

Pre-operative Evaluation for Non-Cardiac Surgery

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INTRODUCTION

Internists as well as sub specialists are often asked to evaluate a patient prior to surgery; however, formal training in the art and science of medical consultation is often lacking. A survey of hospitalists found preoperative medical consultation to be an area of importance and in which the hospitalists felt a need for additional training¹. The role of medical consultant is to identify and evaluate a patient's current medical status and provide a clinical risk profile, to decide whether further tests are indicated prior to surgery, and to optimize the patient's medical condition in an attempt to reduce the risk of complications². This article will briefly discuss general principles of the consultative medicine, technique to improve compliance, and the concept of risk assessment.

DEMOGRAPHICS

Most individuals will require surgery at some point in their lifetimes. Each year 10% of adult population undergoes a non-cardiac surgery. One third of these surgeries are performed in patients 65 years and older. The overall mortality rate of all surgeries is 0.3%. For major surgeries the mortality rate is less than 1% in patients younger than 65 years, but increases to 5% for patients between 65 and 80 years. Patients over the age of 65 are more than twice as likely to present for emergent surgery as younger patients 37% versus 17%³.

PRE-OPERATIVE RISK

Pre-operative risk assessment starts by identifying the "type of surgery" to be performed and the "type of patient" who is to have it. It is these two factors which

determine risk of complications. Even a patient with severe coronary artery disease (CAD) is at relatively low risk from cataract surgery, and a patient without CAD is at relatively high risk from a pneumonectomy. The first part of this equation, the risk to patients from specific types of surgery, has been extensively studied. As a rule, operative death is uncommon, occurring in about 0.3% of all operations. The high risk, intermediate risk, and low risk surgeries are given as in (Table 1).

The second part of the risk equation is determined by the patient's health. The American Society of Anesthesiologists (ASA) physical scale gives a global impression of the clinical state of the patient which correlates well with surgical outcome (Table 2)⁴.

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH CORONARY ARTERY DISEASE

A significant proportion of patients who undergo surgery have either known CAD or risk factors for it. The fear of peri-operative cardiac complications is often the concern that prompts preoperative medical consultation. Cardiac risk is the most feared and most studied complication of surgery. Pre-operative cardiac evaluation requires the consultant to assess the patient's probability, severity, and stability of CAD, and the likelihood of a peri-operative cardiac complication.

Post-operative mortality related to cardiac complications occur during anesthetic inductions (10%), intra-operative period (35%), or post-operatively (55%). The risk of peri-operative myocardial infarction is maximum during 24 to 48 hours after surgery. 50% of peri-operative myocardial infarctions are fatal and 60% are not accompanied by chest pain⁵.

Table 1: Risks of surgery with mortality

Grade of risk	Type of surgery	Mortality
A. High Risk Surgeries	i. Emergency Major Surgeries in elderly	>5%
	ii. Aortic and Major vascular Surgeries	
	iii. Peripheral arterial procedures	
	iv. Surgeries with prolonged duration	
B. Intermediate Risk Surgeries	i. Carotid endarterectomy	< 5%
	ii. Head and Neck Surgeries	
	iii. Prostate Surgeries	
	iv. Orthopaedic Surgeries	
C. Low risk Surgeries	i. Endoscopic Procedures	<1%
	ii. Breast Surgeries	
	iii. Cataract Surgeries	
	iv. Superficial procedures	

Table 2: American Society of Anesthesiologists physical scale

Class	Physical status	Mortality
I	Normal healthy person, <80 years old	0.1%
II	Mild systemic disease	0.2%
III	Severe but not incapacitating systemic illness	1.8%
IV	Incapacitating systemic illness that is constant threat to life	7.8%
V	Moribund patient unlikely to live 24 hours, regardless of surgery	9.4%
E	Emergency surgery, add suffix to any Class	-

Preoperative evaluation of a patient's cardiac risk is done using a careful history, physical examination and ECG. Based on this information, various risk indices, guidelines, can further assist the physician in deciding which patients can undergo surgery without further testing and which patients might benefit from further cardiac evaluation or medical therapy prior to surgery. The science of cardiac risk stratification began with the landmark study of Goldman and colleagues in 1977 that identified risk factors among the history, physical examination, electrocardiogram, general medical status, and type of surgical procedure. More recently, the revised cardiac risk index of Lee and colleagues has been shown to outperform the original index⁶ (Table 3).

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH NON-ISCHEMIC HEART DISEASE

A careful history and examination may be the most valuable tool in assessing a patient's risk of perioperative cardiovascular complications. It should identify the

Table 3: The revised cardiac risk index

Factor	Adjusted Odds Ratio (OR) For Cardiac Complications In Derivation Cohort
High-risk surgery	2.8
Ischemic Heart Disease	2.4
History of Congestive Heart Failure	1.9
History of cerebrovascular disease	3.2
Insulin therapy for Diabetes Mellitus	3.0
Pre-operative serum creatinine	3.0

Cardiac Complication Rates, %			
Class	Number of factors	Derivation cohort	Validation cohort
I	0	0.5	0.4
II	1	1.3	0.9
III	2	3.6	6.6
IV	3-6	9.1	11.0

presence of hypertension, hemodynamically significant atrial and ventricular arrhythmias, conduction defects, congestive heart failure, and valvular heart diseases. The presence of a pacemaker or implantable cardioverter-defibrillator device should be noted. A complete medication list must be obtained and documented. Exercise-functional capacity which has independent prognostic significance for determining the risk of cardiopulmonary complications in the perioperative setting must be assessed.

Congestive Heart Failure

As demonstrated in the cardiac risk indices, clinically significant congestive heart failure is an important risk

factor for peri-operative mortality. Decreased cardiac functional status or evidence of pulmonary congestion, raised JVP, or an S3 gallop on examination are all associated with increased risk of peri-operative complications. Echocardiography, however, does not seem to add to the information gathered from history and physical examination when assessing pre-operative risk. Pre-operative treatment of congestive heart failure should be relatively gradual, as dehydration is associated with intra-operative hypotension which itself is a risk factor for perioperative complications. For patients with decompensated congestive heart failure, it is prudent to delay elective surgery for at least a week while gentle diuresis is attempted.

Hypertension

Peri-operative hypertension or hypotension occurs in about 25% of hypertensive patients undergoing surgery. Two pre-operative predictors of peri-operative hypertensive events include preoperative stage 3 hypertension and surgery type. Investigators have confirmed the value of effective pre-operative blood pressure control among patients with established hypertension, and it is recommended that antihypertensive medications be continued during the peri-operative period. It is important to avoid withdrawal of beta-blockers and clonidine because of a potential rebound increase in heart rate and blood pressure. Clinicians should remember, however, the potential benefits of continuing ACE inhibitors and AT-II receptor antagonist therapy in maintaining control of hypertension and/or preventing exacerbation of congestive heart failure. Only diuretics need to be stopped 24-48 hours prior to surgery⁷. Hypertension per se is not a risk factor for cardiac problems. However poorly controlled hypertensive with CAD can develop hemodynamic instability during surgery which can be deleterious to the heart.

Valvular Disease

The surgical outcome of patients with valvular heart disease are directly related to their cardiac functional status. Class I and II patients tolerate surgery well; peri-operative morbidity and mortality is much higher for patients with limited functional status. Regurgitant lesions are better tolerated than stenotic ones. The presence of hemodynamically significant aortic stenosis (AS) dramatically increases peri-operative risk, and patients suspected of having AS should have pre-operative echocardiography. The presence of severe or critical AS makes many types of surgery prohibitively dangerous; valve replacement should precede major surgery in such cases. Similarly, symptomatic mitral

stenosis is associated with a higher incidence of peri-operative complications including sudden death. Endocarditis prophylaxis is indicated for patients with prosthetic valves and valvular disease undergoing procedures likely to cause bacteremia; oral, gastrointestinal, respiratory and genitourinary surgery, as well as those involving incision and drainage of an infected site.

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH LIVER DISEASE

Patients with liver disease undergoing surgery face significant post-operative complications. The pre-operative evaluations of these patients is a challenging task because of complex functions of liver, peri-operative stress and the unpredictable effects of medications and anesthesia. The preoperative risk assessment should take into account the type of liver disease, the degree of hepatic impairment and the operative risks associated with the procedure. Routine pre-operative testing of liver function however is not recommended in asymptomatic patients. Patients with acute, chronic, alcoholic hepatitis and cirrhosis have increased post-operative mortality and morbidity. However laparoscopic procedures when compared with their open laparotomy counterparts may decrease operative mortality and morbidity in cirrhotics⁸.

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH ENDOCRINE DYSFUNCTIONS

Diabetes Mellitus

Patients with diabetes mellitus who undergo surgery have an increased risk of developing complications⁹. They are particularly at greater risk for infections, metabolic, electrolyte, renal, and cardiac complications during and after surgery. The objectives for the pre-operative assessment of patients with diabetes mellitus include evaluation of the status of their diabetes, identifying other medical problems, consideration of the type of surgery planned to assess the surgical risk, and measures to minimize the risk of surgery. The patient's current therapy for diabetes should be ascertained including diet, oral medications and doses, and any insulin therapy including the type and dose. A chemistry panel to evaluate electrolytes and renal function should be ordered before surgery. An ECG should be taken before any major surgery for patients with diabetes mellitus. Whether any additional tests are indicated would depend on patient's medical problems and the type of surgery planned. The timing of surgery is also important, particularly when other medical conditions co-exist with diabetes.

Thyroid Diseases

Though older case studies reported perioperative complications in undiagnosed hypothyroid patients, recent retrospective case-matched control studies found no differences in surgical outcome between hypothyroid and euthyroid cases^{10,11}. The effect of thyrotoxicosis on the heart carries perioperative risk for the hyperthyroid patient. The greatest risk is thyroid storm, which may lead to cardiovascular collapse and death. Patients with mild hyperthyroidism can go to surgery with preoperative beta blockade, but elective surgery should be postponed in those with moderate to severe disease until they are euthyroid.

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH PULMONARY DISEASES

Pulmonary function is altered in patients undergoing surgery. Decreased functional residual capacity, vital capacity and cough contribute to aspiration, atelectasis, pneumonia, respiratory failure, and acute respiratory distress syndrome, which are associated with substantial mortality and morbidity. Surgical procedures that carry higher risk of post-operative pulmonary complications (PPC) include thoracic and upper abdominal surgery, procedures which require prolonged anesthesia (greater than 2 hours) and obviously lung resection. The presence of obstructive lung disease, a smoking history with productive cough, morbid obesity and hypercapnia are all patient characteristics associated with higher pulmonary risk. Nearly one fourth of deaths occurring within 6 days post-operatively are related to PPC¹².

In general, it is agreed that in patients with no history or symptoms of clinically significant lung disease and a normal lung examination, no further investigations are required. Functional status correlates well with pulmonary function, and in active patients a history and physical examination are usually sufficient to estimate operative risk. Routine preoperative pulmonary function testing or chest X Ray is not recommended¹³. For patients with known asthma or chronic obstructive pulmonary disease (COPD), the goal is to maximize respiratory function; to adjust medical regimens to bring patients to their "personal best".

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH HEMATOLOGIC DISEASES

Although severe anemia and thrombocytopenia are associated with peri-operative complications, the chance of these abnormalities being discovered in a healthy patient with no history of disease is extremely small. A history of bleeding diathesis, cirrhosis, hematological

malignancy or easy bruisability should prompt assessment of platelet count and prothrombin time.

Patients on antiplatelet medications (such as aspirin) or who are chronically anticoagulated fall into two categories. Those needing "tight control" i.e. those with mechanical heart valves can be placed on heparin pre-operatively. Those in whom "loose control" is acceptable i.e. patients on aspirin for CAD or warfarin for CVA prophylaxis, can discontinue anticoagulation a week prior to surgery and resume the medications on post-operative day one. NSAIDs should also be discontinued five to seven days before surgery.

Venous thromboembolism (VTE), a term encompassing deep vein thrombosis (DVT) and pulmonary embolism (PE) is one of the most common post-operative complications¹³. Prophylaxis of DVT is particularly important after surgery. Patients undergoing pelvic or lower extremity surgery are at highest risk, particularly those having hip or knee replacement. For healthy patients under the age of 40 undergoing general surgery, early ambulation is sufficient. For older patients, elastic stockings and low-dose heparin (5,000 units SQ bid) are recommended. Orthopedic patients with hip fractures or undergoing hip replacement are prophylaxed with warfarin or low-molecular-weight heparin.

PRE-OPERATIVE RISK EVALUATION OF PATIENTS WITH RENAL FAILURE

Preventing post-operative ARF, especially in subjects with pre-existing chronic kidney disease, and caring for ESRD patients undergoing surgery are challenging and best accomplished by a team comprised of physician, nephrologist, cardiologist, surgeon, anesthesiologist, endocrinologist and nutritionist. Elimination of risk factors for ARF whenever possible, as well as early diagnosis, may improve the outcome of this devastating illness¹⁵. Hypertensive and especially diabetic individuals suffering from ESRD have serious co-morbid conditions such as myocardial dysfunction, coronary artery and peripheral vascular diseases. Before surgical interventions, particularly those capable of inducing renal ischemia, one must identify potential factors such as volume depletion, hypotension, sepsis, nephrotoxin exposure, obstructive jaundice, and pre-existing chronic kidney disease. Elective surgery should be delayed until these abnormalities are improved.

PRE-OPERATIVE RISK EVALUATION OF ELDERLY PATIENTS

As the population ages, the older patients are considered for surgery with greater frequency. The surgical procedures that are done in elderly are cataract, prostate surgery, biliary disease, cancer and orthopedic

surgeries. General physiologic declines in all organ systems are characteristic of ageing, but the most important ones affecting surgical risks are those of cardiovascular, pulmonary, immunological and central nervous systems. These systems must be assessed by an orderly preoperative evaluation that aims to optimize the patient's status and anticipate and minimize postoperative complications.

PRE-OPERATIVE LAB TESTING

A battery of tests are usually ordered before surgery which is often based upon policy at the respective hospital. These tests are expensive and may not have any clinical relevance. In a study by Schein et al it has been concluded that, routine medical testing before cataract surgery does not measurably increase the safety of surgery¹⁶. Smetana et al have recommended a set of laboratory tests before elective surgery with indications there of which is as in Table 4. In general, clinicians should order tests only if the outcome of an abnormal test will influence management¹⁷.

PRE-OPERATIVE MEDICATION MANAGEMENT

Because some medications are known to influence surgical risk or surgical decisions (anticoagulants, antiplatelet drugs, hormonal therapies and herbal drugs), it is important to obtain a complete medication list from the patient. Most medications are tolerated well through surgery and do not interfere with anesthetic administration. Therefore, most drugs should be continued through morning of surgery unless totally unnecessary (e.g., vitamins) or contraindicated (e.g., herbal drugs). Diabetics will require adjustment of insulin or oral hypoglycemic drugs. Those on chronic steroids will require stress-dose steroids. Patients on antihypertensive medications may require parenteral equivalents while NPO. Anti-ischemic regimens can be changed to transdermal or parenteral equivalents. A careful review with the patient should also include alcohol use and evaluation of the potential for alcohol withdrawal while hospitalized. In particular, antihypertensives, anticoagulants and antipsychotic medications should be checked peri-operatively. Necessary medications can be given with a sip of water a few hours before surgery.

BETA-BLOCKERS FOR ELECTIVE SURGERY

The most important recent observation in the field of perioperative cardiac risk is that peri-operative beta-blockers markedly reduce the risk of cardiac

Table 4: Recommendations for lab tests prior to elective surgery

<i>Tests</i>	<i>Incidence of abnormalities that influence management</i>	<i>Indications</i>
1. Hemoglobin	0.1%	Anticipated major blood loss or symptoms of anemia
2. TLC	0.0%	Symptoms suggest infection, myeloproliferative disorder or myelotoxic indications
3. Platelet Count	0.0%	History of bleeding diathesis, myeloproliferative disorder or myelotoxic indications
4. Prothrombin Time	0.0%	History of bleeding diathesis, chronic liver disease, malnutrition, recent or long-term antibiotic use
5. Glucose	0.5%	Obesity or known diabetes
6. Urine	1.4%	No indication
7. LFT	0.1%	No indication. Consider albumin for major surgery or chronic illness
8. RFT	2.6%	Age > 50 years, hypertension, cardiac disease, major surgery, medication that affect renal function
9. Electrolytes	1.8%	Known renal insufficiency, congestive heart failure, Medication that affect electrolytes
10. ECG	2.6%	Men > 40 years, Women > 50 years, Known CAD, Diabetes, or Hypertension
11. Chest X-Ray	3.0%	Age > 50 years, Known cardiac disease or pulmonary disease, Symptoms or exam suggest cardiac or pulmonary disease

complications in selected patients. Four separate large-scale randomized trials have now addressed the benefit of this observation. The result of these trials show reduction in the rate of post-operative myocardial infarction and cardiac deaths from 55 to 93%¹⁸. The patients who benefit from beta blockade include those with history of known or suspected CAD.

SUMMARY

The goal of pre-operative risk assessment is to determine if a patient is at average or increased risk for a specific procedure, or to recommend diagnostic testing if this determination cannot yet be made. However many internists may be uncomfortable in this role¹⁹. As no patient is clear of risk, the phrase "medical clearance" is

misleading and should not be used by a medical consultant. Good communication is an essential feature of preoperative evaluation. Findings and recommendations should always be discussed with the referring anesthetist and surgeon, ideally in person. The patient should understand that medical consultation has been requested by their anesthetist or surgeon, that these services are working together as a team to optimize the care and that the final decision on whether or not to operate will be made by the surgeon. In an era where outcomes are important, the physician evaluates patients undergoing non-cardiac surgery and outline the perioperative risks, optimize the chronic conditions and make evidence based recommendations for patients, the anesthesiologists and surgical team. This systemic approach results in state and quality care for patients.

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