



The Comparison of %Ejection Fraction Between 4D MSPECT and Myometrix in Gated Myocardial SPECT

Taratip Narawong, M.Sc.

Division of Nuclear Medicine, Department of Radiology, Rajavithi Hospital, Bangkok 10400, Thailand

Abstract

Objective: To compare the %Ejection Fraction (%EF) between 4D MSPECT and Myometrix software in Gated Myocardial SPECT for a one day protocol study in Rajavithi hospital.

Materials and Methods: The 100 retrospective data of the Gated Myocardial SPECT from the suspected Coronary Artery Disease patients during July to October 2011 was reanalyzed by an experienced operator. Two software i.e, 4D MSPECT and Myometrix were used. The reconstruction parameters for rest study was OSEM/MLEM 2 iterations 10 subsets with no attenuation correction and the post filter of 3D Butterworth at critical frequency of 0.548 power 12.6. The reconstruction parameters for stress study was OSEM/MLEM 2 iterations 10 subsets and the post filter of 3D Butterworth at critical frequency of 0.45 power 10. The %EF, end diastolic volume (EDV) and end systolic volume (ESV) were compared between each software. A two tailed pair t-test was used to test the statistically significant difference in these three value for both intraoperator and interoperator studies.

Results: The average age of the patient was 63.9 ± 12.1 (mean $\pm$ SD) with 44 female and 56 male. In intraoperator study, the mean %EF of 4DMSPECT showed the good correlation with Myometrix for both rest and stress study ($r=0.95$ and $r=0.96$, respectively.) In interoperator study, the mean %EF of 4DMSPECT also gave the good correlation with Myometrix for both rest and stress study ($r=0.99$ and $r=0.99$, respectively). The statistical test between two software showed no significant difference. ($p>0.05$).

Conclusion: The %EF from both software gave the good correlation. Since these two software packages used different algorithm so it did not recommend to interchange between these two software.

Keywords: Ejection Fraction, Gated Myocardial SPECT, 4DMSPECT, Myometrix

Introduction

Gated Myocardial perfusion SPECT (GSPECT) is the routine Nuclear Medicine study for assessment of the Coronary Artery Disease (CAD) because of several factors as follows: first it is a simple method which can be finished within a single study. Second, the Tc-99m labeled perfusion tracers allow ECG gating with flexible acquisition protocols. Third, the fast acquisition and processing by the advanced multidetectors SPECT makes this technique simple, practical and user friendly in clinical setting. Fourth, GSPECT measurements have been extensively validated against many other standard cardiac imaging modalities,¹ such as the good correlation with echocardiography^{2,3} or Magnetic Resonance Imaging⁴⁻⁶ or even the comparison between each software packages.^{7,8} Though there were several publications about the study of the software packages but those were the study about Emory Cardiac Toolbox (ECTb) and Myometrix or ECTb and 4D MSPECT. The purpose of this retrospective study is to compare the %EF from 4D MSPECT and Myometrix in the suspected CAD patients.

Materials and Methods

Study population

Reviewed the patient file of the suspected Coronary Artery Disease (CAD) patients who underwent Tc-99m MIBI Gated Myocardial SPECT (GSPECT) from July to October 2011. The data which had a complete study i.e., rest and stress data, were included in this study. Other uncompleted data were excluded such as the patient who could not do the stress study.

Gated SPECT acquisition

A one day rest/stress protocol using 370/1110

MBq of Tc-99m MIBI was performed in every patient. Both acquisitions began 60-90 minutes after Tc-99m MIBI injection. All studies used a dual-headed GE-Infinia SPECT system (GE Medical Systems, Milwaukee, WI, USA) equipped with Low Energy High Resolution collimator. The acquisition protocol for rest study was step-and-shoot with 25 second per view, total 60 views, 3 angle per view, total 180 angle. Matrix size of 64 x 64, ECG gating acquired 8 frames per cardiac cycle, zoom 1.3 and no attenuation and scatter correction were applied. The stress study protocol was the same as rest study except the time per view was reduced to be 20 second per view.

Image reconstruction

The reconstruction parameters for all rest studies were OSEM/MLEM 2 iterations 10 subsets with no attenuation correction and the post filter of 3D Butterworth at critical frequency of 0.548 power 12.6. The reconstruction parameters for all stress studies were OSEM/MLEM 2 iterations 10 subsets and the post filter of 3D Butterworth at critical frequency of 0.45 power 10. The experienced operator reanalyzed all data and compared the value of %EF, EDV and ESV of Myometrix with 4DMSPECT software packages for the intraoperator study. For interoperator study, the previous %EF, EDV and ESV were recorded and compared with the second reconstruction analysis by the experienced operator for both rest and stress study.

Statistical analysis

The patient data were presented as mean $\pm$ SD. Moreover, the correlation between each software packages was presented. The paired student's t-test was used to analyze the statistically significant

cant difference at the 95% confidence. A p-value of less than 0.05 was considered as statistically significant.

Ethics

This study was approved by the Rajavithi hospital ethics committee.

Results

There were 100 patients with average age of 63.9 ± 12.1 (44 female and 56 male). The patient characteristics were shown in table 1.

The result of the intraoperator study for the comparison between two software was shown in table 2. The %EF, EDV(ml) and ESV(ml) were presented in mean $\pm$ SD for both rest and stress study.

The result of the interoperator study for the comparison between two software was shown in

table 3. The %EF, EDV(ml) and ESV(ml) was presented in mean $\pm$ SD for both rest and stress study.

The correlation analysis and the statistically significance test (p-value) were shown in table 4 for intraoperator and in table 5 for interoperator comparison. All parameters were compared such as %EF, EDV(ml) and ESV(ml), rest and stress study for both 4D MSPECT and Myometrix software.

Discussion

As the previous study showed that 4D MSPECT gave the most reliable data compared with other software package when using the software phantom.⁹ But because of the display format which is not suitable for the needs of the physicians in the Rajavithi hospital and they prefer the display format of the Myometrix software than 4D MSPECT. Therefore, this study used the 4D MSPECT as the gold

Table 1 Patient characteristics (n=100)

Characteristics	No. of patients
Mean age $\pm$ SD (year)	63.9 ± 12.1 (range 24-87)
Gender : Male	56 (56%)
: Female	44 (44%)

Table 2 Mean, standard deviation(SD), and range of %EF, EDV and ESV calculated by 4DMSPECT and Myometrix in intraoperator comparison.

parameter	Mean $\pm$ SD (range)	
	4DMSPECT	Myometrix
Rest Study		
%EF	56.80 ± 18.89 (19-92)	50.24 ± 19.37 (9-87)
EDV(ml)	117.11 ± 78.40 (33-457)	107.89 ± 79.84 (28-553)
ESV(ml)	61.79 ± 67.02 (3-325)	65.84 ± 77.05 (4-505)
Stress study		
%EF	53.77 ± 19.55 (18-91)	49.34 ± 19.72 (4-85)
EDV(ml)	124.90 ± 86.75 (36-564)	110.95 ± 81.63 (30-558)
ESV(ml)	71.16 ± 78.54 (3-461)	68.70 ± 77.82 (4-489)

Table 3 Mean, standard deviation (SD), and range of %EF, EDV and ESV calculated by 4DMSPECT and Myometrix in interoperator study.

parameter		mean±SD (range)	
		first analysis	second analysis
Rest Study			
%EF	4DMSPECT	56.77±18.77 (19-92)	56.80±18.89 (19-92)
	Myometrix	50.45±19.61 (8-87)	50.24±19.37 (9-87)
EDV(ml)	4DMSPECT	116.71±77.37 (33-457)	117.11±78.40 (33-457)
	Myometrix	107.44±79.49 (28-553)	107.89±79.82 (28-553)
ESV(ml)	4DMSPECT	61.79±66.53 (3-325)	61.79±67.02 (3-325)
	Myometrix	65.38±76.66 (4-505)	65.84±77.05 (4-505)
Stress study			
%EF	4DMSPECT	54.05±19.42 (18-91)	53.77±19.55 (18-91)
	Myometrix	49.42±19.88 (5-85)	49.34±19.71 (4-85)
EDV(ml)	4DMSPECT	123.31±86.29 (36-564)	124.93±86.75 (36-564)
	Myometrix	110.34±81.02 (30-558)	110.95±81.63 (30-558)
ESV(ml)	4DMSPECT	69.79±77.89 (3-461)	71.16±78.54 (3-461)
	Myometrix	67.19±75.81 (4-489)	68.70±77.82 (4-489)

Table 4 Correlation analysis and the p-value for the statistical significant difference analysis for intraoperator study between 4D MSPECT and Myometrix

	Pearson correlation	p-value
Rest study		
%EF	0.95	0.98
EDV(ml)	0.97	0.68
ESV(ml)	0.95	0.49
Stress study		
%EF	0.96	0.91
EDV(ml)	0.99	0.81
ESV(ml)	0.99	0.41

Table 5 Correlation analysis and the p-value for the statistical significant difference analysis for interoperator study between the first and second analysis for 4D MSPECT and Myometrix

	Pearson correlation		p-value	
	4D MSPECT	Myometrix	4D MSPECT	Myometrix
Rest study				
%EF	0.99	0.99	0.32	0.35
EDV(ml)	0.99	0.99	0.33	0.33
ESV(ml)	0.99	0.99	0.32	0.33
Stress study				
%EF	0.99	0.99	0.36	0.33
EDV(ml)	0.99	0.99	0.37	0.34
ESV(ml)	0.99	0.99	0.36	0.37

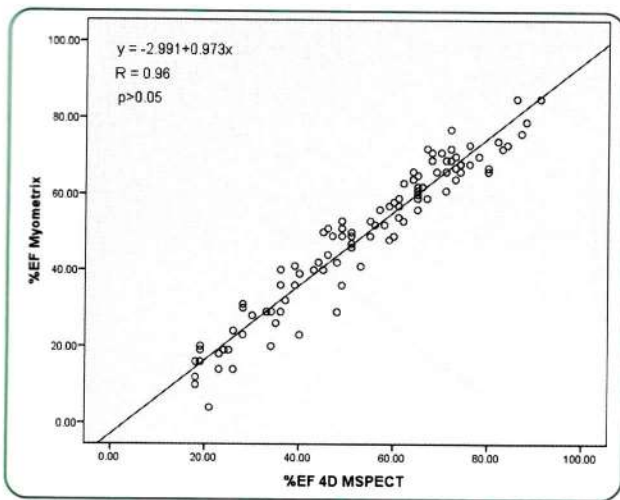


Fig.1(a)

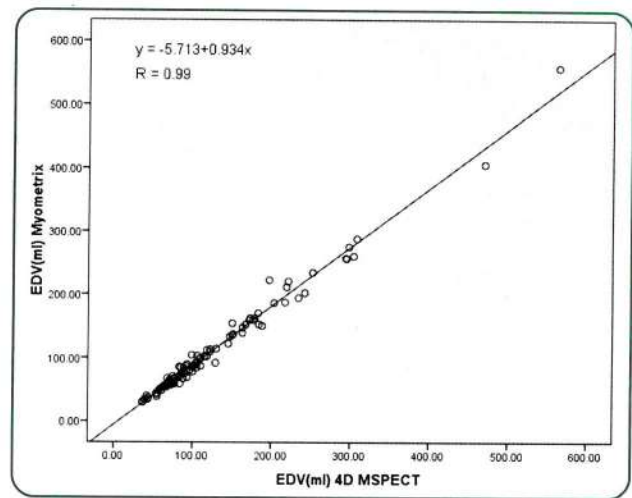


Fig.1(b)

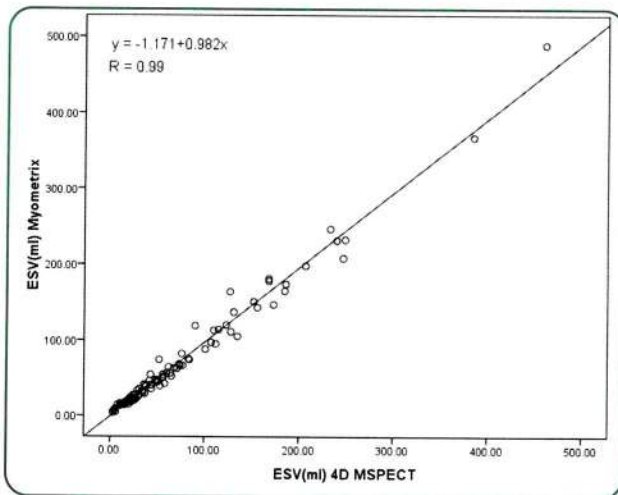


Fig.1(c)

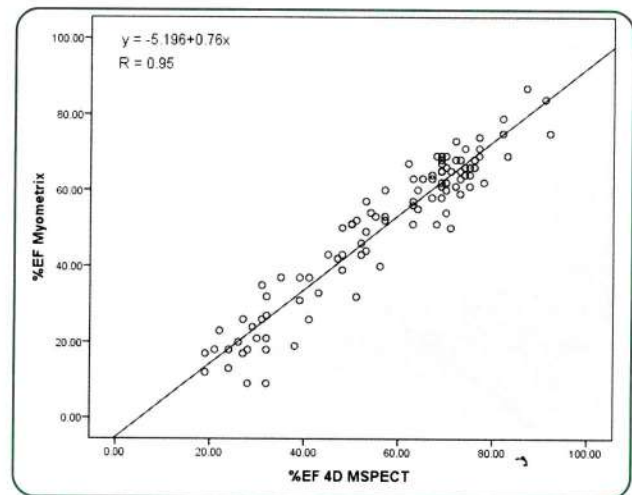


Fig.1(d)

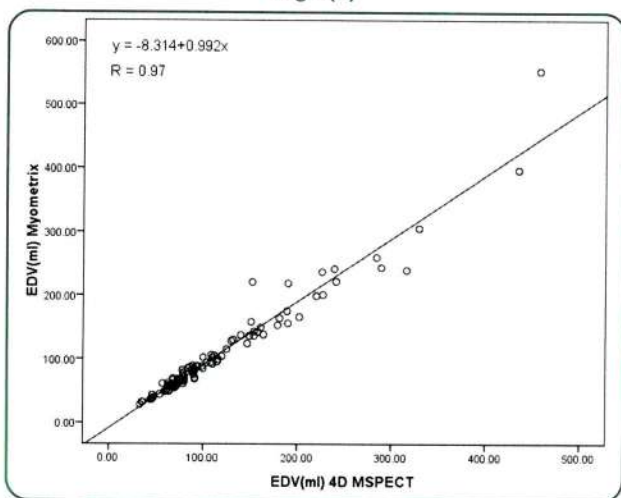


Fig.1(e)

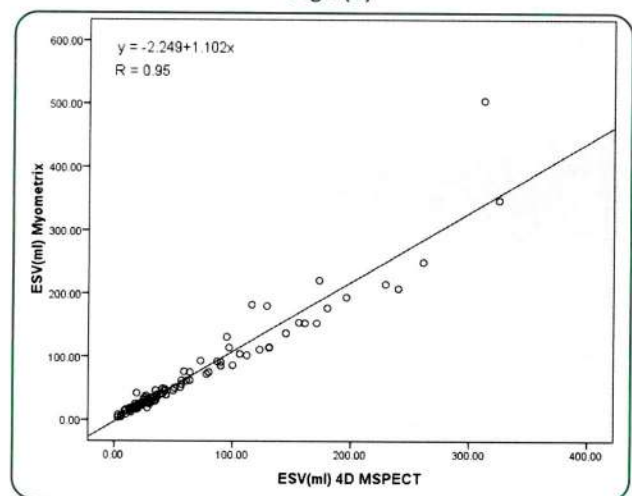


Fig.1(f)

Fig.1 Correlation analysis of %EF (a), EDV(ml) (b) and ESV(ml) (c) calculated by 4D MSPECT and Myometrix for stress study and correlation analysis of %EF (d), EDV(ml) (e), and ESV(ml) (f) for rest study in Intraoperator comparison.

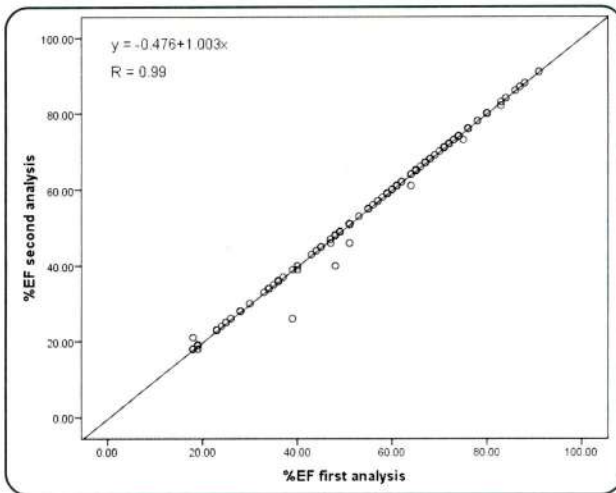


Fig.2(a)

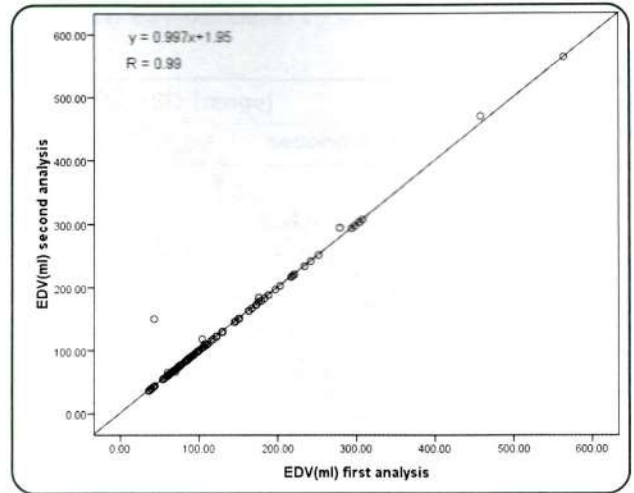


Fig.2(b)

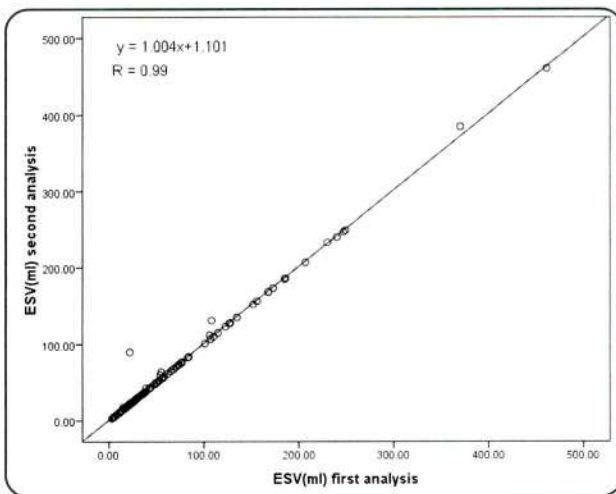


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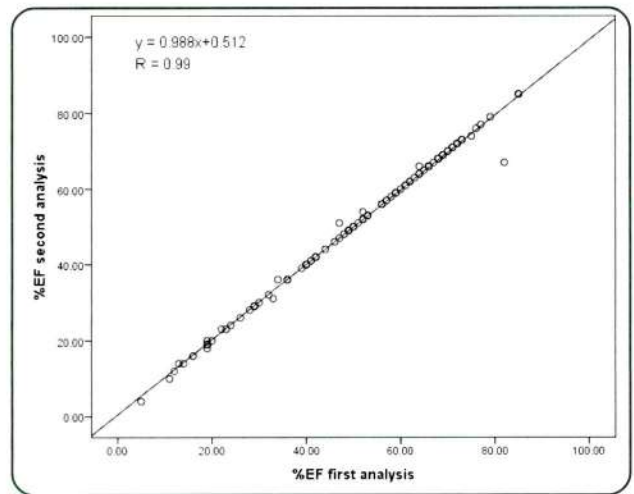


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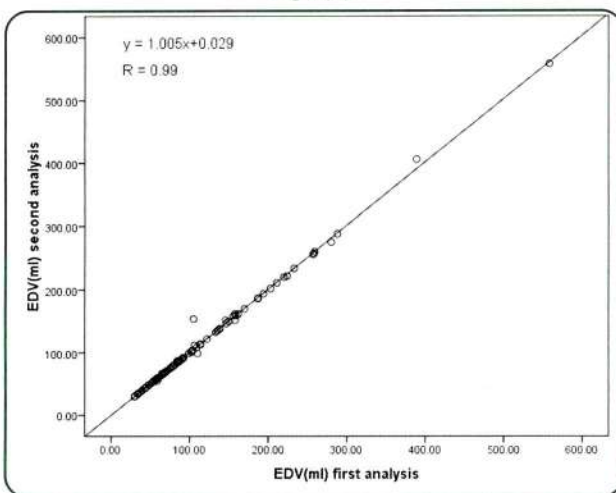


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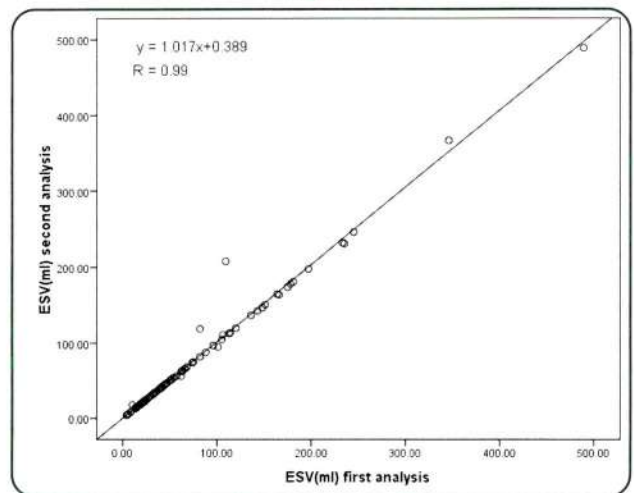


Fig.2(f)

Fig.2 Correlation analysis of %EF (a), EDV(ml) (b) and ESV(ml) (c) calculated by 4D MSPECT and correlation analysis of %EF(d), EDV(ml)(e), and ESV(ml) (f) calculated by Myometrix for stress study in Interoperator comparison.

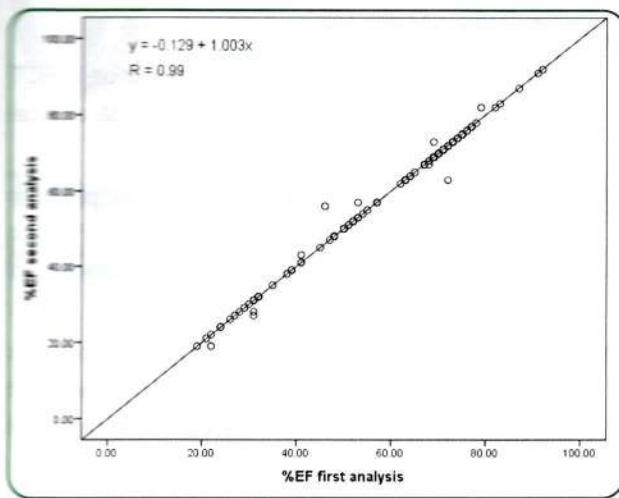


Fig.3(a)

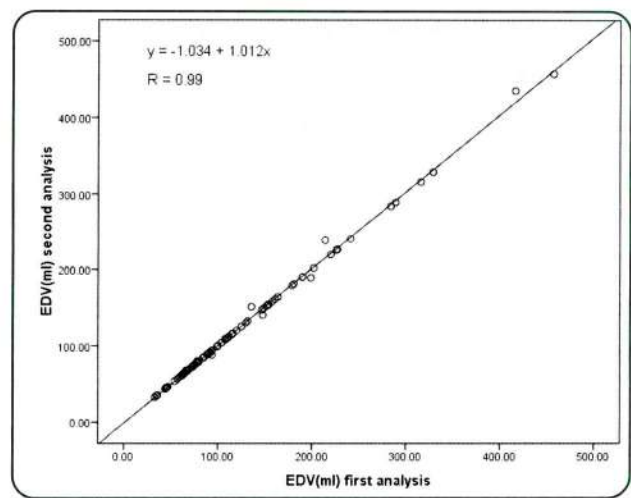


Fig.3(b)

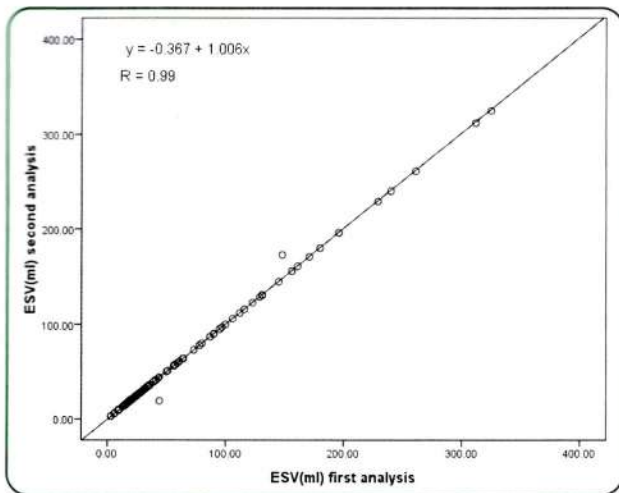


Fig.3(c)

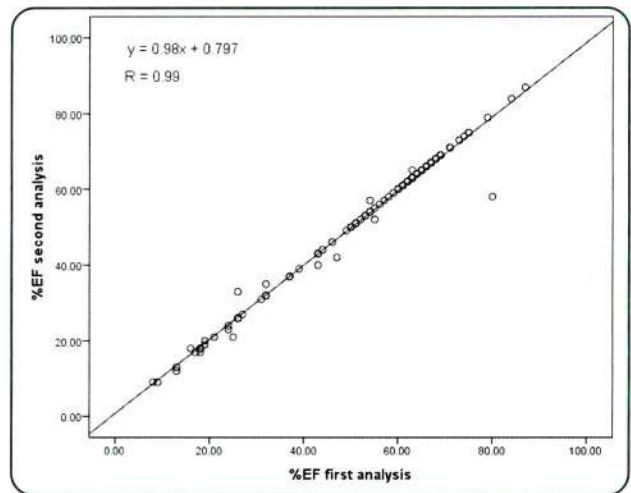


Fig.3(d)

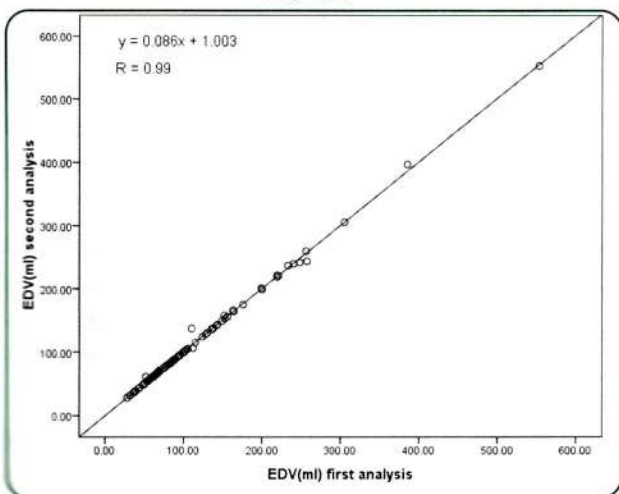


Fig.3(e)

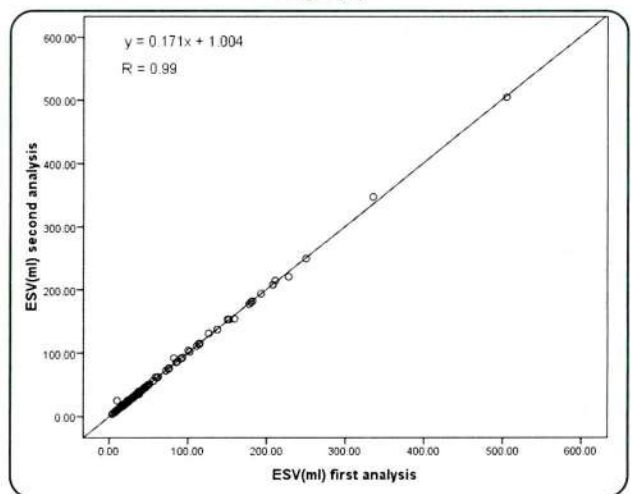


Fig.3(f)

Fig.3 Correlation analysis of %EF (a) , EDV(ml)(b) and ESV(ml) (c) calculated by 4D MSPECT and correlation analysis of %EF (d), EDV(ml) (e), and ESV(ml) (f) calculated by Myometrix for rest study in Interoperator comparison.

standard. In the Intraoperator comparison, the %EF, EDV(ml) and ESV(ml) showed the good correlation between 4D MSPECT and Myometrix for both stress and rest studies. ($R=0.95-0.99$) Though all these values showed a slightly different as shown in table 2 but there was no statistically different significance for this intraoperator study ($p>0.05$) as shown in table 4.

In interoperator comparison, the %EF, EDV(ml) and ESV(ml) showed the good correlation between 4D MSPECT and Myometrix for both stress and rest studies. ($R=0.99$) Though all these values showed a slightly different as shown in table 3 but there was no statistically different significance for this interoperator study ($p>0.05$) as shown in table 5. This comparison showed that the consistency in using these two software packages was good though the operators who used these software were different. This meant that these two software packages were reliable. Therefore, we can report the result from Myometrix software package though the physician uses the 4D MSPECT software package to diagnose the suspected CAD patients by Gated SPECT study in the Rajavithi hospital.

Conclusion

There were no statistically significant difference between all these studies. Though, the study showed a good correlation but it was not recommended to interchange these two software packages.

Acknowledgement

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