Ambulatory Surgery: How Much Testing Do We Need?

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Preoperative testing is done to predict risk, alter management, and improve outcomes. If this is the premise, then each test needs to be considered with one or all of these three aims in mind.

Currently more than two thirds of surgeries in the United States are done on an ambulatory basis. Apfelbaum predicts the growth of ambulatory surgeries to be close to 80% of all surgeries[1] in the United States within the next couple of years.

Patient selection is a major factor in running a successful ambulatory surgery unit with good patient outcomes. Different models of ambulatory surgery centers have different selection criteria. Some may offer full-service anesthesia and physically be part of the main hospital making admission a possibility, as part of the process. Others may not want the inefficiency of fiber-optic intubation for the difficult intubation and screen these patients out. Still others are free standing and admission is not an acceptable option, rather a complication and continuous quality improvement factor; consequently they have stricter selection criteria for appropriate patients.

Traditionally, preoperative testing has been part of the screening process for appropriate preoperative care and selection. Preoperative testing costs this country an estimated $18 billion annually. Ambulatory surgery is by definition low-risk surgery[2] and patients, who are usually American Society of Anesthesiologists (ASA) physical status 1 or 2, expect to be discharged home safely. Mortality risk in ASA 1 and 2 patients is 0.06% to 0.08% and 0.27% to 0.4%[3–5] in all surgeries, much lower in this low-risk category.

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Measuring differences in outcomes, when poor outcomes are so rare, needs appropriately powered, randomized controlled studies. Many studies have been published since the late 1970s supporting selective testing. Although various organizations, including the ASA and the Society for Perioperative Assessment and Quality Improvement, and agencies, such as Centers for Medicare and Medicaid Services, have supported appropriate and minimal testing there is still confusion about what is appropriate and resultantly minimal buy in into these cost-saving and evidence-backed initiatives.

EVIDENCE

It has long been accepted that no routine testing is indicated. Preoperative tests without specific indications lack utility. Few abnormalities detected by nonspecific testing result in changes in management, even in the elderly, and rarely have such changes benefited patients or lack of testing affected safe anesthesia.[6] It has also been demonstrated that eliminating routine testing does not increase risk.[7–9] Although Schein's work is procedure specific (cataract), these findings can potentially be extrapolated to other low-risk surgeries.

Statistically normal results are defined as within two standard deviations of the mean, which means that 5% of normal people will have an abnormal result when just one test is performed. The more tests, the more abnormal results, but not necessarily the more abnormalities. The major impacts of unnecessary testing are patient anxiety, increased costs, delays while waiting for further tests and consults, and possible injury from unnecessary workups. The economic impact is a combination of added testing costs and impact on operating room schedule. There are also medico-legal implications of not following up on abnormal test results.[10–12] Abnormal test results can lead to injury[10] (1 in 2000) associated with further workup.

Routine testing has a frequency of abnormal results in 0.0% to 2.6% in multiple studies reviewed.[13] When selective testing is done, abnormal results are more frequent: 30% in a study by Charpak and colleagues.[14] These abnormal results are not unexpected and were more likely to change management.

Attempts have been made to introduce testing guidelines following evidence from the literature. These guidelines are not yet uniformly followed, despite more than 30 years of evidence and education. A recent retrospective chart review from Canada[15] found a big variance in compliance with ordering guidelines (5%–98%). Only 61.6% of all the tests performed were normal, but management was affected by only 2.6% of the tests. Katz and colleagues[16] found a similar magnitude of over ordering compared with local guidelines.

Kaplan and colleagues[11] in his study of 2000 subjects found that 60% of tests were not indicated, and only 0.22% of these abnormal results prompted some management change. Another study of 991 subjects older than 40 years of age, by Ajimura and colleagues[17] found 52.5% had some laboratory abnormality, but none lead to a change in management.

A recent pilot study from Canada advocates no preoperative testing in ambulatory patients. Chung and colleagues[8] showed no difference between the routine testing and no testing groups in ambulatory surgery patients with regard to adverse events at 7 and at 30 days. There were several limitations to the study. Exclusion criteria selected out subjects with significant medical issues, especially cardiac and respiratory. Because bad outcomes are rare, the sample size was not large enough. Noncompliance was allowed; subjects wishing to be tested crossed over in the study. Further studies need to be done before no testing becomes the new routine. But the

importance of this study is again raising the lack of benefit in testing, and in the current health economic climate this fact cannot be ignored.

As the majority of ambulatory patients are ASA 1 and 2, the goal of assessing these healthier patients is to detect any previously unrecognized disease that may increase perioperative risk above baseline. Mortality is low.[18] Warner and colleagues[19] found a 1- to 30-day postoperative major morbidity and mortality of 0.08% (n = 33) in a group of 38,598 ambulatory surgery subjects. Four subjects died: two of myocardial infarcts and two of unrelated motor vehicle accidents.

Do patients who are not ASA class 1 or 2 need to be treated differently? Natof,[20] in a study of more than 13 000 subjects, found that well-controlled subjects who were ASA class 3 were at no higher risk for postoperative complications than those in ASA class 1 or 2.

SPECIFIC POPULATIONS
Age

Older age is another concern as a risk factor. Previously published work by Chung and Mezei[21,22] showed no increase in major cardiovascular complications in the elderly compared with younger subjects, and to their advantage, the older group had a lower incidence of postoperative nausea and vomiting.

Extremes of age may confer higher risk for postoperative admission especially in infants less than 55 to 60 weeks post-conceptual age and also in elderly patients older than 85 years of age.[18] Preoperative testing does not appear to play a role in decreasing this risk.

Generally, age is not considered a risk factor for adverse outcomes in ambulatory surgery,[23] but a systematic review by Smetana and colleagues[24] found that age greater than 60 (odds ratio [OR] 2.09) and greater than 70 (OR 3.04) to be an independent risk factor for the development of postoperative pulmonary complications in all surgeries. Again testing does not play a role in decreasing these complications, only identifying those at risk.

Obesity

Obesity is not a risk factor for major adverse outcomes.[25] The review by Smetana and colleagues[24] found one study where morbid obesity is a predictor of postoperative pulmonary complications, but this remains controversial. Obesity is however, an independent risk factor for deep vein thrombosis.[26]

So What Do We Do?

The preoperative history and physical (H&P) are the key elements in patient assessment, which is backed by legislation and professional society standards. Basic Joint Commission regulatory requirements for all patients include a history and physical performed within 30 days of the procedure.[27] In addition, ASA has standards and guidelines for preanesthesia care[28] that specifically state that no routine testing is indicated.

In the Australian Incident Monitoring Study,[29,30] inadequate preoperative evaluation and communication problems were shown to be sentinel contributing factors to preventable major adverse events (incidence 3.1%) including death and major morbidity. Laboratory testing or lack thereof was not implicated in these complications.

How preoperative assessment is achieved varies by institution. Some assess patients only on the day of surgery, others have all patients come through a preoperative evaluation clinic approximately 2 weeks before surgery. Some authors[31,32] have

found the latter method to be cost effective in reducing day of surgery cancellations, even in the healthier ambulatory population.

No testing substitutes for a history and physical examination. An important component of the history is assessing self-reported exercise tolerance. Reilly and colleagues[33] showed that postoperative complications were inversely related to exercise ability. Although the study group was major surgeries, this can be extrapolated to ambulatory surgery.

Tests should only be ordered if the result will change the anesthetic or surgical plan or decrease the risk of the procedure. If medical condition is stable, then laboratory tests performed in the preceding 4 months[34] to 1 year[35] can be used.

The following tests are the minimum to be considered:

Tests

Type and screen

- Surgeries with anticipated blood loss
- Rhesus antibody result needed for possible Rhogam therapy.

Pregnancy

Beta human chorionic gonadotrophin (bHCG) assay is recommended but not mandated by the ASA, and policy is institution specific. Mandated testing will identify some previously undiagnosed pregnancies, and elective surgery is then postponed, but this testing comes with a cost. A study by Kahn and colleagues quantified this cost as $3273/ true positive pregnancy test.[36] Consider testing in all women of reproductive age, except after hysterectomy or oophorectomy. This testing can be done on the day of surgery but is recommended earlier if history suggests pregnancy is a possibility, as cancellations on the day of surgery have a bigger economic impact.

It is not clear what the extent of the risk of anesthesia is to the fetus, but current practice is not to do elective surgery in patients who are pregnant when it can be delayed, because there is risk to the fetus, especially in the first trimester, and increased risk for miscarriage.[37]

Hemoglobin

Anemia is a marker of perioperative mortality.[19,38] It is unclear if the increased risk is from the underlying causative disease or the anemia itself.

Hemoglobin preoperatively may be indicated in patients with symptoms of anemia, history of bleed, chemotherapy, radiotherapy, chronic renal failure, and clinical findings compatible with anemia. It is indicated as a baseline in surgery where significant blood loss (>500cc)[39] is expected.

Platelet count

Platelet count is indicated if patients have personal or family history of bleeding or bruising.

Coagulation studies

Coagulation studies are only done when patients have a personal or family history of bleeding or bruising, in the presence of liver disease or metastases, severe malnutrition, Vitamin K deficiency, and patients on anticoagulant therapy. Abnormal results by routine screening have not shown clear positive predictive value for operative bleeding.[40–43]

Electrocardiogram

Twenty million preoperative electrocardiograms (ECGs) are performed each year, but there is no consensus by practitioners about whom, if anyone, should get these tests.

Recent publications[7,44–46] have questioned the value of the routine preoperative ECG and prior publications that included the ECG as part of the perioperative risk assessment,[47–50] may no longer be valid in this respect.

The utility of the screening 12 lead ECG for assessing for perioperative risk has been questioned. It is also unclear when an abnormal ECG should alter management.[45,51] A meta-analysis[52] found the resting ECG to be a poor screening tool for coronary artery disease. One study by Tervahauta and colleagues[53] found that if evidence of CAD was present on screening ECG, there was higher mortality in this group, but the perioperative implications of this non-surgery–related work are not known. Van Klei and colleagues[46] found, in a prospective observational study in subjects older than 50 years of age having non-cardiac surgery, that 45% of subjects had an abnormality on preoperative ECG, and bundle branch blocks were associated with postoperative myocardial infarction and death, but had no added predictive value over recognized risk factors such as gender, age, and the components of the revised cardiac risk index[49] (high-risk surgery, history of one or more of the following: ischemic heart disease, congestive heart failure, chronic renal failure, cerebrovascular accident, insulin dependent diabetes).

Correll and colleagues found that age greater than 65 years was an independent predictor of preoperative electrocardiogram abnormalities[54] but any management change was already indicated by the H&P. Rabkin and Horne[55] showed new ECG changes caused no cancellations, only minor change in anesthesia technique in 1% of subjects, and no difference in outcome.

The specificity of an ECG abnormality in predicting postoperative cardiac adverse events is only 26% and a normal ECG does not exclude cardiac disease.[45]

An ECG should not be done simply because of age. Previous recommendations for age-based testing were derived from the high number of ECG abnormalities found on patients who were elderly. The Centers for Medicare and Medicaid Services do not reimburse for preoperative or age-based ECGs.[56]

The ASA Preoperative Evaluation Practice Advisory recognized that ECGs did not improve prediction beyond risk factors identified by patient history.[28]

The AHA makes the following recommendations for preoperative ECG.[2]

Class 1: Recommendations for resting ECG are in patients undergoing vascular surgery or in those undergoing intermediate risk procedures who have known coronary artery, cerebrovascular, or peripheral vascular disease. If we accept ambulatory surgery as low risk, then this does not apply to the ambulatory subset of patients. But what about the 3-hour shoulder repair? Orthopedic surgery is considered intermediate risk, or does the arthroscopic component of this procedure make it an endoscopic procedure and thus a low-risk procedure? This question causes controversy.

Class 2a: Patients for vascular surgery with no risk factors

Class 2b: Patients with one risk factor for intermediate risk surgery

Class 3: Patients for low risk surgery who are asymptomatic (ECG should not be performed because it is not helpful and may even be harmful).

These recommendations suggest that patients undergoing ambulatory surgery (low risk) should not get ECGs if they are asymptomatic. Patients with class 2 angina pectoris undergoing a knee arthroscopy are low risk and symptomatic; which class does

this fall into? There is no doubt that there are still a lot of unknowns out there. Ideally, perhaps the annual ECG from the primary care physician (PCP) would be adequate if symptoms were stable over the interceding interval. Reading further into the text of the AHA guidelines and the primary article,[18] it is suggested that stable (not asymptomatic) ambulatory patients need not have ECGs because morbidity and mortality associated with these procedures is so low and risk is negligible.

Chemistry

A review by Smetana and Macpherson[13] found that only 1.8% of electrolyte tests affected management and most of these were predictable from patients' history of renal disease or diuretic use.

> Electrolytes: Consider testing if there have been recent changes in medication known to affect electrolytes (eg, diuretics, steroids) or in patients on digoxin. Also consider checking potassium in end-stage renal disease.

Chronic renal failure with a creatinine greater than 2mg/dl is an independent risk factor for perioperative morbidity and mortality.[2,24] Creatinine is indicated if patients are to receive contrast media. If the test is abnormal renal protective strategies can be used or an alternative study can be performed. Consider for risk assessment if it will affect informed consent, and no recent testing results are available.

> Glucose should be checked on admission in patients who are diabetic and hourly in procedures lasting longer than 1 hour. Presuming that patients who are diabetic have good routine care, including regular glucose checks; a HBA1C less than seven; and assessment for end organ damage,[57] specifically workup of cardiac symptoms or abnormal ECG and a serum creatinine, then it is not necessary to test further for minor surgery.

Urinalysis

Urinalysis (UA) is never indicated for anesthesia. For orthopedic surgery with hardware implants, a urinalysis is frequently ordered to decrease the risk for subsequent infection. It is rare that the organisms associated with asymptomatic bacteriuria cause orthopedic infection, and the administration of preoperative prophylactic antibiotics, which is standard of care, is usually enough to prevent this anyway. However, the catastrophic outcome of an infected joint is cited by the surgeons as a reason to maintain the practice of ordering UAs. No difference was found in wound infections in knee surgery whether UA was normal or abnormal. It was estimated by Lawrence[58,59] that the cost of treating wound infections (non-implant) was 500 times less than the cost of screening urinalyses and so these tests are not recommended.

Liver function tests

Albumin is a marker of chronic disease and markedly low levels may affect wound healing. It was the only laboratory predictor of postoperative pulmonary complications in the review by Smetana.[24]

Patients with acute hepatitis should not undergo elective surgery. Child-Pugh[60] grade C should also not undergo elective surgery. Those assessed as grade B are at increased risk and may benefit from therapy to improve their score before surgery. Decisions to perform these tests are guided by significant findings on history and physical examination.

Chest X ray

Chest X-Ray (CXR) abnormalities increase with age. A review of studies of routine preoperative CXRs by Joo and colleagues[61] found that most abnormalities are predicted on history and physical examination. Only 10% of those investigated for an abnormal CXR had a change in management. CXR usually only confirms clinical findings and is not useful at reducing risk.[62]

CXRs should be considered in patients with new signs or symptoms, history of end-stage renal disease, or decompensated heart failure, if it will change management. Patients with the latter are rarely candidates for the ambulatory setting except for minor procedures like ophthalmologic surgeries.

Cardiac evaluation

Cardiac evaluation is indicated based on the presence of active cardiac conditions[2] and patients with these are not current candidates for elective ambulatory surgery. Patients with unexplained dyspnea on exertion may warrant an echocardiogram – Class 2a.[2]

Heart failure, compensated and decompensated, carries increased risk for cardiac complications, approximately 5% to 7% and 20% to 30% respectively, and an echocardiogram may be considered for quantifying degree and type if it will change management.[63]

Pulmonary function testing

Postoperative pulmonary complications (PPC) are a common event (incidence ranges from 0%–75%).[64,65] They are more frequently associated with the presence of pulmonary risk factors and certain surgical factors: surgical site and length of procedure. Thoracic and upper abdominal surgeries are the highest risk procedures. Laparoscopic procedures significantly decrease the risk,[66] so surgical site is not usually a predisposing factor in ambulatory surgery. Duration of surgery greater than 2.5 to 4 hours confers increased risk.[24]

Independent patient risk factors for PPCs include smoking; pulmonary hypertension; obstructive sleep apnea[67] (see later discussion); morbid obesity; moderate to severe chronic obstructive pulmonary disease; congestive heart failure; poor general health, including baseline functional status (physical and mental); and age.[24]

Well-controlled asthma[68] and upper respiratory tract infections (URIs) are not risk factors for PPCs in adults. Patients with an intercurrent bronchitis of bacterial etiology are at a higher risk for postoperative pneumonia, and antibiotic therapy administered preoperatively can decrease this risk.[64] History, and not testing, affects outcome here.

A detailed history of pulmonary symptoms, medication compliance, presence of productive cough, and physical examination is adequate in patients undergoing ambulatory surgery. Pulmonary function testing (PFTs) is usually reserved for patients undergoing major non-ambulatory surgeries. A possible exception is the assessment of poorly controlled asthma to differentiate between severe asthma (not usually a candidate for ambulatory surgery) and inadequately treated bronchospasm. No studies have shown PFTs to improve outcomes.

Arterial blood gases

Arterial blood gases are not indicated in the ambulatory settings are they are markers of severe disease and these patients are not ambulatory candidates.

Sleep consult/polysomnography

Obstructive sleep apnea (OSA) is common with 4% of women and 25% of men having some degree of the disease. It is more common in the obese population.[69,70] The majority are undiagnosed.

Patients should be screened for OSA. The STOP/BANG screen[69] is a useful validated tool that can easily identify those who may have OSA. These patients can then be assessed for the need for further preoperative testing. The ASA[71] has published Practice Guidelines for the Perioperative Management of Patients with OSA. It applies an OSA scoring system (**Table 1**). The score takes into account the severity of the OSA, the invasiveness of the surgery, and the need for postoperative opiates. To accurately ascertain this score, polysomnography (PSG) is necessary. It should be ordered when the result would change the decision about venue, type of anesthesia, or proceeding with surgery.

In surgeries performed under local with or without sedation, PSG is advised for patients concurrently for health maintenance and risk reduction, but the results are not superior to clinical assessment in changing perioperative management and this workup can be done after surgery by the PCP.

Those patients with an OSA score of 5 or 6 are not appropriate for free-standing ambulatory centers. Patients with a score of 4 should be assessed on a case by case basis, especially if surgery interferes with use of continuous positive airway pressure (CPAP) or other OSA treatment devices.[70,71]

Patients also need to be monitored in recovery longer than their non-OSA counterparts. Patients with OSA should be first case or early enough in the day, especially in facilities that are not open overnight.

Pediatrics

Routine diagnostic testing in children is traumatic and this stress often leads to an uncooperative child on the day of surgery. Preoperative hemoglobin is not indicated in healthy children[72] unless there is anticipated blood loss. It can be considered in ex-premature infants if clinically indicated or not recently tested. Coagulation tests do not predict surgical bleeding in healthy children with no history of bleeding tendency or family history of bleeding disorders.[73] Many pediatricians and pediatric surgeons still insist on coagulation studies in surgeries where hemostasis is vital, specifically tonsillectomies and neurosurgical procedures.

Table 1
Scoring of Obstructive Sleep Apnea patient for management decisions

(maximum possible score = 6)		
Choose the higher of the following 2 scores and add to OSA severity score below:		
Opiate Need	**or**	**Surgical Invasiveness**
0 = None		0 = none
1 = Low dose oral		1 = Superficial/local anesthesia
2 = High dose oral		2 = Peripheral/general anesthesia
3 = Parenteral/neuroaxial		3 = Airway/major/abdominal
OSA Severity by PSG Result:		
1 = Mild		
2 = Moderate		
3 = Severe		

SUMMARY

Routine testing is not the standard of care. **Table 2** provides a summary of indicated testing for Ambulatory Surgical procedures.

There is no doubt that we are still over-testing preoperatively. We know that testing rarely changes management, and rarely affects outcome. We need to base our testing decisions on a good history and physical and evaluation of effort tolerance, and then order only those tests which offer information about risk—needed for informed consent; and those where expected results would alter management or outcome. Testing may need to be individualized to level of patient medical care and patient compliance.

It is recommended that anesthesiologists should be doing the ordering as they do it more appropriately and with effective cost reduction.[74]

Pasternak,[75] in an editorial advocates judicious testing and a formal structure for preoperative assessment for better implementation of evidence based management of patients.

There is already three decades of evidence in the literature supporting less testing, but as adverse outcomes are rare, we need better powered more inclusive prospective studies to back our current expert opinion based decisions.

Table 2
Summary of tests and their indications for ambulatory surgery (low risk surgery)

Test	Indicated	Guidelines	Exceptions
ECG	No	Class 3 AHA	—
Complete blood count	No	—	Anemia Anticipated blood loss Premature infants
bHCG	Yes by history	Institution specific	—
Coagulation studies/platelets	No	—	Personal/family history of bleeding diathesis Anticoagulants Liver disease ? Tonsillectomy and neurosurgery - controversial
Liver function tests	No	—	Risk assessment –cirrhosis Acute history
Pulmonary Functions	No	—	Only as part of routine management of asthma
Arterial blood gases	No	—	—
UA	No	—	Insertion of hardware
PSG	No	ASA practice advisory	Diagnosis of severe OSA will change venue
CXR	No	—	—
Type and screen	—	—	Anticipated blood loss >500cc Rhogam
Electrolytes	No	—	Recent change in medications affecting potassium/electrolytes
Creatinine	No	—	Contrast dye study
Glucose	No	—	Morning of surgery

We must also remember that even with best evidence studies, circumstances vary at different institutions and testing needs to be locally customized to the individual variations and restrictions of the practice.

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