IMPORTANCE

• Half of all currently performed surgical procedures are in patients aged 65 yrs and older

• Urologic operations are performed in patients who are older and sicker than average
Anesthetic Procedures for Urology by Age and Gender and Annual Rate in Catalonia in 2003

GOALS OF GERIATRIC ANESTHESIA

• Elderly patients take longer to return to their preoperative state and often fail to ever be quite as functional as before an operation

Anesthetic Goal:

Facilitate recovery
Avoid functional decline
OBJECTIVES

• Briefly review geriatric anesthetic risks
  – This is not a physiology lecture

• Provide overview of risk assessment tools
  – Cardiovascular
    • Review updated ACC/AHA Guidelines
  – Pulmonary
  – Functional

• Summarize current thinking
ALL ELDERLY ARE NOT ALIKE

- *Aging* must be distinguished from *age-related disease*
AGE-RELATED DECLINE IN HOMEOSTASIS

Increased use of physiologic reserves with aging – fewer reserves available for stress of surgery – may cross precipice into organ failure or death.
ANESTHETIC RISKS SPECIFIC TO AGE

• Physiologic changes occur with aging
  – All body systems

• More sensitive to anesthetic agents
  – Adverse drug reactions more common

• However, age does not imply a level of function
  – Must determine functional capacity in each patient
  – Risk correlates with coexisting disease and procedure

• Post-operative concerns
POSTOPERATIVE COMPLICATIONS

- Patients older than 80 yrs have higher morbidity (51%) and mortality (7%) after surgical procedures than patients overall (28% and 2.3%, respectively)

POSTOPERATIVE COMPLICATIONS

• Major complications increase with age.
• Directly related to poor outcome in the elderly.
  – In patients > 80 yrs, there is a 25% increased 30-day mortality when there are post-op complications.

TYPES OF POSTOPERATIVE COMPLICATIONS

• Cardiac (12%)
• Pulmonary (7%)
• Neurologic (15%)
  – Delirium (15-53%)
  – POCD
  – Stroke
  – Nerve injury
HOW DO WE IDENTIFY PATIENTS AT HIGH RISK FOR COMPLICATIONS?

Risk indices
WHY PREDICT PERIOP RISK?

• Proper informed consent
• Fitness for surgery
  – Risk may be too high to proceed in unfit patient
• Best choice of surgical procedure
  – May choose less aggressive/invasive therapy
• Peri-operative surveillance
  – Invasive monitoring, ICU care
HOW DO WE PREDICT RISK?

• CLASSIFYING SYSTEMS & RISK INDICES
  – ASA Classification (1941)
  – REVISED CARDIAC RISK INDEX (1999)
    • Part of ACC/AHA current guidelines (2007)
  – RFI (2007)
  – MICHIGAN (2009)
  – FRAILTY SCORE (2010)
<table>
<thead>
<tr>
<th>CLASS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 1</td>
<td>A normal healthy patient</td>
</tr>
<tr>
<td>PS 2</td>
<td>A patient with mild systemic disease</td>
</tr>
<tr>
<td>PS 3</td>
<td>A patient with severe systemic disease</td>
</tr>
<tr>
<td>PS 4</td>
<td>A patient with severe systemic disease that is a constant threat to life</td>
</tr>
<tr>
<td>PS 5</td>
<td>A moribund patient who is not expected to survive without the operation</td>
</tr>
<tr>
<td>PS 6</td>
<td>A declared <em>brain-dead patients whose organs are being harvested</em></td>
</tr>
<tr>
<td>E</td>
<td>Modification for emergency operation</td>
</tr>
</tbody>
</table>

Original classification developed in 1941. Its intended use was descriptive rather than predictive of outcome or risk. (This was the first attempt at risk stratification developed for patients.)

*Saklad M. Grading of patients for surgical procedures. Anesthesiology. 1941; 2(3):281-284.*

Expanded in 1994 to include organ donors.
ASA PHYSICAL STATUS

• Subjective
  – Variability in scoring between evaluators
• Score is irrespective of planned surgical procedure
  – Emergency surgery is given special classification
• Age is not an independent factor

Still in use! and has been revalidated many times.
ASA CLASSIFICATION AND POSTOPERATIVE COMPLICATIONS

• Significant correlation between postoperative complications and ASA class

MORTALITY AFTER EMERGENCY SURGERY IN THE ELDERLY

<table>
<thead>
<tr>
<th>MORTALITY (%)</th>
<th>ASA I-II</th>
<th>ASA III</th>
<th>ASA IV</th>
<th>ASA V</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>18</td>
<td>44</td>
<td>89</td>
<td></td>
</tr>
</tbody>
</table>

Prospective cohort study
4315 patients
  Retrospectively derived predictors in cohort of 2893 patients
  Prospectively validated results in cohort of 1422 patients
Age ≥ 50 yrs
Elective surgery
Outcome: cardiac complications
REVISED CARDIAC RISK INDEX

Study in patients undergoing major non-emergent procedures.

- Six independent correlates of major cardiac complications
- Each risk factor is assigned one point:
  - High risk surgery
  - Ischemic heart disease
  - History of congestive heart failure
  - History of cerebrovascular disease
  - Insulin therapy for diabetes
  - Preoperative serum creatinine > 2.0 mg/dL
- Age did not correlate with complications
  - Authors noted that this should not be taken as evidence that age is not a worrisome prognostic factor
REVISED CARDIAC RISK INDEX

<table>
<thead>
<tr>
<th>POINTS</th>
<th>CLASS</th>
<th>RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>I</td>
<td>0.4%</td>
</tr>
<tr>
<td>1</td>
<td>II</td>
<td>0.9%</td>
</tr>
<tr>
<td>2</td>
<td>III</td>
<td>6.6%</td>
</tr>
<tr>
<td>3 or more</td>
<td>IV</td>
<td>11%</td>
</tr>
</tbody>
</table>

• High risk surgery
• Ischemic heart disease
• History of congestive heart failure
• History of cerebrovascular disease
• Insulin therapy for diabetes
• Preoperative serum creatinine > 2.0 mg/dL
REVISED CARDIAC INDEX

• Recommendations
  – Not defined
  – Class III and IV patients may require more extensive preoperative evaluation and more intense peri-operative surveillance
REVISED CARDIAC RISK INDEX

- Index used in current ACC/AHA Guidelines
ACC/AHA 2007 GUIDELINES

Who needs further workup?

ALGORITHM

• Evidence-Based
Decision Making in Cardiac Evaluation Before Non-Cardiac Surgery - I

- **Need for Non-cardiac surgery**
  - elective
  - **Active cardiac conditions**
    - yes: **Eval & treat per ACC/AHA guidelines**
    - no: **Low risk surgery**
      - yes: **Proceed to O.R.**
      - no: **Ex tol: ≥ 4 METS**
        - yes: **Proceed to O.R.**
        - no: emergency

- **Post-op risk stratification & risk factor management**
  - Consider O.R.
Decision Making in Cardiac Evaluation Before Non-cardiac Surgery II

Poor or Unknown Functional Capacity

≥ 3 risk factors
vascular
intermediate
Test if it will change management

1-2 risk factors
vascular
intermediate
Proceed to O.R. with HR control.
Consider noninvasive test if it will change management.

No risk factors
To O.R.
# Procedure-Specific Risk

<table>
<thead>
<tr>
<th>Low Risk (&lt; 1%)</th>
<th>Intermediate Risk (1-5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Endoscopy</td>
<td>• Intraperitoneal</td>
</tr>
<tr>
<td>• Superficial procedures</td>
<td>• Intrathoracic</td>
</tr>
<tr>
<td>• Cataracts</td>
<td>• Carotid endarterectomy</td>
</tr>
<tr>
<td>• Breast</td>
<td>• Endovascular procedures</td>
</tr>
<tr>
<td></td>
<td>• Head and neck</td>
</tr>
<tr>
<td></td>
<td>• Orthopedic</td>
</tr>
<tr>
<td></td>
<td>• Prostate</td>
</tr>
</tbody>
</table>
Exercise Tolerance

My Exercise Plan:
Stretch strenuously
between naps.

1 MET → 10 METS
What is 4 METS?

- Walking 4 blocks
- Climbing 1-2 flights of stairs
- No limiting symptoms
Minor Predictors

• Not proven to independently increase risk
  – Advanced age (>70)
  – Abnormal EKG
  – Rhythm other than sinus
  – Uncontrolled systemic HTN

• Multiple minor predictors lead to a higher suspicion of CAD but are not incorporated into algorithm
Michigan ACS-NSQIP (2009)

- Prospective study
- 7740 non-cardiac operations
  - General, vascular, urologic
- Incidence of cardiac adverse events 1.1%
- Pre-operative and intra-operative model
- Determined 9 independent predictors

Michigan ACS-NSQIP RISK FACTORS

- Age ≥ 68
- BMI ≥ 30
- Emergency surgery
- Previous PCI or cardiac surgery
- Active CHF
- Cerebrovascular disease
- HTN
- Operative duration ≥ 3.8 hrs
- Transfusion of ≥ 1 unit pRBCs

CAE: cardiac arrest, dysrhythmia, Q-wave MI, non-STEMI

Absent:
- IDDM
- Creat > 2
- High risk surgery

# Frequency and Hazard Ratio of CAE Based on Number of Preop Risk Factors

<table>
<thead>
<tr>
<th>PREOP RISK CLASS</th>
<th>FREQUENCY OF CAE</th>
<th>HAZARD RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I (0 risk factors)</td>
<td>0.2%</td>
<td></td>
</tr>
<tr>
<td>Class II (1 risk factor)</td>
<td>0.5%</td>
<td>2.3</td>
</tr>
<tr>
<td>Class III (2 risk factors)</td>
<td>1.3%</td>
<td>6.0</td>
</tr>
<tr>
<td>Class IV (3+ risk factors)</td>
<td>3.6%</td>
<td>16.7</td>
</tr>
</tbody>
</table>

### Perioperative CAE Risk Factors and Adjusted Hazard Ratios

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>HAZARD RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 68</td>
<td>2.3</td>
</tr>
<tr>
<td>Active CHF</td>
<td>4.1</td>
</tr>
<tr>
<td>BMI ≥ 30</td>
<td>1.9</td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>2.2</td>
</tr>
<tr>
<td>Prior cardiac intervention</td>
<td>2.0</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>2.0</td>
</tr>
<tr>
<td>HTN</td>
<td>1.7</td>
</tr>
<tr>
<td>Duration of operation ≥ 3.8 hrs</td>
<td>2.2</td>
</tr>
<tr>
<td>PRBCs ≥ 1 unit</td>
<td>2.6</td>
</tr>
</tbody>
</table>

ANEMIA

• Preoperative anemia increases the risk of adverse outcomes in elderly men undergoing elective surgery
  – Any degree of anemia
  – Independent of the type of surgery

• Postoperative cardiac events are closely linked with anemia

PULMONARY RISK and ACP GUIDELINES (2006)

• Pulmonary complications
  – Highest hospital costs
  – Longest length of stay
  – Age is the most powerful risk factor

• Guidelines developed
  – A = good evidence
  – B = fair evidence
  – C = probably not a risk factor
  – D = good evidence NOT a risk factor

# RISK FACTORS FOR POSTOP PULMONARY COMPLICATIONS

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>STRENGTH OF RECOMMENDATION</th>
<th>ODDS RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced age</td>
<td>A (good)</td>
<td>2.09-3.04</td>
</tr>
<tr>
<td>ASA class ≥ II</td>
<td>A</td>
<td>2.55-4.87</td>
</tr>
<tr>
<td>CHF</td>
<td>A</td>
<td>2.93</td>
</tr>
<tr>
<td>Functionally dependent</td>
<td>A</td>
<td>1.65-2.51</td>
</tr>
<tr>
<td>COPD</td>
<td>A</td>
<td>1.79</td>
</tr>
<tr>
<td>Weight loss</td>
<td>B (fair)</td>
<td>1.62</td>
</tr>
<tr>
<td>Impaired sensorium</td>
<td>B</td>
<td>1.39</td>
</tr>
<tr>
<td>Cigarette use</td>
<td>B</td>
<td>1.26</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>B</td>
<td>1.21</td>
</tr>
<tr>
<td>Abnormal chest exam</td>
<td>B</td>
<td>NA</td>
</tr>
<tr>
<td>Diabetes</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>D (not)</td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>PROCEDURE</td>
<td>STRENGTH OF RECOMMENDATION</td>
<td>ODDS RATIO</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>----------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Aortic aneurysm repair</td>
<td>A (good)</td>
<td>6.9</td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>A</td>
<td>4.24</td>
</tr>
<tr>
<td>Abdominal surgery</td>
<td>A</td>
<td>3.01</td>
</tr>
<tr>
<td>Upper abdominal surgery</td>
<td>A</td>
<td>2.91</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>A</td>
<td>2.53</td>
</tr>
<tr>
<td>Prolonged surgery</td>
<td>A</td>
<td>2.26</td>
</tr>
<tr>
<td>Head and neck surgery</td>
<td>A</td>
<td>2.21</td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>A</td>
<td>2.21</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>A</td>
<td>2.1</td>
</tr>
<tr>
<td>General anesthesia</td>
<td>A</td>
<td>1.83</td>
</tr>
<tr>
<td>Peri-operative transfusion</td>
<td>B (fair)</td>
<td>1.47</td>
</tr>
<tr>
<td>Hip surgery</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Gynecologic or urologic surgery</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>
**UPDATED RESPIRATORY FAILURE INDEX**

- Major vascular and general surgery
- 180,359 patients
- 45 potential risk factors
- 28 risk factors identified as independent predictors
- Respiratory failure defined as post-op mechanical ventilation for > 48 hours or unanticipated reintubation

### SOME IMPORTANT RISK FACTORS

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>ODDS RATIO</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA class III</td>
<td>2.9</td>
<td>+3</td>
</tr>
<tr>
<td>ASA class 4 or 5</td>
<td>4.9</td>
<td>+5</td>
</tr>
<tr>
<td>Orofacial surgery</td>
<td>6.6</td>
<td>+7</td>
</tr>
<tr>
<td>Work RVU &gt; 17</td>
<td>4.4</td>
<td>+4</td>
</tr>
<tr>
<td>Albumin &lt; 3.5</td>
<td>1.5</td>
<td>+1</td>
</tr>
<tr>
<td>Aneurysm surgery</td>
<td>1.6</td>
<td>+2</td>
</tr>
<tr>
<td>Age &gt; 65</td>
<td>2.1</td>
<td>+2</td>
</tr>
<tr>
<td>Smoker</td>
<td>1.1</td>
<td>+1</td>
</tr>
<tr>
<td>Emergency</td>
<td>2.4</td>
<td>+2</td>
</tr>
</tbody>
</table>

**POINTS per risk level:**
- **Low:** $< 8$
- **Medium:** 8-12
- **High:** $> 12$
Respiratory Risk Index and Respiratory Failure Rates

NEW PULMONARY RISK FACTORS
OBSTRUCTIVE SLEEP APNEA

Postoperative Pulmonary Complications

WHAT ANESTHESIOLOGISTS OFTEN DON’T CONSIDER IN RISK ASSESSMENT

• Frailty
• Fatigue
• Mental status
• Depression
• ADL
# FRAILTY SCORE (2010)

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinking (weight loss)</td>
<td>Unintentional ≥ 10 # in past year</td>
</tr>
<tr>
<td>Decreased grip strength</td>
<td>Measure with hand-held dynamometer</td>
</tr>
<tr>
<td>Exhaustion</td>
<td>Effort and motivation</td>
</tr>
<tr>
<td>Low physical activity</td>
<td>Leisure time activities</td>
</tr>
<tr>
<td>Slowed walking speed</td>
<td>Speed walked for 15 feet at normal pace</td>
</tr>
</tbody>
</table>

Each criterion is scored with a 0 or 1  
**Frail: 4-5  Intermed: 2-3  Nonfrail: 0-1**

Frail patients (score > 1) have more postoperative complications, longer length of hospital stay, and increased discharges to nursing homes/assisted living facilities.

AGE AND RISK

• Older patients do worse after emergency surgery
  – More co-morbidities (deterioration of organ function)
  – Morality rate in patients > 74 are double that of patients aged 65-74

• Age is an independent risk factor for PPCs but may or may not be for CAEs.

• A physically fit elderly patient should not be denied an emergency operation based on age