



Department of
Family Medicine

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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Location: David Braley Health Sciences Center

OUTLINE

- Background
- Study Rationale
- Objectives
- Methods
- Results
- Discussion
- Conclusion

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 percentile
- 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 (ρ) 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

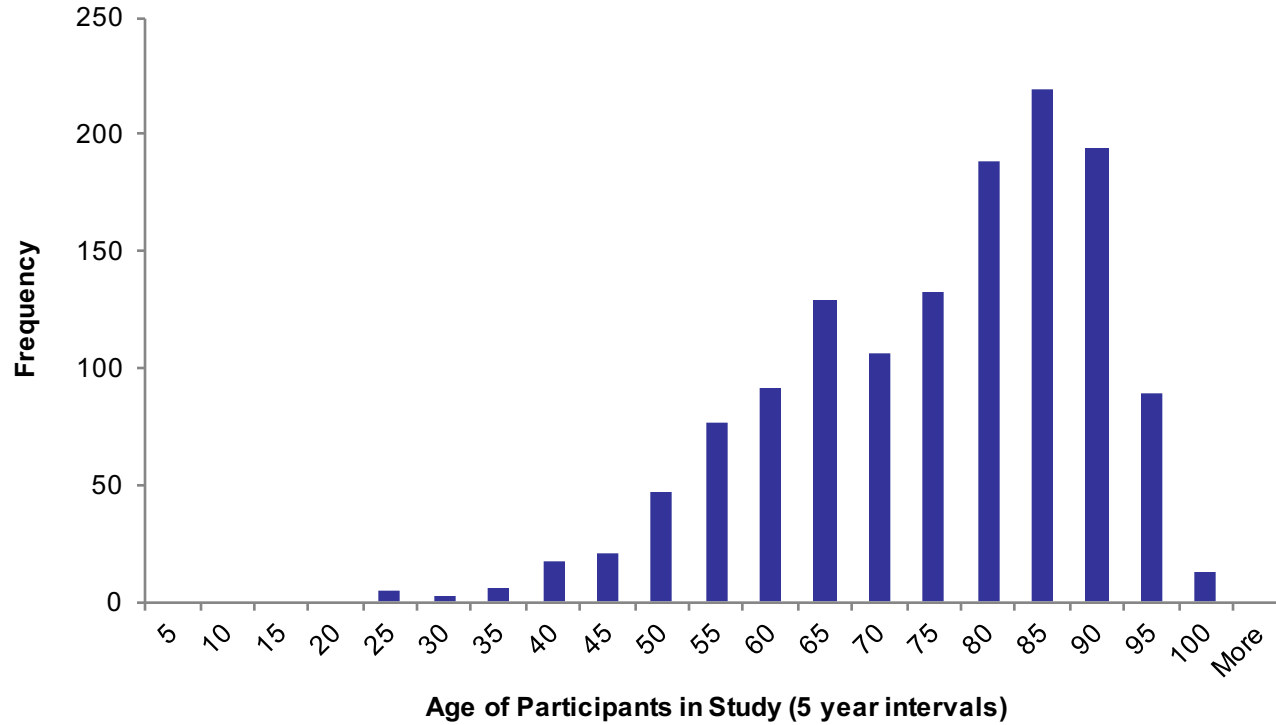
RESULTS

Table 1. Patient Characteristics

Characteristic	Result
Patients in Study	1264
Patient Visits	1340
Mean Age (yrs)	73.2
Age Range (yrs)	21 -100
Sex (%)	
Male	53.6%
Female	46.4%
Mean Heart Rate (bpm)	91.1
Heart Rate Range (bpm)	27 - 239

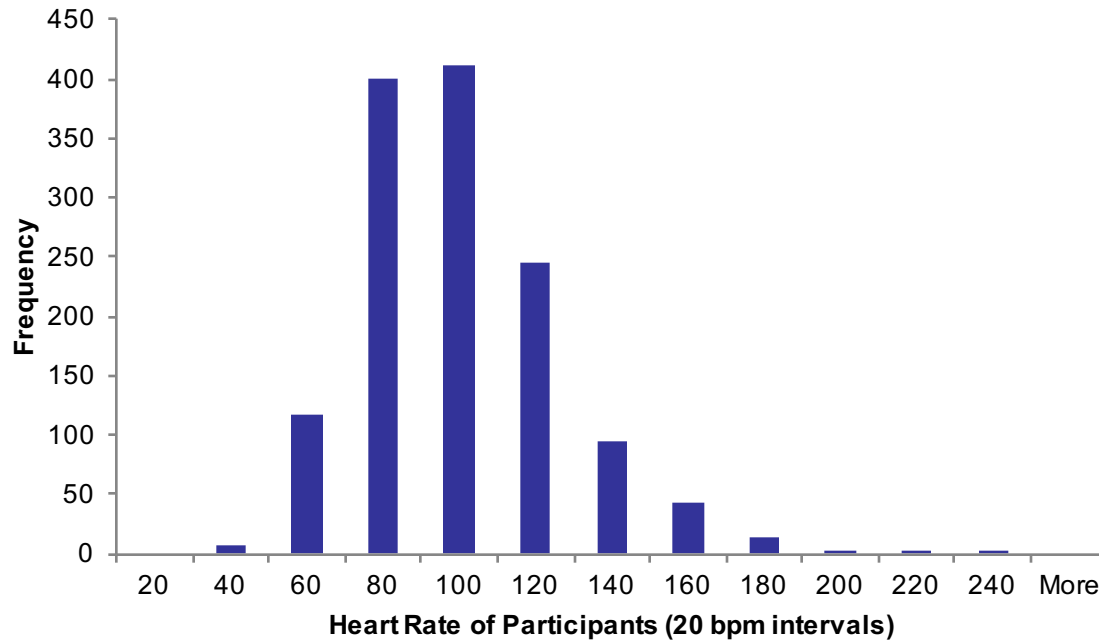
RESULTS

Age Distribution



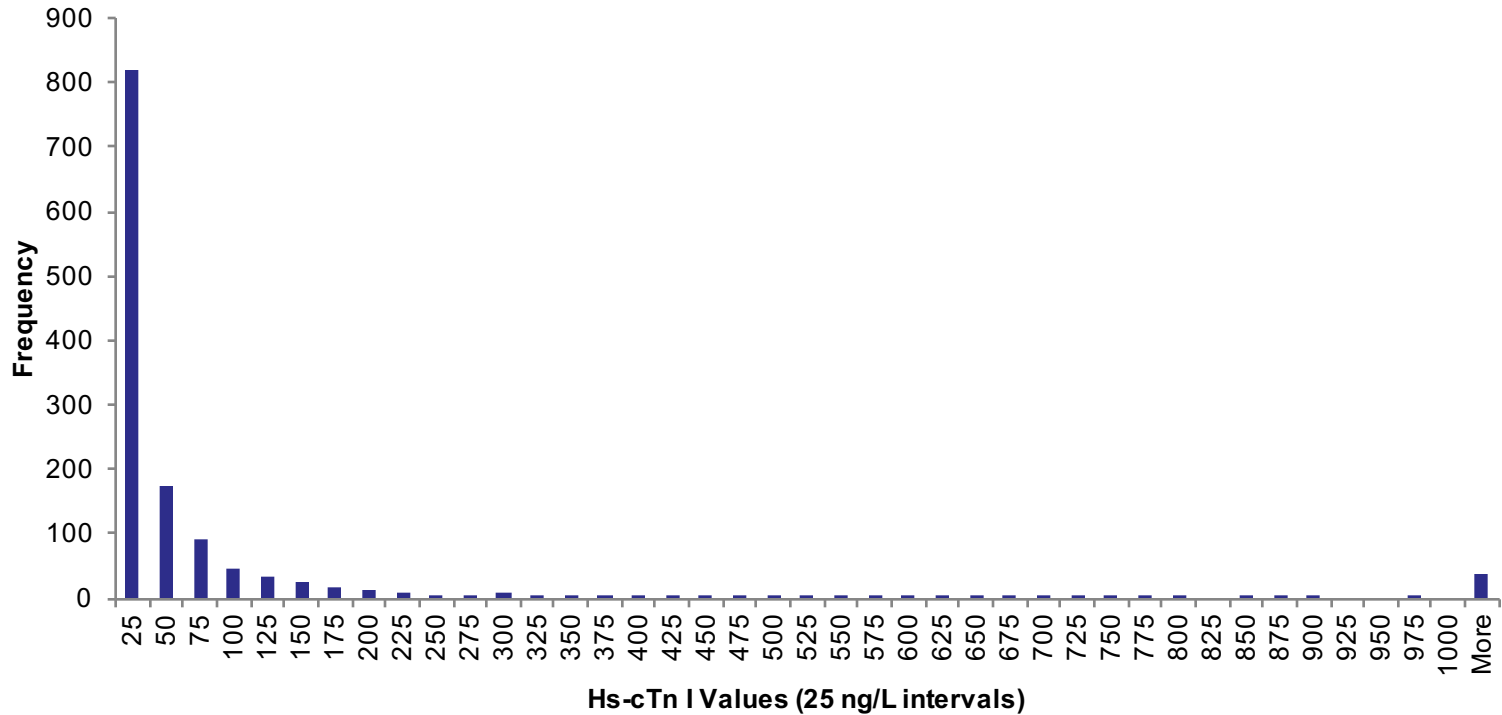
RESULTS

Heart Rate Distribution



RESULTS

hs-cTn I Results Distribution

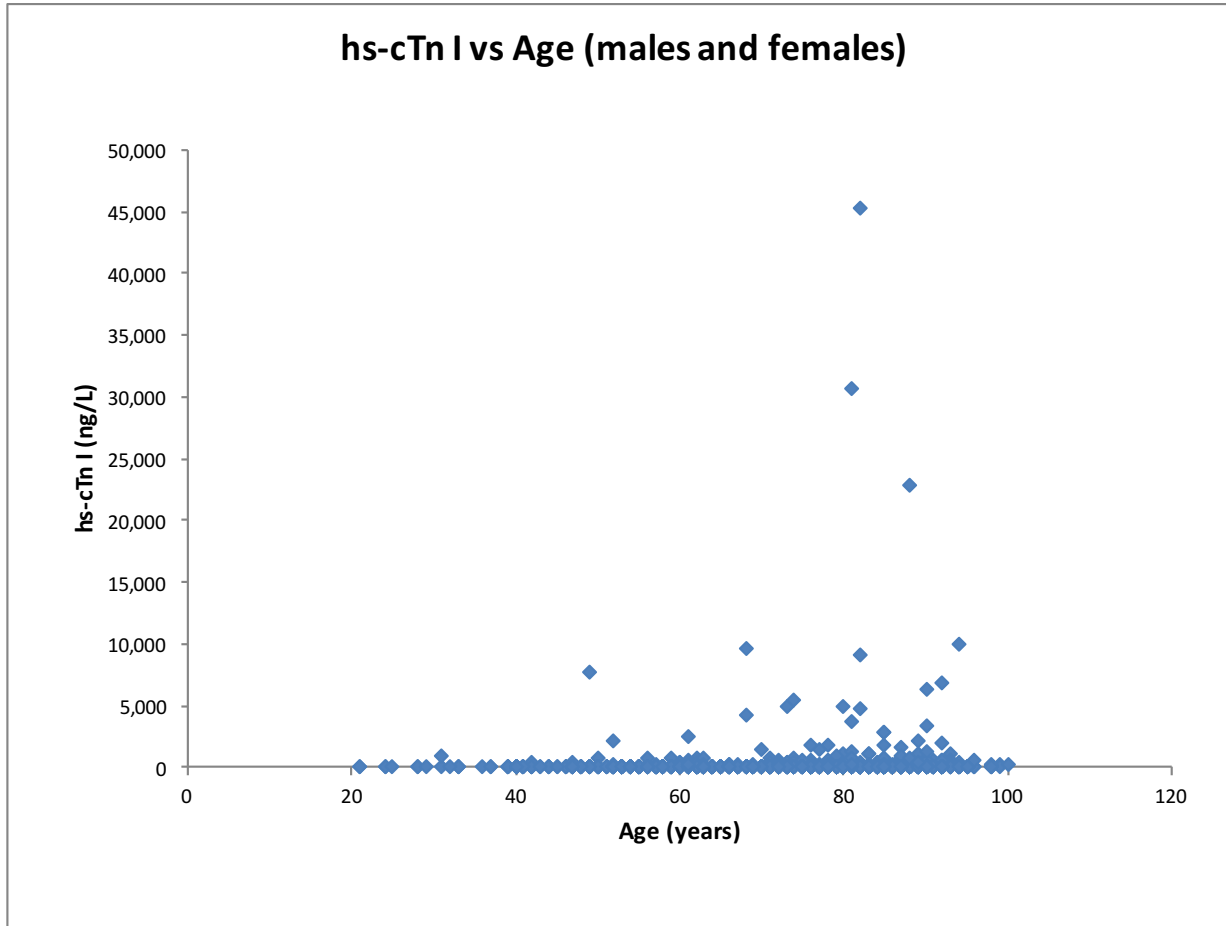


RESULTS

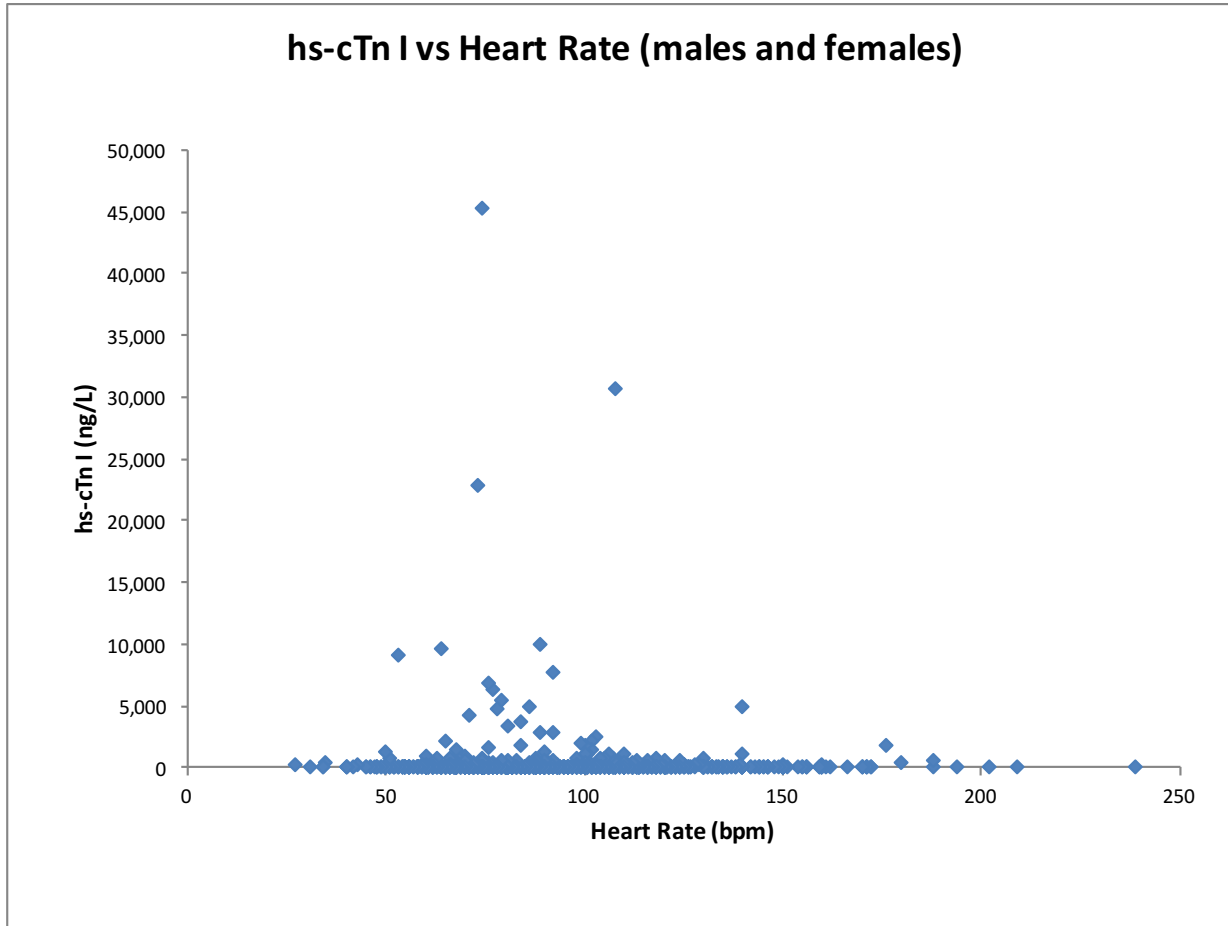
Table 2. Results for all patients

	Rho	P-Value
hs-cTn I vs. Age	0.364	0.000
cTn I vs. Age	0.304	0.000
hs-cTn I vs. Heart Rate	0.112	0.000
cTn I vs. Heart Rate	0.085	0.002

RESULTS



RESULTS



RESULTS

Table 3. Results for Males

	Rho	P-Value
hs-cTn I vs. Age	0.380	0.000
cTn I vs. Age	0.342	0.000
hs-cTn I vs. Heart Rate	0.050	0.181
cTn I vs. Heart Rate	0.016	0.677

RESULTS

Table 4. Results for Females

	Rho	P-Value
hs-cTn I vs. Age	0.370	0.000
cTn I vs. Age	0.289	0.000
hs-cTn I vs. Heart Rate	0.197	0.000
cTn I vs. Heart Rate	0.182	0.000

RESULTS

Table 5. hs-cTn I by gender

	Range	Mean
Males	0.005-22,852	167.45
Females	0.183-45,276	270.75
t-test		p-value=0.30

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

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REFERENCES

- Amsterdam, E. A., Wenger, N. K., Brindis, R. G., Casey, D. E., Ganiats, T. G., Holmes, D. R., ... Zieman, S. J. (2014). 2014 AHA/ACC Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*, *130*(25), e344–e426.
- Ben Yedder, N., Roux, J. F., & Paredes, F. A. (2011). Troponin elevation in supraventricular tachycardia: primary dependence on heart rate. *The Canadian Journal of Cardiology*, *27*(1), 105–109.
- Crowder, K. R., Jones, T. D., Lang, E. S., Wang, D. M., Clark, S. M., Innes, G. D., ... McRae, A. D. (2015). The impact of high-sensitivity troponin implementation on hospital operations and patient outcomes in 3 tertiary care centers. *The American Journal of Emergency Medicine*, *33*(12), 1790–1794.
- Cullen, L., Parsonage, W., Greenslade, J., Aldous, S., George, P., Lamanna, A., ... Than, M. (2014). Use of sex-specific cut-offs with highly sensitive troponin I assay values for the diagnosis of acute myocardial infarction in emergency patients with chest pain. *European Heart Journal*, *34*(suppl 1).

REFERENCES

- Eijsvogels, T. M. H., Hoogerwerf, M. D., Oudegeest-Sander, M. H., Hopman, M. T. E., & Thijssen, D. H. J. (2014). The impact of exercise intensity on cardiac troponin I release. *International Journal of Cardiology*, 171(1), e3–4.
- Gore, M. O., Seliger, S. L., Defilippi, C. R., Nambi, V., Christenson, R. H., Hashim, I. A., ... de Lemos, J. A. (2014). Age- and sex-dependent upper reference limits for the high-sensitivity cardiac troponin T assay. *Journal of the American College of Cardiology*, 63(14), 1441–1448.
- Kavsak, P. A., MacRae, A. R., Yerna, M.-J., & Jaffe, A. S. (2009). Analytic and Clinical Utility of a Next-Generation, Highly Sensitive Cardiac Troponin I Assay for Early Detection of Myocardial Injury. *Clinical Chemistry*.
- Kuster, N., Monnier, K., Baptista, G., Dupuy, A.-M., Badiou, S., Bargnoux, A.-S., ... Cristol, J.-P. (2015). Estimation of age- and comorbidities-adjusted percentiles of high-sensitivity cardiac troponin T levels in the elderly. *Clinical Chemistry and Laboratory Medicine*, 53(5), 691–698.
- McKie, P. M., Heublein, D. M., Scott, C. G., Gantzer, M. L., Mehta, R. A., Rodeheffer, R. J., ... Jaffe, A. S. (2013). Defining high-sensitivity cardiac troponin concentrations in the community. *Clinical Chemistry*, 59(7), 1099–1107.

REFERENCES

- Menacer, S., Claessens, Y.-E., Meune, C., Elfassi, Y., Wakim, C., Gauthier, L., ... Chenevier-Gobeaux, C. (2013). Reference range values of troponin measured by sensitive assays in elderly patients without any cardiac signs/symptoms. *Clinica Chimica Acta; International Journal of Clinical Chemistry*, 417, 45–47.
- Mueller-Hennessen, M., Lindahl, B., Giannitsis, E., Biener, M., Vafaie, M., deFilippi, C. R., ... TRAPID-AMI Investigators. (2016). Diagnostic and prognostic implications using age- and gender-specific cut-offs for high-sensitivity cardiac troponin T - Sub-analysis from the TRAPID-AMI study. *International Journal of Cardiology*, 209, 26–33.
- Reichlin, T., Sou, S. M., Hochgruber, T. H., Vogler, E., Roost, K., Zellweger, M., ... Mueller, C. (2014). Short term physical exercise leads to a small troponin increase measurable with a high-sensitive cardiac troponin I assay. *European Heart Journal*, 34(suppl 1).
- Schofer, N., Brunner, F. J., Schlüter, M., Ojeda, F., Zeller, T., Baldus, S., ... Blankenberg, S. (2016). Gender-specific diagnostic performance of a new high-sensitivity cardiac troponin I assay for detection of acute myocardial infarction. *European Heart Journal. Acute Cardiovascular Care*.
- Slagman, A., Searle, J., Vollert, J. O., Storchmann, H., Büschenfelde, D. M. Z., von Recum, J., ... Möckel, M. (2015). Sex differences of troponin test performance in chest pain patients. *International Journal of Cardiology*, 187, 246–251.

REFERENCES

- Thygesen, K., Mair, J., Giannitsis, E., Mueller, C., Lindahl, B., Blankenberg, S., ... Jaffe, A. S. (2012). How to use high-sensitivity cardiac troponins in acute cardiac care. *European Heart Journal*.
- Vidali, M., Verzotti, E., Cabraz, N., Santi, F., Puma, A., Bellomo, G., ... Avanzi, G. C. (2015). "Real life use" of troponin in the emergency department: a survey of over 3000 cases. *Biochimica Medica*, 25(3), 421–429. <http://doi.org/10.11613/BM.2015.043>
- 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.
- Vidali, M., Verzotti, E., Cabraz, N., Santi, F., Puma, A., Bellomo, G., ... Avanzi, G. C. (2015). "Real life use" of troponin in the emergency department: a survey of over 3000 cases. *Biochimica Medica*, 25(3), 421–429.
- 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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