method that ensures rapid induction and emergence from anesthesia, with the patient feeling little discomfort in the recovery period and thus allowing for a reasonably quick discharge. The margin for error is considerably smaller in outpatient procedures, since often little time is available to stabilize a patient during the perioperative period if one discovers excessive or insufficient depth of anesthesia.

As with any procedure, the anesthetic technique is discussed with the patient and a notation made in the record of this fact. This discussion constitutes informed consent and is increasingly being conducted with the same formality as the surgical consent. Just as the surgeon is required to state potential complications and potential unplanned interventions that may occur, patients should be advised of alternative plans that may ensue. These plans are usually in the form of general anesthesia in the event that other techniques are insufficient for the procedure's successful completion. At times, patients for whom general anesthesia is contraindicated may have a procedure performed with sedation or a regional technique. In these circumstances, both surgeon and patient should be fully aware that an attempt to perform the procedure one way does not constitute open clearance to proceed under all circumstances. Also, if the initial effort is unsuccessful, the surgery should be discontinued and performed in a different setting.

On occasion, primary-care providers advise patients, suggest appropriate anesthetic techniques and agents, and at times place these suggestions in the medical record. While done with the best of intention, this practice often prejudices the discussion between the anesthesiologist and the patient and may cause undue confusion and distress on the day of surgery. Accordingly, the primary-care provider is discouraged from this practice. Instead, patient concerns and preferences, if any, should be noted with discussion of technique and agents left to the discussion between the anesthesiologist and patient.

Monitoring and anesthesia equipment

A fully operational anesthesia system includes pulse oximetry, capnography, ECG, blood pressure measurement, and precordial or esophageal stethoscope. The provision of anesthesia services in any location, whether inside or outside of the operating room, requires the availability of these modalities of monitoring as a minimum standard of care. Within the operating room, the ability to monitor inspiratory and expiratory inhalation agents is proving to be of significant value in modifying anesthetic technique to allow for smooth induction and rapid emergence.

Monitored sedation

Monitored sedation, when possible, often provides the safest, most comfortable, and most efficient anesthetic management. It is especially desirable in patients whose medical condition (e.g., major cardiorespiratory disease and difficult airways) makes them relatively more difficult candidates for general anesthesia. Whereas regional and general anesthesia may provide deep anesthesia over a large body area and allow leeway to both anesthesiologist and surgeon, monitored sedation requires scrupulous technique by both. Common procedures using these techniques include carpal tunnel repair; other hand procedures; cataract extraction and lens implanting; significant dermatologic procedures; and some hernia repairs.

Procedures that can often be performed by experienced surgeons in this way include breast biopsies; inguinal hernia repairs; limited superficial procedures on the skin and subcutaneous tissue; ophthalmic procedures such as cataract extraction; and procedures on distal portions of extremities to a local block by the surgeon. Surgery performed with local anesthesia thus requires a technique that is limited, is amenable to local infiltration, is performed rapidly, and does not require excessive doses of either local anesthesia or sedation. Surgical skill is critical; attempts to perform such invasive procedures as tonsillectomy and laparoscopy with sedation and local anesthesia is fraught with potential disaster in the hands of anyone but the most skilled surgeon.

With some surgeons, patient sedation may not be required. In general, however, sedation allows a patient to achieve a more relaxed state and permits a more pleasant and rapid completion of the procedure. A wide array of drugs is employed. The standard technique that has generally worked well involves the use of a benzodiazepine with a short-acting narcotic, replacing the past practice of relying on barbiturates. Midazolam's tendency to cause less postoperative drowsiness than diazepam, combined with its faster onset of action and less vein-irritating nature, has made midazolam the mainstay of current techniques. Contrary to much conventional wisdom, the retrograde amnesia associated with midazolam is minimal and instead is marked by the patient's impaired ability to integrate events into long-term memory after its administration [40–42].

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Administration of short-acting narcotics, such as fentanyl (1–2 µg/kg), can supplement the sedative nature of the midazolam, with the anesthesiologist checking closely for any impaired or compromised ventilation. Alfentanil (10–20 µg/kg) is also effective and provides more rapid onset and shorter duration of action than fentanyl. As with all procedures, varying levels of stimulation occur, usually associated with initial and subsequent injections of local anesthetic into the surgical site. Administration of 25–50 mg of a short-acting barbiturate or 10–20 mg of propofol immediately before anesthesia induction may preclude the need for larger doses of longer-acting agents. Frequent need for such medication, however, indicates the need for deeper sedation.

An alternative and increasingly popular approach to sedation involves the intravenous use of propofol, a rapid-onset, short-acting hypnotic. After an initial dose of 1 mg/kg, increments of 0.25 mg/kg up to a total dose of 2.5 mg are used to achieve sedation. A continuous infusion of 20 µg/kg is then used to maintain sedation, adjusting to the patient's level of sedation and vital signs. When using this technique, one must remember that propofol is a hypnotic and not an analgesic. Therefore its success depends even more on appropriate local anesthetic use than with a benzodiazepine or hypnotic, although propofol has the advantage of faster onset and cessation of action.

A critical point to remember is that the surgeon administers the local agent to provide anesthesia. Patient discomfort that persists despite sedation in the unstimulated state may indicate the need for more local anesthetic infiltration or alteration of technique. In some individuals, "light" sedation with local anesthesia may not be satisfactory. While light sedation is designed to provide a calming influence, these individuals may proceed to what is known as "deep" sedation. When used, deep sedation carries many of the risks of general anesthesia and, at times, may be more problematic. Patients receiving deep sedation have a profound alteration of consciousness and may not be able to cooperate with a surgeon's request to remain still, at times becoming agitated. The patient's airway muscles also become relaxed, causing potential airway obstruction and desaturation of blood oxygen content. When this occurs, general anesthesia may be preferred as a means of protecting the airway and providing a situation permitting the surgeon to complete the procedure.

Regional anesthesia

Regional anesthesia offers a potentially major benefit for patients undergoing procedures on the extremities. Although this is especially true for those patients for whom general anesthesia may provide a significant risk, regional anesthesia also provides advantages for the general patient population. The most frequently cited criticisms of regional anesthesia, other than spinal, is the time that is needed to place and establish a block, usually 20 to 30 minutes, and the perceived risk of failure and need to switch to general anesthesia.

In assessing the usefulness of regional anesthesia, one must consider recovery time and the patient's postoperative comfort. In a review of 543 brachial plexus blocks, Davis [43] found a success rate of 93% for anesthesiologists performing such blocks regularly. Bowe *et al.* [44] and Baysinger *et al.* [45] demonstrated that brachial plexus anesthesia for carpal tunnel release and upper extremity procedures did not significantly differ from general anesthesia in total OR and recovery room time. However, the incidence of postoperative nausea, emesis, and pain requiring medication was less than half that found in patients who had general anesthesia.

Similar findings have been shown for arthroscopy of the knee with the patient under epidural or spinal anesthesia, and administration of a narcotic by this route for prolonged analgesia [46–48]. As with brachial plexus blockade, the incidence of nausea, emesis, and postoperative pain were significantly less than with general anesthesia. Bach *et al.* [49] demonstrated a frequency of pain of 20.3% vs 27.0% in patients under regional and general anesthesia, respectively, but found significantly less nausea and emesis (4.1% vs 16.5%, respectively). Bowe *et al.* [44] found an even greater difference in postoperative pain (27% vs 65% for regional vs general) and nausea with emesis (1.5% vs 25% for regional vs general). In all studies, neither OR nor recovery times were significantly different between these two groups. Of interest is the additional finding of Randel *et al.* [50] that epidural anesthesia results in a decreased recovery time of 123 minutes, compared with 164 minutes for general anesthesia.

Epidural anesthesia has been found to provide significant benefit and safety for peripheral vascular, urologic, gynecologic, and arthroscopic surgery. Randel *et al.* [50] showed that the additional time required for placement of the block should be compensated for by reduced time to oral intake, ambulation, voiding, and discharge. Although the incidence of moderate to severe headache was less than with either general or spinal anesthesia, patients undergoing epidural anesthesia did have a higher incidence of moderate to severe backache.

Spinal anesthesia usually offers the benefit of a more rapidly achieved and intense block than that achieved with epidural anesthesia. The risk of spinal headache and subsequent distress used to be a major issue. Three aspects of spinal headache were of concern, especially in the ambulatory setting: (a) its occurrence 2–3 days postoperatively, after routine follow-up has already been accomplished; (b) it incapacitates the patient for several days thereafter; and (c) the potential need for readmission or further intervention with a blood patch. Advocates of spinal anesthesia point out the low incidence of postoperative spinal headache as a justification for its use. Some advocates, such as Mulroy [51] have maintained that alteration in technique and appropriate patient selection can reduce the incidence to well under 1% or less and assert that maintenance of a recumbent position does not help avoid headache [52,53] and may simply delay its onset. The use of 27-gauge needles and use of Greene "pencil point" or Whitacre

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side-port needles has reduced the incidence of postdural puncture headaches to less than 1%. The decreasing costs and clinical advantages of the 27-gauge Whitacre is increasingly making it the standard for spinal anesthesia.

The use of spinal anesthesia is still relatively contraindicated in patients with preexisting back pain or injury unless it presents a clear advantage in the patient at risk for general anesthesia.

A final but important consideration in this area is the increasing use of regional anesthesia to supplement general anesthesia for postoperative analgesia. This situation usually arises in the administration of caudal anesthetics to pediatric patients undergoing urologic or lower extremity procedures. The most significant of these has been the use of caudal anesthesia in the pediatric population undergoing genitourinary and lower-extremity procedures. It is noteworthy that caudal anesthesia has found widespread favor in alleviating the discomfort associated with inguinal hernia repairs, orchioepexies, and other procedures. Although the delayed discharge associated with caudal anesthesia has been the principal objection to its use, usually by surgeons, the use of 0.125% bupivacaine has diminished the incidence of postoperative urinary retention while maintaining equivalent analgesia to the point that this consideration should no longer prevent its use.

Local infiltration with anesthetics is also useful in diminishing postoperative pain. Placing local anesthetics into the wound is an increasingly popular technique. Casey *et al.* [54] found that simple instillation of 0.25% bupivacaine was as effective as a more elaborate ilioinguinal or iliohypogastric block with bupivacaine for patients having inguinal hernia repair. Studies have also found a significant reduction in postoperative pain in patients having bilateral tubal ligation, with injection of 5 mL of 1% etidocaine into the banded portion of the tube [55]. Narchi *et al.* [56] obtained similar results in patients undergoing laparoscopy, with 80 mL of 0.5% lidocaine or 0.5% bupivacaine applied to the right subdiaphragmatic area. Studies are currently evaluating instillation of local anesthetics and narcotics in the knee joint for arthroscopy. Such techniques require close cooperation and communication between the surgeon and anesthesiologist.

General anesthesia

When required, general anesthesia remains a safe and effective manner to achieve the goals of anesthesia. Principal problems associated with the otherwise successful general anesthetic are somnolence, nausea and emesis, postoperative pain, and associated delays in discharge and, in ambulatory surgery, possible admission. As the number of procedures performed with sedation and regional anesthesia increases, general anesthesia may be required less frequently. Nonetheless, it remains a mainstay of anesthetic practice, and considerable progress has been made to reduce the problems just listed.

Before the introduction of propofol, sodium pentothal or thiopental were accepted as the mainstays for induction. Considerable evidence now shows that propofol offers distinct advantages. Sampson *et al.* [57] in an analysis of the two agents, compared 4 mg/kg of thiopental with 2.5 mg/kg of propofol followed by 100% O₂ for outpatient procedures. The recovery time until patients were comfortable postoperatively was considerably better for the patients receiving propofol than for those receiving thiopental. These findings of reduced recovery time, less nausea, and greater postoperative alertness have also been consistently reported in other studies. Anecdotal information from practitioners also note patient emergence marked by greater satisfaction, at times bordering on a transient pleasant euphoria. Marais *et al.* [58] and Sung *et al.* [59] in separate studies indicative of future cost-benefit analyses, also found that propofol, by decreasing patient stay and postoperative symptoms, was also effective in reducing costs. Because of its application on a near-universal basis for sedation and general anesthesia, propofol is the most commonly used anesthetic agent in virtually all parts of the world today.

The availability of newer agents has altered perspectives on optimal maintenance of general anesthesia. Specifically, propofol; the short-acting neuromuscular agents atracurium, vecuronium, mivacurium, and rocuronium; the short-acting narcotics fentanyl, alfentanil, sufentanil, and remifentanyl; and newer inhalation agents desflurane and sevoflurane are allowing new approaches to general anesthesia in the outpatient.

Before the availability of these agents, the major issue was whether an inhalation technique or a balanced technique with narcotics and nitrous oxide (N₂O) was optimal. In assessing volatile agents, little has been found to differentiate among them as to postoperative drowsiness, headache, myalgia, or nausea and vomiting [59,60] and perioperative stability. However, the introduction of short-acting hypnotics and narcotics, such as propofol and alfentanil, has assisted in the development of total intravenous anesthesia (TIVA) as a means of providing general anesthesia. In two studies, propofol in a continuous infusion of 12 mg/kg/hour was compared with enflurane [61] and enflurane and isoflurane. In both instances, patients receiving propofol had significantly less nausea and emesis, less recovery time, and less need for intervention for these problems in the recovery room.

Conclusions

The interaction of primary-care providers and anesthesiologists is one of the most critical for the safety, efficiency, and comfort of patients. These individuals bring different perspectives and expertise to the care of the patient undergoing surgical procedures. It is increasingly important for each to have a better understanding of the issues involved in chronic patient care and perioperative management at a time when the health-care system is placing more demands on physicians and the systems in which they work.