Clinical and Operational Impact of POCT high-sensitivity Troponin I in an Emergency Department

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Background

High-sensitivity cardiac troponin (HS-Trop) is used in 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% of all emergency hospital admissions in 2017-18[1].

Until relatively recently, HS-Trop has not been available as a point of care test (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 real-time point of care HS-TropI 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 **give an actionable result at 0h, and facilitate rapid discharge / admission to cardiology**

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, all tested 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 the Quidel Triage True 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:

Centaur (Siemens; contemporary standard of care test)**:** serum samples: 3-site sandwich immunoassay, using biotin / streptavidin magnetic latex conjugated with direct chemiluminescence detection.
Analytical range 3 - 25 000 ng/L
Alinity (Abbott; current standard of care test)**:** serum samples: 2-step chemiluminescent microparticle immunoassay.
Analytical range 10 – 50 000 ng/L

Target lab turnaround time from sample receipt: 1h

POCT HS-TropI:

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
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:

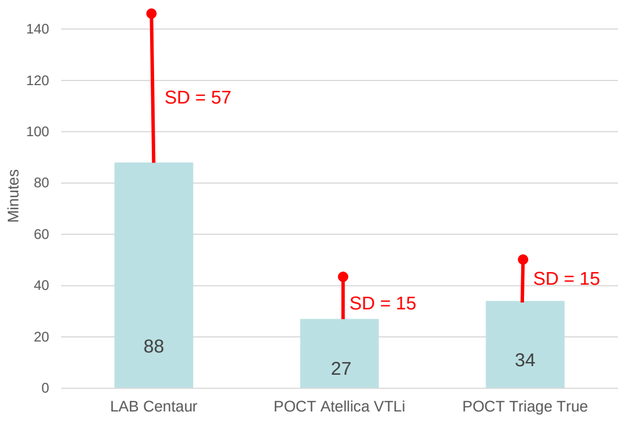
- 83 samples with successful comparison between Centaur / Alinity and VTLi
- 68 samples with successful comparison between Centaur and Triage True
- 64 samples with successful comparison between Alinity and Triage True
- 80 samples were the 1st troponin test. 17 were 2nd test (in this episode of care), 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 Centaur 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 (pre-August 2022- for Siemens assay)
6. Frimley Health ACS Guidelines (post August 2022 – for Abbott assay)
7. Chem Lab Med 2021; 59, Special Suppl, pp S94 – S998, Nov/Dec 2021
8. JACC (2020) 75 (10) 1111-24

Results

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



Bars = median time (minutes)
= + 1SD

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 lab FBC analysis for patient care had to be prioritised, and the sample was retrieved and run later.
No turnaround time is given for the lab Abbott method as this was processed offline after completion of standard of care testing on the serum sample.

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

Method	0h rule out criteria	Performance (proportion of patients meeting criteria[a])	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 (85%)	**100%** (43)	**0/4 patients**
LAB Alinity	F <16ng/L M <34ng/L at least 6h after onset[6]	34/41 patients (83%)	**100%** (39)	**0/1 patient**
POCT Atellica VTLi	<4ng/L at least 2h after onset symptoms[7]	7/63 patients (11%)	**100%** (58)	**0/3 patients**
POCT Triage True	<3ng/L[8]	32/68 patients (47%)	**100%** (63)	**0/4 patients**

[a]Inclusion criteria for assessment of clinical appropriateness of rule out - must be 1st sample, must have a result, must have a clinical outcome, must fit rule-out criteria.

Proportion of actionable results[b] from 1st patient test

[b]no second test for delta change required; ie ACS can be ruled-in or ruled-out from the first patient test.

	LAB Centaur	LAB Alinity	POCT Atellica VTLi	POCT Triage True
Rule-out criteria	<47ng/L at least 6h after onset symptoms[5]	F <16ng/L M <34ng/L at least 6h after onset[6]	<4ng/L at least 2h after onset symptoms[7]	<3ng/L[8]
			AND >99th centile >6h after onset	
Rule-in criteria	>120 ng/L[5]	>64ng/L[6]	>3x 99th Centile[c]	>60ng/L[8]
Tests with an actionable result[b]	42/71 **(59%)**	37/68 **(54%)**	35/65 **(54%)**	48/62 **(77%)**

[c]proposed - currently under investigation in Imperial study.

NB In this study, 35% patients were tested before 6h after onset of symptoms

Discussion

This small study provides real-world information on POCT HS-TropI use in ED, including time-saving impact; demonstrating availability of actionable 0h test results over an hour sooner compared to lab; facilitating rapid decision making, which can support flow and reduce bed occupancy.

The results are not always in agreement with the laboratory, but lab platform immunoassays are not gold-standard tests. HS-Trop is not standardised, and there is known variation in target epitopes, so differences between methods are to be expected. The ability of the 3 tests to rule-out or rule-in 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 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, or whether transfer should be to ED, or direct to specialist cardiology services.

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