Title: The effect of heart rate and age on the high-sensitivity cardiac troponin I assay versus the previous fourth generation cardiac troponin I test

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Investigators: Dr. Nicole Desforges, Dr. Amy McCulloch, Dr. Andrew Worster, Dr. Pete Kavsak

Location: David Braley Health Sciences Center
DISCLOSURES

• None
BACKGROUND

- Cardiac troponins (cTn) are used in the diagnosis of ACS
- 2010 – development of more sensitive assays that can detect troponins in a greater proportion of patients
- Dubbed high-sensitivity troponins (hs-cTn)
- Increased rate of detection may lead to more false positives and more unnecessary invasive testing
STUDY RATIONALE

• Diagnosis of ACS is based on serum troponin above the 99th%ile
• Reference value can be affected by population studied, assay employed and sample measured (EDTA vs heparin plasma vs serum)
• There have been reports that increased heart rate (HR) from exercise/SVT can increase cTn levels in the absence of cardiac ischemia
• There is also conflicting evidence about the effect of gender and age on cTn cutoff values
STUDY RATIONALE

• We sought to identify any association between elevated HR and hs-cTn I or between age and hs-cTn I in patients presenting to the ED.

• We also sought to determine if gender played a role on these relationships.
OBJECTIVES

• Describe the relationship between HR and hs-cTn I versus cTn I
• Describe the relationship between age and hs-cTn I versus cTn I
• Identify if gender has an impact on these associations
METHODS

- Design: Prospective cohort study
- Setting: Hamilton Health Sciences
- Time Frame: November 28 2012 – February 28 2013
- Population: Adults presenting to the ED who had a cTn I drawn
- Exclusion: hs-cTn I data not available, VSA
METHODS

- hs-cTn I was measured parallel and concurrently to every cTn I
- hs-cTn I results were not used for clinical care
- Providers were blind to hs-cTn I results
- 1264 patients with 1340 visits where a cTn I was drawn over the study period
- Triage HR or first HR measured during visit and demographic data were extracted from Meditech
METHODS

• Statistical analysis with MS Excel 2016 Analysis ToolPak
• Spearman ranked correlation coefficient (rho) was calculated for
  – hs-cTn I vs HR
  – cTn I vs HR
  – hs-cTn I vs Age
  – cTn I vs Age
• Separate coefficients were calculated for males, females and overall study population
## RESULTS

**Table 1. Patient Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients in Study</td>
<td>1264</td>
</tr>
<tr>
<td>Patient Visits</td>
<td>1340</td>
</tr>
<tr>
<td>Mean Age (yrs)</td>
<td>73.2</td>
</tr>
<tr>
<td>Age Range (yrs)</td>
<td>21 - 100</td>
</tr>
<tr>
<td>Sex (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>53.6%</td>
</tr>
<tr>
<td>Female</td>
<td>46.4%</td>
</tr>
<tr>
<td>Mean Heart Rate (bpm)</td>
<td>91.1</td>
</tr>
<tr>
<td>Heart Rate Range (bpm)</td>
<td>27 - 239</td>
</tr>
</tbody>
</table>
RESULTS

Age Distribution

Age of Participants in Study (5 year intervals)

Frequency
RESULTS

Heart Rate Distribution

Heart Rate of Participants (20 bpm intervals)
RESULTS

hs-cTn I Results Distribution

Hs-cTn I Values (25 ng/L intervals)
### RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Rho</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>hs-cTn I vs. Age</td>
<td>0.364</td>
<td>0.000</td>
</tr>
<tr>
<td>cTn I vs. Age</td>
<td>0.304</td>
<td>0.000</td>
</tr>
<tr>
<td>hs-cTn I vs. Heart Rate</td>
<td>0.112</td>
<td>0.000</td>
</tr>
<tr>
<td>cTn I vs. Heart Rate</td>
<td>0.085</td>
<td>0.002</td>
</tr>
</tbody>
</table>

**Table 2.** Results for all patients
RESULTS

hs-cTn I vs Age (males and females)
RESULTS

hs-cTn I vs Heart Rate (males and females)
Table 3. Results for Males

<table>
<thead>
<tr>
<th></th>
<th>Rho</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>hs-cTn I vs. Age</td>
<td>0.380</td>
<td>0.000</td>
</tr>
<tr>
<td>cTn I vs. Age</td>
<td>0.342</td>
<td>0.000</td>
</tr>
<tr>
<td>hs-cTn I vs. Heart Rate</td>
<td>0.050</td>
<td>0.181</td>
</tr>
<tr>
<td>cTn I vs. Heart Rate</td>
<td>0.016</td>
<td>0.677</td>
</tr>
</tbody>
</table>
# RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Rho</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>hs-cTn I vs. Age</td>
<td>0.370</td>
<td>0.000</td>
</tr>
<tr>
<td>cTn I vs. Age</td>
<td>0.289</td>
<td>0.000</td>
</tr>
<tr>
<td>hs-cTn I vs. Heart Rate</td>
<td>0.197</td>
<td>0.000</td>
</tr>
<tr>
<td>cTn I vs. Heart Rate</td>
<td>0.182</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Table 4.** Results for Females
RESULTS

Table 5. hs-cTn I by gender

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>0.005-22,852</td>
<td>167.45</td>
</tr>
<tr>
<td>Females</td>
<td>0.183-45,276</td>
<td>270.75</td>
</tr>
<tr>
<td>t-test</td>
<td></td>
<td>p-value=0.30</td>
</tr>
</tbody>
</table>
DISCUSSION

• No monotonic correlation between HR and hs-cTn I or cTn I
• Weak positive monotonic correlation between Age and hs-cTn I
  – Not clinically significant
• No difference in hs-cTn I between genders
DISCUSSION

• Previously posited correlations do not extend to clinical setting

• Possible confounders:
  – Beta-blockers
  – Effect of ACS
  – Effect of co-morbidities (renal failure)
DISCUSSION

• Study limitations:
  – Time between triage HR and cTn I up to 24 hours
  – Higher proportion of elderly patients
  – Did not analyze data by chief complaint or diagnosis
CONCLUSION

• No correlation between hs-cTn I levels and HR
• A statistically significant but clinically insignificant positive correlation between hs-cTn I and age
• No difference in hs-cTn I with gender
• Effects of confounders not accounted for in this study
  – An evaluation of troponin levels of subsets of the population with factors known to affect troponin levels as well as a subset of healthy subjects is recommended for further study
  – It is possible that strong correlations may exist within these subsets but we require additional data to evaluate this possibility
THANKS

• Dr. Amy McCulloch
• Dr. Erich Hanel
• Adam Marchionni
REFERENCES


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• Worster, A., Krizmanich, W., Preyra, I. J., & Kavask, P. (2013). A comparison of high-sensitivity cardiac troponin I assay with the current sensitive cardiac troponin I test in the emergency department. Canadian Journal of Emergency Medicine, 15(Supplement S1), S68.


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