Clinical Policy: Appropriate Utilization of Cardiovascular Imaging in ED Patients with Chest Pain
Presenters

W. Franklin Peacock, MD, FACEP, FACC

Michael Kontos, MD, FACC
APPROPRIATE CV IMAGING OF ED CP

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Associate Chair and Research Director
Baylor College of Medicine, Houston, TX
Accreditation Management Board of Directors

Michael C. Kontos, MD, FACC, FAHA
Medical Director, Coronary Intensive Care Unit
Co-Director, Chest Pain Evaluation Center
Professor, Departments of Internal Medicine (Cardiology), Radiology and Emergency Medicine
Virginia Commonwealth University Medical Center
Richmond, Virginia
DISCLOSURES

• Frank Peacock
  • Research Grants: Abbott, Boehringer Ingelheim, Brainbox, CSL Behring, Daiichi-Sankyo, Janssen, Ortho Clinical Diagnostics, Portola, Relypsa, Roche, Siemens
  • Consultant: Abbott, Astra-Zeneca, Bayer, Beckman, Ischemia Care, Dx, Instrument Labs, Janssen, Nabriva, Ortho Clinical Diagnostics, Relypsa, Roche, Quidel, Salix, Siemens
  • Expert Testimony: Johnson and Johnson
  • Stock/Ownership Interests: AseptiScope Inc, Brainbox Inc, Comprehensive Research Associates LLC, Emergencies in Medicine LLC, Ischemia DX LLC.

• Michael Kontos
  • None
APPROPRIATE UTILIZATION OF CARDIOVASCULAR IMAGING

2015 ACR/ACC/AHA/AATS/ACEP/ASNC/NASCI/SAEM/SCCT/SCMR/SCPC/SNMMI/STR/STS Appropriate Utilization of Cardiovascular Imaging in Emergency Department Patients With Chest Pain

Emergency Department Patients With Chest Pain Writing Panel

Frank J. Rybicki, MD, PhD, Co-Chair a,1,2
James E. Udelson, MD, Co-Chair b
W. Frank Peacock, MD, Co-Chair c
Samuel Z. Goldhaber, MD b
Eric M. Isselbacher, MD b
Ella Kazerooni, MD a
Michael C. Kontos, MD b

Harold Litt, MD, PhD a
Pamela K. Woodard, MD a

a Official American College of Radiology Representative. b Official American College of Cardiology Representative. c Official American College of Emergency Physicians Representative.

d Department of Radiology, The University of Ottawa.
Clinical Practice Guideline recommendations are “should” or “should not” directives.

Performance measures represent “must do”.

Appropriate use criteria “reasonable to do” clinical steps.

Together, define best practices based on evidence.
APPROPRIATENESS CRITERIA

• Balances risk and benefit of a tx, test, or procedure in the context of available resources for an individual pt with specific characteristics

• Provides guidance to supplement the clinician’s judgment as to whether a pt is a reasonable candidate for the given tx, test or procedure
The process of arriving at Appropriate Usage Criteria
APPROPRIATENESS RATING

• 7, 8, or 9:
  • Appropriate as benefits generally outweighing risks
  • Effective but not always necessary
    • Depends on physician judgment and patient preferences

• 4, 5, or 6:
  • Maybe appropriate
    • Variable evidence or agreement regarding the benefit/risk ratio
  • Potential benefit on the basis of practice experience in the absence of evidence or due to variability in the population

• 1, 2, or 3
  • Rarely appropriate; lack of a clear benefit/risk advantage
  • Rarely effective option
  • Exceptions should have documentation of the reasons for proceeding
• Consensus was defined as ≥60% of the panel giving a rating of:

  • Appropriate (A)
  • May be appropriate (M)
  • Rarely appropriate (R)

• If consensus was not reached (>60% agreement) within a clinical scenario, the rating was assigned M*
AUC

• Case based determinate of entering the criteria.....
ASSUMPTIONS

• All ED patients with potential CP syndromes undergo evaluations that include:
  • H and P
  • ECG to identify/exclude STEMI
  • Cardiac and/or pulmonary biomarker analysis
• Some patients will be diagnosed with non-CV illnesses → no imaging required
• Patients with STEMI on initial the ECG, or initial biomarkers and/or ECG clearly consistent with ACS/NSTEMI are admitted and treated according to guidelines
• After the initial evaluation, most patients will be risk stratified into 1 of the 3 diagnoses:
  • ACS
  • PE
  • AAS
• A minority of patients for whom a leading diagnosis is not possible
Emergency Department Patients with Chest Pain

Yes

Initiate Treatment

No

Actionable Diagnosis of Chest Pain Established

Entry Point 1: Suspected NSTEMI/Acute Coronary Syndrome (Section 2, Table 2)

Entry Point 2: Suspected Pulmonary Embolism (Section 3, Table 3)

Entry Point 3: Suspected Acute Syndromes of the Aorta (Section 4, Table 4)

Entry Point 4: Patient for whom Leading Diagnosis is Problematic or Not Possible (Section 5, Table 5)
**AUC Indication**

**Indications 1 and 2**
1. Diagnostic ECG for STEMI
2. Initial history/physical examination and/or chest radiography identifies a likely noncardiac diagnosis (e.g., pneumothorax, costochondritis, lesion in the esophagus)

**Indications 3-7**
- Positive initial diagnosis of NSTEMI/ACS
- Initial ECG and/or biomarker analysis unequivocally positive for ischemia
- Equivocal initial diagnosis of NSTEMI/ACS
- Equivocal initial troponin or single troponin elevation without additional evidence of ACS
- Ischemic symptoms resolved hours before testing
- Low/Intermediate likelihood initial diagnosis of NSTEMI/ACS
- TIMI risk score = 0, early hsTrop negative
- Normal or nonischemic on initial ECG, normal initial troponin

**Indications 8, 9, 10**
- Diagnosis unequivocally positive for NSTEMI/ACS
- Serial troponins or ECG not positive for NSTEMI/ACS
- Serial ECG and troponins negative for NSTEMI/ACS
- Serial ECG or troponins borderline for NSTEMI/ACS

**ED Evaluation Process**

**Step 1**
Initial evaluation
ECG, H and P → STEMI → cath

Not a STEMI

**Step 2**
Further ED evaluation/risk stratification
ECG findings, initial troponin results

Troponin → positive → cath

Negative

**Step 3**
Initial evaluation negative → obs status

Troponin results
**AUC Indication**

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ECG findings, initial troponin results

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Initial evaluation negative → obs status
Troponin results
INITIAL WORKUP IS DX FOR STEMI OR A NONCARDIAC DX IS LIKELY

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<tr>
<th>Indication</th>
<th>Chest Radiography</th>
<th>Echocardiography Rest</th>
<th>CMR Rest</th>
<th>SPECT Rest</th>
<th>CCTA</th>
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<td>1. Diagnostic ECG for STEMI</td>
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<td>R</td>
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Appropriate use key: A = appropriate; M = may be appropriate with rating panel consensus; R = rarely appropriate.

CCath, catheter-based coronary angiography; CCTA, coronary CT angiography; CMR, cardiovascular MR; ECG, electrocardiogram; SPECT, single-photon emission computed tomography; STEMI, ST-segment elevation myocardial infarction.

Will almost always do a CXR
2) H&P OR CXR IDENTIFIES LIKELY NONCARDIAC DX
**INITIAL WORKUP IS DX FOR STEMI OR A NONCARDIAC DX IS LIKELY**

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SECTION 2: IMAGING OF PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS
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Troponin cutpoints

AMI

99th %ile

Don’t call me cutpoint

95th %ile, like every lab test in the world

LOD

TRD

LOD

HOURS
## Positive initial diagnosis of NSTEMI/ACS

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<td>M⁺</td>
<td>M⁺</td>
<td>A</td>
<td>A</td>
<td>R</td>
</tr>
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<td>R</td>
<td>M</td>
<td>M⁺</td>
<td>A</td>
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ED VISITS - US

130,000,000 annually

10.4 million chest pain pts (8.0%)

6.24 million pt suspected or actual cardiac

4.1 million pt sent home non-cardiac

50,000 MIs

3.1 M non-cardiac (50%)

1.2 M AMI (20%)

1.5 M UA (24%)

374,400 sudden death (6%)
ASC RISK SCORES

Common Variables
Age
ECG
Markers
History

Other Variables
Risk factors
Known CAD
Vital Signs

TIMI Score
- AGE
  1 = ≥65
- ECG
  1 = ST changes ≥0.5 mm
- CORONARY DISEASE
  1 = Known stenosis
- ASPIRIN USE
  1 = Within 7 days
- RISK FACTORS
  1 = 3 or more
- SEVERE ANGINA
  1 = ≥ 2 in 24 hours

GRACE Score
- AGE
  Years
- ECG
  1 = ST changes ≥0.5 mm
- SYSTOLIC BP
  mmHg
- CREATININE
  μmol/L
- TROPOIN
  1 = >99th centile
- HEART RATE
  BPM
- CARDIAC ARREST
  1 = Yes
- KILLIP CLASS
  Category

EDACS Score
- AGE
  2 to 20 = Age categories
- GENDER
  6 = Male
- CORONARY DISEASE
  or ≥3 RISK FACTORS
  4 = if age 18-50
- TYPICAL SYMPTOMS
  3 = Diaphoresis
  5 = Radiation to shoulder/arm
- ATYPICAL SYMPTOMS
  - 6 = Worse on palpation
  - 4 = Pleuritic

HEART Score
- AGE
  2 = ≥65
  1 = ≥45 < 65
- HISTORY
  2 = Typical
  1 = Atypical
- ECG
  2 = ST depression
  1 = T-wave inversion
- RISK FACTORS
  2 = 2 or more
  1 = 1
- TROPOIN
  2 = ≥5 x upper limit
  1 = 1 - 3 x upper limit

LOW RISK CRITERIA
0 or 1
108 or less
Less than 16
3 or less

LOW RISK......COMPARING RISK SCORES

• PEARL data set:
  • 7 ERs
  • N=458
• Suspected ACS patients
• Dr documented risk of MI before Tn results known as: Low, Moderate, or High

EFFECT OF USING THE HEART SCORE IN PATIENTS WITH CHEST PAIN IN THE ED
A STEPPED-WEDGE, CLUSTER RANDOMIZED TRIAL

• N=3648 (1827 SOC vs 1821 HEART score)
  • Low-risk cohort; MACE = 2.0% (95% CI, 1.2% to 3.3%)

• No difference in ...........
  Early discharge  Readmissions
  ED revisits      Outpatient visits

• Dr’s were hesitant to refrain from admission and diagnostic tests in low risk HEART score pts.

• Using the HEART score in CP patients is safe, but the effect on health care resources is limited.

Poldervaart JM. Ann Intern Med. 2017;166:689-697
## EDACS-ADP

**ED ASSESSMENT CHEST PAIN SCORE - ACCELERATED DIAGNOSTIC PROCEDURE**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Parameter</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>18-50 yo with CAD, or &gt;2 risk factors</td>
<td>+4</td>
</tr>
<tr>
<td>Age</td>
<td>18-45</td>
<td>+2</td>
</tr>
<tr>
<td></td>
<td>46-50</td>
<td>+4</td>
</tr>
<tr>
<td></td>
<td>51-55</td>
<td>+6</td>
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<tr>
<td></td>
<td>56-60</td>
<td>+8</td>
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<td>61-65</td>
<td>+10</td>
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<td>66-70</td>
<td>+12</td>
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<td></td>
<td>71-75</td>
<td>+14</td>
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<td></td>
<td>76-80</td>
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<td>81-85</td>
<td>+18</td>
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<td>&gt;85</td>
<td>+20</td>
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<td>Signs and Symptoms</td>
<td>Diaphoresis</td>
<td>+3</td>
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<td>Arm or shoulder radiation</td>
<td>+5</td>
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<td></td>
<td>Pain occurred or worsened with inspiration</td>
<td>-4</td>
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<td></td>
<td>Pain is reproduced with palpation</td>
<td>-6</td>
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**Low Risk Criteria**
- EDACS Score <16
- No new ECG ischemia
- Negative 0 and 2h Tn
ICare-ACS Improving Care Processes for Patients With Suspected ACS

METHODS

• 7 Hospitals

• Agnostic: Tn platform/timing
  • 4 Roche Gen 5 hsTnT
  • 1 Abbott Architect hsTnl
  • 2 Siemens Ultra Tnl

• Agnostic: Risk Stratification Tool
  • 5 EDACS (low risk <16)
  • 2 TIMI (Low risk = 0)

Than MP. Circulation. 2017 Nov 14. pii: CIRCULATIONAHA.117.031984
METHODS

• Implementation of a clinical pathway for the assessment of suspected ACS that included:
  ✓ A clinical pathway document
  ✓ Structured risk stratification
  ✓ Specific times for ECG & serial Tn w/in 3 hrs of arrival
  ✓ Directions for combining risk stratification, ECG, and Tn in an ADP

Than MP. Circulation. 2017 Nov 14. pii: CIRCULATIONAHA.117.031984
• Pre-implementation: N=11,529
• Post-implementation: N=19,803
• Mean 6-hour D/C rate increased
  • from 8.3% (range, 2.7%–37.7%) to 18.4% (6.8%–43.8%).
  • Odds of being D/C within 6 hours = 2.4 higher

• Pts without ACS; median LOS decreased by 2.9 hrs
  • (95% confidence interval, 2.4–3.4)

• If D/C by 6 hrs;
  • No change in 30-day MACE rates
    • SOC=0.52% vs ADP=0.44% ($P=0.96$)
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<td>R</td>
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<td>A</td>
<td>R</td>
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Lost to follow up
Admit them all and let the insurance company sort them out...

Discharge them all and let God sort them out...
Normal troponin/ECG
High Risk Score?
AUC Indication

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Troponin \(\rightarrow\) positive \(\rightarrow\) cath
Negative

Step 3
Initial evaluation negative \(\rightarrow\) obs status
Troponin results
**OBSERVATIONAL PATHWAY**

8) **ANY ECG OR TN UNEQUIVOCALLY (+) FOR NSTEMI/ACS**

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N = 1113

ED CP

5 yr F/U

MACE

MI

HF

CV die

Abbott Architect i2000

Roche Cobas e411

Mortality based on Type of Troponin Elevation

N=2929
hsTnI
1 year

N=1577
Cont Tnl
2 years

N=1010
Cont Tnl
2 years

Shah ASV et al AJM 2015;128;493-501; Saaby L et al AJM 2014;127;295-302; Cediel Heart 2017;103:616-622
“NON-SPECIFIC” TN ELEVATIONS ARE ASSOCIATED WITH WORSE OUTCOMES

• Associated with underlying cardiac abnormalities
• Usually associated with “sicker” presentation
• Variably found as an independent predictor
• In most cases, should indicate further cardiac evaluation is (probably) necessary
• Unclear exactly what test and when should be performed
What Test Next?
**OBSERVATIONAL PATHWAY**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Exercise ECG</th>
<th>Echocardiography</th>
<th>CMR</th>
<th>SPECT/PET</th>
<th>CCTA</th>
<th>CCath</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Serial troponins or ECG not positive for NSTEMI/ACS</td>
<td></td>
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</tr>
<tr>
<td>9. Serial ECG and troponins negative for NSTEMI/ACS</td>
<td>A</td>
<td>R</td>
<td>A</td>
<td>R</td>
<td>A</td>
<td>R</td>
</tr>
<tr>
<td>10. Serial ECG or troponins borderline for NSTEMI/ACS</td>
<td>M*</td>
<td>M*</td>
<td>A</td>
<td>R</td>
<td>A</td>
<td>R</td>
</tr>
</tbody>
</table>

Appropriate use key: A = appropriate; M* = may be appropriate as determined by lack of consensus by rating panel; R = rarely appropriate.

ACS, acute coronary syndrome; CCath, catheter-based coronary angiography; CCTA, coronary CT angiography; CMR, cardiovascular MR; ECG, electrocardiography; NSTEMI, non-ST-segment elevation myocardial infarction; SPECT, single-photon emission computed tomography.
SECTION 5: IMAGING OF PATIENTS FOR WHOM A LEADING DIAGNOSIS IS PROBLEMATIC OR NOT POSSIBLE
19) OVERALL LIKELIHOOD OF ACS, PE, OR AAS IS LOW

20) OVERALL LIKELIHOOD OF ACS, PE, OR AAS IS NOT LOW
<table>
<thead>
<tr>
<th>Indication</th>
<th>“Triple-Rule-Out” CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. Overall likelihood of ACS, PE, or AAS is low</td>
<td>R</td>
</tr>
<tr>
<td>20. Overall likelihood of ACS, PE, or AAS is not low</td>
<td>A</td>
</tr>
</tbody>
</table>

Appropriate use key: A = appropriate; R = rarely appropriate.

AAS, acute aortic syndrome; ACS, acute coronary syndrome; CTA, CT angiography; PE, pulmonary embolism.
SUMMARY

• Must consider clinical impression
  • Enter the AUC with the appropriate pre-test probability
  • A (-) test does not mean it was an inappropriate test

• Changing landscape
  • hsTn
  • Increased availability of echocardiography in real time
  • Improved CT scanners

• Consider local availability and expertise
  • MR, stress echo

• Changing diagnostic options
• There is still plenty of controversy
For More Information

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  - www.acep.org/equal
  - equal@acep.org

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