A Novel Outpatient Pathway for Chest Pain Visits to the Emergency Department

ASNC 2016 Choosing Wisely Challenge

Felix Krainski, Besiana Liti, Lane Duvall
A Novel Outpatient Pathway for Chest Pain Visits to the Emergency Department that

- reduces length of stay
- reduces radiation exposure
- is safe
- is cost-effective

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Background

  • the short-term likelihood of a cardiac event in low-risk patients is very small and supports the rationale of outpatient stress testing when the preferred strategy of pre-discharge testing is unavailable.
  • Outpatient stress testing within 72 hours is reasonable.
  • This approach is recognized by ACC/AHA guidelines on management of patients with unstable angina.

Circulation. 2010;122:1756-1776
Circulation. 2007 Aug 14;116(7):e148-304
Table 7. Short-Term Risk of Death or Nonfatal MI in Patients With UA/NSTEMI*

<table>
<thead>
<tr>
<th>Feature</th>
<th>High Risk</th>
<th>Intermediate Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Accelerating tempo of ischemic symptoms in preceding 48 h</td>
<td>Prior MI, peripheral or cerebrovascular disease, or CABG; prior aspirin use</td>
<td>No high- or intermediate-risk feature but may have any of the following features:</td>
</tr>
<tr>
<td>Character of pain</td>
<td>Prolonged ongoing (greater than 20 min) rest pain</td>
<td>Prolonged (greater than 20 min) rest angina, now resolved, with moderate or high likelihood of CAD</td>
<td>Increased angina frequency, severity, or duration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest angina (greater than 20 min) or relieved with rest or sublingual NTG</td>
<td>Angina provoked at a lower threshold</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nocturnal angina</td>
<td>New onset angina with onset 2 weeks to 2 months prior to presentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New-onset or progressive CCS class III or IV angina in the past 2 weeks without prolonged (greater than 20 min) rest pain but with intermediate or high likelihood of CAD (see Table 6)</td>
<td></td>
</tr>
<tr>
<td>Clinical findings</td>
<td>Pulmonary edema, most likely due to ischemia</td>
<td>Age greater than 70 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New or worsening MR murmur</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S_3 or new/worsening rales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypotension, bradycardia, tachycardia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age greater than 75 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG</td>
<td>Angina at rest with transient ST-segment changes greater than 0.5 mm</td>
<td>T-wave changes</td>
<td>Normal or unchanged ECG</td>
</tr>
<tr>
<td></td>
<td>Bundle-branch block, new or presumed new</td>
<td>Pathological Q waves or resting ST-depression</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sustained ventricular tachycardia</td>
<td>less than 1 mm in multiple lead groups (anterior, inferior, lateral)</td>
<td></td>
</tr>
<tr>
<td>Cardiac markers</td>
<td>Elevated cardiac TnT, TnI, or CK-MB (e.g., TnT or TnI greater than 0.1 ng per ml)</td>
<td>Slightly elevated cardiac TnT, TnI, or CK-MB (e.g., TnT greater than 0.01 but less than 0.1 ng per ml)</td>
<td>Normal</td>
</tr>
</tbody>
</table>
Observation vs. Accelerated Testing

- Chest pain patients, including low-risk, are usually observed and “ruled out” with at least two sets of cardiac enzymes prior to stress testing.
- Alternatively, accelerated diagnostic protocols have been considered:
  - Immediate ETT in low-risk patients, discharge if negative.
  - 6 hour observation with serial cardiac enzymes and EKGs in moderate-risk patients.
    - Stress echo or MPI if negative.

*Amsterdam EA et al.*
Testing Modalities

• Options for Noninvasive Testing
  • Exercise Treadmill Testing
  • Myocardial Perfusion Imaging (MPI) and Stress Echocardiography
    • most used modalities in low-risk chest pain patients with inability to exercise or baseline ECG changes
  • PET
    • greater spatial resolution, higher sensitivity, and more reliable attenuation correction than MPI
    • higher cost, limited availability
• Coronary Artery Imaging
  • Calcium Score
  • CT Coronary Angiography
• Stress MRI

Circulation. 2010;122:1756-1776
Our Novel approach to the problem

In addition to doing it as an outpatient
Optimizing Testing Efficiency

• Perfusion imaging adds little to the patient’s prognosis if they completed a negative, high level (≥10 METs) exercise treadmill test
• True for patients with
  • low and intermediate to high clinical risk for CAD
  • patients with or without known CAD

Bourque JM et al.
J Am Coll Cardiol. 2009;54:538-45
J Nucl Cardiol. 2011;18:230-7
Optimizing Testing Efficiency

- Provisional radioisotope injection in low risk patients is safe and cost-effective
  - 965 low-risk chest pain patients visiting the ED
    - 192 underwent exercise-only
    - 773 underwent perfusion imaging stress testing
    - no cardiac deaths in the exercise-only group

*Duvall WL et al.*
Eur J Nucl Med Mol Imaging. 2015 Feb;42(2):305-16

*Duvall WL et al.*
Optimizing Testing Efficiency

Unadjusted All-Cause Mortality Based on Stress Protocol

<table>
<thead>
<tr>
<th>Months of F/U</th>
<th>Exercise-Only</th>
<th>Exercise + Imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>192</td>
<td>773</td>
</tr>
<tr>
<td>6</td>
<td>192</td>
<td>769</td>
</tr>
<tr>
<td>12</td>
<td>119</td>
<td>621</td>
</tr>
<tr>
<td>18</td>
<td>83</td>
<td>449</td>
</tr>
<tr>
<td>24</td>
<td>49</td>
<td>291</td>
</tr>
<tr>
<td>30</td>
<td>41</td>
<td>186</td>
</tr>
</tbody>
</table>

Percent Survival (%)

Exercise-Only: 94.8%
Exercise + Imaging: 97.4%
p = 0.54

Duvall WL et al.
Eur J Nucl Med Mol Imaging. 2015 Feb;42(2):305-16
Optimizing Testing Efficiency

• Provisional radioisotope injection in low risk patients is safe and cost-effective
  • 965 low-risk chest pain patients visiting the ED
    • 192 underwent exercise-only
    • 773 underwent perfusion imaging stress testing
    • no cardiac deaths in the exercise-only group
    • at 1 year, there was no difference in the number of repeat functional stress tests (1.6% vs 2.1%, p = 0.43)
    • fewer angiograms (0% vs 4.0%, p = 0.002)
    • lower cost ($65 ± $332 vs $506 ± $1,991, p = 0.002) in the exercise-only group

_Duvall WL et al._
Eur J Nucl Med Mol Imaging. 2015 Feb;42(2):305-16
_Duvall WL et al._
MPI Imaging Protocols

• Stress-First vs Rest-Stress
• If stress first images are normal can defer rest imaging.
• Prefer low dose stress first studies as high dose rest images can be performed the same day if needed.
Radiation Exposure in MPI

Choosing Wisely Challenge

- Novel testing algorithm for low-risk/low to intermediate risk patients presenting to the ED with chest pain
  1) risk stratification testing is shifted from an observation or prolonged ED stay to an outpatient visit within 72 hours of ED visit
  2) a provisional radioisotope injection protocol is implemented if adequate exercise is achieved without symptoms and with negative ECG response.
  3) stress first if possible for pharmacologic stress
Patient Selection

• Patients qualifying for an outpatient return visit had
  • atypical chest pain
  • no known coronary artery disease (CAD)
  • at least two sets of negative cardiac enzymes
  • overall low traditional risk factor profile.
Proposal

- We hypothesized that this novel protocol would
  - decrease length of stay
  - lower healthcare cost
  - reduce patient radiation exposure
  - maintain safe outcomes
Methods

• Retrospective analysis of a prospective cohort of patients with ED visits for chest pain between Oct 2015 and Feb 2016

• A set of similar patients admitted to the chest pain unit served as a comparison group.

• Outcomes included
  • length of stay
  • hospital reimbursement
  • tests performed & radiation exposure
  • follow-up visits
**Guidelines for Patients for Outpatient Stress Testing Within 72 hrs**

Stress test within 72 hrs of ED evaluation possible if:

- No evidence of ischemia on ECG (ST elevation or depression, new LBBB)
- Normal troponin x2 measured 4 hours apart
- No history of CAD
- Low or Low-Intermediate risk patients
- Patient finishes ED evaluation after hours (roughly 4:00pm to 4:00am)
- Patient able to return for stress testing within 72 hours (ideally 48 hours)

Stress test within 72 hrs of ED evaluation not appropriate if:

- Non-cardiac chest pain
- Only one set of troponin needed for evaluation. Patient should follow-up first
- History of CAD, PCI, CABG
- Patient has pre-existing relationship with cardiologist. Patient should be notified
- Patient cannot return for stress testing within 72 hours (ideally 48 hours)
- Patient finishes ED evaluation (2 sets of troponin) during 4:00am to 4:00pm

Appropriate paperwork should be completed

- Patient’s name and information placed in time slot on schedule
- Patient instruction form completed with date and time of appointment

If the stress test is abnormal:

- The patient will be returned to the ED for further evaluation
- Cardiology consultation can be obtained to decide whether outpatient follow-up and optimal medical therapy are appropriate

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**Emergency Department**

Email: Jeff.Finkelstein@hhchealth.org & Kenneth.Robinson@hhchealth.org

**Hartford Hospital Emergency Department Follow-up Cardiac Stress Testing**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>NAME</th>
<th>MR#</th>
<th>PHONE#</th>
<th>RESULTS</th>
<th>NO SHOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon 10am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Mon 12pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Mon 1pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Tues 10am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
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<tr>
<td>Tues 12pm</td>
<td></td>
<td></td>
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<td>NI / Abn</td>
<td></td>
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<tr>
<td>Tues 1pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Wed 10am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Wed 12pm</td>
<td></td>
<td></td>
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<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Wed 1pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Thurs 10am</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
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<tr>
<td>Thurs 12pm</td>
<td></td>
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<td>NI / Abn</td>
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<tr>
<td>Thurs 1pm</td>
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<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Fri 10am</td>
<td></td>
<td></td>
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<td></td>
<td>NI / Abn</td>
<td></td>
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<tr>
<td>Fri 12pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
<tr>
<td>Fri 1pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NI / Abn</td>
<td></td>
</tr>
</tbody>
</table>

Please provide patient with **Hartford Hospital Emergency Department Instructions for Patients Referred for Cardiac Stress Testing**

Cardiac Stress Lab:

- [Link to Hartford Hospital Cardiac Stress Lab Instructions]
Hartford Hospital Emergency Department Instructions for Patients Referred for Cardiac Stress Testing

Location: Hartford Hospital Cardiac Stress Lab, South Building #208, Second Floor. Patient Registration 30 minutes prior to your scheduled appointment.

Name: ____________________________

Stress Test Date: ________________

Stress Test Time: ________________

Procedure Preparation

- Do not eat or drink products with caffeine for 12 hours before the test.
- Do not eat or drink anything except water for 4 hours before the test.
- You may take your medications with sips of water.
- Do not smoke for several hours before the test.
- Wear comfortable clothing and walking shoes or exercise sneakers.
- Bring a list of your current medications to the test.
- If you have diabetes, bring your glucose monitor to the test.

Definition

A stress test measures how well the heart works when it is beating fast and working hard. During these times, often images of the heart are taken as part of the stress test which allows doctors to see how well it is working.

Reasons for Test

During physical activity, your body needs higher levels of oxygen. It gets oxygen from the blood vessels in your heart which carry blood to your organs. A cardiac stress test is used to evaluate whether you have heart disease.

- Determine whether complaints of chest pain are related to your heart condition.
- Evaluate if the heart is normal and as healthy as it can be.
- Evaluate whether blockages may be present.

Post Procedure

- Electrodes will be attached to your chest.
- Blood pressure and ECG readout will be done.

The cardiac stress test is done on a treadmill. You will slowly start walking and at regular intervals the speed and elevation will be increased. People who cannot exercise may get a medical test instead to substitute for exercise. Your ECG, blood pressure, heart rate, and symptoms will be observed.

Patient Name

Address

City, State, Zip code

Dear Patient Name;

You were seen in our Emergency Department at Hartford Hospital and referred for a stress test of your heart. You were referred for this test because your physician had some concerns that your symptoms might be coming from your heart.

It has been brought to my attention that you have missed your appointment. We understand that there are occasions when one must miss an appointment due to unforeseen circumstances or a scheduling conflict.

Our priority is to offer the best and safest care. It is imperative that you reschedule your appointment for a cardiac stress test through your primary care physicians or clinic. We will follow up with your primary care physician or clinic as soon as possible.

Thank you,
Results

• 156 patients (age 51.4 ± 9.9 yrs, 53.8% female and 1.6 ± 1.1 traditional cardiac risk factors)
  – Underwent the ED outpatient stress testing protocol
  – No show rate 29.5%
Results

- All patients returning for stress testing were subject to our provisional injection protocol
  - 109 (70.5%) patients returned for outpatient testing
Results

• 10 patients (9.2%) had an abnormal result (7 MPI’s and 3 ETT’s) of which 4 (3.6%) underwent catheterization
  – 2 had angiographic CAD and 1 underwent revascularization.
Results – Reduction in Length of Stay

Length of Stay (hours)

72% reduction  p<0.0001

Observation: 27.37
Outpatient: 7.68
Safety

• 30 day return visits to the ED
  – 10.9% of the population returned to the ED for care for any reason within 30 days
  – in patients who completed their outpatient testing compared to those who did not
    • all-cause visits were reduced by 47%
    • cardiac visits were reduced by 75%
  – no returning patients underwent angiography or revascularization
Results – Reduction in Healthcare Burden

• Payer mix
  • Medicare (6.4%)
  • Medicaid (38.2%)
  • Private/commercial insurance (50.5%)
  • Self-paying patients (4.5%)
Results – Reduction in Healthcare Burden

- Hospital reimbursement per patient
  - $781 ± 686 for outpatient stress testing patients
  - $3,696 ± 1,795 for chest pain unit patients
Results – Reduction in Radiation Exposure

![Bar chart showing reduction in radiation exposure]

- Conventional Rest-Stress (hypothetical): 1319 mSv
- Provisional Injection Stress-First: 193 mSv
- 85% reduction
Conclusion

• The implementation of our novel approach to treating low-risk chest pain patients presenting to the ED has affected important aspects of
  • 1) the provider-patient interaction
  • 2) healthcare cost and hospital administration
  • 3) choosing the right test for the right patient
  • 4) safe outcomes
Conclusion

1) provider-patient interaction

- patients expressed satisfaction with the ability to return for outpatient testing in a timely fashion and decrease in time spent in the ED (anecdotal)

- Providers were happier being able to discharge low-risk patients from the ED and following-up in the outpatient setting through a streamlined discharge and follow-up process instead of clogging the ED and monitored beds with additional patients
Conclusion

2) healthcare cost and hospital administration
   - a decrease in length of stay and optimized resource utilization achieved through our novel outpatient protocol appears overall positive
   - reduction in bottom-line hospital reimbursement in these low-risk patients through a shift towards less lucrative outpatient follow-up will have to be carefully assessed and weighed against better availability of beds and other resources for sicker patients in a revenue-oriented hospital environment
3) choosing the right test
   reduction in radiation exposure to our patients by choosing the most efficient test for the individual patient
Conclusion

• 4) safe outcomes
  • 30 day all-cause and cardiac return visits to the ED were reduced substantially in patients who returned for testing compared to those who did not