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What Laboratory Tests Are Required for Ambulatory Surgery?

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Keywords

• Preoperative testing • Ambulatory surgery • Laboratory testing
• Preoperative evaluation • Low-risk surgery

Key points

- Current indications for preoperative testing represent a synthesis of expert opinion, and are not based on a sufficient number of adequately powered and controlled trials.
- Abnormal preoperative test results are considered in many cases of questionable clinical significance, and have not been shown to predict adverse outcomes.
- Elimination of routine testing and more selective use based on patient history and physical examination has been shown to decrease cost without detriment to patient care.

INTRODUCTION

Ambulatory, or same-day, surgery is being used with increasing frequency because of the significant cost savings and increased convenience for patients and health care providers. At present, more than 60% of surgical procedures in North American are performed in the ambulatory setting [1–5]. Ambulatory surgical procedures are performed in patients with no medical problems or those with stable chronic medical illnesses. The procedures are generally less than 1 to 2 hours in duration, and have minimal blood loss, low complication rates, and minimal expected postoperative care. Examples include inguinal hernia repair, umbilical hernia repair, breast biopsy, partial or total mastectomy,

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hemorrhoidectomy, and arthroscopy. With improvements in surgical and anesthetic techniques, the patient and procedure selection criteria for ambulatory surgery are rapidly expanding, and more patients with multiple preexisting medical conditions are candidates. As the indications for ambulatory surgery have evolved, evidence-based recommendations regarding preoperative testing have lagged. Clear indications for testing in the ambulatory surgery setting have not been defined.

Preoperative testing may be used as part of the screening process, in addition to physician assessment with a comprehensive history and physical examination, to guide appropriate patient selection and optimize perioperative care. Commonly ordered preoperative tests include chest radiograph (CXR), electrocardiography (ECG), hemoglobin/complete blood count (Hb/CBC), creatinine, electrolytes, liver function tests (LFTs), albumin, and coagulation parameters.

There is a broad spectrum of operative factors and patient characteristics that may prompt preoperative testing. Operative factors that are potential indications for testing include expected blood loss greater than 500 mL, prolonged anesthesia time, and high procedure complexity. This article discusses preoperative testing as it applies to ambulatory surgery, so these operative factors do not apply and are not discussed. Potential indications for preoperative testing in the ambulatory setting include extremes of age, symptoms, personal risk factors for disease (eg, smoking, alcohol, family history), and the presence of specific acute and chronic disease processes. For the purposes of this discussion, "routine" preoperative testing is defined as testing in the absence of specific indications.

PREOPERATIVE LABORATORY TESTING: GOALS, BENEFITS, AND RISKS

The goal of preoperative testing is to detect abnormalities that might adversely affect outcomes. In the case of known chronic medical conditions, preoperative testing can be used to assess the current status of disease. Examples include creatinine, potassium, and bicarbonate levels in patients with chronic kidney disease; HbA_{1c} to assess long-term diabetic control; or ECG in patients with heart disease to assess for interval changes from a known baseline. Preoperative testing in asymptomatic or healthy patients has the potential to detect undiagnosed disease processes that may put patients at increased risk for perioperative complications. However, such screening should be reserved for populations at high risk for a specific condition (eg, ECG screening in asymptomatic patients with multiple cardiac risk factors) to avoid high costs and potentially high false-positive rates when the pretest probability of a specific condition is low.

Preoperative testing allows for correction of suspected or unsuspected abnormalities that might adversely affect anesthetic or surgical outcomes. Findings that place patients at higher risk for specific complications allow for optimization of a patient's preoperative health status and establishment of perioperative

plans to prevent, anticipate, and better manage problems, enhancing the quality and outcome of the perioperative experience [6,7]. Preoperative testing may also establish baseline values for tests that will be monitored after surgery.

Finally, in some instances preoperative testing is not based on patient characteristics or clinical indications. Testing may be done based on institutional policy or provider preference, or to provide medical-legal protection [5,8,9].

Despite the potential benefits, preoperative testing in the absence of clear indications can lead to prohibitive cost. It is estimated that up to $18 billion are spent annually for preoperative testing in the United States, in many cases for unnecessary tests that do not alter perioperative management [5,10,11]. Previous studies have shown that preoperative testing in the absence of clear indications leads to abnormal results in 30% to 50% of cases [5,8,12–15]. Because of the low prevalence of disease in the ambulatory population and, therefore, the low pretest probability, these abnormal results are often of questionable clinical significance [5,12–14]. Moreover, harm to patients may come from overtreatment of false-positive results or positive results with little clinical significance [16]. Unnecessary preoperative testing increases pain and inconvenience for the patient, and may lead to additional harm and anxiety from further workup required if abnormal values are reported [17]. Roizen [18] reported that in up to 60% of cases, abnormal results of preoperative laboratory testing are not noted or investigated. In these cases, the legal risk for not following up or acting on an abnormal result may be greater than not ordering a test [7].

CURRENT RECOMMENDATIONS FOR PREOPERATIVE LABORATORY TESTING

Current guidelines for preoperative testing in the United States are based on the 2002 Practice Advisory from the American Society of Anesthesiology (ASA) Task Force on Preanesthesia Evaluation [6]. As acknowledged in their report, current scientific literature is insufficient to create evidence-based guidelines, and their current recommendations represent a synthesis of expert opinion and data from small, nonrandomized, and/or underpowered studies. In Canada, guidelines for preoperative laboratory testing are given by the Canadian Anesthesiologists' Society (CAS) [19] and the Ontario Preoperative Testing Grid (OPTG) [12].

The ASA, CAS, and OPTG advocate against the use of routine preoperative testing. In the ASA practice advisory, they state that preoperative tests without indications lack utility and should be ordered on a selective basis according to information obtained during medical record reviews, patient's interview, and preoperative physical examination. However, the guidelines for selective testing are too general to be interpreted or applied in specific clinical situations. In addition, the language of current recommendations is imprecise. For example, "advanced age" is often used as an indication for testing without defining a clear minimum age. In addition, recommendations are often based on the ASA physical status classification system, a system for assessing fitness

of patients before surgery. The ASA classification system has been criticized as inaccurate because it is based on anesthesiologists' judgment, and different providers often assign different ASA classes to the same patient [20–22].

There also are differences in recommendations between societies (Table 1). For example, the CAS does not recommend preoperative testing for "advanced age." The ASA recommends CBC and ECG only, and the OPTG additionally recommend creatinine level, electrolytes, and chest radiography (CXR). In all 3 cases, no clear definition of advanced age is provided. These differences in recommendation between societies are also seen among other conditions and test types.

CURRENT DATA FOR USE OF SPECIFIC TESTS

Testing in older patients

As the United States population ages and the criteria for ambulatory surgery expand, older patients represent an increasing proportion of patients undergoing ambulatory surgery. The overall mortality rate following ambulatory surgery is 4 to 8 deaths per 100,000 procedures [23], and this risk increases to approximately 41 per 100,000 procedures in patients older than 65 years [2]. Older patients have been shown to be at increased risk for intraoperative complications [24], postoperative admission [2], and pulmonary complications [8]. However, in the absence of significant comorbidities, most surgeons do not consider age a contraindication for ambulatory surgery. Although older patients are at increased risk for abnormal tests, preoperative testing has not been shown to decrease adverse outcomes in this high-risk population [5]. There are advocates of testing in all older patients [18,25] and strong arguments against this practice [5,14,26,27]. However, minimum age cutoffs are often not stated, and when stated, vary from study to study. In addition, studies arguing against testing in all older patients fail to provide unambiguous indications for testing [5,14,26,27].

Electrocardiography

Because cardiac complications after surgery can be devastating, the use of routine preoperative ECG has been extensively debated. The incidence of ECG abnormalities increases with age, male gender, higher ASA class, and a preexisting diagnosis of heart disease, hypertension, diabetes, or peripheral vascular disease [28]. ECG abnormalities have been shown to predict postoperative ischemic events and arrhythmias [25,29]. However, the indications for and role of preoperative ECG testing in low-risk ambulatory surgery remain unclear [29–36]. The ASA Task Force reviewed 12 studies evaluating routine ECG use and 17 studies reviewing ECG use for specific indications [6]. A wide range of ECG abnormalities were noted in both groups: 7% to 43% of routine ECG and 5% to 78% of ECG done for specific indications. In patients with abnormal findings, management was changed in 9% of patients receiving routine ECG (based on only one study) and 2% to 20% of patients having ECG done for specific indications. Based on these data, the ASA

Task Force did not reach a consensus on a specific minimum age for obtaining preoperative ECG in patients without specific risk factors, and recognized that age alone might not be an indication for an electrocardiogram. In addition, the Task Force agrees that an ECG may be indicated for patients with known cardiovascular risk factors or for patients with risk factors identified in the course of a preoperative evaluation, but again, they are not specific regarding these risk factors.

Chest radiography

The ASA Task Force reviewed 20 studies evaluating routine preoperative CXR and 9 studies evaluating preoperative CXR done for indications [6]. There was a wide range of CXR abnormalities detected in the various studies and a wide range in the incidence of subsequent changes in management based on these findings. CXR abnormalities were detected in 3% to 60% of routine CXR and 8% to 65% of CXR done for indications. These studies demonstrated changes in management based on preoperative CXR in 0% to 51% of routine CXR and 0.5% to 74% of indicated CXR. The Task Force concluded that clinical characteristics to consider in obtaining preoperative CXR include smoking, recent upper respiratory infection, chronic obstructive pulmonary disease (COPD), and cardiac disease. The investigators recognized that CXR abnormalities may be higher in such patients, but do not conclude that extremes of age, smoking, stable COPD, stable cardiac disease, or resolved recent upper respiratory infection should be considered unequivocal indications for chest radiography.

Hemoglobin/hematocrit

The incidence of anemia in healthy adults is low [37,38]. The ASA Task Force [6] recommends against routine Hb and hematocrit testing before surgery, and recommend selective testing in patients with liver disease, extremes of age (age limits not specified), history of anemia, bleeding, or other hematologic disorders.

Olson and colleagues [39] performed a retrospective analysis of 9584 patients classified as ASA class 1 or 2 who underwent elective low-risk surgery. Using a hemoglobin cutoff for clinically significant anemia of less than 9 g/dL, only 75 patients (0.8%) were identified as anemic, with 4 presenting with values of less than 7 g/dL, in all cases with clinical indicators. All 4 of the 9584 patients identified as anemic required perioperative transfusion. Given the low incidence of anemia and the presence of symptoms when the anemia was clinically significant, Olson and colleagues recommend against routine Hb/hematocrit testing. Testing should only be performed if signs and symptoms suggestive of anemia are present.

Narr and colleagues [40] reported abnormal Hb or hematocrit values (defined as <10.0 g/dL) in 0.8% of 3782 patients in whom preoperative testing was performed. Only in 0.1% of all patients did Hb testing change preoperative management.

Table 1
Summary of current ASA, CAS, and OPTG recommendations for specific tests in patients undergoing ambulatory surgery

	Test							
Indication	Hb/CBC	Creatinine	Electrolytes	LFTs	Albumin	Coagulation parameters	CXR	ECG
Advanced age	ASA[a] OPTG	OPTG	OPTG				OPTG	ASA[a] OPTG (>45 y)
Anemia	ASA CAS							
Bleeding disorders	ASA					ASA CAS OPTG		
Other hematologic disorders	ASA					OPTG		
Cardiovascular disease	CAS OPTG						ASA CAS	ASA CAS OPTG
Pulmonary disease	CAS OPTG						ASA CAS OPTG	ASA
Renal disease	CAS OPTG	CAS OPTG	ASA CAS OPTG			ASA		OPTG
Liver disease	CAS OPTG			OPTG		ASA CAS OPTG		
Endocrine disease		CAS	ASA					
Malignancy	CAS OPTG						CAS OPTG	

Hypertension	OPTG	CAS OPTG	CAS OPTG			OPTG	CAS OPTG
Diabetes		OPTG	CAS OPTG				CAS
Recent upper respiratory infection			CAS			ASA	
Smoking	OPTG					ASA OPTG	OPTG
Alcohol abuse	OPTG			OPTG	OPTG		
Diuretic use		CAS OPTG	ASA CAS OPTG				OPTG
ACE inhibitor use		OPTG					OPTG
Digoxin use		CAS OPTG	ASA CAS OPTG				OPTG
Steroid use			OPTG				
Anticoagulant therapy	OPTG				ASA CAS OPTG		
Risk factors for cardiac disease							CAS

Abbreviations: ACE, angiotensin-converting enzyme; ASA, American Society of Anesthesiologists; CAS, Canadian Anesthesiologists' Society; CBC, complete blood count; Hb, hemoglobin; LFT, liver function test; OPTG, Ontario Preoperative Testing Grid.

[a]Though recommended for advanced age by ASA, specific age guidelines are not given.

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Chemistry

The ASA Task Force [6] recommends selective use of chemistry tests, such as electrolytes, glucose, and liver and renal function tests, in patients receiving preoperative diuretics, steroids, or digoxin, diabetic patients, and patients with renal or liver dysfunction.

In a systematic review of the literature performed by Munro and colleagues [15], in studies when routine testing was evaluated the incidence of abnormal results was less than 1.4% of cases for sodium or potassium, less the 2.5% for blood urea nitrogen (BUN) and creatinine, and less than 5.2% for glucose, and abnormal results rarely changed the preoperative management of these patients. Similar results were obtained in a more recent systematic review by Smetana and Macpherson [8].

Coagulation studies (prothrombin time, partial thromboplastin time, and platelets)

The ASA Task Force [6] recommends obtaining coagulation tests for patients with bleeding disorders, on anticoagulation medication, and with renal or liver disease. Routine testing is not recommended because the incidence of abnormal results is low; change in management occurs in fewer than 5.3% of patients; the incidence of adverse events in patients with abnormal results is very rare (lower than 0.6%); and the positive predictive value for postoperative bleeding is low [41]. It is unlikely that a significant bleeding disorder would remain undiagnosed into adulthood.

Hemoglobin A_{1c}

Previous studies have shown that patients with diabetes and elevated preoperative HbA_{1c} have worse postoperative outcomes after cardiac [42,43], colorectal [44], and vascular surgery [45]. The ASA Task Force [6] does not comment on the use of HbA_{1c} as part of the preoperative laboratory evaluation for elective surgery. There are no data evaluating the effect of long-term poor glucose control on outcomes following ambulatory surgery. If HbA_{1c} has not been obtained in the 30 days before surgery and glucose control is reportedly poor, one may consider testing and delay of elective surgery until blood glucose is better controlled. However, studies are needed to provide evidence for policy regarding HbA_{1c} testing in ambulatory surgery.

Pregnancy test

As anesthesia and surgery pose potential risk to the unborn fetus [46], especially during the first trimester when the history and physical findings are unclear and the risk of miscarriage is increased [47], pregnancy tests are recommended in females of reproductive age (who have not had hysterectomy) undergoing elective surgery. Previous studies have shown that positive results (ranging between 0.3% and 2.2% of cases) led to changes in management in 100% of the cases [48–52]. Although not unequivocal, the ASA Task Force [6] recommends considering pregnancy tests for all female patients of childbearing age.

CURRENT USE OF TESTING IN NORTH AMERICA

Because of the lack of consensus regarding clear indications for testing, preoperative testing is often based on provider preference and historical institutional protocols. Often surgeons, anesthesiologists, and even patients expect that there will be some tests performed before any operative procedure, and testing is often performed out of routine or habit. Moreover, inappropriate use of testing may result from lack of communication between multiple providers (surgeons, anesthesiologists, and primary care physicians) caring for ambulatory surgery patients. For example, most recommendations regarding preoperative testing originate in the anesthesia literature. However, a Canadian study found that 80% of preoperative tests were ordered by surgeons, suggesting that lack of communication between specialties may account for a large portion of noncompliance [12].

Uncertainty regarding the indications for testing leads to high rates of unnecessary testing. Single-institution studies in the United States and Canada demonstrate that up to two-thirds of preoperative laboratory tests obtained are not indicated, based on current recommendations for selective testing [12,14,26,53]. Even after implementation of the OPTG checklist in Canada, noncompliance ranged from 5% to 98% depending on the test or guideline analyzed [12].

A recent study using National Surgical Quality Improvement Program (NSQIP) data evaluated preoperative testing in 73,596 patients undergoing elective inguinal hernia repair [54]. At least 1 preoperative laboratory test (CBC, electrolytes, LFTs, or coagulation parameters) was performed in 63.8% of patients, with at least 1 abnormal test recorded in 61.6% of these patients. In a subgroup analysis of 25,149 patients with no comorbidities and no clear indications for testing, 54% had at least 1 preoperative test. Rates of individual tests for the overall cohort and the subgroup with no comorbidities are shown in Table 2. Also, preoperative testing increased with increasing age, even in the subgroup with no comorbid conditions, rising from 34% in patients younger than 20 years to 75% in patients 81 years and older.

Further analysis performed by the authors of Medicare beneficiaries using 100% Texas Medicare claims data (unpublished data, 2008–2009) undergoing hernia repair (inguinal, femoral, epigastric, and umbilical) or knee/shoulder arthroscopy, demonstrated similar findings, with more than 70% of older patients with no comorbidities undergoing at least 1 test (Table 3) before surgery. Rates of tests varied only slightly across procedure types. In patients with no documented comorbid conditions in the year before surgery, CXR rates exceeded 35% and ECG rates exceeded 50%.

Uncertainty regarding indications for preoperative testing is also reflected in the wide geographic and hospital/facility-level variation in use of tests. Using 100% Medicare claims data for Texas (2008–2009), the authors examined variation at the level of the facility and health service area (HSA) in patients undergoing hernia repair and knee/shoulder arthroscopy. An HSA is a collection of ZIP codes whose residents receive most of their inpatient care from the

Table 2
Use of preoperative laboratory testing and abnormal results in patients undergoing hernia repair from the National Surgical Quality Improvement Program database, 2005–2010

	Total	%	Abnormal	%[a]
Overall Cohort (N = 73,596)				
Any test	46,977	63.8	28,938	61.6
Hematology	43,153	58.6	16,944	39.3
Chemistry	39,402	53.5	15,824	40.2
Coagulation	13,746	18.7	1556	11.3
LFT	17,433	23.7	3974	22.8
All	7291	9.9	5419	74.3
Subgroup Without Comorbidities (N = 25,149)				
Any test	13,591	54.0	7361	54.1
Hematology	13,018	51.8	4708	36.2
Chemistry	10,504	41.8	3460	33.0
Coagulation	3720	14.8	220	5.9
LFT	4931	19.6	905	18.4
All	2038	8.1	1348	66.1
Labs Performed the Day of Surgery (N = 7209)				
Any test	7209	100.0	4443	61.6
Hematology	6198	86.0	2595	41.9
Chemistry	5516	76.5	2257	40.9
Coagulation	2554	35.4	586	22.9
LFT	1859	25.8	618	33.2
All	971	13.5	808	83.2

Abbreviation: LFT, liver function tests.
[a]Among patients with specific test.
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hospitals in that area [55]. The percentage of patients undergoing preoperative CXR ranged from 10% in the lowest HSA to 90% in the highest (Fig. 1A). ECG use ranged from 15% to 95%, with the lowest decile using preoperative ECG in fewer than 40% and the highest decile in greater than 80% of cases (see Fig. 1B). A map showing HSA-level variation in rates of CXR use before hernia repair is shown in Fig. 2. Similar variations in other tests (CBC, electrolytes, creatinine, LFTs, and coagulation tests) were seen across patients undergoing hernia repair or knee/shoulder arthroscopy.

Similar variation in the use of preoperative testing was seen at the facility level. In patients undergoing hernia repair, preoperative CXR use varied from 0% to 95% between facilities doing at least 30 procedures in the time period. The bottom decile of facilities performed CXR in fewer than 10% of cases and the top decile of facilities performed CXR in more than 80% of cases. Likewise, preoperative ECG was performed less than 40% of the time in the bottom decile and greater than 90% of the time in the top decile of facilities.

It can be argued that patients may differ in severity of chronic illness and other factors among different facilities and providers. However, it is reasonable

Table 3
Preoperative testing before hernia repair or arthroscopy in Texas Medicare beneficiaries (>65 years)

	% Overall patients undergoing test[a]		% Patients with no comorbidities[b] undergoing test[a]	
Test	Hernia repair N = 13,029	Arthroscopy[c] N = 21,993	Hernia repair N = 3187	Arthroscopy[c] N = 5515
Hb/Hematocrit	53.1	57.3	49.6	49.1
Platelet count	51.8	54.1	48.3	46.0
Creatinine	27.0	29.9	23.2	24.9
Electrolytes	53.6	60.6	48.2	50.4
LFTs	35.2	35.9	30.9	27.9
Albumin	32.4	33.4	28.1	25.9
Coagulation parameters	16.2	18.8	9.2	12.4
CXR	43.5	41.0	38.1	34.9
ECG	62.0	57.6	59.5	51.0
Any of above tests	84.5	81.2	78.9	73.4

[a]In the 30 days before surgery.
[b]Patients with none of 30 Elixhauser comorbidities.
[c]Knee and shoulder arthroscopy only.
Data from 100% Texas Medicare claim data, 2008–2009.

to postulate that patient characteristics would vary much less across HSAs, especially patients undergoing low-risk, elective ambulatory surgery. As such, the authors hypothesize that the observed HSA-level variation in testing arises because of uncertainty in the appropriateness of current guidelines and subsequent practice variation, rather than selection based on patient characteristics.

EVIDENCE FOR FURTHER REFINEMENT/DEFINITION OF CURRENT GUIDELINES

Better evidenced-based criteria are needed to guide selective preoperative testing in the ambulatory setting. The current guidelines are directed to guide the preoperative evaluation of patients undergoing any surgical procedure, including inpatient procedures. Usually, patients undergoing relatively simple procedures with low complication rates performed in the ambulatory setting are healthy or have stable chronic disease. These procedures are not done emergently, and guidelines applicable to all complex inpatient surgical procedures may not be relevant in this setting. For example, a patient with well-controlled diabetes or stable cardiac disease and good functional status may be a candidate for testing before major abdominal or vascular surgery, but the same patient might not need testing before low-risk ambulatory procedures.

There is evidence to suggest that the current guidelines can be refined for the ambulatory setting. Multiple studies of patients undergoing elective surgery find that abnormal tests lead to changes in management in only 0% to 9% of cases (Table 4) [13,14,26,27,33,35,40,54,56–61]. Kaplan and colleagues [14]

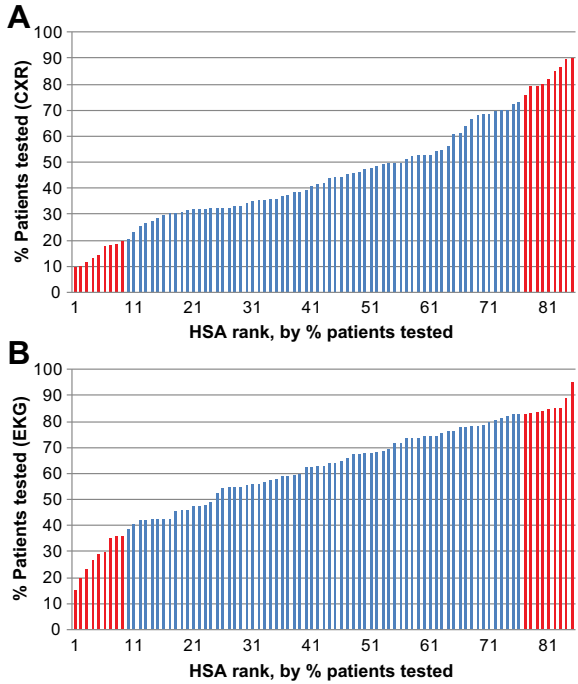

Fig. 1. For each test type, the graphs show the proportion of Texas Medicare beneficiaries in each health service area (HSA) undergoing hernia repair who underwent preoperative testing. (*A*) Chest radiograph (CXR). (*B*) Electrocardiogram (EKG). CXR use varied from 10% to 90% between HSAs. EKG use varied from 15% to 95%. (*Data from* 100% Texas Medicare claim data, 2008–2009.)

evaluated 2000 patients who underwent 6200 routine preoperative tests, and found that 60% of tests were not indicated and only 0.2% had clinically relevant abnormal results. The presence of abnormal results was not associated with change in management or worse postoperative outcomes. Likewise, Narr and colleagues [40] reported abnormal results in 4% of 3782 patients who underwent ambulatory surgery, and found no association between abnormal results and worse postoperative outcomes. In addition, no change in perioperative care management was attributed to the abnormal testing results. Smetana and Macpherson [8] reported similar results after performing a systematic review of the literature. Changes in management were seen in fewer than 0.1% of patients with abnormal CBC results, to up to 2.6% of the cases with abnormal chemistry results.

In 1987, Turnbull and Buck [57] studied 1010 healthy patients undergoing open cholecystectomy for cholelithiasis. In more than 5000 tests ordered, they found that only 4 patients potentially benefited from the battery of tests and concluded that, when compared with the information obtained during the preoperative history and physical examination of patients undergoing

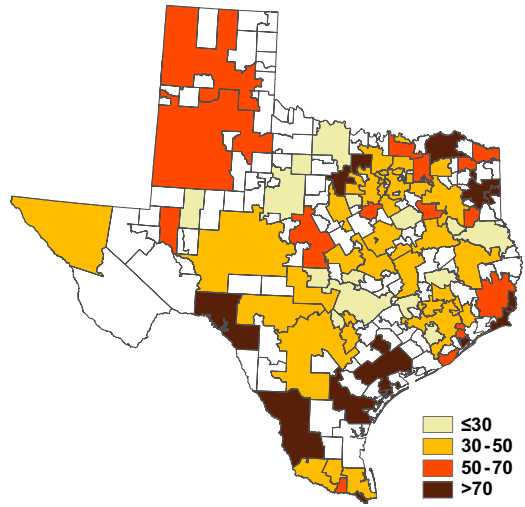

Fig. 2. Percentage of Texas Medicare beneficiaries receiving a preoperative chest radiograph before hernia repair by HSA in Texas. No clear pattern in the use of preoperative chest radiography was seen across HSAs, and variation in the use of chest radiography is evident, even between contiguous HSAs. Colors indicate percentages. (*Data from* 100% Texas Medicare claim data, 2008–2009.)

Table 4
Summary of previous studies evaluating unnecessary testing, incidence of abnormal results, and impact on management

Authors [Ref.], year	N	% Unnecessary	% Abnormal	% Clinical impact
Delahunt and Turnbull [27], 1980	803	NR	21.4	NR
Kaplan et al [14], 1985	2000	61[a]	4.1[b]	0.2[c]
Turnbull and Buck [57], 1987	2570	NR	4.5[b]	0.3
Charpak et al [13], 1988	3866	NR	30[b]	9[c]
Narr et al [40], 1991	3782	NR	4.2	1.2
Macpherson et al [60], 1993	111	NR	0.81	0
Perez et al [61], 1995	3131	NR	27	1.2
Allison and Bromley [26], 1996	61	65.4	NR	NR
Muskett and McGreevy [33], 1986	200	NR	35.5[b]	5.9[c]
Wattsman and Davies [59], 1997	142	58.4[a]	30.6[b]	1.3[c]
Dzankic et al [58], 2001	526	NR	6.8[b]	NR
Benarroch-Gampel et al [54], 2012	73,596	NR	61.6	NR

Abbreviation: NR, not reported.
[a]Percentage of unnecessary tests.
[b]Percentage of abnormal tests.
[c]Percentage of tests that change management.

ambulatory surgery, preoperative testing did not provide additional information that altered the management of otherwise healthy patients.

In a population-based study using the NSQIP participant use data file [54], the authors found that surgery was performed despite abnormal results in 61.6% of patients undergoing same-day testing (see Table 2). Neither preoperative testing nor abnormal results across test types were associated with increased perioperative morbidity and mortality.

In a multicenter landmark study by Schein and colleagues [35], 19,557 patients undergoing cataract surgery were randomized to 2 groups: (1) no preoperative testing or (2) a standard battery of routine tests including ECG, CBC, electrolytes, BUN, creatinine, and glucose. Overall incidence of perioperative complications (including hospital admission and death) did not differ between these 2 groups even after stratifying by patient demographics or ASA class. Although the study design is strong, its generalizability might be limited by the low-risk nature of cataract surgery. Cataract surgery requires a very short period of general anesthesia and sedation, so the findings may not be widely applicable to all ambulatory surgical procedures. Also, the investigators excluded patients who had an indication for testing in the previous 28 days. It is possible that the results were similar in the 2 groups because patients had been optimally evaluated by a complete history and physical examination. In an editorial, Roizen [18] points out that many preoperative assessments for ambulatory surgery are done within 7 days of surgery and may not be adequate for assessing and acquiring needed tests.

In Canada, Chung and colleagues [56] evaluated postoperative outcomes in 1061 patients undergoing ambulatory surgery who were randomly assigned to receive preoperative laboratory testing or not. Although the investigators applied strict exclusion criteria, with only relatively healthy patients undergoing randomization, their study shows no difference in postoperative complications at 7 and 30 days after surgery between tested and untested patients.

Previously, Narr and colleagues [62] performed a retrospective review of 1044 patients undergoing surgical and diagnostic procedures at the Mayo Clinic, randomly selected from a pool of 5120 patients in whom no preoperative laboratory testing was obtained. It was concluded that patients who are assessed by careful history and physical examination, and deemed to have no indication for testing, could safely undergo low-risk elective surgery without preoperative testing.

Other studies have evaluated the utility of "selective" testing. In a 1988 study, Charpak and colleagues [13] evaluated the usefulness of 12 selectively ordered tests based on current indications. The study included 15,920 tests performed in 3866 patients. Thirty percent of performed tests were not indicated according to their preoperative testing protocol. In addition, test results were abnormal 30% of the time. Surgery was delayed or canceled for 19 patients and modified in 1 case, and a treatment was instituted or anesthetic management influenced in 9%. When assessed by the anesthesiologists/anesthetists, 22% of recommended tests and 5% of nonrecommended tests were found

useful. The investigators concluded that although the usefulness of selectively ordered preoperative tests may be higher, better criteria for their indications are needed, because some nonrecommended tests in their protocol were found to be useful.

SUMMARY

Current recommendations from the 2002 ASA Task Force on Preanesthesia Evaluation are not specific to ambulatory surgery and are not based on strongly designed and adequately powered studies. Furthermore, although the ASA does not advocate routine testing or testing without indication, the guidelines for "selective" or "indicated" testing are unclear. As a result, preoperative testing in the United States is overused relative to the current ASA Task Force recommendations. Uncertainty regarding indications leads to wide variation in the use of preoperative testing across providers.

There is evidence to suggest that current guidelines may recommend testing more than is necessary. Several studies reviewed in this article have shown that the elimination of routine testing and more selective use based on patient history and physical examination findings would decrease cost and increase patient satisfaction without detriment to patient care. Future studies should evaluate the effectiveness of testing in specific clinical situations, allowing for identification of clear conditions under which preoperative testing should be performed. This approach would allow the promulgation of clear guidelines, the development of which should involve surgeons (as members of a multidisciplinary team), anesthesiologists, and hospital administrators, together with governing bodies such as the ASA and American College of Surgeons that offer support for the dissemination and broad adoption of guidelines.

In the future, studies should focus not only on identifying specific clinical situations whereby preoperative testing will be beneficial but also on determining current barriers to improving adherence to guidelines. Potential barriers include institutional policies for testing, physician reluctance to change practice, problems in communication between members involved in perioperative care, and legal consequences of not ordering preoperative tests. Identification of reasons for overuse of testing is the first step toward changing practice. Once clear guidelines are developed, the creation of preoperative clinics that centralize preoperative care, or promoting the use of clinical pathways and/or checklists for determining appropriate tests, may improve the adequate use of preoperative tests. It will be critical for quality improvement measures to include surgeons, anesthesiologists, hospital administrators, and governing bodies such as the ASA and American College of Surgeons to achieve success.

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