

Part 1: Basic Principles

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Chapter 1

Patient Evaluation

Alan S. Herford and Wayne K. Tanaka

This chapter will cover how to obtain a patient history and carry out a full physical examination. It will cover comorbidities and systemic diseases of relevance to the oral and maxillofacial surgeon in the cardiovascular system (including cardiac disease and hypertension), the pulmonary system (including tobacco use and asthma), and also the endocrine systems, to cover obesity.

Suitable imaging and laboratory studies will also be discussed to arrive at a diagnosis of the patient's medical history, assess anesthetic and surgical risks, and determine whether a procedure would be best carried out in the office or as an inpatient taking into account the medical history.

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The goal of preoperative evaluation is to reduce patient risk and the morbidity of surgery and is based on the premise that it will modify patient care and improve outcome. The preoperative evaluation has several components and should be guided by the patient and surgery being contemplated. It is important to understand that some patients will require an in-depth, thorough examination prior to undergoing surgery, whereas others may benefit from a more focused examination. The type depends on many factors including the age and health of the patient, existing comorbidities, and the type of surgical procedure

planned. Thus, it is important for the clinician to understand how to perform a detailed, in-depth history and physical examination.

The Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) requires that all patients receive a preoperative anesthetic evaluation and the American Society of Anesthesiologists (ASA) has approved Basic Standards for Preoperative Care which outline the minimum requirements for a preoperative evaluation. Preoperative patient assessment is important in order to develop a safe and appropriate surgical and anesthetic plan.¹⁻¹¹ During the preoperative assessment the clinician interviews either the patient or knowledgeable guardian to obtain information. This is followed by a physical examination with special emphasis on the cardiovascular and respiratory systems to help determine risk. Laboratory tests, imaging, and consultations are ordered as deemed necessary based on information obtained during the history and physical examination. Finally, diagnoses are formulated and the treatment options are discussed with the patient followed by obtaining an informed consent.

Obtaining a patient history

The importance of an accurate, detailed history cannot be overemphasized because it provides the framework on which the clinician builds an accurate diagnosis and treatment plan (Fig. 1.1) An inaccurate or incomplete evaluation may lead to a delay in treatment, unnecessary testing, or misdiagnosis.

It is often helpful to review previous medical records. This can provide important information and save time during the interview process. Information such as medications and doses and history of previous surgeries are some examples that can be gleaned from the previous medical records. The clinician may uncover a history of a difficult airway or a history of malignant hyperthermia, and the patient's response to surgical stress and specific anesthetics may be

4 Basic Principles

Schedule procedure:
Reason for procedure:
Brief HPI: Age _____ Gender _____ <input type="checkbox"/> See admission/prior HPI dated _____
<input type="checkbox"/> Patient's records & chart reviewed <input type="checkbox"/> ROS: cardiac & pulmonary unremarkable
Current medications:
Allergies: <input type="checkbox"/> NKDA
Previous surgeries:
Previous hospitals:
<input type="checkbox"/> PHYSICAL EXAM (Check box if normal)
BP _____ / _____ PR _____ RR _____ /min Temp _____ Weight _____ lbs
<input type="checkbox"/> General appearance <input type="checkbox"/> Mental status (Oriented x3)
<input type="checkbox"/> AIRWAY
<input type="checkbox"/> HEART
<input type="checkbox"/> LUNGS
<input type="checkbox"/> ABDOMEN
<input type="checkbox"/> Other
ASA PHYSICAL STATUS (Circle) 1 2 3 4 5
(1) Normal (2) Mild systemic disease (3) Severe but not incapacitating (4) Incapacitating & threat to life (5) Moribund
<input type="checkbox"/> Risks, benefits and alternatives of sedation/analgesia and procedure discussed with patient/family and accepted.
<input type="checkbox"/> THE PATIENT IS AN APPROPRIATE CANDIDATE TO UNDERGO THE PLANNED PROCEDURE AND GENERAL ANESTHETIC

Doctor's Signature _____ **Date** _____

Fig. 1.1 Sample history and physical examination form.

evaluated. If the patient presents in an altered state, these records can be especially helpful. Preoperative questionnaires and computer-driven programs are becoming more common as a way to gather information and save time. This should help to alert the clinician on areas to focus on but should not be used as an alternative to interviewing the patient.

The clinician must assess the reliability of the person giving the history. Every patient should be asked about their chief complaint (CC). This should be transcribed into the medical record in the patient's own words. The chief complaint assists the clinician in establishing priorities during the history-taking process.

The patient should be asked to describe the history of the present illness (HPI). Information should be gathered regarding onset, intensity, quality, location, duration, radiation, and any exacerbating or relieving factors. Constitutional symptoms that relate to the present illness should also be noted. Examples of pertinent positives and negatives with regard to the chief complaint may include fever, chills, loss of weight, weakness, etc.

The past medical history (PMH) alerts the clinician to any coexisting illnesses that may have an impact on any planned surgeries. Information regarding the severity of an illness should be obtained. For example if a patient reports a history of asthma, the severity and frequency of episodes, previous hospital treatments, and current control should be ascertained. Past surgical history can also help to identify factors that may impact the ability for a patient to undergo a safe surgical procedure. Patients should be asked about medications they are taking as well as any over-the-counter and herbal products. Any allergies to drugs should also be documented, including what type of allergic response a patient may have experienced. A family history (FH) may reveal risk factors for patients as well as the possibility of inherited illnesses such as hemophilia or malignant hyperthermia.

The social history (SH) of a patient should include information regarding their social support system and also any habits such as tobacco, alcohol, or illicit drug use. These habits may adversely affect healing and also increase a patient's risk for undergoing a planned surgical procedure.

A review of systems (ROS) is a comprehensive method of inquiring about a patient's symptoms on an organ system basis. The review of systems may reveal undiagnosed medical conditions unknown to the patient. Concerns raised in the cardiovascular and respiratory systems for example may have importance with regard to a patient undergoing a safe surgical procedure. Patients should also be asked about the presence or recent history of an upper respiratory infection. Symptoms such as shortness of breath, cough, wheezing, stridor, snoring, or sleep apnea can alert the clinician to underlying illness that may increase the risk of morbidity associated with a procedure.

Physical examination

During the physical exam the clinician further reinforces or disproves impressions gained during the history-taking portion. Vital signs are recorded at the beginning of the physical exam. These include blood pressure, pulse rate, respiratory rate, and temperature. Next the patient's general appearance should be noted. It is important when documenting findings to only use commonly used, accepted abbreviations in order to avoid confusion. The physical exam should proceed in a stepwise, systematic manner. Evaluation typically involves inspection, palpation, percussion, and auscultation of the organ system being evaluated. The areas involved typically include the head, eyes, ears, nose, and throat (HEENT) region, in addition to the lungs, abdomen, heart, genitourinary, musculoskeletal, skin, and neurological exam. The detail in which these examinations take place is based on the health of the patient, including any comorbidities, and the type of surgical procedure planned. The examination may be cursory in healthy patients or extensive in patients with coexisting disease. For patients sustaining severe trauma a neurological examination should include a Glasgow Coma Score (Table 1.1). A cranial nerve exam should be performed to uncover any abnormalities (Table 1.2). For patients undergoing facial trauma, the eyes should be evaluated for any afferent pupillary light defects (Fig. 1.2).

Table 1.1 Glasgow coma scale.

EYE RESPONSE (E)

- 4 = Open spontaneously
- 3 = Open to verbal command
- 2 = Open to pain
- 1 = No response

VERBAL RESPONSE (V)

- 5 = Oriented, converses
- 4 = Disoriented, converses
- 3 = Inappropriate responses
- 2 = Incomprehensible
- 1 = No response

MOTOR RESPONSE (M)

- 6 = Obeys verbal command
- 5 = Localizes to pain
- 4 = Withdrawal from pain
- 3 = Decorticate (flex) to pain
- 2 = Decerebrate (extend) to pain
- 1 = No response to pain

NOTE: Scoring exam used to monitor changes in level of consciousness. Score is sum of eye, verbal, and motor responses. Range 3 (worst) to 15 (normal).

It is important to thoroughly assess the airway in patients undergoing anesthesia. This evaluation involves determination of the thyromental distance, the ability to flex the base of the neck and extend the head, and examination of the oral cavity including the dentition and interincisal opening. The Mallampati classification is useful for assessing the tongue size relative to the oral cavity, although by itself the

Table 1.2 Cranial nerves.

Cranial nerve	Function
I. Olfactory	Smell
II. Optic	Visual acuity/fields and fundoscopic examination of each eye
III, IV, VI. Oculomotor, Trochlear, Abducens	Eyelid opening, extraocular movements (IV, superior oblique; VI, lateral rectus; III, all others), direct and consensual pupillary light reflexes
V. Trigeminal (V, ophthalmic; V2, maxillary; V3, mandible)	Corneal reflex, facial sensation, jaw opening, bite strength
VII. Facial	Eyebrow raise, eyelid close, smile, frown, pucker, taste
VIII. Vestibulocochlear	Auditory acuity of each ear, Rinne (air vs bone conduction) and Weber (lateralizing) tests, oculocephalic reflex (doll's eye maneuver), oculovestibular reflex (ear canal caloric stimulation)
IX, X. Glossopharyngeal, Vagus	Palate elevation, swallowing, posterior taste, phonation, gag reflex
XI. Spinal Accessory	Lateral head rotation, neck flexion, shoulder shrug
XII. Hypoglossal	Tongue protrusion and strength on lateral deviation

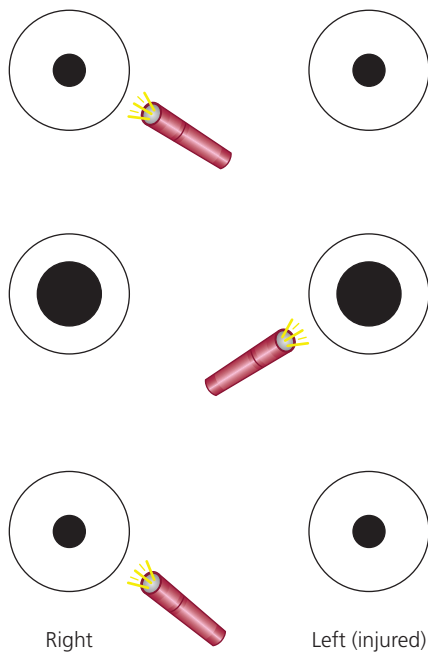


Fig. 1.2 Afferent pupillary light defect. When the optic nerve is damaged the sensory stimulus sent to the midbrain is reduced. The pupil responds less vigorously and dilates from its prior constricted state (Marcus Gunn pupil).

Mallampati classification has a low positive predictive value in identifying patients who are difficult to intubate (Fig. 1.3).^{12,13} The cervical spine should be assessed and cleared for patients that have undergone significant trauma.

The remainder of the physical examination should proceed in a systematic way. For a complete descrip-

tion of examination techniques the reader is advised to consult textbooks on physical diagnosis.

Comorbidities/systemic diseases

The clinician needs to assess potential risk factors and understand their effect on treatment. Changes in heart rate, rhythm, blood pressure, preload, afterload, and inotropy may occur during surgery and these can have deleterious effects especially in patients with comorbidities. The risks for complications are greatest when caring for patients who are already medically compromised. Many significant untoward events can be prevented by careful preoperative assessment along with attentive intraoperative monitoring and support.¹⁴

Cardiovascular system

Cardiac disease

Cardiac complications following non-cardiac surgery constitute an enormous burden of perioperative morbidity and mortality. More than one million operations annually are complicated by adverse cardiovascular events, such as perioperative myocardial infarction or death from cardiac causes.¹⁵ Common cardiac risk factors include diabetes, hypertension, family history of heart disease, hypercholesterolemia, and obesity. Certain populations of patients, such as the elderly, diabetics, or women, may present with more atypical features.

Methods for evaluating a patient's cardiac risk preoperatively include a careful history, including exercise tolerance, physical examination, and electrocardiogram (EKG). Based on this information, various risk indices, guidelines, and algorithms can assist the clinician in deciding which patients can undergo surgery without further testing and which patients may benefit from further cardiac evaluation or medical therapy prior to surgery. Risk assessment involves evaluating patients' comorbidities and exercise tolerance, as well as the type of procedure to be performed to determine the overall risk of perioperative cardiac complications. Exercise tolerance is a major determinant of cardiac risk and need for further testing. Beta blockade has shown clear benefits in risk reduction whereas revascularization procedures, such as coronary artery bypass grafting, have not been shown useful in reducing non-cardiac surgical risk.¹⁶⁻¹⁸

The Goldman Index is a multifactorial index used to assess cardiac risk associated with non-cardiac surgeries. It is based on a study by Goldman *et al.*¹⁹ that prospectively studied 1001 patients. A risk index was formulated based on potential risk factors for cardiac complication and actual complications. For class I patients (0-5 points) only 0.7% had life-threatening complications whereas class IV patients





Class	Direct visualization, patient seated	
Class I	Able to visualize the soft palate, fauces, uvula, anterior and posterior tonsillar pillars	
Class II	Able to visualize the soft palate, fauces, and uvula; the anterior and posterior tonsillar pillars are hidden by the tongue	
Class III	Only the soft palate and base of uvula are visible	
Class IV	Only the soft palate can be seen (no uvula seen)	

Fig. 1.3 Mallampati classification.

(>26 points) experienced life-threatening complications 22% of the time. A previous history of congestive heart failure was the factor most predictive of complications, followed by a myocardial infarction within the previous 6 months. Detsky *et al.*²⁰ included unstable angina and remote myocardial infarction as additional risk factors. They simplified the scoring system into three classes attempting to improve predictive accuracy. In another update of the Goldman

Cardiac Risk Index, Lee *et al.*²¹ studied 4315 patients aged 50 years and older who were undergoing elective, major non-cardiac procedures. Six independent predictors of complications were identified (high-risk type of surgery, history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin, and preoperative serum creatinine >2.0 mg/dl). Cardiac complication rates rose with an increase in

the number of risk factors present. Rates of major cardiac complications with 0, 1, 2, or 3 of these factors were 0.5, 1.3, 4, and 9% respectively, in the derivation cohort and 0.4, 0.9, 7, and 11% respectively, among 1422 patients in the validation cohort.

Angina pectoris can be a symptom of ischemic heart disease. It presents as substernal chest pain that may radiate to the arm, neck, or mandible and represents a reduced delivery of oxygen to the myocardium. It most commonly is the result of coronary heart disease and is classified as stable, unstable, or variant.²² Stable angina pectoris is characterized by no change over 2 months with regards to precipitating factors, frequency, intensity, and duration of attacks. Unstable angina pectoris represents a patient who has experienced worsening of the symptoms recently. Unstable angina pectoris is worrisome because patients are at an increased risk for developing a myocardial infarction.^{23,24} Variant pectoral angina (Prinzmetal's angina) may occur in patients without coronary artery disease and represents vasospasm of the coronary arteries. Patients with angina pectoris should be thoroughly evaluated to determine surgical risk.

The use of vasoconstrictors in local anesthetics in patients with coronary heart disease is controversial in the literature.²⁵ A study by Neves *et al.*²⁶ found no difference in blood pressure, heart rate, or evidence of ischemia in patients treated with or without vasoconstrictor.

Studies estimate the risk of perioperative myocardial infarction to be 0.13% for patients without a history of myocardial infarction and approximately 6% in patients with a history of previous myocardial infarction.^{27,28} Multiple studies have demonstrated an increased incidence of reinfarction if the myocardial infarction was within 6 months of surgery.^{23,29,30}

Congestive heart failure is the single most important risk factor for perioperative cardiac morbidity. Perioperative management includes optimizing fluid management, and maximizing drugs such as inotropes, vasodilators, and antidysrhythmics. Symptoms obtained during the history-taking portion may be worrisome for congestive heart disease. These include findings such as orthopnea and dyspnea. The patient should be questioned about limitation of physical activity such as ability to climb stairs or how far a patient can walk. Signs such as ankle edema, ascites, distended neck vein, and rales on pulmonary auscultation may help to identify congestive heart failure.

Valvular disease can affect the risk of a procedure. Symptoms of valvular disease should be sought, such as angina, syncope, or congestive heart failure from aortic stenosis which would require further evaluation. A history of valvular disease may dictate the need for subacute bacterial endocarditis prophylaxis (Table 1.3). Valvular heart disease presents with a murmur on physical exam. The clinician must determine the severity of the murmur and whether the patient requires preoperative antibiotic prophylaxis to prevent endocarditis.³¹ Aortic stenosis, aortic regurgitation, mitral valve stenosis, mitral valve insufficiency, mitral valve prolapse, and cardiomyopathy are some cardiac conditions which can be detected by cardiac auscultation. Goldman and Caldera recognized aortic stenosis as an independent risk factor for poor outcome increasing the risk for perioperative cardiac death by a factor of 14.³²

Algorithms for preoperative evaluation of cardiac patients undergoing noncardiac surgery are useful in guiding the need for further testing and evaluation. These algorithms are based on the available evidence and expert opinion that integrates clinical history, surgery-specific risk, and exercise tolerance. Implementation of American College of Cardiology/American Heart Association (ACC/AHA) guidelines for cardiac risk assessment prior to non-cardiac surgery reduces preoperative resource utilization, improves medical treatment, and preserves a low rate of perioperative cardiac complications.^{33,34} Studies have shown perioperative cardiac morbidity is greatly reduced by perioperative β -adrenergic blockade administration.^{35,36} The American College of Physician Guidelines uses the Detsky modification of the cardiac risk index.^{20,37} Patients that are class II or III are considered high risk. For patients that are classified as class I, other clinical factors can be used to further stratify risk. The Guidelines suggest that there is insufficient evidence to recommend diagnostic testing for non-vascular surgery patients.

In patients for whom further work-up is deemed necessary, this may include cardiovascular tests such as EKG, non-invasive cardiovascular tests such as an exercise EKG or pharmacologic testing in patients who are unable to exercise. The exercise EKG is the most cost-effective and least invasive method for detecting ischemia, with a sensitivity of 70–80% and

Table 1.3 AHA SBE prophylaxis regimens.

	Adult	Child
Dental, oral, upper respiratory tract	Amoxicillin	PO
	2 g PO 1 h prior	Amoxicillin
	Clindamycin ^a	50 mg/kg
	600 mg PO 1 h prior	Azithromycin
	600 mg IV/IM 30 minutes prior ^b	15 mg/kg
	Cephalexin or Cefadroxil ^a	Clindamycin
	2 g PO 1 h prior	10 mg/kg
	Azithromycin ^a	
	500 mg PO 1 h prior	IV/IM
	Ampicillin ^b	Ampicillin
	2 g IV or IM 30 minutes prior	50 mg/kg
	Cefazolin ^{a,b}	Clindamycin
1 g IV/IM 30 minutes prior	10 mg/kg	
	Gentamicin	
	1.5 mg/kg	
	Vancomycin	
	20 mg/kg	
	Cefazolin	
	25 mg/kg	

^a Penicillin allergy.

^b PO intolerant.

specificity of 60–75% for identifying coronary artery disease. Pharmacologic stress thallium imaging is useful in those patients unable to exercise. Dipyridamole or adenosine is administered as a coronary vasodilator to assess flow heterogeneity. A redistribution defect is predictive of perioperative cardiac events. Dopamine can also be used to increase myocardial oxygen demand, by increasing the heart rate and blood pressure. Stress echocardiography is another preoperative test that can reveal regional wall motion abnormalities which represent areas at risk for myocardial ischemia. Echocardiography can assess cardiac ejection fraction and also provide information regarding valvular function. Coronary angiography provides information regarding the coronary anatomy. Unlike exercise or pharmacologic stress tests, coronary angiography provides anatomic, not functional, information.

Hypertension

Hypertension is a common disease which can increase perioperative cardiac risk. Hypertension has been associated with an increase in the incidence of silent myocardial ischemia and infarction.³⁸ The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure recently revised their definition.³⁹ Hypertensive patients with left ventricular hypertrophy are at a higher perioperative cardiac risk than non-hypertensive patients.⁴⁰

Controversy exists regarding whether to delay a surgical procedure in a patient with untreated or poorly controlled hypertension. Aggressive treatment of high blood pressure does diminish long-term risk. A study often quoted as the basis for delaying surgery for patients with a diastolic blood pressure greater than 110 mmHg actually demonstrated no major morbidity in that group of patients.³² Other authors have found little association between blood pressures less than 180 mmHg systolic or 110 mmHg diastolic and postoperative outcomes. Patients with severe hypertension are more prone to perioperative myocardial ischemia, ventricular dysrhythmias, and lability in blood pressure. For patients with blood pressures greater than 180/110 mmHg there is no absolute evidence that postponing surgery will decrease the cardiac risk.⁴¹ For patients without end-organ changes, such as renal insufficiency or left ventricular hypertrophy, it may be appropriate to proceed with surgery. However patients with a markedly elevated blood pressure and new onset of a headache should have surgery delayed for further medical treatment. Patients with hypertension may have a contracted intravascular volume and therefore have an increased susceptibility to vasodilator effects of commonly used sedative and anesthetic agents. For elective surgery it is best to have the patient's blood pressure optimized prior to surgery.

Risk factors for hypertension include smoking, hypercholesterolemia, increasing age, family history of cardiovascular disease, and diabetes. Untreated hypertension commonly causes coronary heart disease, cardiomegaly, congestive heart failure, and end-organ damage. When evaluating a patient with hypertension, it is important to determine the presence of end-organ damage (heart, lung, and cerebrovascular systems). An elevated systolic blood pressure may be a better predictor of postoperative myocardial ischemia than elevated diastolic blood pressure.³⁹

Pulmonary system

Pulmonary complications are a major cause of morbidity for patients undergoing a surgical procedure. They occur more frequently than cardiac complications with an incidence of 5–10% in those having major non-cardiac surgeries.^{42,43} Perioperative pulmonary complications include atelectasis, pneumonia, bronchitis, bronchospasm, hypoxemia, and respiratory complications.⁴⁴ Both the site and type of surgery are the strongest predictors of complications. With regards to the surgical site, thoracic surgery is associated with the highest risk for perioperative pulmonary complications, whereas major head and neck surgery is associated with a 24–47% risk of pulmonary complications.^{45,46} A decrease in postoperative vital capacity and functional residual capacity contributes to hypoxemia and atelectasis.⁴⁷ General anesthesia also results in mechanical changes such as a decrease in the functional residual capacity as well as an altered diaphragmatic motion. This can lead to a mismatch between ventilation and perfusion creating shunting and dead space ventilation. The functional residual capacity may take up to 2 weeks to return to baseline.⁴⁸ A general anesthetic can also cause inhibition of mucociliary clearance, increased alveolar capillary permeability, inhibition of surfactant release, and increased sensitivity of the pulmonary vasculature to neurohormonal mediators. The duration of anesthesia has been shown to be a risk factor for postoperative pulmonary complications, with morbidity rates increasing after 2–3 hours.⁴⁹

For patients with an upper respiratory illness, surgery should be delayed if possible for at least 2 weeks after resolution of the illness. A recent study found a 10% incidence of severe complications, respiratory as well as cardiac arrest, pneumonia, and prolonged intubation due to increased sputum.⁵⁰

During the presurgical evaluation, the clinician should obtain information about exercise tolerance, chronic cough, or unexplained dyspnea. On physical exam, findings of rhonchi, wheezing, decreased breath sounds, dullness to percussion, and a prolonged expiratory phase are important. Preoperative pulmonary function tests are usually reserved for patients undergoing lung resection or those undergoing major surgery who have unexplained pulmonary

signs and symptoms after a history and physical examination.

Tobacco

Tobacco is an important risk factor. Even among smokers without chronic lung disease, smoking is known to increase carboxyhemoglobin levels, decrease ciliary function, and increase sputum production. Nicotine also stimulates the cardiovascular system. Discontinuing smoking for 2 days can decrease carboxyhemoglobin levels, abolish nicotine effects, and improve mucus clearance. However, a study by Warner showed that smoking cessation for at least 8 weeks was necessary to reduce the rate of postoperative pulmonary complications.⁵¹ Patients who smoke often show an increase in airway reactivity under general anesthesia. Administration of a bronchodilator such as fluticasone preoperatively may be beneficial in this group of patients.⁵²

Asthma

Asthma causes episodic narrowing of the small airways, which produces wheezing and dyspnea. Patients should be questioned regarding precipitating factors, frequency and severity of attacks, medications used, and current status. Frequent use of bronchodilators, hospitalizations for asthma, and the requirement for systemic steroids are all indicators of the severity of the disease. Airway hyper-reactivity may persist for several weeks after an episode of asthma.⁵³ Patients may require xanthine-derived bronchodilators, such as theophylline, and corticosteroids. Cromolyn sodium is useful for protecting against acute attacks but is ineffective once broncho-

spasm occurs. Sympathomimetic amines in aerosol form such as epinephrine or metaproterenol can be administered if wheezing begins. Clinicians should be aware of the role of anxiety in initiating bronchospasm and also the potential adrenal suppression in patients receiving corticosteroid therapy. Elective therapy should be delayed if a respiratory tract infection or wheezing is present. In addition to bronchodilators, perioperative steroids may be beneficial as prophylaxis for severe asthmatics. The possibility of adrenal insufficiency is also a concern for patients who have received extended treatment with steroids and should be administered "stress doses" of steroids perioperatively. The risks of complications are low for asthmatics treated with short-term steroids undergoing surgery.⁵⁴ There is no association with impaired wound healing or infections. It is recommended for patients using inhaled steroids that these be regularly administered starting at least 48 hours prior to surgery for optimal effectiveness.⁵⁵

Endocrine system

Endocrine disorders can affect the course of anesthesia and should be evaluated preoperatively (Table 1.4). A decrease in adrenal cortical activity such as seen in Addison's disease, may lead to a decreased production and availability of cortisol and aldosterone thus altering cardiovascular stability. Patients who are taking glucocorticosteroids may have suppression of the pituitary gland and may require supplementation of cortisol (rule of twos). In patients on long-term corticosteroids, the clinician should have a high index of suspicion for adrenal cortical suppression and Cushing's syndrome. Classic symptoms found in Cushing's syndrome include

Table 1.4 Clinical manifestations of endocrine diseases.

	Diabetes mellitus	Pheochromocytoma	Addison's disease	Hyperthyroidism	Hypothyroidism	Hyperparathyroidism
General	Polydipsia/polyuria	Heat intolerance, palpitations, intermittent hypertension, sweating	Fatigue, sweating	Heat intolerance, warm, moist skin	Cold intolerance	Polydipsia
Cardiovascular	Cerebrovascular disease	Tachycardia, bounding pulse	Sudden drops in blood pressure	Tachycardia, atrial fibrillation, congestive heart failure	Bradycardia, cardiomegaly,	Hypertension, heart block
Neurologic	Blurred vision, retinopathy	Headaches, diaphoresis	Dizziness, headache	Nervousness, tremor, hyperactive reflexes	Slow mental function, hyporeflexia	Weakness, lethargy, headache, insomnia
Gastrointestinal	Weight loss	Weight loss, abdominal pain	Weight loss, diarrhea	Diarrhea	Delayed gastric emptying	Anorexia, nausea, vomiting, constipation
Musculoskeletal	Charcot joints	Signs of poor perfusion	Muscle weakness, joint and muscle pain	Muscle weakness, bone resorption	Large tongue, amyloidosis	Bone pains, arthritis, pathologic fractures
Renal	Kidney disease	Urinary retention	Urinary loss of sodium	Chronic renal failure	Impaired free water clearance	Polyuria, hematuria

moon facies, striations of the skin, trunk obesity, hypertension, easy bruisability, and hypovolemia. These patients should have any fluid and electrolyte abnormalities corrected preoperatively.

Patients with a pheochromocytoma may present with overproduction of epinephrine and norepinephrine in the adrenal medulla which can lead to hypertension and tachycardia intraoperatively. The classic findings for pheochromocytoma include intermittent hypertension, headache, diaphoresis, and tachycardia. In patients with other endocrine tumors, a pheochromocytoma should be ruled out as part of a multiple endocrine neoplasia (MEN) syndrome.

Thyroid and parathyroid disease have clinical manifestations that are important to evaluate preoperatively. Disorders of the thyroid can present as hypothyroidism or hyperthyroidism. The presurgical evaluation should focus on the signs and symptoms of hyperthyroidism and hypothyroidism. Thyroid function tests including thyroid stimulating hormone (TSH), triiodothyronine (T3), and thyroxine (T4) are used to assess for disorders of the thyroid. Patients with hypothyroidism may exhibit cold intolerance, myxedema, fatigue, and/or depression. Severe hypothyroidism can lead to coma, cardiovascular collapse, and heart failure, and surgery should be postponed until it is corrected. Hyperthyroidism, such as seen in Grave's disease, presents with symptoms including hyperexcitability, weight loss, hypertension, and tachycardia. Thyroid storm can occur during anesthesia. Medications such as propylthiouracil or methimazole may be helpful preoperatively to reduce thyroxine secretion. Beta-blockers may be useful to stabilize the adrenergic activity during surgery. Large goiters may impact the patency of the airway and make intubation more difficult. Patients with hyperparathyroidism often have hypercalcemia and the serum calcium level should be determined preoperatively.

The pituitary gland has control of many glands and organs. Increased production of pituitary hormones can lead to secondary hyperthyroidism, secondary Cushing's syndrome, and acromegaly.

Diabetes mellitus is the most common endocrinopathy and has both acute and chronic disease manifestations. The disease process causes impairment of normal blood flow and subsequent end-organ damage. Type 1 diabetes is characterized by insulin dependency and typically occurs at a young age, whereas type 2 diabetes is often non-insulin dependent and occurs later in life. Preoperative assessment of patients with diabetes includes determining their degree of blood sugar control and evaluation of any end-organ damage. Perioperative complications increase with poorly controlled diabetes with end-organ damage. Diabetics have an increased risk of coronary artery disease, perioperative myocardial infarction, hypertension, and congestive heart failure. They are also at an increased risk for cerebral vascular, peripheral vascular, and renal vascular disease.

Myocardial infarction or ischemia may be "silent" if diabetic autonomic neuropathy is present. Diabetes accelerates the progression of atherosclerosis leading to a higher incidence of coronary artery disease than in non-diabetics. There is also a higher incidence of silent myocardial infarction in this group of patients. Eagle *et al.*³⁴ demonstrated that diabetes is an independent risk factor for perioperative cardiac morbidity. An EKG should be obtained to examine for the presence of Q waves. Laboratory assessments for diabetics include a blood sugar and HbA1c. A blood glucose level gives a value at one point in time whereas the glycosylated fraction of adult hemoglobin (HbA1c) gives a better assessment of control over the previous 2 months. Perioperative concerns with diabetic patients include poor healing with possible infection and diabetic ketoacidosis. Hypoglycemia should be avoided in order to prevent central nervous system damage. Managing surgical patients with diabetes must take into account the type of diabetes, how well the patient controls their blood sugar, and the stress associated with the surgical procedure.

Obesity

A patient is considered obese when their body weight is 20% or more above ideal weight. Obesity can be measured by the body mass index (BMI) which is derived by dividing the weight in kilograms by the height in meters squared ($BMI = Wt/ht^2$).

A BMI greater than 30 suggests increased morbidity due to stroke, heart disease and diabetes.⁵⁶ At a minimum, these conditions indicate the need for close evaluation of the patient's airway and cardiac and pulmonary status.⁵⁷ Even with an adequate airway, ventilation may be difficult because of the patient's size and a tendency toward hypoxemia. There may also be significant cardiovascular changes.

On the other hand, the clinician should not dismiss a low BMI, especially with evidence suggesting an eating disorder. Nutritional deficiency may be present along with significant cardiac changes, fluid and electrolyte imbalances, delayed gastric emptying, and severe endocrine abnormalities.⁵⁸

Other organ systems

Disease affecting the renal system has important implications for fluid and electrolyte management, as well as the metabolism of certain drugs. Liver disease is associated with altered protein binding and volume distribution of drugs, as well as coagulation disorders.

Patients should be questioned regarding bleeding problems. This includes questions regarding bruising, bleeding, and the use of medications that influence platelet function such as aspirin, other non-steroidal anti-inflammatory drugs, and anticoagulants. Medications such as acetyl-salicylic acid and other non-selective non-steroidal anti-inflamma-

Table 1.5 Clotting indices.

Measurement	Normal result	Comments
Prothrombin time (PT)	11–15 s	Measures intrinsic and common pathways (Factors I, II, V, VII, and X)
Activated partial thromboplastin time (aPTT)	20–35 s	Measures extrinsic and common pathways (Factors I, II, V, VIII, IX, X, XI, and XII)
Bleeding time	2–7 minutes	Tests platelet and vascular phases (independent of coagulation cascade)
Thrombin time	6.3–11.1 s	Measures ability to form initial clot from fibrinogen
International normalized ratio (INR)	1.0	(PT patient/PT control) × international sensitivity index (ISI)
Fibrinogen	200–400 mg/dl	Factor I

tory analgesics can inhibit platelet function. Liver disease may decrease the amount of clotting factors. Inherited disorders such as von Willebrand's disease and hemophilia A and B may require administration of various factors preoperatively to minimize bleeding risk.⁵⁹ Reduced ristocetin cofactor levels are often seen in patients with von Willebrand's disease.⁶⁰

Screening tests for bleeding disorders include prothrombin time (PT) or international normalized ratio (INR) to assess the extrinsic and final common pathway and activated partial thromboplastin time (PTT) to test the intrinsic and final common pathways (Table 1.5). Platelet counts may be helpful in patients with thrombocytopenia. Bleeding times measure qualitative platelet function. They are used less and may be unreliable.

Patients with transient ischemic attacks (TIAs) or stroke should undergo a thorough evaluation. Patients who have had unstable TIAs or a stroke within the previous 6 months should have their surgery delayed if possible. Surgery can lead to a hypercoagulable state which may exacerbate cerebral arterial disease. Questioning should include the degree of compliance with medical therapy.

Controversy exists regarding the management of patients on anticoagulation therapy. Some clinicians prefer to admit a patient to the hospital and begin therapy with heparin. This can then be stopped immediately prior to surgery followed by restarting the heparin after the surgical procedure and while beginning oral therapy with warfarin. Low-molecular-weight heparin can be considered as a way to bridge anticoagulation during the interruption of warfarin for high bleeding-risk procedures.⁶¹ A study by Ferrieri *et al.*⁶² noted a low 1.96% risk of bleeding complications in patients undergoing oral surgical procedures with an INR ≤ 5.5 who did not stop their oral anticoagulant therapy. Other authors have found that it is not necessary to reduce oral anticoagulant therapy.^{63–65}

Disorders of the musculoskeletal system have been associated with an increased risk of malignant hyperthermia. Osteoarthritis may result in difficulty exposing the glottic opening during intubation. Rheumatoid

arthritis is a multisystem disease and a thorough review of systems should be performed. These patients may have restrictive lung disease, temporomandibular joint manifestations with restricted opening and hypoplastic jaw, pleural effusions, pericarditis, and anemia. Epilepsy is a common neurological disorder. Patients should be questioned on frequency, duration, and type of seizures they experience. Risks of pulmonary aspiration and respiratory insufficiency during seizure episodes should be taken into account.

Imaging

A patient's presentation will dictate which films are required. Radiographs such as plain films, cone beam, fanning computed tomography (CT), nuclear scans, and arteriography are helpful in various circumstances. The risks associated with these studies should be weighed against the added benefit from them.

Laboratory studies

Many institutions have preadmission screening test algorithms based on factors such as age of the patient (Table 1.6). Preoperative laboratory tests should be ordered based on defined indications such as positive findings on a history and physical exam. A thorough history and physical examination can be used to identify those medical conditions that might affect perioperative management and direct further laboratory testing. A study by Golub *et al.*⁶⁶ reviewed the records of 325 patients who had undergone preadmission testing prior to surgery. Of these 272 (84%) had at least one abnormal screening test, while only 28 surgeries were canceled or delayed. Only three patients potentially benefited from preadmission testing, including a new diagnosis of diabetes in one and non-specific EKG changes in two. Another study by Narr *et al.*⁶⁷ demonstrated minimal benefits from routine testing and proposed that routine laboratory screening tests were not required in healthy patients.

Table 1.6 Sample preadmission screening test algorithm. (EBL, estimated blood loss; HTN, hypertension; IVDA, intravenous drug abuse; LMP, last menstrual period; ABG, arterial blood gases; CBC, complete blood count; PT, prothrombin time; PTT, partial thromboplastin time; LFTs, liver function tests; CXR, chest X-ray; EKG, electrocardiogram; HCG, human chorionic gonadotropin; UA, urinalysis; PFTs, pulmonary function tests; T/S, type and screen.)

CIRCLE APPROPRIATE LABS TO ORDER												
Preoperative condition	ABGs	CBC	PT/PTT	Lutes	BUN/Creat	Blood/Glucose or Accucheck	LFT	CXR	EKG	Hcg preg/UA	PFTs	T/S
Possible EBL >500ml		X										X
Neonates		X										
Age: >40 yr									X			
Age: >75 yr		X				X			X			
Cardiovascular disease/ chronic HTN		X			X			X	X			
Use of diuretics, digoxin				X*	X				X			
Severe pulmonary disease/ prethoracotomy	X	X						X	X		X	
Malignancy/radiation/ chemotherapy		X,plt		X	X							
Hepatic disease		X,plt					X					
Chronic alcoholism		X,plt		X	X		X		X			
Renal disease (dialysis)		X		X*	X*			-/+	-/+			
Bleeding disorder/ anticoagulant therapy		X,plt*	X*									
Diabetes				-/+	X	X*				>30 yr		
Possible pregnancy/ gyn surgery										X*		
IVDA												>30 yr

Note: Not all diseases are included. Therefore, the physician should use own judgment regarding patients having diseases that are not listed.

In patients with stable medical conditions, labs and EKGs within the last 3 months, and CXR within the last year, will be acceptable. X Items should be done within 72 hours of surgery.

* Urine pregnancy test if LMP >21 days with possibility of pregnancy or menstruating females <18 years of age, all women undergoing tubal ligation and all women having a hysterectomy who are in their reproductive years or who are experiencing the first year of menopause.

Type & screen

Type & cross _____ units PRBCs

Other Labs – Specify

Provider signature

Table 1.7 American Society of Anesthesiologists physical status classification.

Status	Disease state
ASA class 1	No organic, physiologic, biochemical, or psychiatric disturbance
ASA class 2	Mild to moderate systemic disturbance that may not be related to the reason for surgery
ASA class 3	Severe systemic disturbance that may or may not be related to the reason for surgery
ASA class 4	Severe systemic disturbance that is life threatening with or without surgery
ASA class 5	Moribund patient who has little chance of survival but is submitted to surgery as a last resort (resuscitative effort)
Emergency operation (E)	Any patient in whom an emergency operation is required

In a follow-up study a cohort of patients was followed who had no preoperative testing and was found to include no deaths or major morbidity.⁶⁸ By combining information from the history, physical examination, exercise tolerance, and stress of a proposed surgical procedure, inappropriate testing can be reduced, whereas, more importantly, appropriate screening tests will be performed.

Arriving at a diagnosis

During the history-taking portion of the preoperative evaluation the surgeon is developing a list of possible diagnoses. By examining the patient he or she then proceeds to further narrow the possible diagnoses and solidify clinical impressions developed during the history. Laboratory data and imaging may further clarify the diagnosis or diagnoses. Once the clinician has obtained enough information a treatment plan can be developed. The patient is informed of the risks, alternatives, and possible benefits to a potential procedure.

Assessing anesthetic/surgical risk

Once the clinician has gathered information by interviewing and examining the patient, he or she can classify them according to the American Society of Anesthesiologists (ASA) Classification of Physical Status (Table 1.7). Patients with a lower ASA classification represent a lower surgical risk than do patients with severe systemic disease. This system is commonly used and is helpful in identifying risk factors so that modifications in the treatment plan can be undertaken. The surgical procedure influences the scope of preoperative evaluation required by determining the potential range of physiologic flux during the perioperative period. The AHA/ACC guidelines describe risk stratification for non-cardiac surgery.⁶⁹ These can be divided into low, intermediate, and high with a reported risk of cardiac death and non-fatal myocardial infarction of <1, <5, and >5% respectively. Head and neck surgeries are considered intermediate-risk procedures. Examples of low-risk procedures would be cataract surgery and superficial procedures, whereas high-risk procedures would be surgeries such as emergency major operation or anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss.

Office vs inpatient

Once the clinician has gathered pertinent information during the preoperative work-up, he must decide where best to perform the surgical procedure.

Safety continues to be the guiding factor in deciding where various types of procedures should be per-

formed. Options available include office surgery, ambulatory surgery centers, and traditional hospital-based locations. Many variables are considered when deciding on whether to perform a surgery in the office or perform the surgery elsewhere.

Oral and maxillofacial surgeons routinely perform a large number and variety of procedures in the office setting. There the surgeon can perform the procedures under local anesthetic, intravenous (IV) sedation or general anesthetic. Oral and maxillofacial surgeons have developed an excellent track record with a long history of patient safety. Perrott *et al.* looked at outcomes of office-based ambulatory anesthesia by oral and maxillofacial surgeons.⁷⁰ The study involved 34191 patients, of whom 71.9% received deep sedation or general anesthesia, 15.5% received conscious sedation, and 12.6% received local anesthetic. The complication rate was 1.3% and almost all complications were minor and self-limiting. Only two patients had complications requiring hospitalization. In fact, oral and maxillofacial surgeons have been performing surgeries in an office setting much longer than other specialties. Their training and ability qualifies them to manage a patient's airway as well as any emergencies, thus minimizing surgical risk.

The type of procedure is an important determinant of where the surgery should be performed. For local bone graft harvest, the invasiveness of the surgery is similar to surgically removing impacted third molar teeth, and the risk to patients is low. Harvesting bone from the posterior iliac crest and cranium, on the other hand, is more invasive, and although the risk of major complications is low, the risk is higher than for local graft harvest. These complications include bleeding from the surgical site and postoperative infection. It is important when performing these types of procedures in the office or ambulatory surgery center to avoid compromising the sterility of the procedure.

Patient factors should also be an important part of the decision on where to perform the procedure. Patients with poorly controlled medical conditions such as morbid obesity or poorly controlled hypertension should be carefully evaluated, and appropriate preoperative testing should be performed to determine their surgical risk. Patient factors such as increased age, an operating time longer than 120 minutes, cardiac diagnoses, peripheral vascular disease, cerebrovascular disease, malignancy, and immunodeficiency can place patients at higher risk for immediate hospital admission.⁷¹

Advantages of performing surgery in a hospital setting include the addition of another health care provider to administer anesthetic during the surgical procedure. Imaging techniques such as ultrasonography, CT, and chest radiographs are readily available as are blood chemistries to rapidly diagnose and treat complications. Also procedures such as interventional radiology, for such things as embolization, are available. Ultimately the decision on where to perform a

surgery depends on both the surgeon and informed patient considering the type and length of the procedure, patient health factors, and safety.

Summary

The process of preoperative evaluation is essential in assessing the medical condition of patients, evaluating their overall health status, determining risk factors, and educating them. The goal of preoperative evaluation is to reduce patient risk and the morbidity of surgery.

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