

CLINICAL COMMENTARY

Preoperative Laboratory Testing

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Primary care physicians often find themselves in the role of preoperative medical consultant. In this role, we are either asked by the surgeon to order specific preoperative tests or we are left to use our judgment as to what is indicated based on the patient's risk factors, history and physical, type of surgery, and the overall health of the patient.

The area of preoperative testing is one fraught with controversy as to what constitutes medically indicated tests. Studies have been done, both retrospective and prospective, assessing the value of various testing, and I will comment on these studies. It can be said that by and large most healthy patients going for elective surgical procedures need little if any testing preoperatively. Furthermore, taking a good history, always the most important component, in conjunction with the physical exam will lead one most of the time to know what tests to order when taking into account the type of surgery.

In this article, I plan to first review the literature with respect to preoperative testing and then comment on practical aspects of preoperative consultation as it relates to such testing. This article deals with ambulatory surgery predominantly. I will not deal with preoperative cardiac testing, except as it relates to electrocardiograms (ECGs). A recently updated set of guidelines by American College of Cardiology/American Heart Association (ACC/AHA) for stratifying patients undergoing non-cardiac surgery and to help assess the need for stress testing can be found on the internet (see Reference No. 1). Another useful reference for predicting cardiac risk of major non-cardiac surgery has been published in *Circulation*.²

The importance of developing a sensible approach to preoperative laboratory testing is illustrated by the landmark study of Schein et al who did a prospective study evaluating over 18,000 patients undergoing cataract surgery, half of whom did not have routine testing (ECG, complete blood cell count (CBC), electrolytes, creatinine, glucose) and half who did.³ There were no significant differences between the no-

test group and the test group in rates of intraoperative and postoperative events, even when the rates were stratified by age, co-existing illness, medical history, and American Society of Anesthesiologists (ASA) risk class. While these results cannot be necessarily generalized to all types of surgery, they do reinforce the fact that for the most part cataract surgery is a low-risk procedure and that routine testing prior to surgery is not indicated. The operative word here of course is "routine" and I will try to elucidate in this article what is meant by this.

This study also underscored the importance of asking whether tests ordered for a given patient will alter the management or outcome of that patient's surgery. It is incumbent on the medical consultant to ask this question. Unnecessary testing not only leads to increased health care costs (estimated to be over \$150 million annually for routine tests before cataract surgery alone⁴ and in the billions of dollars for all surgeries), but also may lead to unnecessary follow-up testing to pursue minor, but not clinically relevant, laboratory abnormalities.

I will now review studies which have been done to look at the value of individual pre-operative laboratory tests. I have chosen to illustrate the topic with a small sampling of the literature. While a multitude of studies have been published, those here are representative of many other findings.

Coagulation Tests

Two studies in South Africa attempted to address the necessity of preoperative hematologic screening in patients without a history of abnormal bleeding. In one study, after excluding those on aspirin or with a history of abnormal bleeding, 111 asymptomatic patients prior to undergoing major surgery had a prothrombin time (PT), partial thromboplastin time (PTT), bleeding time and platelet count ordered. One patient was found to have mild thrombocytopenia and eight had a prolonged PTT. None of the patients had excessive perioperative bleeding. In a second study, done over 4 months, 49 out of 1,872 patients required more preoperative blood transfusions than anti-

pated. All of these were attributable to technical reasons, as opposed to hematologic abnormalities.⁵ Of course, the caveat is that a good bleeding history must be taken, including questions related to spontaneous bruising, excessive bleeding after minor trauma, dental extractions, or prior surgery, or with menses.

In the setting of a negative bleeding history and exam, PT/PTT testing would be indicated then for conditions that have the potential to cause bleeding, such as in patients with severe liver disease, those with malnutrition (who may be vitamin K deficient) and those on anticoagulants, although in those undergoing relatively avascular procedures such as cataract surgery, coagulation tests are generally not needed even in these conditions. Patients undergoing high-risk surgery from a hemostatic point of view (for example neurosurgery) would be candidates as well.

Complete Blood Cell Count

In multiple studies, baseline hemoglobin and estimated perioperative blood loss have been shown to predict the need for transfusions in patients who are undergoing surgery expected to have at least moderate blood loss (greater than 500 mL). Procedures with potential blood loss of less than 500 mL include arthroscopy, laparoscopic cholecystectomy and inguinal hernia repair. Surgeries with greater than 500 mL potential blood loss include hysterectomy, joint replacement, major gastrointestinal or genitourinary surgery and major vascular or cardiothoracic procedures as well as intracranial procedures.⁶ Besides surgery in which the potential expected blood loss exceeds 500 mL, preoperative CBCs would be indicated in those with a history of bleeding or clinically significant anemia, a history of renal failure, or radiation therapy or chemotherapy within the past 6 months. Other conditions that may warrant CBCs include those with chronic severe illnesses, such as those in ASA class 3 or 4, although such patients will generally be eligible for ambulatory surgery only if going for minor surgery.

Electrolytes

The chief reason to obtain electrolytes is to determine if patients have abnormalities that may increase the risk of arrhythmias or complications in the setting of volume shifts, or to identify renal problems that may increase the risk of acute renal failure postoperatively. In 8 studies reviewed by Smetana et al,⁷ involving

7,764 patients, only 1.8% of all electrolyte tests influenced management and most of these could have been predicted on the basis of diuretic use or renal insufficiency. With regard to renal function, in 12 studies they evaluated involving 15,437 patients, in only 2.6% of the tests of renal function was management influenced.⁷

They have extrapolated from recent data that a preoperative creatinine greater than 2 posed greater risk for postoperative complications, thus advocating that preoperative testing of renal function be done for patients with a "substantial likelihood" of renal insufficiency and in those undergoing major surgery. However, exactly what subpopulation this should be composed of has not been prospectively evaluated. Besides renal failure, conditions that increase the probability of electrolyte or glucose abnormalities that may affect management include those on medications such as diuretics, digoxin, or steroids or patients with diabetes.

Urinalysis

Urinalyses are often requested by surgeons prior to various types of surgery. Suffice it to say that multiple studies in the literature demonstrate no value in routine urinalysis. Here again, finding abnormalities in most urine tests may lead to needless expense and often unnecessary treatment of urine cultures which may be ordered as a result. There are two instances in which routine urinalysis is felt to be indicated: in those with symptoms of a urinary tract infection and in those undergoing an implant device or prosthetic joint or other orthopedic hardware.

Electrocardiogram

The main reason to obtain preoperative ECGs in an asymptomatic patient is to help decide if further cardiac testing is needed to help assess risk of perioperative cardiac complications. In terms of stratifying cardiac risk in general for major non-emergent non-cardiac surgery, two guidelines stand out. The modified Lee index, based on a prospective validation, came up with 6 factors with prognostic value for major cardiac complications.² One of these factors is ischemic heart disease. Thus, an ECG which shows evidence of ischemic heart disease, if not already known or suspected from the history, could alter management. The other guideline (ACC/AHA updated in 2002 by Eagle et al.)¹ includes evidence of a prior myocardial infarction (MI) by ECG or by

history as a factor which may place a patient in a risk group that warrants preoperative cardiac stress testing. Thus again the finding of ECG changes consistent with a silent MI not otherwise suspected could change management.

The Framingham study demonstrated that with increasing age came an increased incidence of ECG abnormalities, specifically previously undetected MI.⁸ In this study, 5,127 men and women between ages 30 and 84 were followed over 30 years. In the 45- to 55-year-old group of men, the 10-year incidence of unrecognized myocardial infarction (as defined by ECG evidence of an MI in the prior two years, namely pathologic Q waves or loss of R waves consistent with an MI) was 1.7%. For the 55- to 64-year-old range, it was 2.8%, and in those over 65 it was 11.4%. For women in the 55- to 64-year-old range, 1.8% had a prior infarction and 5.5% in women over age 65. Age therefore appears to be one of the key factors in predicting the likelihood of an abnormal ECG.

Despite this finding, routine preoperative ECGs have questionable value. In a meta-analysis by Smetana of 16 studies involving 10,524 patients going for ambulatory surgeries (most with no significant medical history), 29.6% of patients had some abnormality on the ECG but only 2.6% of all ECGs influenced management.⁷ They "acknowledge the lack of confident evidence to support a beneficial effect of preoperative ECGs on reducing adverse postoperative outcomes." They recommend ECGs for various subsets of patients and go on to say they feel that preoperative ECGs are "probably" not necessary for patients undergoing minor procedures under conscious sedation such as endoscopic and cataract surgeries.

Taking all of this into account, preoperative ECGs are indicated in males over age 50 and females over age 60. In patients under these ages, ECGs are indicated in those with a history of a treated arrhythmia; coronary artery disease or congestive heart failure; severe peripheral vascular disease; morbid obesity; longstanding or poorly-controlled hypertension or diabetes; smoking over 20 pack-years; and a family history of premature MI (before age 60). All of these are felt to be conditions that increase the pre-test probability of an abnormal ECG.

For patients of any age, if there has been a normal ECG in the past 12 months and the patient has good functional tolerance (greater than 4 METS which is walking up two flights of stairs or walking 4 miles per hour), is asymptomatic and has no new risk factors for coronary artery disease, a repeat ECG is not necessary.

If an abnormal ECG is found on preoperative evaluation, it should be compared with prior ECGs when possible. If the ECG is not changed but suggests ischemia or MI, then one should document results of a formal evaluation for coronary artery disease performed in the past two years. If that evaluation either demonstrated myocardium at risk or was not performed, then the patient would require preoperative cardiology evaluation. If the ECG showed new abnormalities, which were suggestive of ischemia or MI, the patient also would require cardiology consultation.

The above criteria for obtaining preoperative ECGs are derived primarily in conjunction with anesthesiology (Harvey Rosenbaum, personal communication) and, while not all evidence-based, do speak to the issue of looking for risk factors that could lead to the finding of an abnormal ECG which could change management. The above, with minor modifications, are currently the guidelines being used by the Preoperative Evaluation Suite at both UCLA Medical Center campuses (Westwood and Santa Monica). It should be noted that a separate protocol exists governing preoperative testing for gastric bypass surgery. Practically speaking, the type of surgical procedure really does play a role in determining the necessity of ECGs or what kind of follow-up evaluation is necessary. For example, an otherwise healthy patient going for cataract surgery or other low risk procedures, who has evidence of an old MI on ECG but who has good functional tolerance, still will not need cardiac stress testing or cardiology consultation if one uses the Eagle et al guidelines.¹ However, firm criteria, such as age requirements for ECGs regardless of the type of surgery, are often set in place perhaps to cover the possibility that the medical consultant will not take into account all of the nuances involved in the area of preoperative testing.

Chest X-ray

In a meta-analysis by Archer et al looking at routine preoperative chest x-rays reported in the literature

between 1966 and 1992, 10% of films were found to have an abnormality.⁹ However, only 0.1% of the patients had a finding which changed preoperative management. There are no convincing data in the literature that show that routine chest x-rays are of value in the absence of symptoms or signs pointing to an abnormality. Thus it is reasonable to order routine chest x-rays in the presence of signs or symptoms of congestive heart failure or abnormal pulmonary findings (other than bilateral wheezing in the asthmatic patient).

Pregnancy Testing

Testing to rule out pregnancy should be done in any premenopausal female for whom there is a suspicion or possibility of pregnancy. If this test is done, it should be performed within 24 hours of surgery (for example, the morning of surgery).

From a practical standpoint, one must be prepared to deal with preoperative test requests that accompany patients undergoing surgery at UCLA and outside UCLA. How does one handle requests for tests that fall outside the guidelines recommended for specific circumstances in this article?

First, it should be emphasized that the medical consultant and anesthesiologist always have the ability to order tests for indications that do not appear here. For tests that clearly have no indication, for example chest x-ray requests in asymptomatic healthy patients (especially when not undergoing thoracic or upper abdominal surgeries), one should not order them and explain the reasoning in the consultation note. Urinalysis requests for asymptomatic patients not undergoing types of procedures noted above is another example of a test that should not be ordered. CBCs requested for patients undergoing cataract surgery for no reason other than being above a certain age should also be denied.

Occasionally, requests for tests will come through that will raise one's eyebrows. A 34-year-old healthy patient of mine, with a normal history and exam, was sent to me for a preoperative evaluation prior to microdissection by one of our surgeons. The form that he brought in stated "standard preop including: CBC with platelets, Chem 7, PT/PTT, electrolytes, glucose, BUN, creatinine, SGBT (*sic*), SGOT, HCT, type and screen, EKG, chest x-ray, history and physical with clearance." I called the surgery sched-

uler and explained the lack of indications for these tests and she said it was all right not to order them if I did not think he needed them. This is an example of a case where there is no medical indication for these tests and one should not feel compelled to order them (although it should be stated that in such procedures involving a small incision and small space, the surgeon may indeed require coagulation tests beforehand).

For patients coming to us who are having surgery outside UCLA, it is sometimes more difficult to avoid test ordering, in that many times requests are based on facility requirements. Still, if the tests requested clearly have no medical indication, I will not order them. If tests are of equivocal indication, I will attempt to contact the surgeon's office. If I cannot get an answer while the patient is with me, I may at times order tests that have some justification to avoid undue inconvenience to the patient having surgery outside UCLA. At times, patients will be caught in the middle when one chooses not to order what is being requested. I will explain the rationale in these cases to the patient and say that I am following what makes medical sense and that the surgeon or anesthesiologist may still choose to order the tests.

Another scenario is that of the patient who is undergoing cosmetic surgery by a plastic surgeon outside UCLA (and not covered by insurance). Unless requested tests are clearly medically indicated for reasons other than surgery, I will inform the patient that I can order any tests for them but that it is not ethical to bill the tests to their insurance if the procedure itself is not covered. In such cases, I will have the financial code changed to self-pay.

Many patients coming for preoperative evaluation have had laboratory tests done in the recent past for other reasons. One retrospective study in a tertiary care hospital attempted to determine whether the knowledge of normal preoperative lab results in the prior year could reduce the necessity of re-ordering tests for elective surgery. The study, involving 1,109 mostly elderly male patients, found that almost one half of admission tests duplicated tests done in the year before surgery and that changes from previous normal ranges to results that would affect preoperative management were very rare (0.4%) and in almost all cases were predicted from the history.¹⁰ Thus, if the consultant believes that a patient's clinical status

has not changed since the last time tests were done, there may not be a need to repeat them. For example, a patient on a diuretic known to have normal electrolytes in the recent past on that diuretic, and who is going for minor surgery, may not need electrolytes repeated. This again is where good clinical judgment must be relied upon.

It is often easier to order any and all laboratory tests requested than it is to deduce from the history and exam what tests are indeed medically indicated. As with many other areas in medicine, there is often the feeling that one might be missing something if one did not order a test. Yet, it behooves the medical consultant to give thought to test ordering. In the long run this will make the most sense, both economically and from the standpoint of good medical practice.

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