

# PREOPERATIVE LABORATORY TESTING

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Preoperative laboratory testing should allow the gathering of information that will be used in the improvement of the surgical outcome for the patient. This is accomplished through the detection of conditions that may alter the assessment of surgical and anesthetic risk. With the large number of preoperative tests available to physicians, it is difficult to determine which of these labs are indicated for a particular surgical candidate. In the past, it was common practice to use routine screening tests for all patients scheduled for a medical procedure. This practice came under scrutiny with the advent of managed care, when several studies concluded that pre-operative laboratory screening was neither cost-effective nor predictive of postoperative complications.<sup>1</sup> This information has shifted the ordering of these tests from a general screening of all patients to a more focused laboratory evaluation following a thorough history and physical exam. This paper will discuss some of the factors that should be considered when ordering these laboratory studies. It will also focus on a number of frequently ordered preoperative tests and some of the indications for requesting them.

### **FACTORS TO CONSIDER WHEN ORDERING PREOPERATIVE TESTS**

It is estimated that the cost of preoperative testing in the United States, excluding physician's fees, approaches 12 billion dollars annually.<sup>2</sup> Studies have shown that anywhere from 40% to 90% of all preoperative tests are not indicated, based on the patient's history and physical.<sup>3</sup> This suggests that 4 to 10 billion dollars could be saved annually by eliminating unindicated preoperative tests. In a fee-for-service setting, these additional tests would yield a profit for the health care facility, however, in a new cost-conscious medical environment this is not necessarily the case.<sup>4-7</sup>

Along with cost, there are other factors that should be considered when ordering preoperative tests. Research has shown that in many cases pre-surgical laboratory tests are ineffective in finding asymptomatic disease.<sup>7,8</sup> It has also been the conclusion in several studies that abnormal test results are

often ignored and not pursued by the surgeon. This exposes the physician to possible legal liability for failure to pursue a documented abnormality.<sup>3,4,9</sup> McPherson, Snow and Lofgren found in their study that a high percentage of patients having had tests within the last year prior to elective surgery could substitute these findings for a preoperative screening without affecting surgical management.<sup>10</sup> This finding agrees with previous research and may be a viable option, assuming there has been no change in the patient's clinical state.

Ordering tests that are not warranted by a history and physical examination may also increase the risk to the patient. They may be harmed directly by the follow-up of false positive results that directs the physician's attention away from more important medical issues. These findings may also unnecessarily postpone a warranted surgical procedure. Conversely, the patient may be harmed from neglect secondary to false-negative results and the possibility of overlooked disease.<sup>11</sup>

### **PREOPERATIVE TESTS**

There are numerous tests that may be ordered in preparation for surgery. The following studies have been chosen for discussion because of the frequency in which they are ordered. They will each be discussed briefly with examples of recommended indications.

#### **Pregnancy Test**

Women of childbearing age should be screened to rule out pregnancy. Studies have not shown an increase in surgical complications during pregnancy, though it is clearly in the best interests of the patient, fetus, and doctor to be aware of this condition prior to surgery. While gathering the patient's history one should inquire about date of last menstruation and/or prior hysterectomy. If deemed necessary, a urine or blood level of human chorionic gonadotropin (HCG) should be ordered to protect against any chance of possible fetal morbidity.

**Indications**

- Women of child-bearing age without history of hysterectomy

**Complete Blood Count**

A preoperative Complete Blood Count is a baseline test for the evaluation of possible deficits in circulating cells. It includes basic data on red and white blood cells, such as red blood cell (RBC) count, hemoglobin and hematocrit measurement, white blood cell (WBC) count, and WBC differential. This test also comments on the morphology of the white and red blood cells, if there is any abnormal appearance. The WBC count may be increased in acute bacterial infections, hemorrhage, tissue necrosis, and leukemia; while decreased in super infections, viral infections, and following radiation therapy or cancer fighting medications. Hematocrit and hemoglobin levels are important in detecting anemia or polycythemia and a platelet count will provide quantification of possible thrombocytopenia without regard to platelet function. A differential white blood cell count is a morphological examination of 100 WBCs in a peripheral smear. The different types of WBCs are counted and expressed as a percentage of the whole.

A CBC is indicated in a host of circumstances. Examples include surgeries when significant blood loss is a possibility or when infection of the lower extremity is evident or suspected. Patients with known congestive heart failure and coronary artery disease can also benefit from this test because of the propensity of these conditions to worsen with anemia.<sup>12</sup>

**Indications**

- Any procedure commonly associated with significant blood loss
- History of anemia
- Renal insufficiency
- Recent or current infection
- History of malignant disease
- Recent immigrant
- Diabetes mellitus
- Cardiac disease
- Pregnancy
- Institutionalized patients over age 75 years

**Blood Chemistry**

Biochemical profiles have been available in health care facilities since the advent of the simultaneous

multiple analysis (SMA). These have been known to include anywhere from 7 to 20 independent chemical determinations used as a relatively inexpensive screening examination to measure hepatic, cardiac, renal, endocrine, and metabolic function. Although known to have a high rate of false-positive results, these profiles may have some prognostic value.

Serum potassium is the principal cation of intracellular fluid. When elevated it may be indicative of acidosis, renal failure, hemolysis, mineralcorticoid deficiency, massive tissue necrosis, high penicillin dosage, and over-supplementation of potassium. Hypokalemia may be present in patients with significant diarrhea, aldosteronism, Cushing's syndrome and patients taking diuretic medications.<sup>13</sup>

Serum Sodium is the principal cation of the extracellular fluid. Levels may become elevated with dehydration, aldosteronism, Cushing's syndrome, and with the use of certain diuretic medications. Levels of sodium are decreased in patients with congestive heart failure, ascites, excessive fluid loss (diarrhea, vomiting, sweating), and Addison's disease.<sup>13</sup>

Serum creatinine and blood urea nitrogen (BUN) levels are valuable preoperatively to rule out renal insufficiency, and to aid in necessary drug dosage modification. They are both substances in the serum that are dependent on the kidney for excretion. It is because of this dependence that their levels provide an index of current renal function. Creatinine serum concentration is a more accurate determinate of glomerular filtration than BUN because of its linear relationship to this filtration rate. Creatinine levels stay reasonably constant through production and excretion in the absence of muscle disease. BUN is not as sensitive of a single measurement of renal function because it is influenced by variations in urine flow rate and the production and metabolism of urea.

Serum glucose concentration is often measured due to the increased operative risk associated with diabetes mellitus. An elevated level in this category could be an early indication of Type II diabetes mellitus.

Liver function tests such as albumin and the aminotransferases have a role in unmasking disease and can aid in being indicators for wound healing potential. A decrease in serum albumin can be found in patients with chronic liver disease, nephrosis, malabsorption, and starvation. An

increase usually comes from dehydration. The aminotransferases most widely used are aspartate aminotransferase (AST) and alanine aminotransferase (ALT). These enzymes, when elevated, are found in liver disease, myocardial infarction, heart failure, and muscle injury.

### **Indications**

- Diuretic therapy
- Diabetes mellitus
- Renal disease
- Cardiac disease
- Liver disease
- Hypertension
- Excessive diarrhea, vomiting, sweating
- Known malignant disease
- Diabetes insipidus
- Steroid therapy
- Pancreatic, hypothalamic, or adrenal disease

### **Urinalysis**

Urinalysis is a guide to intrinsic genitourinary disease. It includes a qualitative evaluation for the presence of glucose, nitrites, protein, blood, bacteria, and also measures the pH of the urine being examined. This test can help rule out a urinary tract infection as well as aid in exposing renal disease and diabetes mellitus. It is a relatively inexpensive and time-conscious test that is sensitive while being non-invasive.

### **Indications**

- Recent history or symptoms of urinary tract infection

### **Coagulation Studies**

Blood tests for hemostasis include prothrombin time (PT), partial thromboplastin time (PTT), platelet count, and a bleeding time. Prothrombin time is a measurement of the extrinsic blood coagulation pathway most often used to monitor patients on anticoagulation medications, such as warfarin (Coumadin). These values can be abnormal with Vitamin K deficiency, liver disease, malabsorption, and with the ingestion of the aforementioned warfarin. Partial thromboplastin time measures the intrinsic blood coagulation pathway and is commonly used to monitor the patient undergoing heparin therapy. Bleeding time may be taken to measure the

effectiveness of the function of platelets in coagulation. It is increased in patients who have recently been medicated with aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), or have a qualitative platelet disorder such as von Willebrand's disease.

Multiple studies have shown that few patients have a prolonged partial thromboplastin time (PTT) or prothrombin time (PT) that do not have a clinical indication for these tests.<sup>14-16</sup> In fact, these tests combined with a bleeding time have shown a low predictive value as a preoperative screening test.<sup>17</sup> Not all patients need routine preoperative coagulation studies. Only those with a history of bleeding disorders, liver disease, malnutrition, or patients currently on anticoagulant therapy should be considered for these screening tests.

### **Indications**

- Anticoagulant therapy
- Liver disease
- History of bleeding disorder
- Malnutrition
- Malabsorption

### **Electrocardiography**

Electrocardiogram (ECG) is a test that is at times unreliable, whose results will often be non-conclusive. However, in view of the morbidity associated with cardiac complications during surgery, the ECG is a test that should be utilized despite its lack of specificity. Many studies have been done to link ECG abnormalities with perioperative complications without defined outcomes or conclusions.<sup>18-20</sup> What has been found is a direct association between age and ECG abnormalities.<sup>19,21</sup> In light of these findings, preoperative electrocardiograms are recommended in men over the age of 45 years and women over the age of 55 years. Also included is anyone with a medical history positive for cardiac disease.

### **Indications**

- Men over the age of 45 years
- Women over the age of 55 years
- History of Coronary Disease, Hypertension, Peripheral Vascular Disease, Diabetes Mellitus
- Cardiotoxic medications-tricyclic anti-depressants, phenothiazines, doxorubicin

## Chest X-Ray

Obtaining a chest x-ray preoperatively is a point of controversy among many physicians. Research has shown that abnormal findings are only rarely followed up on, and tend not to affect the surgical plan.<sup>22,23</sup> Other studies have shown that certain risk factors including smoking, history of cancer, and exposure to toxic chemicals all increase the chance of an abnormality visualized on the chest x-ray.<sup>24</sup> Along with these risk factors age and prior history of lung disease may also warrant use of this modality.

## Indications

- History of smoking
- History of cancer
- Signs and symptoms of active lung disease
- Patient over 70 years of age without recent chest x-ray
- History of lung disease

## CONCLUSION

Patients undergoing surgery are shuffled through a continuum of medical care contributed to by the internist, surgeon, and anesthesiologist. It is necessary that all of these parties work in harmony to ensure the best possible outcome for their shared patient. This includes proper communication and organization in the ordering of preoperative screening tests. The selection of these tests should be governed by information gained from a comprehensive history and physical examination, as well as from the patient's other medical providers. If each patient is individualized in this fashion, an informed and cost-effective choice will be made in ordering preoperative screening tests.

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