The time-saving impact of POCT high-sensitivity Troponin I in an Emergency Department

Riddoch FC, Phillips B, Heaney KJ
Point of Care Testing, Berkshire and Surrey Pathology Services, Frimley Health NHS Foundation Trust

Background

High-sensitivity cardiac troponin (HS-Trop) is used in acute hospital emergency departments (EDs) alongside clinical history and ECG to support the assessment of patients with symptoms of acute coronary syndrome (ACS) such as chest pain and shortness of breath[1,2,3].

Chest pain and suspected MI were the cause of ~5% all emergency hospital admissions in 2017-18[1].

Until relatively recently, HS-Trop has not been available as a POCT, resulting in delays to decision-making whilst awaiting lab results. HS-Trop tests must demonstrate <=10% imprecision at the 99th centile, and the ability to measure troponin in >=50% healthy individuals[4]. HS-Trop permits earlier and more reliable decision making in ACS, by using predictive algorithms for rule-out, rule-in, and 0-1h / 0-2h / 0-3h delta.

We performed a study to evaluate the impact of point of care testing (POCT) for high-sensitivity cardiac troponin I (HS-TropI) in ED, to assess suitability for our services and to generate evidence of patient benefit to inform a business case.

Aims

To use POCT HS-TropI real-time measurements to:

- assess real-life comparable **turn-around time** against lab testing
- **interrogate clinical performance** of POCT compared to lab
- assess ability of POCT and lab testing to **rule-out ACS at 0h, and facilitate rapid discharge**
- examine the reliability of methods in producing **a timely and valid result**

These will provide real-world evidence to support a business case for implementation of POCT HS-TropI in EDs

Materials and methods

100 Patients presenting to the ED at Frimley Park Hospital (FPH) with suspicion of ACS who were having a HS-Trop test as part of their care had an additional lithium heparin sample taken, (with verbal consent) for testing on the Siemens POCT method, within 2h of collection. Serum samples were analysed in the blood sciences lab as per usual service. Residual EDTA samples taken for FBC were retrieved for testing on Quidel POCT method within 4h of collection. Samples were collected over 12 days between 8am and 4pm. All methods passed relevant acceptance testing.

Laboratory HS-TropI: Current standard of care test.
Centaur (Siemens): serum samples: 3-site sandwich immunoassay, using magnetic latex conjugated with streptavidin, with biotinylated capture monoclonal antibodies raised against 2 cardiac troponin I epitopes. Detection is via direct chemiluminometric technology.
Analytical range 3 - 25000 ng/L*. Analytical time ~18mins*.
Target lab turnaround time from sample receipt: 1h *(without dilution).

POCT HS-TropI:

(a) Atellica VTLi (Siemens): lithium heparin venous whole blood: Sandwich immunoassay using paramagnetic particles and frustrated total internal reflection detection.
Analytical range 1.6 - 1250 ng/L. Analytical time ~8 minutes

b) Triage True (Quidel): EDTA venous whole blood: Direct fluorescence immunoassay employing murine monoclonal antibodies.
Analytical range 0.1 – 1000 ng/L. Analytical time ~15 minutes

Patients/Samples: 100 samples tested:

- 83 samples with successful comparison between lab and VTLi
- 68 samples with successful comparison between lab and Triage True
- 80 samples were the 1st troponin test. 17 were 2nd test (in this episode of care), and 3 were 3rd test or unknown.
- 4 patients had both 1st and 2nd test done during study collection hours
- 7 patients were diagnosed with ACS, and 87 had other final diagnoses (from ED letters, which may include consideration of the lab HS-Trop)

References

1. NICE CG95
2. European Heart Journal (2021) 42, 12891367
3. European Heart Journal (2019) 40, 237–269
4. Clin Chem. 2017;63(1):73–81
5. Frimley Health ACS Guidelines
6. Chem Lab Med 2021; 59, Special Suppl, pp S94 – S998, Nov/Dec 2021
7. JACC (2020) 75 (10) 1111-24

Results

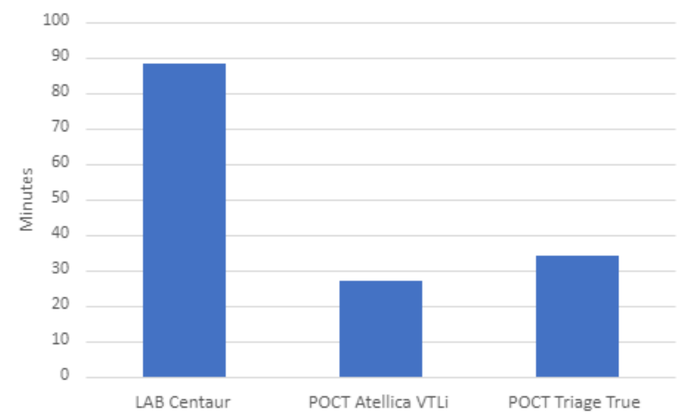
Clinical concordance against 99th Centile

Method	99th Centile FEMALES (ng/L)	99th Centile MALES (ng/L)	Clinical concordance of POCT vs LAB
LAB Centaur	47 (combined level used by lab)		
POCT Atellica VTLi	18.5	27.1	**77 / 83 samples**
POCT Triage True	18.5	25.7	**67 / 68 samples**

Clinical ability to rule-out on 0h sample (1st sample only)

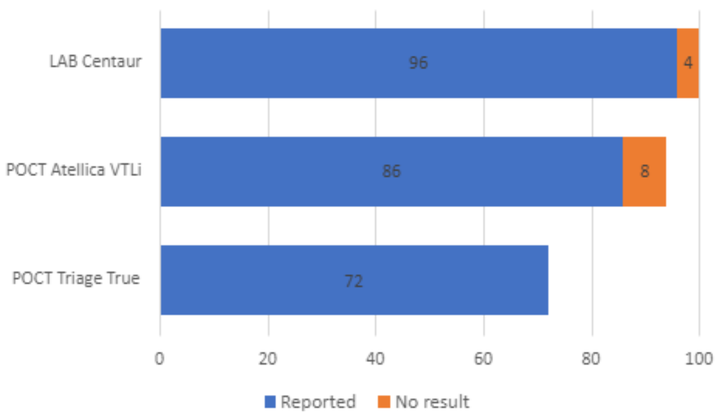
Method	0h rule out criteria	Performance (proportion of patients meeting criteria)	Predictive value of rule-out (n)	Number ACS patients falsely ruled-out
LAB Centaur	<47ng/L at least 6h after onset symptoms[5]	41/48 patients	**100% (43)**	**0/4 patients**
POCT Atellica VTLi	<4ng/L at least 2h after onset symptoms[6]	7/63 patients	**100% (58)**	**0/3 patients**
POCT Triage True	<3ng/L[7]	32/68 patients	**100% (63)**	**0/4 patients**

Median time from order (on EPR) to result available:



NB Triage True time is theoretical, as if the sample had been run as soon as it was delivered to ED POCT room. In reality FBC analysis for patient care had to be prioritised, and the sample was retrieved and run later.

Analytical reliability – number of tests with reported results:



NB For the purpose of the study, we agreed to accept a lot of VTLi cartridges with a known higher invalid rate. However a similar invalid rate was seen across all lots used for the study.

Discussion

This is a small study, but provides real-world information on POCT HS-TropI use in ED, including time-saving impact; demonstrating result availability over an hour sooner compared to lab; facilitating rapid decision making, which can support flow and reduce occupancy.

The results are not always in agreement with the laboratory with regard to 99th centile, but the latter is not a gold standard test. HS-Trop is not standardised, and there is variation in target epitopes, so differences between methods are expected. The ability of the 3 tests to rule-out at 0h varies significantly. When compared to independently-assessed clinical diagnosis however, all 3 tests demonstrated 100% negative predictive value, and no patients with ACS were falsely ruled out.

This study provides information demonstrating the real and potential benefits of POCT HS-TropI in ED, which can support a business case for implementation. Initial implementation into ED, could be for rule-out of ACS in low suspicion patients. More evidence can then be generated to support further indications such as 0h rule-in, and 0-1h / 0-2h delta change protocols.

Both POCT methods are small, portable devices, which potentially permit assessment against suspected ACS pathway to commence at pre-hospital stage e.g. ambulance crews testing the patient *in situ* to inform need for transfer / whether transfer should be to ED, or direct to specialist cardiology services.

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