Clinical and Economic Implications of Inconclusive Noninvasive Test Results in Stable Patients With Suspected Coronary Artery Disease: Insights From the PROMISE Trial

Introduction

• Suspected coronary artery disease (CAD) is commonly evaluated with noninvasive diagnostic tests (NIT) accounting for over 4 million tests and $500 million in annual healthcare costs.
• NIT results can sometimes be inconclusive, but the relative frequencies and medical costs of such inconclusive results remain unclear.

Objectives

• Assess the prevalence of inconclusive NIT results across various testing modalities.
• Quantify the frequency of subsequent testing following inconclusive results.
• Estimate the 24-month attributable medical costs of inconclusive results.

Methods I

• In the PROMISE trial, patients with suspected CAD were randomized to and received either stress testing (4533 patients) or anatomic testing with coronary computed tomographic angiography (CTA) (4677 patients) and followed for a median of 25 months.
• Site-determined NIT test results included those which were non-diagnostic, uninterpretable, or if ≥45% target heart rate was achieved on exercise or dobutamine.

Methods II

• The frequency of inconclusive NIT results by test type, subsequent testing, and the effect on prospectively-collected, cumulative 24-month medical costs using logistic and linear regression models were analyzed.
• Cost estimates were derived from: 1) the Premier Research Database for index testing, 2) hospital billing data for hospital costs, and 3) Current Procedure Coding System codes in the 2014 Medicare national reimbursement schedule for physician costs.
• Total costs (fixed plus variable) were discounted at 3% annual rate and adjusted to 2014 U.S. dollars using the Producer Price Index for hospital care.

Results

• The frequency of inconclusive tests was 23.7% for exercise ECG, 11.9% for stress echo, 6.9% for stress nuclear, and 6.4% for CTA (8.0% overall) (p<0.01 all stress versus CTA; p<0.01 nuclear versus CTA).
• The median calcium score for conclusive CTAs was 402 versus 387 for conclusive positive and 9 for conclusive negative CTAs, p<0.01.
• Compared to negative NITs, inconclusive NITs were more referred to a 2nd NIT stress test (34% vs 18%) and to catheterization when compared to negative NITs, respectively.
• 24-month costs were higher for inconclusive NITs than negative NITs by $4030 (CTA) and $2905 (stress).

Table 1: Frequency of Conclusive/Inconclusive Results by Test Type

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Inconclusive</th>
<th>Conclusive Positive</th>
<th>Conclusive Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise ECG</td>
<td>34 (12.5%)</td>
<td>54 (12.5%)</td>
<td></td>
</tr>
<tr>
<td>Stress ECG</td>
<td>32 (10.7%)</td>
<td>67 (21.8%)</td>
<td>18 (5.6%)</td>
</tr>
<tr>
<td>CTA</td>
<td>246 (7.9%)</td>
<td>246 (7.9%)</td>
<td>246 (7.9%)</td>
</tr>
<tr>
<td>Other</td>
<td>30 (9.7%)</td>
<td>30 (9.7%)</td>
<td>30 (9.7%)</td>
</tr>
</tbody>
</table>

Table 2: Association between Inconclusive Test Results from Initial NIT and Total Medical Costs for Overall Stress and CTA

<table>
<thead>
<tr>
<th>Time from Randomization</th>
<th>Total Medical Costs ($) (Cumulative LS Means [95% CI])</th>
<th>Adjusted Difference in Costs ($) (P-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconclusive</td>
<td>CTA</td>
<td></td>
</tr>
<tr>
<td>Conclusive Negative</td>
<td>4602 (1626-7083)</td>
<td>-1196 (-2129-208)</td>
</tr>
<tr>
<td>Conclusive Positive</td>
<td>5979 (4614-7343)</td>
<td>-1929 (-2769-320)</td>
</tr>
<tr>
<td>Difference (%) CI</td>
<td>-5264 (-7036-3474)</td>
<td>.01</td>
</tr>
</tbody>
</table>

Conclusions

• Inconclusive NITs are a significant finding that lead to increased testing and costs when compared to negative results.
• Possible contributors to observed higher costs with inconclusive CTA tests include high calculation burden in inconclusive CTA tests, lack of accompanying functional information, and provider and site unfamiliarity with management of CTA results.
• These results may help guide NIT selection in patients with chest pain.

Contact Information

Akash Goyal, MD, 234 Davis Heart & Lung Research Institute, 473 W. 12th Avenue, Columbus, Ohio 43210, akash.goyal@osumc.edu

Disclosures

AG – none; PSD – HeartFlow

Summary

• Among patients with stable angina undergoing NIT, inconclusive CTA tests were significantly more costly than inconclusive stress tests overall; nuclear stress and CTA had similar inconclusive rates.
• Inconclusive NITs were associated with significantly more referral to a 2nd NIT test and to catheterization when compared to negative NITs, respectively.