Observation Medicine 2013: Science & Solutions
Chest Pain: Past, Present and Future

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Original Plan for This Talk
Past: Clinical Characteristics
Present: Biomarkers/Stress Testing
Future: New Imaging Modalities

PAST, PRESENT, AND FUTURE: ED-based Observation Units have a role in the evaluation of chest pain and ACS.

Compared to inpatient admissions:
• More Efficient
• Safer
• Cheaper

Why Observation?
Goal: 0% miss rate
Reality: >0% miss rate
• Large numbers of patients presenting
• High prevalence of underlying disease
• Diversity of presentation/features
• Limitation of tools
• Impracticality/danger of testing everyone w/ gold standard

A Walk Through Time: Early Stage CPOUs

EVALUATION:
• Clinical Characteristics
• ECGs
• Telemetry
• Cardiac Enzymes
• Tincture of time?

?’s:
Clinical Characteristic Algorithms (Goldman), ECG-driven computer algorithms (ACI-TIP), continuous 12 leads, 15 leads

Benefits:
• Identify AMI and don’t send home.
• Save CCU beds.
• Identify who could follow up.

Pitfalls:
• Misses CAD/ACS spectrum.
• Takes Skill.
• Some people don’t follow up.
A Walk Through Time: Biomarkers

The Troponin Era

"?s:
The rapid ED rule-out?
How many different MB/troponin protocols can we develop? (Erlanger)

Benefits:
- Identify AMI.
- Send some home w/o obs?
- More sensitivity.
- Takes Less Skill (quant. test).

Pitfalls:
- Still misses ACS spectrum?
- Still Takes Some Skill.
- Takes (too much?) Time.

Present: Stress Testing

ECG Treadmill -> Thallium/SPECT/echo

"?s:
- What new group of patients can we stress test?
- What about Cardiac CTA?
- Cardiac MRI?
- Lipids?

Benefits:
- Move care upstream.
- Save hospital inpatient beds.
- Rule out "omni-badness".

Pitfalls:
- Overtesting?
- Radiation.
- Crowded ED's.
- Dooming to PCI?

Clinical Characteristics and Decision Rules:
Past, Present, and Future

Back to the Future?

The 80's: Goldman Score

Clinical Characteristics and Decision Rules:
Past, Present, and Future

Although a predominant feature of protocols of the PAST

Still have a role in patient selection in the PRESENT

In the FUTURE, will further refine who should be placed in observation.

Cardiac Biomarkers:
Past, Present, and Future

"The Value of Nothing"
-W. Frank Peacock
Cardiac Biomarkers

- Non-invasive
- Repeatable
- Quantitative/Reproducible
- Relatively inexpensive
- Widely available 24/7
- Don’t require specialized personnel or technology

A Markers-only Approach

- Those at low risk for CAD
- Those with reliable outpatient follow-up
- Previously risk-stratified patients
- NOT on optimal medical therapy

High Sensitivity Troponins

http://retro-tavern.blogspot.com/2008/05/80s-cell-phone.html

The Promise

Detect More AMIs:

<table>
<thead>
<tr>
<th>Troponin Assays</th>
<th>AUC</th>
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<tbody>
<tr>
<td>Abbott–Architect</td>
<td>0.96</td>
</tr>
<tr>
<td>Roche High-Sensitive TnT</td>
<td>0.96</td>
</tr>
<tr>
<td>Roche TnT I</td>
<td>0.95</td>
</tr>
<tr>
<td>Siemens</td>
<td>0.96</td>
</tr>
<tr>
<td>STANDARD</td>
<td>0.90</td>
</tr>
</tbody>
</table>

At what cost to Specificity?

“cardiac troponin is now measurable in the serum of normal healthy individuals” . . .

“A mild mannered laboratory test which gave a dichotomous diagnosis of myocardial infarction, yes or no, has metamorphosed (Marvel comics fashion) to a rampaging diagnostic monster.”

Collinson, PO. Clinical Biochemistry 45 (2012) 717–718
The Problem: “Low Specificity”

1. Specificity 75.6%  
   PPV 53.8%
2. Specificity 61%  
   PPV 91%

One-hour rule-out and rule-in of acute myocardial infarction using high-sensitivity cardiac troponin

- N=436
- Rule out: (60%)  
  - 100% sensitivity and NPV
- Rule in: (17%)  
  - specificity 97% PPV 84%
- "Observational zone" (23%)  
  - AMI of 8%  
  - 30-day survival was 98.6%


Cardiac Biomarkers: Past, Present, and Future

A core element of protocols of the PAST.

Still plays a key role for selection and evaluation in the PRESENT.

May obviate the need for obs in more patients in the FUTURE, and maybe replace stress testing?

Stress Testing: Past, Present, and Future

“A permission slip to discharge”?  
  - Judd Hollander, MD

Stress Testing: Past, Present, and Future

- Safe: Complication rate 0.4 to 1 event per 1000
- Echo: annual mortality 1%, increases after 6th year
- SPECT: annual event (death or nonfatal MI) rate of 0.6%
- Chan, 2003 AJEM: -made no difference in 30d events, repeat visits
- False Positives?Prevalence?
- “Obs Creep”  
- Resources, Staff

Advantages

- Great prognostic indicator (duration of exercise, HR response)
- Assess functional capacity
- Reproduction of symptoms

Disadvantages

- Exercise capability
- Target Heart Rate?
- Motivation-dependent
- Equipment

Adenosine

Advantages
- Very short half life (5 sec)
- More predictable vasodilation
- Stenosis, dissection
- Generally done with SPECT

Disadvantages
- Blocked by caffeine and theophylline
- Expensive
- Small % don’t vasodilate-no objective confirmation
- Bronchospasm, heart block
- More frequent side effects
- No exercise info

Dobutamine

Advantages
- Titratable, verifiable
- Generally done with Echo

Disadvantages
- IV access
- No Exercise info
- HTN
- Arrhythmias-Staffing, Tele
- Aortic stenosis

Stress ECG

Advantages
- Widely available
- Inexpensive
- Accuracy tested in broad population
- Duke Treadmill Score, METS, reproduce sx’s, BP response?

Disadvantages
- Reduced sensitivity and specificity
- Requires good baseline ECG for optimal interpretation
- Does not localize area of ischemia

Stress Echocardiography

Advantages
- Portable, quick
- Good specificity
- Can localize area of ischemia
- Can assess valves, EF, wall thickness, chamber size

Disadvantages
- Interpretation reproducibility
- Baseline wall motion abnormal difficult
- Poor windows

SPECT

Advantages
- Reproducible results
- High sensitivity
- Can assess ventricular size, EF
- Good for localization and extent of ischemia
- Can assess viability

Disadvantages
- Expensive
- Labor/time intensive
- Radiation
- Artifacts (breast, diaphragm, bowel, LBBB)
- Balanced ischemia
- Cannot assess valves

Dobutamine Echo for CAD by # Vessels

JACC 1997:30:595
SPECT

- Sensitivity 88%, Specificity 77%
- Higher sensitivity for single vessel, LM
- Better if underlying wall motion abnl.

**Stress Testing:**
**Past, Present, and Future**

Although validated in the relatively recent PAST

It is the cornerstone of our evaluation in the PRESENT.

It will play an important role in the foreseeable FUTURE, until new technology displaces it.

**Imaging: Past, Present, and Future**

**“The End of the Beginning”: CTCA**

- Multiple Studies: Litt, Hollander, ROMICAT etc.
  - Sens = 88-100%
  - Spec = 85-100%
  - PPV = 93-100%
  - NPV = 93-100%
- Cost Effective option Khare, et al.
- IN THE RIGHT PATIENT

**CTCA: Normal Coronaries =D/c**

**CARDIAC MRI**

- Advantages
  - Very high sensitivity
  - Can differentiate ischemia, infarction, infiltrative process
  - Can assess subendocardial ischemia, function, valves, EF, viability, and aorta

- Disadvantages
  - Claustrophobia
  - Labor intensive
  - Not well validated
  - Can not do very unstable patients
  - No ICD’ s/Pacers
  - Cost?
MRI SCORECARD

<table>
<thead>
<tr>
<th>Study</th>
<th>Sensitivity</th>
<th>Specificity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>93</td>
<td>75</td>
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<tr>
<td>3</td>
<td>91</td>
<td>62</td>
</tr>
<tr>
<td>4</td>
<td>93</td>
<td>75</td>
</tr>
<tr>
<td>Pooled Avg</td>
<td>91</td>
<td>76</td>
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Imaging: Past, Present, and Future

CT and MRI for other organ systems is an established indication from the PAST.

CT and MRI for cardiac evaluation is entering the PRESENT.

They will likely play a greater role in the FUTURE.

Putting It All Together

- Serial Biomarkers: Everyone
  - When needed, stress test
- If possible, exercise
- ECG: good prognostic info, nl baseline ECG
- Echo: best for 3 v dz, no radiation
- SPECT: best for single vessel, better prognostic evidence
- CTCA or cMRI: Stenosis, Dissection, equivocal tests, baseline abnls

Where Are We Going? Trends

More Skill -> Less Skill
Upstream Care
Working Up Lower-Risk Patients
Better (more) Technology
Catch the Very-Low Risk AMI

Beyond ACS?

Atrial Fibrillation
HTN
Pulmonary Embolism
- Low-Risk Cohort
  - Similar to DVT protocols
- Oral Thrombin Inhibitors

Total Metabolic Screening
- Lipids
- HgbA1C
- Risk Factor Modification
Biomarker-only Risk Stratification?

PREDICT: Gene Expression Score from Blood Draw
- N= 1,160 stable outputs referred for cath
- 6 gene expression terms containing 23 genes + clinical characteristics
- Every 10 point increase = 2x odds of CAD
  - Outperformed MPI and Diamond Forrester classification
- Predicted clinical outcomes (MACE)

Shared Decision-making

- RCT of Decision aid vs usual care 204 pts
- PATIENTS chose obs less frequently (58% vs 77%)
- No major adverse cardiac events after discharge