PERIOPERATIVE CARDIOVASCULAR ASSESSMENT OF PATIENTS UNDERGOING NON-CARDIAC SURGERY

MMI 406 - CDSS
Final Project
Our Group

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- Linda Bund
- Natalie Schwartz
- David Sumner
What we’ll discuss

• The Problem
• The Guidelines (past & present)
• CDSS : A Concept
• CDSS : System Architecture
• CDSS : Barriers to Implementation
• CDSS : Implementation
• CDSS : Evaluation
Why are we looking at this particular area of medicine?
Purpose of the “Medical Clearance “Evaluation

- To identify patients with, either known or asymptomatic, ischemic heart disease, who may be at increased risk of peri-operative morbidity and mortality and
- To optimize peri-operative medical management in high risk patients, in order to reduce these risks
The Problem

- More patients of advanced age are becoming candidates for non-cardiac surgery
- More likely to uncover serious cardiovascular issues in this group of patients
- Need an evidence-based, cost-effective approach for
  - Identifying high risk patients
  - Identifying low risk patients that can be sent to the OR without expensive, unnecessary preoperative testing
History of Perioperative Cardiac Assessment

- Physical status classification (American Society of Anesthesiologists)
- Cardiac risk index (Goldman)
- Revised cardiac risk index (Lee)
- Eagle criteria
- ACC/AHA Task Force Report
Physical Status Classification (ASA Criteria)

I. No systemic, organic or psychiatric disease
II. Mild to moderate systemic disease
III. Severe systemic disturbance
IV. Severe life-threatening systemic disorder
V. Moribund patient – not expected to survive

E. Emergency Procedure
# Cardiac Risk Index

<table>
<thead>
<tr>
<th>History</th>
<th>Age over 70</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI in last 6 months</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>JVD or $S_3$</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Significant aortic stenosis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rhythm Other than sinus or PACs</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>More than 5 PVC/min</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>pO$_2$ &lt;50, pCO$_2$ &gt;30</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>K$^+$&lt;3, bicarb&lt;20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN&gt;50, Creatinine &gt;3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevated ALT or chronic liver disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedridden from non-cardiac causes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Emergency</td>
<td>4</td>
</tr>
<tr>
<td>Aortic, Intrathoracic or Intraperitoneal</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

Goldman et al. NEJM 1977;297, 845-850
Revised Cardiac Risk Index

6 independent predictors (n=2893)

1. High risk surgery
2. Ischemic Heart disease
3. Heart failure
4. Cerebrovascular disease
5. Pre-op Treatment with insulin
6. Creatinine > 2mg/dl

<table>
<thead>
<tr>
<th># Predictors</th>
<th>Rate of Major Cx</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4%</td>
</tr>
<tr>
<td>1</td>
<td>0.9%</td>
</tr>
<tr>
<td>2</td>
<td>7.0%</td>
</tr>
<tr>
<td>3</td>
<td>11.0%</td>
</tr>
</tbody>
</table>

Lee et al. CIRCULATION 1999;100:1043
Eagle Criteria

5 Clinical Predictors of post-op cardiac events

1. Q waves on EKG
2. Angina
3. Ventricular ectopy requiring treatment
4. Diabetes requiring therapy
5. Age > 70yrs

# of predictors correlates with Post-op events

ACC/AHA Task Force Report

- Need for non-cardiac surgery
- Cardiac history/ previous evaluation
- Clinical predictors
- Functional capacity
- Surgical risk
- Tests to determine cardiac risk

Circulation 1996; 93:1278-1317
ACC/AHA Decision Making Pocket Guide for Preoperative Cardiac Assessment
ACC/AHA 2007 Guidelines

• Emphasize that cardiac intervention is rarely necessary to lower the risk of surgery

• Pre-operative tests are only recommended if the information obtained will result in
  – a change in the surgical procedure performed,
  – a change in medical therapy, or
  – lead to the use of perioperative monitoring

• Fleisher et al. J Am Coll Cardiol, 2007; 50:159-242
The 2007 Guidelines

1 - Reproduced for clarity in presentation. Based on Figure 1 from ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery: Executive Summary:

STEP 1
- Emergency non-cardiac Surgery?
  - Yes: Class I LOE C
  - No:
    - Active Cardiac Conditions?
      - Yes: Class I LOE B
        - Evaluate & Treat per ACC/AHA guidelines
        - Operating Room
      - No: Consider Operating Room
    - No: Low Risk Surgery?
      - Yes: Proceed with Planned Surgery
      - No:
        - Good Functional Capacity? MET level ≥ 4 w/o symptoms?
          - Yes: Proceed with Planned Surgery
          - No or Unknown:
            - Yes: 1 or 2 Clinical Risk Factors
              - Proceed with Planned Surgery
            - No or Unknown:
              - Vascular Surgery
                - Class IIa LOE B
                - Consider testing if it will change management
              - Intermediate risk surgery
                - Proceed with planned surgery with HR control (Class IIa, LOE B) planned surgery or consider noninvasive testing (Class IIb, LOE B) if it will change management
              - Vascular Surgery
                - Intermediate risk surgery
                - Proceed with Planned Surgery
              - Intermediate risk surgery
                - Proceed with Planned Surgery

Perioperative surveillance and postoperative risk stratification and risk factor management
The Role of CDSS

Guideline Outcomes / Compliance

“Guideline development needs to be completed with guideline implementation, which should ultimately lead to evidence-based clinical practice”

“In our opinion, the addition of web-based patient management tools would be an ideal extra tool to assist physicians with providing decision support and collecting data”

Our Environment

EMR
CDSS: A Concept
Stakeholder Requirements Analysis

- CDSS is based on 2007 Guidelines
- CDSS is executable from within EMR, at point of care
- CDSS Includes:
  - Procedural knowledge representation
  - Rule-based propositional logic
  - Predictive knowledge
- Captures data for iterative improvements
- Can be made required or optional
Logic

Variable Table

<table>
<thead>
<tr>
<th>Variable</th>
<th>Names</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP1</td>
<td>Yes/No</td>
<td>1/0</td>
</tr>
<tr>
<td>STEP2</td>
<td>Yes/No</td>
<td>1/0</td>
</tr>
<tr>
<td>STEP3</td>
<td>High/Int/Low</td>
<td>2/1/0</td>
</tr>
<tr>
<td>STEP4 (1-6)</td>
<td>Total RFs</td>
<td>1-5</td>
</tr>
<tr>
<td>REC</td>
<td>(defined text)</td>
<td>1/2/3</td>
</tr>
</tbody>
</table>

Logic

If STEP1, SET REC=1 GOTO End
ELSE
    IF (STEP2-1 or STEP2-2 or STEP2-3 or STEP2-4) = 1, THEN SET REC=2 GOTO END
ELSE
    IF STEP3= “0” then SET REC=1, GOTO END
ELSE
    SET STEP4-6= (STEP4-1+ STEP4-2+ STEP4-3 + STEP4-4 + STEP4-5)
    IF NOT STEP4-6 then SET REC=1, GOTO END
    etc etc……
# The CANS Tool

<table>
<thead>
<tr>
<th>Admin</th>
<th>Medications</th>
<th>LABs</th>
<th>Imaging</th>
<th>Notes</th>
<th>Orders</th>
<th>Tools</th>
</tr>
</thead>
</table>

## Patient Record

<table>
<thead>
<tr>
<th></th>
<th>Primary Provider: Lee, John S</th>
</tr>
</thead>
<tbody>
<tr>
<td>James S. Biener</td>
<td></td>
</tr>
<tr>
<td>Age: 55</td>
<td></td>
</tr>
<tr>
<td>Sex: M</td>
<td></td>
</tr>
<tr>
<td>Ht: 5'9&quot;</td>
<td></td>
</tr>
<tr>
<td>Wt: 185</td>
<td></td>
</tr>
<tr>
<td>Pt ID# 75234A</td>
<td></td>
</tr>
</tbody>
</table>

**Active Problems:**
- Hypertension *(ICD-9-CM 401.9)* 07/15/10 Bajun, Arturo G
- Hepatitis C carrier V02.62 04/06/09 Lee, John S
- Diabetes *(ICD-9-CM 250.00)* 03/12/09 Lee, John S

- Asthma NHLBI Guidelines
- **Cardiovascular Assessment for Non-Cardiac Surgery (CANS) Tool**
- MHA Depression Screen Tool
- NCBI Geriatric Depression Scale (GDS) Tool
- Reynolds Risk Score Assessment Note
- STAT Framingham Heart Age Tool
The Interface

Patient's Data From EMR

Calculated Data from Surgical Procedure Index

Data Pulled from EMR
The Interface

Provider accepts findings at each step.

Diagnostic & Calculated results based on Duke Activity Status Index Index
Provider can enter data into tool

Provider accepts or rejects CANS Recommendation. (reject requires a reason for future evaluation studies)
11/10/10 - Cardiac Assessment for Non-cardiac Surgery - by CANS Tool
Patient is 55yo male with Diabetes, Hypertension, Hepatitis C carrier. Presents for Cardiac Risk Assessment for non-cardiac surgery [Prostate] scheduled for 11/20/10

Patient has no active cardiac conditions, surgery is low risk, patient has low functional capacity. (1) clinical risk factor: Diabetes: Controlled.

Recommendation: PROCEED WITH PLANNED SURGERY WITH HEART RATE CONTROL OR CONSIDER NON-INVASIVE TESTING IF IT WILL CHANGE MANAGEMENT. // Accepted.
E/S Lee John S. Primary Care Provider - 11/10/10
The System

- Project Management Designation
- Hardware Procurement
  - New database server for CDSS installation
- Software Development
  - Updates to database programming of EMR
- Application acquisition and customization
- Report Management
  - Data-gathering jobs to prepare reports on CDSS usage including comparisons such as progress, outcomes, and patient care
The System
Barriers to Implementation

• Requirements for robust network architecture
  – Ensure limited latency issues
• Interoperability concerns integrating with existing architecture and applications.
• To date, the medical knowledge base is incomplete
  – In part because of insufficient clinical evidence
• Adhering to the new system is thought to be too tedious
• Physicians may lack faith in the algorithm
Barriers to Implementation

- Internal organization culture
- Implementation ‘Champion’ needed
- Mitigating patient concerns
  - Risk of feelings of isolation in the encounter
  - Risk of patients feeling clinicians are just obeying computer output
- Site workflow concerns
  - Startup period and learning curve
- Potential computer literacy issues
Design & Development

• Workflow Fit
• Guidelines for constructing our CDSS (Bates et al\textsuperscript{1}, 10 commandments):
  – Speed Is Everything
  – Anticipate Needs and Deliver in Real Time
  – Fit into the User’s Workflow
  – Little Things Can Make a Big Difference
  – Recognize that Physicians Will Strongly Resist Stopping
  – Changing Direction Is Easier than Stopping
  – Simple Interventions Work Best
  – Ask for Additional Information Only When You Really Need It
  – Monitor Impact, Get Feedback, and Respond
  – Manage and Maintain Your Knowledge-based Systems

\textsuperscript{1}http://www.ncbi.nlm.nih.gov/pmc/articles/PMC264429/
Design & Development

• Requirements Specification

• Project Plan
  – Resources Commitment
  – Device Placement Analysis

• Interface Considerations

• Test Plan
  • Testing Schedule
  • Test Script
  – Verification
  – Validation
Design & Development

- Control Process
- Documentation
- Change Management
  - Regression Testing
- Issues Management
- Development of Required P & P
- User Acceptance
  - Sign-off
Implementation

• End-User Training
• Activation/Deployment
  – Phased Approach
  – Activation Plan
  – Support
    • Go-live and beyond
• Maintenance/Upgrade
Evaluation

**Impact on Patient Outcomes and Safety**
- Create a local patient database to compare short & long term patient morbidity and mortality, pre- and post- implementation of CANS tool
- Databases to be utilized for CQI and clinical research studies
- Establish a supplemental knowledge base for more frequent updates of the algorithm and decision support tools, tailored to institutional/departmental objectives and responding to the needs of the medical community
Evaluation

• **Impact on Provider Satisfaction**
  – Track provider compliance with tool
    • Analyze and compare different provider behaviors
  – Study physician opt-outs, reasons for overriding algorithm-based recommendations, system response times, # alerts triggered
  – Soliciting feedback
    • Survey to staff of medical consultants, surgeons, anesthesiologists
    • Survey to OR scheduling department & pre-admission testing
Evaluation

- **Impact on Utilization of Hospital Resources**
  - Impact on # of non-invasive cardiac procedures ordered and performed and revenue
  - Impact on LOS
  - Impact on institutional bed utilization
  - Impact on OR scheduling and efficiency
Evaluation

- **Impact on Risk Management**
  - Providers ultimately responsible for pt care
  - Locally produced CDSS & hospital liability
  - Must ensure:
    - Accuracy of knowledge base
    - Knowledge bases are routinely updated
    - System operates correctly every time
    - Data quality
    - Data presented optimally via provider interfaces
    - Rule updates do not, inadvertently, cause existing rules to function improperly
Questions?