INTRODUCTION

- 3 Million surgical procedures performed each year in the UK with a 30 day mortality of 0.7-1.7%.
- A recent study published by a UK health database which studied 4 million surgical procedures demonstrated that a small group of patients had a mortality of 80% but only underwent 12.5% of the surgical procedures.
- The Confidential Enquiry into Peri-operative Deaths looked at a series of 500,000 patients, and showed that the majority of postoperative deaths occurred in elderly patients with pre-existing cardiac or pulmonary disease.
- These high-risk patients have a poor postoperative outcome due to their inability to meet the oxygen transport demands imposed on them by the nature of the surgical stress response.
It is important to remember that the identification of the high risk surgical patient will only be of any value if there is a change in these patients peri-operative care prompted by the abnormal findings.
SURGICAL STRESS AND DO2

- Major surgery is associated with a significant systemic inflammatory response with an increase in the systemic oxygen demand.
- The inflammatory response generated by major surgery leads to an increase in the oxygen requirement from an average of 110 ml/min/m² to 170 ml/min/m².
- Studies have shown that a major surgical procedure such as an AP resection will increase the systemic oxygen demand by up to 40%.
- In health DO2 is augmented by increasing the cardiac output and the oxygen extraction ratio.
- If a patient is unable to do this due to cardiopulmonary disease, tissue dysoxia results, which in the face of increased metabolic demands will lead to cellular dysfunction, organ dysfunction, failure and death.
- Complications and death following surgery have been associated with reduced DO2 and VO2 or a surrogate, the central venous oxygen saturation.
- Reduced perfusion of the gut has also been implicated in post operative organ dysfunction, due to disruption of the gut endothelial barrier with bacterial translocation activating multiple inflammatory pathways.
- It must be noted that global DO2 is measured, whereas it is probable that regional, organ specific or microcirculatory areas are the ones with compromised oxygenation.
- Nevertheless, it has been shown that augmenting global DO2 is beneficial.
WHAT IS A HIGH RISK SURGICAL PATIENT

- Various definitions of high risk.
- Two different components of high risk - high risk patient and high risk procedure.

**High risk patient** - individuals' risk of mortality is greater than 5% or twice the risk of the general population undergoing the same procedure.

**High risk procedure** - high risk procedure is a procedure with an operative mortality exceeding 5%.

**Extremely high risk patient** - Surgical patients with a probable mortality of greater than 20% - studies have shown greatest benefit of perioperative optimisation and ICU care in these patients.

DR N GRABOWSKI - 2/2/2011
IDENTIFICATION OF THE HIGH RISK SURGICAL PATIENT - PATIENT FACTORS

- Detailed history and physical examination focusing on pre-existing disease is the first step in identifying the high-risk patient.
- The impact of these co-morbidities on the functional status of the patient will highlight those that will benefit from further investigation and intervention.
- In patients with low functional capacity, formal exercise stress testing should be done; this involves objectively measuring the ability of the cardiovascular system to meet oxygen demands under stress.
- Several scoring systems have been developed to identify high-risk surgical patients (see next slides).
- The most commonly used one is the ASA - patients with an ASA score of 3 and 4 have a 50% mortality for some procedures.
- The American College of Cardiology (ACC) guidelines identify a group of cardiac conditions, that when present indicate significant clinical risk:
  - unstable coronary syndromes (unstable angina or a MI within the last month)
  - decompensated cardiac failure
  - arrhythmias
  - Severe valvular disease
CLINICAL CRITERIA FOR HIGH-RISK SURGICAL PATIENTS

LEES ET AL. CRITICAL CARE 2009 13:231

- 1. Severe cardiac or respiratory illness resulting in functional limitation.
- 2. Extensive surgery planned for carcinoma involving bowel anastomoses.
- 3. Acute massive blood loss (>2.5 litres)
- 4. Aged over 70 years with moderate functional limitation of one or more organ systems.
- 5. Septicemia (positive blood cultures or septic focus).
- 6. Respiratory failure (PaO2 < 8 kPa on FiO2 >0.4, that is a PF ratio of <200 or ventilation > 48 hours).
## American Society of Anaesthesiologists Classification (ASA)

<table>
<thead>
<tr>
<th>ASA Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Healthy Patient</td>
</tr>
<tr>
<td>2</td>
<td>Mild Systemic Disease with no functional limitation</td>
</tr>
<tr>
<td>3</td>
<td>Systemic Disease with functional limitation</td>
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<tr>
<td>4</td>
<td>Severe Systemic Disease with constant threat to life</td>
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<tr>
<td>5</td>
<td>Moribund patient unlikely to survive 24 hrs with or without surgery</td>
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<tr>
<td>E</td>
<td>Denotes emergency surgery</td>
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ASSESSING FUNCTIONAL CAPACITY

- Physiological age rather than chronological age is a predictor of mortality can be difficult to objectively quantify.
- Many commonly performed investigations for cardiac disease none designed for preoperative screening however.
- A study performed by the Study of Perioperative Ischaemia Research Group did not support the use of transthoracic echo in the assessment of cardiac risk prior to non cardiac surgery- poor correlation between echo findings and functional capacity and reserve.
- Ejection fraction assessed by radionuclide ventriculography correlates poorly with exercise capacity and the peak oxygen uptake.
- Dobutamine stress echocardiography while used for the evaluation of myocardial ischaemia and can detect wall motion abnormalities, gives no objective measurement of functional capacity.
ASSESSING FUNCTIONAL CAPACITY

**SOWHAT ARE THE ALTERNATIVES?**

A preoperative screening test should ideally be specific and sensitive for the detection of subclinical cardiac failure and cardiac ischaemia. It should be non-invasive, inexpensive and easy to perform on short notice.

**CARDIOPULMONARY EXERCISE TESTING (CPX)**

CPX measures oxygen uptake at increasing levels of work and objectively determines cardiopulmonary performance under conditions of stress.

This test is normally performed using an exercise bicycle using respiratory gas analysis as well as an ECG.

The most repeatable and relevant measurement is the anaerobic threshold (AT).

This is the point at which aerobic metabolism is inadequate for maintenance of high energy phosphate production in exercising muscles, resulting in anaerobic metabolism.

The AT is expressed as a value of oxygen consumption indexed to body mass (ml/min/kg).

In a series of 1600 patients it was shown that an AT of > 11 ml/min/kg predicts postoperative survival with high sensitivity and specificity. In this series all patients that died due to cardiovascular events postoperatively had an AT less than 11 ml/min/kg.
IDENTIFICATION OF THE HIGH RISK SURGICAL PATIENT-SURGICAL FACTORS

- High risk surgery relates to the extent, invasiveness or complexity of the procedure.

- Vascular surgery, extensive surgery for carcinoma, intra-abdominal surgery for sepsis, multiple cavity trauma surgery, emergency surgery and surgery of a long duration.

- All of these factors are associated with an increase in the stress response to the surgical insult, an increase in the oxygen demand and an increased rate of complications and death.
# American College of Cardiology Specific Cardiac Risk

<table>
<thead>
<tr>
<th>Risk of Mortality or Major MI</th>
<th>Surgical Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong> (&gt;5%)</td>
<td>Vascular: Aortic, Peripheral Vascular</td>
</tr>
<tr>
<td><strong>Intermediate</strong> (-1-5%)</td>
<td>Intraperitoneal, Intrathoracic Procedures, Carotid Endarterectomy, Head and Neck Surgery, Prostate Surgery, Major Orthopaedic Surgery, Gynaecologic Surgery</td>
</tr>
<tr>
<td><strong>Low</strong> (&lt;1%)</td>
<td>Endoscopic Procedures, Breast Surgery, Cataract Surgery, Superficial Surgery</td>
</tr>
</tbody>
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**Dr. N. Grabowski** - 2/2/2011
THE EMERGENCY PATIENT

- Must be kept in mind that emergency procedures have a significantly higher morbidity and mortality.

- The approach to the patient presenting for emergency surgery remains the same as that for the elective patient as far as possible - thorough history and examination as well as appropriate special investigations.

- Patients identified as being high-risk (as a result of patient factors, the pathological process necessitating the emergency surgery as well as the type of surgery planned) will benefit from goal-directed preoperative resuscitation as well as postoperative monitoring in an ICU setting.
GOAL DIRECTED THERAPY

- There is considerable evidence to demonstrate the benefits of augmenting oxygen delivery in the high-risk surgical patient during the peri-operative period.
- Shoemaker et al showed that, in high risk patients with limited physiological reserve, increasing oxygen delivery in the perioperative period can decrease the mortality from 30-40% by using goal directed therapy.
- Multiple studies further support pre-optimisation before surgery and post-optimisation in ICU in a protocolised goal directed manner improves patient outcome in this high risk population.

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GOAL DIRECTED THERAPY

- Early studies looking at GDT used supranormal values of DO2, VO2 and CI as endpoints to be targeted.
- There was however controversy as the targets aimed at supranormal levels and required pulmonary artery catheter monitoring.
- The following goals and resuscitation endpoints should be looked at in this group of patients:
  - DO2 > 600 ml/ min/ m² - PAC/ LIDCO/ VIGELEO
  - CI > 4.5l/ min/ m² - PAC/ LIDCO/ VIGELEO
  - Metabolic endpoints - lactate, ScvO2 > 70%.
  - Benefit in optimising oxygenation status by means of PPV.
  - The Hb should be at least 7 g/ dl - aim closer to 10 in patients with current unstable angina
  - Maintain the DO2 and CI by using fluids as well as inotropes if necessary (dobutamine or epinephrine was suggested)
  - This goal directed therapy should continue for at least 8 hours peri-operatively.


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PERI-OPERATIVE BETA BLOCKERS

- The peri-operative use of b-blockers has been shown in multiple studies to have a significant reduction in morbidity and mortality in patients at high risk for peri-operative myocardial ischaemia as assessed on dobutamine stress echocardiography.

- A study conducted on vascular patients showed a mortality reduction of 17% to 3.4% with the peri-operative use of bisoprolol, in patients with evidence of myocardial ischaemia.
CONCLUSION

- Most peri-operative deaths are over represented by a group of high risk patients who have insufficient physiological reserves to meet the high demands of major surgery.
- Identification of these patients pre-operatively using criteria as above as well as formal testing of functional capacity should be done.
- The anaerobic threshold has been shown to be a good predictor of physiological reserve and response to major surgical stress.
- Assessment and augmentation of global oxygen delivery peri-operatively by means of specific therapeutic goals has been shown by multiple studies to decrease mortality.
REFERENCES