Original Article

Comparison of Performance Characteristics Between FIA 8000 and Vitros ECiQ Analyzer for Cardiac Troponin I Estimation

Farheen Aslam[1], Tariq Arain[2], Maria Mehmud[3], Zakir Ali[4] and Asma Shaukat[1]

ABSTRACT

Objective: We compared the diagnostic performance of FIA 8000 Quantitative immunoassay point-of-care device for cardiac troponin I (TropP) with fully automated central laboratory Vitros ECiQ Immunodiagnostic Systems (TropV).

Study Design: Experimental study.

Place and Duration of Study: This study was conducted at the Emergency and Pathology Department of Quaid-e-Azam Medical College Bahawalpur over a period of 12 months from September 2015 to October 2016.

Materials and Methods: Blood specimens for cTn I measurement from patients suspected of Myocardial infarction in the ED were divided into two parts. One was analyzed on the FIA 8000. Other was analyzed on Vitros. The calculation of sensitivity, specificity, positive and negative predictive values for TropP were made. In TropP elevated samples imprecision, bias and comparative analysis were performed with respect to TropV.

Results: The specificity and false negative results for TropP were more than TropV. The kappa analysis revealed moderate agreement (κ=0.596). Of the 263 elevated TropP, 18 were negative by TropV, overall TropV results were higher. Coefficient of variations (CVs) was less than 10% in both within and between run assays. Initial comparison of results using Spearman test showed correlation coefficient (r) of 0.98. The results showed good correspondence, when Bland–Altman and Passing–Bablok regression analysis were performed.

Conclusion: The FIA 8000 is helpful in early and reliable diagnosis of myocardial infarction in emergency department.

Key Words: Diagnostic performance, Cardiac troponin I, Vitros ECiQ, FIA 8000

Citation of articles: Aslam F, Arain T, Mehmud M, Ali Z, Shaukat A. Comparison of Performance characteristics between FIA 8000 and Vitros ECiQ Analyzer for Cardiac Troponin I Estimation. Med Forum 2017;28(7):92-96.

INTRODUCTION

Myocardial infarction (MI) is necrosis and damage of myocardial cells due to significant narrowing of coronary arteries. Myocardial damage can be detected by measurement of one of the major sensitive and specific cardiac biomarker troponin I (cTnI) in blood[1,2]. The rise and/or fall of the troponin level, along with clinical symptoms and/or electrocardiogram is necessary to diagnose acute myocardial infarction[3]. Recently proposed guidelines advocate measurement of troponin I for diagnosis and risk assessment ofcoronary syndrome (ACS)[4]. The speedy and fast decisions about management of patients either in ward or intensive cardiac unitare possible by cTnI measurement.[5]

The POCT device can be used for rapid and accurate cTnI measurement in making decision about myocardial infarction and decreasing motility and fatality risks associated with it.[6] An increased cTn concentration is defined as 1 level higher than the 99th percentile of disease free population, on condition that precision is optimal at this level. The precision criteria of co-efficient of variation (CV) <10% at 99th percentile[7] is met by few manufacturers of POCT assay. So measurement of cTnIatco efficient of variation<20% is acceptable[8]. The recent guidelines favor turnaround time of less than 30 minutes for cardiac troponin biomarkers[9]. This rapid turnaround time not only facilitate timely diagnosis but also has valuable role in treatment of acute myocardial infarction.[10] The suggested turnaround time is not achieved by most central laboratories.[14] So hospitals have to rely on rapid point-of-care system to assess patients presenting with cardiac symptoms. It eliminates most pre and postanalytical delays and gives urgent diagnosis in a

[1.] Department of Pathology / Opthalmology[2], Quaid-i-Azam Medical College, Bahawalpur.
[3.] Department of Advanced Biotechnology, Algonquin College, Ottawa, Canada.
[4.] Chief Executive Office Health, Bahawalpur.

Correspondence: Dr. Farheen Aslam, Assistant Professor, Department of Pathology, Quaid-i-Azam Medical College, Bahawalpur.

Contact No: 0300-9686232
Email: farheenaslam75@yahoo.com

Received: May 04, 2017; Accepted: June 06, 2017

time sensitive manner.[11,12] But most point of care devices have reduced analytical sensitivity and false negative trop I measurements may lead to misdiagnosis of acute coronary syndrome while false positive results in unnecessary hospital admission and medical intervention. [13] Central laboratory turnaround times consistently less than 60 minutes are clinically appropriate but often difficult to achieve. The approach of using point-of-care (POC) system in emergency department and immunoassay troponin I method during the stay of patient in cardiology unit is followed by many hospitals. This Inter method difference can be especially troublesome for the physicians.[15] This study is performed to appraise the performance of the poct device being used in our emergency department and to compare the result of first drawn specimen for trop I to that measured on central lab device.

Assay principle

The Vitros ECiQ Immunodiagnostic System is an electro-chemiluminescence immuno assay technique. The measurement range of cTnI kit is 0.012–80 ng/mL. In GP (Gelatin Biotech Inc, Luhe District, Nanjing, China) cTnI Fast Test Kit antigen(sample) and gold labeled antibody form complex. Then another antibody present on test line captures the complex resulting in purplish red line on test zone. The color intensity of test line is proportional to the amount of cTnI in the sample. FIA 8000 Quantitative immunoassay instrument reads the inserted test card and displays the concentration of measured cTnI on the screen. The limit of detection has been determined to be0.5ng/mL. The reportable range of the assay is 0.5–50 ng/mL.

MATERIALS AND METHODS

The study was conducted in Quaid -e-Azam Medical College from September 2015- October 2016. The study was conducted after approval from Ethical committee. We included 630 subjects who admitted in emergency department with symptoms of chest pain. Those who were diagnosed cases of MI were excluded from the study. Troponin I tests were done using both methodologies on blood samples collected at the same draw by dividing the sample into 2 aliquots after receiving samples in the emergency lab (the first 2 Troponin values for each other) according to manfacturer's instructions.

Control materials

Two levels of commercial quality controls (Liquicheck Cardiac Markers Plus, Bio-Rad Laboratories, Hercules, CA, USA) with different concentrations of cTnI (1.57 and 18.8 mg/L) were analyzed on both instruments. They were tested 20 times during a day in the same analytical run for calculating the within-run imprecision. In addition 20 aliquots per level were frozen for the between-run imprecision determination. One aliquot per level was thawed and analyzed over twenty days. Coefficient of variation (%CV) for within-run and between-run imprecision were calculated.

Statistical Analysis: SPSS software version - 20 (SPSS Inc, Chicago) was employed to perform statistical analysis. The calculation of sensitivity, specificity, positive and negative predictive values for troponins was performed. Kappa analysis was carried out to demonstrate correspondence of results. Mean and standard deviation were used to present the variables. The strength of linear relationship between cTnI measurements by laboratory methods was determined by Pearson correlation (r). Bias and agreement between two measured techniques were constructed by Bland and Altman plot using Graph Pad Prism 6 software.

RESULTS

The mean age of patients included in the study was 68.5 ± 10.2 years (range 43 – 84 years). There were 367 (59%) males and 263 (41%) females. The patientswith increased cTnI levels obtained from Vitros analyzer (tropV) was assigned as positive case of MI. The results obtained from FIA 8000 showed sensitivity 69%, specificity 93.4%, positive predictive value 93.1%, negative predictive value 69% and likelihood ratio 10.41. The concordance of cTnI result using kappa analysis showed moderate agreement between Vitros and FIA 8000. ($p<0.001$, $\kappa=0.596$). The test performed on FIA8000 showed lower values as compared to Vitros. But the results of 18 out of 263 Trop P positive patients were found to be negative when sample were analyzed on Vitros. The test values of Trop V results were0.06 - 0.21 ng/mL lower than that ofTropP.

Table No.I: Imprecision of TropV and Trop P

		Mean (ng/ml)	Standard deviation(SD)	Coefficient of variation(CV)%
Within run Imprescion	Trop V(level 1)	1.56	0.02	3.12
	Trop P(level 1)	1.42	0.11	7.74
	Trop V(level 2)	18.65	0.43	2.13
	Trop P(level 2)	16.79	1.37	8.58
Between run Imprescion	Trop V(level1)	1.51	0.06	3.97
	Trop P(level 1)	1.49	0.09	6.04
	Trop V(level 2)	18.23	0.49	2.63
	Trop P(level 2)	16.38	1.31	7.99

Table No.2: Comparative analysis between TropP and TropV:-

	Trop V+	Trop V-	Total
Trop P+	245	18	263
Trop P-	153	186	339
Total	398	204	602

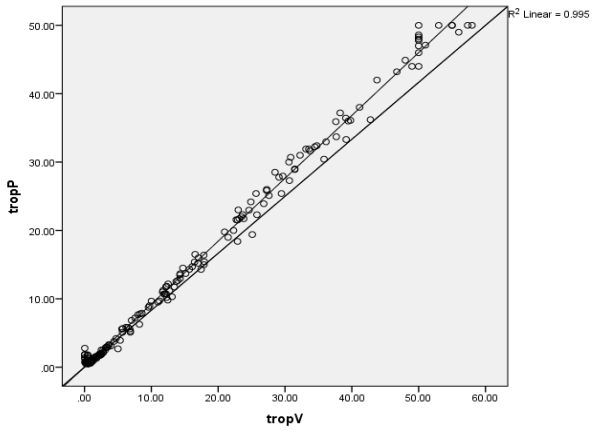

Figure No. 1: Scatter graph of cTnI measured by FIA 8000 and Vitros

The calculated relationship was TropV = 0.919x TropP + 0.052.

Table No.3: Results for the comparison between the Trop P and Trop V Results (at 95% confidence intervals)

Regression equation	Y = 0.9192*X + 0.05231
Intercept	0.05231 (-0.1637 - 0.2683)
Slope	0.9192 (0.9099 - 0.9286)
r	0.9813 (0.9750 - 0.9861)
r^2	0.9950
Bias	1.32(-2.081 - 4.543)

Bland Altman plot between TropP and TropVtest results showed good correspondence, 95% of results were within the ± 2 SD from the mean.

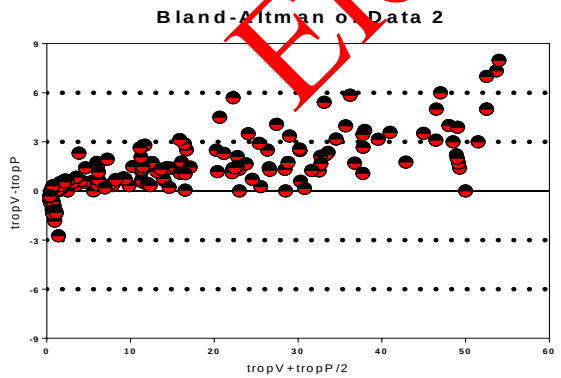

Figure No.2: Bland Altman of Data 2

The initial comparison of results using Spearman test showed a correlation coefficient (r) of 0.98. Passing and Bablok for linear regression analysis gave a positive correlation between two techniques.

DISCUSSION

Emergency departments have to rapidly assess and evaluate the cardiac patients to make appropriate decision about timely disposition and proper management of their condition. Many main labs of hospitals are not able to achieve the turnaround time set for cardiac marker testing in spite of better available analytical techniques.[16]Our study indicated the performance of the 2 analysis techniques that may be helpful for the clinicians in diagnosis and management of patients admitted tothe ED. The new point-of-care FIA analyzer showed more specificity and positive predictive value. But false negative rate was high. The high-specificity of cardiac Troponin testing may help us in the appropriate diagnosis of a cardiac event. It may facilitate in speedy treatment of all true cardiac events thereby improving the patient's recovery and reduction of mortality. It also showed fair degree of agreement of results to auto analyzer by kappa analysis. The low sensitivity is probably due to the fact that we took only the first Troponin measurements for a patient. The studies conducted by Noyen and Hjortshøj[17,18] showed the similar results using other poct devices. The POCT instrument used in our study has turnaround time (TAT) of 15 minutes. This favors the current guideline recommendations which suggest that lab should analyze and repot Trop results within 60 min after the patient has admitted to the cardiology care unit or emergency department.[19] Patients with symptoms of chest pain can be rapidly assessed with estimation of cTnI levels. FIA 8000 has successfully fulfill the role of ruling out patients with symptoms of acute MI. This instrument like other POCT devices has decrease readmission of patients with similar complaints and aid in saving the hospital financial resources.[20] But as with many point-of-care cardiac troponin devices, it is less sensitive than central immunoassay automated analyzers.[21] In our study, the cTnI levels measured by two different instruments purposed linear

relationship but at elevated concentration the best fit line showed substantial proportional bias. (TropV = 0.919x TropP + 0.052).

Our results are in concordant with the other studies using different POCT devices [22, 23]. Similarly the Bland-Altman analysis showed a systematic negative bias for the POCTtest results compared to the laboratory troponin values. These results are similar to those obtained in other comparison studies[24, 25].

CONCLUSION

The FIA 8000 Quantitive immunoassay instrument is an easy, rapid and reliable method for the quantitative analysis of cardiac troponin I. But thisPOCT device faces problem to establish recommendations for rapid turnaround times, high precision and excellent low-end sensitivity.

Recommendations: It is recommended to have serial measurements for at least 6-8 hours in patients suspected of having a heart event rather than first drawn sample used in our study. Point of care testing is a useful tool to rule out ACS, it shortens the stay of patients in emergency department resulting in early discharge and proves to be cost effective. So physicians must balance the need for earlier receiving of tropI results against analytical characteristics of POCT technique. Different scientific organizations are working together to standardize troponin measurement similar to other lab parameters. Soit will be possible in future that compatibletropIresults can be obtained independent of analytical instruments and laboratory setting.

Author's Contribution:
Concept & Design of Study: Farhaven Aslam
Drafting: Maria Mehmud
Data Analysis: Zakir Ali
Revisiting Critically: Tariq Arain
Final Approval of version: Asma Shaukat

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Thygesen K, Alpert JS, Jaffe AS, White HD, Simoons ML, Chaitman BR, et al. Third universal definition of myocardial infarction. J Am Coll Cardiol 2012;60:1581–98.
2. Thygesen K, Alpert JS, White HD. Universal definition of myocardial infarction. Circulation 2007;116:2634–53.
3. Jaffe AS. Chasing troponin: how long can you go if you can see the rise? J Am CollCardiol 2006;48:1763–4.
4. Rooney KD, Schilling UM. Point of care testing in the overcrowded emergency department-can it make a difference? Critical care 2014;18:692.
5. Storrow AB, Lyon JA, Porter MW. A systematic review of emergeny department point of care cardiac markers and efficiency measures. Point care 2009;8:121-5.
6. Stengaard C, Thorsted Sorensen J, Terkelsen CJ. Prehospital point of care testing of biomarkers has diagnostic value in relation to acute myocardial infaction. UgeskrLaeger 2013;175:186-9.
7. José L, Calderón M, Julia M, Pérez V, Bustos F, Juan C. Gómez S. Performance characteristics of loci method for measuring cardiac troponin I on the dimension EXL. Pract Lab Med 2015;1:42.
8. Thygesen K, Mair J, Katus H, Plebani M, Venge P, Collinson P, et al. Study group on biomarkers in cardiology of the ESC working group on acute cardiac care. recommendations of the use of cardiac troponin measurement in acute cardiac care. Eur Heart J 2010;31:2197–204.
9. Friess U, Stark M. Cardiac markers: a clear cause for point-of-care testing. Anal Bioanal Chem 2009;393(5):1453-62.
10. Reichlin AL, Hochholzer W, Bassetti S, et al. early diagnosis of myocardial infarction with sensitive cardiac troponin assay. N Engl J Med 2009; 361:858-67.
11. Giaface AL, Myer JH, Kirchick HJ, et al. point of care cardiac marker strategy facilitates the rapid diagnoss and management of chest pain patients in the emergency department. Am J Clin Pathol 2008;129:788-95.
12. Diercks DB, Peacock WF, Hollander JE, Singer AJ, Birkhahn R, Shapiro N. Diagnostic accuracy of a point-of-care troponin I assay for acute myocardial infarction within 3 hours after presentation in early presenters to the emergency department with chest pain. Am Heart J 2012; 163(1):74-80.
13. Apple FS, Wu AH, Jaffe AS, Panteghini M, Jesse RL, Newby LK, et al. National Academy of Clinical Biochemistry and IFCC Committee for Standardization of Markers of Cardiac Damage Laboratory Medicine Practice Guidelines: analytical issues for biochemical markers of acute coronary syndromes. Clin Chem 2007;53:547-51.
14. Morrow DA, Cannon CP, Rifai N, et al. TACTICS-TIMI 18 Investigators. Ability of minor elevations of troponins I and T to predict benefit from an early invasive strategy in patients with unstable angina and non-ST elevation myocardial infarction: results from a randomized trial. JAMA 2001;286:2405–2412.
15. Aldous S, Mark Richards A, George PM, Cullen L, Parsonage WA, Flaws D, et al. Comparison of new point-of-care troponin assay with high sensitivity

troponin in diagnosing myocardial infarction. Int J Cardiol 2014;177(1):182-6.
16. Lee-Lewandrowski E, Januzzi LJ, Grisson R, Mohammed AA, Lewandrowski G, Lewandrowski K. Evaluation of First-Draw Whole Blood, Point-of-Care Cardiac Markers in the Context of the Universal Definition of Myocardial Infarction. A Comparison of a Multimarker Panel to Troponin Alone and to Testing in the Central Laboratory. Arch Pathol Lab Med 2011;135:459-63.
17. Noyan T, Gozlukaya O, Cankaya S. The Evaluation of Cardiac Troponin I Assays Measured Radiometer AQT90 Flex and ReLIA Analyzers and Determination of Heterophilic Antibody Positivity Rate. J Med Medical Res 2013;1(4): 16-22.
18. Hjortshoj S, Venge P, Ravkilde J. Clinical performance of a new point-of-care cardiac troponin I assay compared to three laboratory troponin assays. Clin Chim Acta 2011;412 (3-4):370-5.
19. Mozina H, Vukan V, Lenart K, Skitek M, Osredkar J. Quantitative point-of-care troponin I in emergency department in comparison with troponin I in central laboratory. Point Care 2010; 9(1):8–11.
20. Scharnhorst V, Krasznai K, Vant veer M, et al. rapd detection of myocardial infarction with a sensitive troponin test. Am J Clin Pathol 2011;135:424-8.
21. Bingisser R, Cairns C, Christ M, Hausfater P, Lindahl B, Mair J, et al. Am J Emerg Med 2012; 30(8):1639-49.
22. Bock JL, Singer AJ, ThodeJr HC. Comparison of emergency department patient classification by point of care and central laboratory methods for cardiac troponin I. Am J Clin Pathol 2008;130: 132-5.
23. Sardi AR, Phillip-Samuel SG, Lamoureux JA. A Comparison of Laboratory Automatic Troponin Testing versus Point of Care Troponin. http://scholarlycommons. baptisthealth Net.
24. Sardi AR, Lamoureux JA, Cohn TM, Phillip-Samuel SG. Point-of-Care Testing of Troponin Levels Compared With Automated Laboratory Evaluation: A Reliability Study. Crit Care Nurs Q 2016;39(4):345-51.
25. Kim TK, Oh SW, Hong SC, Mok YJ, Choi EY. Point-of-care fluorescence immunoassay for cardiac panel biomarkers. J Clin Lab Anal 2014; 28(6):419-27.