Preoperative Anaesthetic Risk Assessment and Risk Reduction Before Surgery

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Each time we undertake a surgery or an invasive procedure under anaesthesia there is a risk involved, based on the clinical problems affecting the patient in addition to the surgical invasion. It is important to measure each individual’s risk before any surgery and reduce risk to a minimum because the operating room is a bad place for surprises. The pre-operative risks affect how the patient behaves during all the phases of anaesthesia and surgery, the intra-operative and post-operative problems, and the post-operative course of recovery. At the present time, with safer anaesthesia and aging of the population leading to patients with co-morbidities being increasingly taken up for surgery, safe anaesthesia practice has become the science and art of predicting, measuring and limiting or optimizing peri-operative risks, with the anaesthesiologist as peri-operative physician and the key cog linking all the other clinicians in the group caring for the higher-risk surgical patient.

The pre-operative risks that affect the peri-operative course are usually those due to systemic co-morbidities. The organ systems affected by disease may be the cardiovascular, pulmonary, hepatic and renal; physiologic risks may also be present, as in extremes of age and pregnancy. Atypical risks include allergies and idiosyncratic reactions to anaesthetic drugs. To measure and optimize patients to reduce anaesthetic risk, we would have to look for, assess and treat each of these problems where treatable. We would also have to change or modify our plan of anaesthesia and analgesia after taking the known risk factors into account, based on evidence-based protocols.

Objectives:

When we undertake pre-operative risk evaluation, we have to understand that we are not “clearing” a patient for surgery, but assessing the secondary problems that can affect surgery and anaesthesia, with a view to correcting or optimizing these. To do this, we need to know the current evidence-based recommendations for evaluation prior to surgery. Risk-stratifying patients according to their surgeries can be done by using standard algorithms. Medical recommendations also have to be taken into consideration, as the co-existing medical diseases of the patient complicate the surgical and anaesthetic procedures and affect recovery.

Risk evaluation:
If the condition requiring surgery is acutely life-threatening, then we may have to go straight to surgery, without further evaluation and optimization of risks beyond the ones elicited in a rapid history-taking, or obvious on clinical examination. The role of risk evaluation arises when the surgery is not emergent. In such patients, we should:

1. Assess the patient’s risk factors for perioperative morbidity and mortality
2. Assess the surgical risk, based on type of surgery.

This information will help determine the need for diagnostic testing, and the measures needed to prepare higher risk patients for surgery. Pre-operative outpatient medical evaluation may help in decreasing the length of hospital stay prior to the surgery, and minimize postponed or cancelled surgeries.

**Pre-operative History-taking:**

A detailed pre-operative history should include the previous medical and surgical history (cause of hospital stay, duration and the treatments), prior complications of any surgery or anaesthesia. All the medications the patient takes regularly, or has taken recently (including OTC drugs) should be listed and rationalized. Drug treatment may need to change prior to the surgery (for eg. OHAs, anticoagulants etc) and this will need a discussion with the primary physician. Any allergy the patient has should be reviewed, and drug interactions sought. The Immunization Status may be important, especially in pediatric patients. If any immunizations in the schedule were missed, the reason should be sought (for eg. frequent respiratory infections).

Personal history should include addiction to smoking, alcohol and drug use. Smokers should be instructed to stop smoking prior to surgery, for as long as possible.

Any special peri-operative needs the patient may have should also be evaluated – for eg. in those with decreased vision or hearing, needing aids; patients with complete dentures, who may be difficult to mask-ventilate without them; patients on inhaled drugs, who may need to carry the inhalers along to the pre-operative holding area; patients at the extremes of age who may require presence of the parents or care-givers till just prior to anaesthesia etc.

The history should close with the need for post-operative personal or social support, for recuperation or rehabilitation after after hospital stay, or even a ride home from the hospital.
Pre-operative physical examination:

A detailed physical examination should include the vitals- height, weight, BMI, BP, HR, O2 saturation (in room air and with oxygen supplementation in patients with pulmonary disease), RR, temperature (for febrile patients), pain scale scoring for those in pain. Special risks like heart blocks and autonomic neuropathy should be recorded and response to drugs evaluated. Systemic examination should include:

Cardiac examination: murmurs, gallops, signs of CHF, irregular rhythms, etc.
Lung examination: signs of acute or chronic pulmonary disease.
Signs of malnutrition
Mental status examination (baseline)

Pre-operative testing:

Directed pre-operative tests according to standard guidelines will help detect and measure risks 1-5. For routine surgeries in apparently-normal patients, the minimum required investigations would be:

- Healthy < age 40y: CBC, Urine routines, Urine HCG (for females in the reproductive age group)
- Healthy > age 40y: Add EKG and blood glucose to the above.

A patient with elevated cardiovascular risk factors would need, in addition to the above:

- If recent MI < 6 weeks, unstable angina, decompensated CHF, significant arrhythmias, severe valvular disease: cardiology consultation.
- Previous MI> 6 weeks, mild stable angina, compensated CHF, DM: stress test, +/- echocardiogram.
- Rhythm other than NSR, h/o abnormal EKG, h/o CVA, advanced age, or low functional capacity: stress test.

Cardiac risk:

Perioperative myocardial infarction around the time of the surgery is the main cause of morbidity and mortality in patients undergoing non-cardiac surgery. Perioperative management aims at optimizing the patient’s condition by identifying underlying cardiac risk factors and diseases. During surgery the patient might be susceptible to prolonged myocardial ischemia, which decreases oxygen supply to the heart during the stress of the surgery in the presence of significant narrowing of the coronary arteries. This will lead to
subendocardial ischemia (decreased blood flow to the inner area of the heart muscle) or may lead to coronary occlusion after a plaque rupture with subsequent blood clot formation.

Systemic medical therapy prior to surgery aims to prevent mismatch of myocardial oxygen supply and demand, and to stabilize coronary plaques to reduce the risk of perioperative myocardial infarction. Medications like beta-blockers, statins and aspirin are widely used for this purpose in this setting.

Around the time of surgery patients should also be asked to change their life-style and medical therapy to lessen the impact of cardiovascular risk factors, as the patient should live long enough after the operation to enjoy the benefit of the surgery.

Several cardiovascular risk indices are available (eg. Detsky's Modified Cardiac Risk Index, Eagle's Cardiac Risk Assessment, ACC-AHA Preoperative Cardiac Risk Assessment) and should be used in assessment.

Predictors of major cardiovascular complications include:

1. Surgery lasting more than one hour in duration.
2. Ischemic heart disease, such as coronary arteriosclerosis, myocardial infarction, or poor circulation to the lower extremities.
3. Congestive heart failure
4. Previous stroke or CVA (cerebro-vascular accident).
5. Insulin-dependent diabetes mellitus.
6. Renal failure.

Depending on the presence of one or more of these factors, we can predict the rate of major cardiac complication after surgery. Complication risk is less than 0.4% if none of these factors are present and 0.9%, 7%, and 11% if one, two or three factors are present respectively.

The use of beta-blockers was associated with a significant decrease in the size of the atheroma (cholesterol build-up) in the artery. Highly selective beta 1-blockers are most recommended and long acting beta-blockers are better than short-acting ones.

Cholesterol lowering agents (statins) have been demonstrated to decrease lipid, lipid oxidation, inflammation, and cell death. These properties of statins may stabilize coronary plaques thereby preventing their rupture and subsequent myocardial infarction in the perioperative period. Side effect such as statin-induced myopathy (muscle
damage) and rhabdomyolysis (muscle destruction) are a major concern, but the potential benefit of perioperative statin therapy appear to outweigh the risk of potential hazard. Therapy should be initiated a few days before surgery in combination with dose adjustment for tight heart rate control. It is strongly advised to continue the beta-blocker therapy throughout the perioperative period. Additionally, there is benefit in the long run for continuation of beta-blocker use, even up to 30 months after surgery.

**Pulmonary risk:**

Pulmonary complications form an important postoperative morbidity after major cardiothoracic and abdominal operations. The appropriate preoperative assessment of the risk of such complications is well defined for lung resection and esophagectomy operations, but it requires refinement for general surgical and cardiovascular operations. However, postoperative pulmonary complications occur after 25 to 50% of major surgical procedures. The accuracy of the preoperative assessment of the risk of such complications is only fair at best. Specific detailed tests such as measurement of spirometric values and diffusing capacity are indicated routinely only for patients who are candidates for major lung resection or esophagectomy.\(^8\)

Because of the high incidence of these complications and their associated costs such as prolonged hospital stay and mortality, we need to be able to predict which patients are at increased risk for developing such complications and to identify techniques that can be used to prevent them.

Risk factors for pulmonary complications can be grouped into patient-related and procedure-related risks. The potential patient-related factors include the following:

1. Age
2. Chronic lung disease
3. Asthma
4. Smoking
5. General health status
6. Obesity
7. Obstructive sleep apnea
8. Pulmonary hypertension
9. Heart failure
10. Upper-respiratory infection
11. Metabolic factors
Surgical factors that may potentially affect pulmonary risk include the following:

1. Surgical site
2. Duration of surgery
3. Type of anaesthesia
4. Type of neuromuscular blockade
5. Additionally, emergency surgery increases the risk for pulmonary complications

Any history suggesting unrecognized chronic lung disease or heart failure, such as exercise intolerance, unexplained dyspnea, or cough, requires further consideration.

Physical examination should be directed toward evidence for obstructive lung disease, especially noting decreased breath sounds, wheezes, rhonchi, or prolonged expiratory phase. In addition, measurement of oxygen saturation by oximetry helps to stratify risk and is useful before high-risk surgeries.

Laboratory tests serve as adjuncts to the clinical evaluation and should be obtained only in selected patients. Potential preoperative laboratory tests include the following:

- Pulmonary function tests (PFTs)
- Arterial blood gas analysis
- Chest radiographs
- Exercise testing

Postoperative pulmonary complications are an important source of perioperative morbidity and mortality. They represent an extension of the normal physiologic changes in the lung that occur with anaesthesia. Definite risk factors for these complications include the following:

1. Age >50 years
2. Chronic obstructive lung disease
3. Congestive heart failure
4. Poor general health status as defined by ASA class >2
5. Functional dependence
6. Obstructive sleep apnea
7. Pulmonary hypertension
8. Low oxygen saturation
9. Serum albumin <35 gm/L
10. Upper abdominal, thoracic, aortic, head and neck, neurosurgery, and abdominal aortic aneurysm surgery
11. Surgery lasting greater than three hours
12. Emergency surgery
13. Use of pancuronium as a neuromuscular blocker

Probable risk factors include the following:

1. General anesthesia (when compared with spinal or epidural anesthesia)
2. PaCO2 >45 mmHg
3. Abnormal chest radiograph
4. Cigarette use within the previous eight weeks
5. Current upper respiratory tract infection.

Summary of the recommended preoperative tests for patients with pulmonary risk factors are:

- CXR, CBC, blood biochemistry, EKG.
- Provide instructions for incentive spirometry or deep breathing exercises.
- Asthma: PFTs or Peak flowmetry
- COPD: PFT, ABG (baseline)
- Cough, dyspnea: Evaluate etiology
- Smoking: Counsel on tobacco cessation 8 weeks prior to procedure.

**Renal risk:**

The rate of perioperative acute kidney injury (AKI) is difficult to know precisely as it is dependent on definitions used and type of surgery studied\(^{10}\). In cardiac surgery, rates of kidney injury range between 7.7% and 11.4 % when defined broadly, whereas frequency of AKI requiring dialysis is generally lower, ranging between <1% and 5%. In gastric bypass surgery AKI reportedly occurs in 8.5% of patients. Kheterpal et al recently studied a noncardiac surgery population with preoperative normal renal function and noted an incidence of renal failure defined by GFR less than 50 mL/min as 0.8%\(^{11}\).

Postoperative AKI increases morbidity, mortality, length of stay, and costs of care. AKI is associated with increased risk of death, as well as risk of progressive renal failure. Reported crude hospital mortality rates associated with AKI are as high as 60%, with 7-fold to 10-fold increase in mortality than those without AKI. Thus the prevention or treatment of AKI and amelioration of its severity would result in improved patient outcomes.
AKI after a surgical procedure results from preoperative comorbid status, the type of surgical procedure, and immediate postoperative course. Renal risk factors have also been stratified into a risk assessment index by Thakar et al\textsuperscript{12}, on the basis of a single center study which included over 30,000 cardiac surgery patients, based on preoperative risk factors to predict postoperative need for dialysis. Female sex, type of surgery (valve replacement with or without coronary-artery bypass grafting), preoperative cardiovascular status, and preoperative renal function were identified as significant predictors of postoperative AKI. This clinical score discriminates predicted probability of AKI between <1\% and >20\%, based on a simple bedside risk-assessment tool.

Pre-operative risk score for AKI after cardiac surgery:

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>1</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>1</td>
</tr>
<tr>
<td>Insulin dependent diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Left ventricular ejection fraction&lt;35%</td>
<td>1</td>
</tr>
<tr>
<td>Prior surgery</td>
<td>1</td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>2</td>
</tr>
<tr>
<td>Preoperative intra-aortic balloon pump</td>
<td>2</td>
</tr>
<tr>
<td>Preoperative creatinine value:</td>
<td></td>
</tr>
<tr>
<td>1.2 to&lt;2.1 mg/dL</td>
<td>2</td>
</tr>
<tr>
<td>&gt;2.1 mg/dL</td>
<td>5</td>
</tr>
<tr>
<td>Surgery type:</td>
<td></td>
</tr>
<tr>
<td>Valve replacement only</td>
<td>1</td>
</tr>
<tr>
<td>Coronary artery bypass graft + valve replacement</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
</tr>
</tbody>
</table>

There appears to be no single therapy that will prevent perioperative AKI. Clinical risk factors are similar but not identical in different surgical populations. It is likely that we can reduce perioperative AKI through better optimization and management of the many comorbidities and hemodynamic derangements that have been shown to impact renal function. We also need to develop more accurate risk prediction indices for patients in other surgical settings.

**Hepatic risk:**

Patients with liver disease are at particularly high risk for morbidity and mortality in the postoperative period due to both the stress of surgery and the effects of general
anesthesia. Decompensated liver disease increases the risk of postoperative complications (eg, acute hepatic failure, infections including sepsis, bleeding, poor wound healing, and renal dysfunction). Assessing risk in these patients is a challenging but important endeavor.

Liver disease comprises a large spectrum of hepatic dysfunction. It includes asymptomatic transaminitis, cirrhosis, and end-stage liver disease. The most common causes of advanced liver disease are chronic viral infections, alcohol abuse, autoimmune disease, drugs or toxins and metabolic disorders.

Cirrhosis is a major risk factor for perioperative complications. Patients with compensated liver disease (mild chronic hepatitis, non-alcoholic steatohepatitis, etc.) generally tolerate surgery well.

Screening for liver disease should include a careful history and physical exploring for: jaundice, alcohol use, blood transfusions, IV drug use, sexual history; spider telangiectasias, palmar erythema, gynecomastia, testicular atrophy, splenomegaly, ascites, etc. Checking serum AST, ALT, alkaline phosphatase and bilirubin could be done for patients with risk factors for liver disease:

- Acute viral hepatitis carried 10% mortality and 11% morbidity in one study of open liver biopsy.
- Alcoholic hepatitis demonstrated 55-100% mortality in patients undergoing laparotomy.
- Other risk factors for morbidity include: ascites, encephalopathy, infection, anemia, malnutrition, jaundice, hypoalbuminemia, portal hypertension, prolonged PT (that does not correct with vitamin K), hypoxemia, and renal insufficiency.

The features of liver disease raise surgical risk are:

- Baseline increased cardiac index and decreased systemic vascular resistance, augmented by anaesthetics and blood loss.
- Poor hepatic metabolism of anaesthetic agents and other medications administered perioperatively.
- Bleeding risk from impaired synthesis of thrombopoetin and clotting factors, splenic platelet sequestration.
- Pulmonary risk from ascites or pleural effusions; pulmonary hypertension and/or hepatopulmonary syndrome.
- Infection risk due to impaired reticuloendothelial cell function, ascites-related risk for abdominal wound dehiscence.
- **Risk for renal insufficiency** due to hypotension, ascites, diuretic therapy, and/or hepatorenal syndrome.

The surgeries that carry the highest risk for patients with hepatic disease are:

- Emergency and trauma surgery
- Surgery involving significant blood loss (>150 mL)
- Intra-abdominal surgery, especially if there has been previous abdominal surgery and lysis of vascular adhesions is required
- Cardiac surgery
- Hepatic resection

Well-known scoring systems have been developed for hepatic risk evaluation.

**Child-Pugh classification** of cirrhosis correlates well with operative morbidity and mortality in retrospective studies. To calculate this score, total the number of points for each presentation on the following chart:

<table>
<thead>
<tr>
<th>Presentation</th>
<th>1 Point</th>
<th>2 Points</th>
<th>3 Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin (g/dL)</td>
<td>&gt;3.5</td>
<td>2.8-3.5</td>
<td>&lt;2.8</td>
</tr>
<tr>
<td>INR (PT secs. prolonged)</td>
<td>&lt;1.7 (&lt;4)</td>
<td>1.7-2.3 (4-6)</td>
<td>&gt;2.3 (&gt;6)</td>
</tr>
<tr>
<td>Bilirubin (mg/dL)</td>
<td>&lt;2</td>
<td>2-3</td>
<td>&gt;3</td>
</tr>
<tr>
<td>Ascites</td>
<td>Absent</td>
<td>Slight-moderate</td>
<td>Tense</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>None</td>
<td>Grade I-II</td>
<td>Grade III-IV</td>
</tr>
</tbody>
</table>

| Class A | 5-6 points | ~10% mortality |
| Class B | 7-9 points | ~30% mortality |
| Class C | 10-15 points | ~75-80% mortality |

**Modified Model for End-stage Liver Disease (MELD) score**: higher scores generally correlate with worse outcomes. For patients with MELD > 15, the finding of serum albumin < 2.5 has been shows to correlate with worse outcomes.

\[
\text{MELD} = 3.78 \times \log_e (\text{bilirubin in mg/dL}) + 11.2 \times \log_e (\text{INR}) + 9.57 \times \log_e (\text{creatinine in mg/dL}) + 6.43 .^*
\]

(*Enter 1 for creatinine < 1.0 or 4 for creatinine > 4 or dialysis. Round to nearest integer.)*

In one retrospective study, mortality risk (all surgeries) was as follows:
In that same study, mortality risk (intra-abdominal surgeries) was:

<table>
<thead>
<tr>
<th>MELD</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prob. of death (%)</td>
<td>5</td>
<td>7</td>
<td>11</td>
<td>17</td>
<td>26</td>
<td>36</td>
<td>50</td>
<td>59</td>
<td>67</td>
</tr>
</tbody>
</table>

It has been suggested that patients with a MELD score below 10 can undergo elective surgery, those with a MELD score of 10 to 15 may undergo elective surgery with caution, and those with a MELD score >15 should not undergo elective surgery.\(^{14}\)

Surgery is generally contraindicated with acute or fulminant hepatitis, alcoholic hepatitis, severe chronic hepatitis, Child class C cirrhosis, and/or severe complications of liver disease, such as coagulopathy, acute renal failure, hypoxic pulmonary disease, infection, etc. Surgery may be considered for patients with Child class A and B cirrhosis (and possibly a subset of patients with Child class C cirrhosis and MELD score <14) only after thorough evaluation by a hepatologist and optimization of medical management. Consideration should be given to delaying elective surgery until after liver transplantation.

We should consider making the following recommendations for all patients with compensated Child’s class B disease:

- Delay surgery until after transplantation and/or suggest a less-invasive option: angioplasty in place of cardiac surgery, cholecystostomy in place of cholecystectomy, etc.
- Preoperative TIPS may reduce perioperative morbidity (decreased GI bleeding) for patients with severe portal hypertension.
- Treat ascites with diuretics (if peripheral edema present), salt restriction and/or paracentesis.
- Evaluate renal function preoperatively.
- Correct coagulopathy with vitamin K and FFP and/or factor VIIA to normalize PT; +/- cryoprecipitate or DDAVP. FFP or factor VIIA, if given, should be given immediately before or during surgery due to short factor half-life and risk for volume overload.
- Keep extra cross-matched blood on hand, but note that transfusion may be associated with worsened outcomes.
Consider transfusing platelets if severe thrombocytopenia is present; optimal platelet count is unknown.

- Monitor renal function (BUN, Cr, electrolytes) and hepatic synthetic function (albumin, PT/INR, glucose) closely.
- Use beta blockade (unless contraindicated) and avoid fluid overload in patients with gastroesophageal varices.

**Bleeding risk:**

Patients undergoing surgery should have a bleeding history taken. This should include detail of previous surgery and trauma, a family history, and detail of anti-thrombotic medication. Patients with a negative bleeding history do not require routine coagulation screening prior to surgery. Personal and family histories are the most important assessments of a patient’s individual risk for bleeding and thrombosis with surgery, and will often rule out the need for routine coagulation testing.

If the bleeding history is positive or there is a clear clinical indication (e.g. liver disease), a comprehensive assessment, guided by the clinical features is required.

The first-line clotting tests commonly used are the activated partial thromboplastin time (APTT) and the prothrombin time (PT). These are both measured using automated analysers. The standardized skin bleeding time (BT) is occasionally performed.

The APTT is a test of the integrity of the intrinsic and common pathways of coagulation. It is designed to detect bleeding disorders due to deficiencies of factors VIII, IX, and XI and inhibitors of the intrinsic and common pathway factors (including lupus anticoagulant and therapeutic anticoagulants). It also detects deficiency of factor XII.

The PT assesses the integrity of the extrinsic and common pathways. PT prolongation detects important deficiencies (or rarely inhibitors) of factors II, V, VII and X. Its main use is for anticoagulant monitoring and detection of acquired bleeding disorders (especially disseminated intravascular coagulation, liver disease and vitamin K deficiency).

Skin bleeding time is the only in vivo haemostasis test available. It is used to test for defects of platelet-vessel wall interaction and could detect inherited or acquired disorders of platelet function, von Willebrand disease (VWD) and abnormalities of vessel wall integrity.
A number of other tests designed to better reflect primary haemostasis and global haemostatic mechanisms have been developed. These include the platelet function analyser-100 (PFA-100), the thrombelastogram and measures of endogenous thrombin potential. Presently, these methods are not used routinely and have not been validated for use in a preoperative setting.

Assessing a patient’s risk of bleeding with surgery:\textsuperscript{15}:

\begin{center}
\includegraphics[width=\textwidth]{diagram.png}
\end{center}

**Risk of perioperative DVT:**

Owing to a growing geriatric population undergoing surgical procedures following which they are confined to bed for periods of time, the risk of peri-operative deep vein thrombosis complicated by embolism is a possible risk we should be conscious about and try to prevent.

We need to understand risk of DVT development in different patient groups, choose risk appropriate DVT prophylaxis, and provide appropriate bridging therapy for patients on anticoagulation.

In those < 40y, VTE risk is approximately 1 in 10,000 while for those of 70 to 80y, the risk rises sharply to about 1 in 625. However, VTE is usually silent & predicting symptomatic VTE is difficult; screening for VTE is not cost-effective.
The independent risk factors for VTE after hospitalization for acute illness are:

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per 10 years)</td>
<td>1.23</td>
<td>1.08, 1.40</td>
<td>0.001</td>
</tr>
<tr>
<td>BMI (kg/m², per 2-fold increase)</td>
<td>2.73</td>
<td>1.52, 4.92</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Extremity Paresis</td>
<td>5.07</td>
<td>2.13, 12.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fracture</td>
<td>4.06</td>
<td>1.62, 10.14</td>
<td>0.003</td>
</tr>
<tr>
<td>Chronic Renal Disease</td>
<td>3.70</td>
<td>1.08, 12.67</td>
<td>0.037</td>
</tr>
<tr>
<td>Central Venous Catheter</td>
<td>3.30</td>
<td>1.63, 6.70</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prior Superficial Vein Thrombosis</td>
<td>2.46</td>
<td>1.19, 5.11</td>
<td>0.016</td>
</tr>
<tr>
<td>Immobility Requiring PT</td>
<td>2.30</td>
<td>1.63, 4.05</td>
<td>0.004</td>
</tr>
<tr>
<td>Anticoagulation Prophylaxis</td>
<td>0.39</td>
<td>0.17, 0.86</td>
<td>0.019</td>
</tr>
</tbody>
</table>

The absolute risk of DVT in hospitalized patients depending on type of surgery is about:

<table>
<thead>
<tr>
<th>Patient group</th>
<th>DVT Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical patients</td>
<td>10–20</td>
</tr>
<tr>
<td>General surgery</td>
<td>15–40</td>
</tr>
<tr>
<td>Major gynecologic surgery</td>
<td>15–40</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>15–40</td>
</tr>
<tr>
<td>Stroke</td>
<td>20–50</td>
</tr>
<tr>
<td>Hip or Knee arthroplasty, HFS</td>
<td>40–60</td>
</tr>
<tr>
<td>Major Trauma</td>
<td>40–80</td>
</tr>
<tr>
<td>Spinal Cord Injury</td>
<td>60–80</td>
</tr>
<tr>
<td>Critical care patients</td>
<td>10–80</td>
</tr>
</tbody>
</table>

These risks can be prevented and managed by using pneumatic compression hose, ambulating patients as soon as possible, prophylactic anticoagulation with low molecular weight heparin to fondaparinux. The anticoagulation may need to be prolonged post-operatively depending on the time taken by the patient for recuperation.

**Medication-associated risks:**

These are important especially in patients with cardiac disease. In patients with recent coronary stenting, whenever possible, delay non-cardiac surgery for:

- 4 to 6 weeks for bare metal stent
- At least 12 months for drug-eluting stent
Optimize antiplatelet therapy with aspirin and clopidogrel by stopping the drugs (if the cardiologists concur) for 3 to 7 days prior to elective surgery, and continuing it or reinstating it as early as possible after the procedure. They may be replaced by heparin or tirofiban, around the time of surgery to keep down the risk of clots. Tirofiban is a synthetic, non-peptide inhibitor acting at glycoprotein (GP) IIb/IIIa receptors in human platelets. It has a rapid onset and short duration of action after proper IV administration. Coagulation parameters turn to normal 4 to 8 hours after the drug is withdrawn.

Also consider the need for endocarditis prophylaxis based on protocol. The major changes in the updated AHA recommendations (2007) for peri-operative IE prophylaxis include the following:\textsuperscript{18}:

1. Only an extremely small number of cases of infective endocarditis might be prevented by antibiotic prophylaxis for dental procedures even if such prophylactic therapy were 100\% effective.
2. Infective endocarditis prophylaxis for dental procedures is reasonable only for patients with underlying cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis. Prophylaxis is not recommended based solely on an increased lifetime risk of acquisition of infective endocarditis.
3. Administration of antibiotics solely to prevent endocarditis is not recommended for patients who undergo a genitourinary or gastrointestinal tract procedure.

The new guidelines are intended to define more clearly when infective endocarditis prophylaxis is or is not recommended and to provide more uniform and consistent global recommendations.

**Conclusion:**

In recent years, with more complex procedures being undertaken in more morbid patients with a number of risk factors, anaesthesiologists have become peri-operative physicians who are the experts in assessing, minimizing and treating peri-operative risk factors. Successful conclusion of anaesthesia care of the surgical patient necessitates that we be conversant with the possible risks and evidence-based management, and assume total care of the patient.

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