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A Comparitive Study of QT Dispersion in Acute Myocardial Infarction between Early Reperfusion and Late Reperfusion Therapy

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Original Research Article

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Abstract: Coronary artery disease has become a global pandemic and one of the leading causes of morbidity and mortality among non-communicable diseases. One of the common complications seen in acute myocardial infarction is the development of arrhythmias, and is seen even before patient reaches the hospital. The complications leading to death in acute myocardial infarction such as malignant ventricular arrhythmias (like ventricular tachycardia and ventricular fibrillation) are very much preventable. QT dispersion (maximum QT interval minus minimum QT interval) was proposed as an index of the spatial dispersion of ventricular recovery. QTd measurement is an attempt by which we can distinguish homogenous myocardium from inhomogeneous myocardium. In other words increased QT dispersion reflects the disparity of ventricular recovery time. Hence QT dispersion provides a cheap, simple and non-invasive method to measure underlying dispersion of ventricular excitability. Q-T dispersion is defined as the difference between maximum and minimum Q-T interval in 12 lead electrocardiograms. QT dispersion represents dispersion of ventricular repolarization, and therefore, is a potential measure of substrates for re-entry tachycardia. QTd from surface ECG was developed as a simple non-invasive clinical risk marker to reflect dispersion of ventricular repolarization at the level of myocardium. Although its exact derivative is not yet fully understood or determined, QTd may depend on a composite of inhomogeneous repolarization forces which includes the T-wave vector and a changing component of local influences believed to be the main explanation for QTd. For many theoretical reasons, QTd may not represent the most useful ECG variable, actually reflecting the actual dispersion of ventricular repolarization. But it is very clear that dispersion of ventricular repolarization at the myocardial level is an important arrhythmogenic substrate. In our study we found that incidence of arrhythmias was high among late group, QT dispersion was higher among those who were perfused late and was lower in those with successful thrombolysis.
Keywords: acute myocardial infarction, QT interval, QT dispersion, early reperfusion, late reperfusion.

INTRODUCTION

Coronary artery disease has become a global pandemic and one of the leading causes of morbidity and mortality among non communicable diseases. Most of the STEMI occurs due to sudden occlusion of the epicardia coronary artery by thrombus or critical ischemia in a pre-existing diseased coronary artery. The disease burden is going to increase in future thence cardiac deaths due to AMI.

The early 30 day mortality rate due to AMI is upto 30% with most of the deaths occurring in first 24 hrs particularly in first hour after MI before reaching hospital. Most of these deaths are increasingly occurring among the young during the productive period of life [1].

The complications leading to death in acute myocardial infarction such as malignant ventricular arrhythmias (like ventricular tachycardia and ventricular fibrillation) are very much preventable [2].

Despite the sobering statistics in the occurrence of AMI and its complications there is a decline in the deaths in the early hours after MI due to the good treatment. The use of sophisticated battery of

tests, like continuous Holter Monitoring, Microvolt T wave alternans, Domain ventricular late potentials are not available to most of the people [3].

QT dispersion (maximum QT interval minus minimum QT interval) was proposed as an index of the spatial dispersion of ventricular recovery. QTd measurement is an attempt by which we can distinguish homogenous myocardium from inhomogenous myocardium. In other words increased QT dispersion reflects the disparity of ventricular recovery time. Hence QT dispersion provides a cheap, simple and non invasive method to measure underlying dispersion of ventricular excitability [4].

AIMS AND OBJECTIVES

- To study QT dispersion in acute myocardial infarction and its comparison after thrombolysis between early and late reperfusion therapy.
- To compare QT dispersion between successful thrombolysis and failed thrombolysis.

MATERIALS AND METHODS

This is an observational study conducted in PESIMSR, Department of medicine in collaboration with Department of Cardiology, for a period of 1 year. A total of 60 cases admitted with acute myocardial infarction and who are thrombolysed were selected for the present study.

Among 60 patients studied 30 cases are those who are thrombolysed in less than 3 hours after the onset of chest pain and rest 30 are those who presented late and thrombolysed later than 3 hours after onset of chest pain.

Patients who fulfil inclusion and exclusion criteria were enrolled for the study after obtaining written informed consent. The study protocol was approved by the ethical committee of PESIMSR for research studies.

Inclusion criteria

Patients admitted in ICCU of PESIMSR hospital with complaints suggestive of acute myocardial infarction and 12 lead ECG showing ST elevations are included in this study. The patients who were thrombolysed are included in the study. Age group included everyone above 18 years who had acute myocardial infarction.

Exclusion criteria

Medical conditions and patients who were on drugs which prolongs the QT interval are excluded from study like

- Electrolyte imbalance
- Patients in atrial fibrillation.
- Unmeasurable T waves.
- Patients with bundle branch block.
- Drugs affecting QT interval- antiarrythmics, macrolide antibiotics, cisapride and other prokinetic drugs.
- Patients with contraindications to thrombolysis.

In all patients with myocardial infarction, routine investigation like complete blood count and urine examination was done. Biochemical parameters like random blood sugar, fasting lipid profile and cardiac enzymes like creatinine phosphokinase (CPK,CK-MB) was done.

ECG Recording

ECG recordings were done on admission before thrombolysis and 90 minutes after thrombolysis, day 2 & day 5, and at 6 weeks of follow up. ECG was recorded with an ECG recorder speed of 25mm/sec.

Measurement of QT dispersion

QT interval was measured in all leads from the beginning of QRS complex to end of T wave. In the presence of U wave, QT interval was measured till nadir of curve between T and U waves. Each QT interval was corrected for the patient's heart rate using Bazett's formula.

$$(QTc = QT/\sqrt{RR\ (sec)})$$

(QTc is the corrected QT interval).

QT dispersion on each electrocardiogram as "the difference between the maximal and minimal QT interval in any of the leads measured". Accordingly QTc dispersion is defined as "the difference between maximal and minimal heart rate corrected QT interval''.

Cases were further divided into

- Those who presented (early) in less than 3 hours after AMI and thrombolysed early and those who are thrombolysed later than 3 hours.
- Successful and failed thrombolysed group.(failed thrombolysis based on clinical and ECG criteria).
- Ventricular Arrhythmia and No Ventricular Arrhythmia group.

The obtained data's were entered and statistical analysis done using SPSS software. Univariate analysis was done with paired t- test and Pearson product moment correlation co- efficient. P value < 0.05 was considered to be statistically significant.

RESULTS

A total of 60 cases with 30 in each group of early and late perfused were studied and analysed.

Table-1: Age and sex distribution of early reperfused cases

AGE	MALE	FEMALE	TOTAL
25- 30	1	0	1
31-40	1	0	1
41-50	6	1	7
51-60	5	5	10
61-70	5	5	10
>70	0	1	1
	18	12	30

The average age of presentation of myocardial infarction among those who were thrombolysed early is 55.8 years (Table-1).

The average age of presentation of myocardial infarction among those who were thrombolysed late is 57.9 years (Table-2).

The above graph represents the mean time of presentation of cases in both early and late group (Chart-1).

Table-2: Age and sex distribution of cases in late thrombolysis

AGE	MALE	FEMALE	TOTAL
<30	0	0	0
31-40	1	0	1
41-50	3	1	4
51-60	7	5	12
61-70	7	6	13
>70	0	0	0
	18	12	30

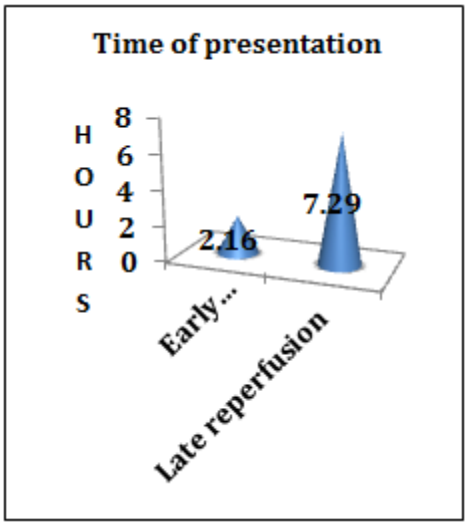

Chart-1: Mean time of presentation in both early and late group

Table-3: QT paremeters in both study groups before and after thrombolysis

	Group	N	Mean	Std. Deviation	P-value
Before thrombolysis max	Early	30	.4727	.02377	0.000
	Late	30	.5153	.04911	
Before thrombolysis min	Early	30	.4220	.02524	0.631
	Late	30	.4183	.03312	
After thrombolysis max	Early	30	.4710	.02784	0.000
	Late	30	.5413	.04876	
After thrombolysis min	Early	30	.4230	.02615	0.064
	Late	30	.4370	.03109	

The above observation shows the mean maximum & minimum QT interval between early and late groups. The correlation between Maximum QT before and after reperfusion in the two groups is statistically significant ($p<0.05$) indicating significant prolongation of maximum Q-T interval in late group on comparing with early group.

Table-4: Mean QT dispersion between early and late thrombolysed cases

	Group	N	Mean	Std. Deviation	P-value
Before thrombolysis	Early	30	50.33	19.025	0.000
	Late	30	97.67	38.118	
After thrombolysis	Early	30	48.33	21.509	0.000
	Late	30	103.00	49.071	
Second day	Early	30	112.00	40.802	0.000
	Late	30	167.67	51.574	
Fifth day	Early	30	44.33	19.945	0.111
	Late	30	54.00	25.944	
Six weeks	Early	30	48.00	18.458	0.228
	Late	30	41.67	21.669	

The above observation represents the mean QTd in the early and late thrombolysis groups, with the QT dispersion being higher in acute myocardial infarction among late reperfused group than early perfused group. The correlation between the QTd and time of reperfusion is statistically significant ($p<0.05$) in those taken before & after thrombolysis and on 2nd day.

Table-5: QT dispersion before and and 2nd day after thrombolysis in early thrombolysis

		Mean	N	Std. Deviation	P-value
	Before thrombolysis	50.33	30	19.025	0.000
	Second day after thrombolysis	112.00	30	40.802	

In the above observation mean QT dispersion before thrombolysis (50.33ms) and 2nd day after thrombolysis (112ms) is compared in the early thrombolysed group and is found to be significantly increased on 2nd day ($p<0.05$) .

Table-6: QT dispersion between before thrombolysis and 2nd day after thrombolysis in late reperfusion

	Mean QTd
Before thrombolysis	97.67
Second day after thrombolysis	167.67

In the above observation mean QT dispersion, before thrombolysis (97.67ms) and 2nd day after thrombolysis (167.67) in late reperfusion group is compared and is found to be significantly increased on 2nd day ($p<0.05$).

Prevalence of arrythmias in early and late reperfusion group.

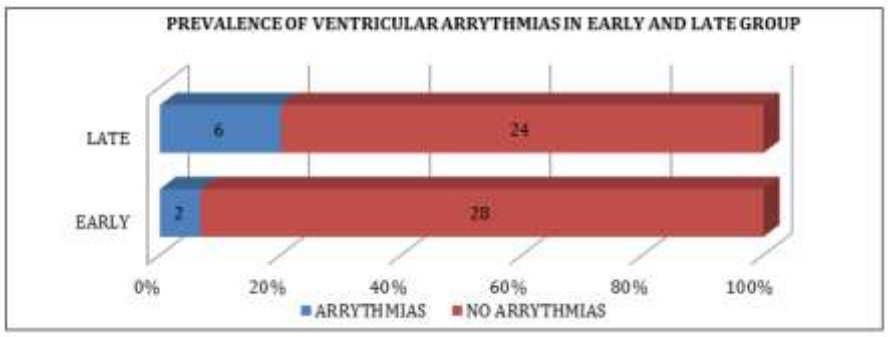

Table-7: Mean QTd in early reperfusion group with ventricular arrythmias

Early group	Ventricular arrythmias	N	Mean	Std. deviation	p- value
Before thrombolysis	Yes	2	85	7.071	
	No	28	47.86	17.074	0.005
After thrombolysis	Yes	2	100.00	14.142	
	No	28	44.64	16.603	0.000
Second day	Yes	2	160.00	14.142	
	No	28	108.57	39.974	0.085
Fifth day	Yes	2	40.00	000	
	no	28	44.64	20.635	0.244

The above observation shows mean QT dispersion values of arrhythmias group and no arrhythmias group before and after thrombolysis, 2nd day and fifth day post thrombolysis. There is a significant increase in QTd in those with arrhythmias compared to those without. This correlation is statistically significant in the ECGs taken before and after thrombolysis, and not in the ones taken on 2nd & 5th day. This indicates significant QT dispersion prolongation among those who had arrhythmias in the earlier phase of thrombolysis.

Table-8: Mean QTd in late reperfusion group with ventricular arrythmias

Late group	Ventricular arrythmias	N	Mean	Std. deviation	P-value
Before thrombolysis	yes	6	81.67	26.394	
	no	24	101.67	39.964	0.257
After thrombolysis	Yes	6	120.00	61.319	
	no	24	98.75	46.092	0.312
Second day	Yes	6	186.67	75.542	
	no	24	162.92	44.671	0.322
Fifth day	Yes	6	56.67	20.656	
	no	24	53.33	27.452	0.784

The above table shows mean QT dispersion values in late reperfusion group in those with and without arrhythmias. There mean QT dispersion was more in those with arrhythmias compared to those without in the ECGs taken after thrombolysis but this correlation was statistically not significant (p>0.05)

Table-9: Mean QTd in successful and failed thrombolysis.

	Status of the treatment	N	Mean	Std. Deviation	P-value
Before thrombolysis	success	56	73.93	38.408	0.957
	Failure	4	75.00	41.231	
After thrombolysis	success	56	75.71	44.716	0.977
	Failure	4	75.00	77.675	
Second day	success	56	139.82	54.689	0.995
	Failure	4	140.00	49.666	
Fifth day	success	56	47.50	21.847	0.038
	Failure	4	72.50	35.940	

In the above observation QT dispersion is compared between those with successful and failed thrombolysis, before and after treatment till 5 days and lower QTd is seen in the recovery phase among those with successful thrombolysis which is statistically significant in the one taken on 5th day post thrombolysis.

DISCUSSION

Acute myocardial infarction in the spectrum of ischemic heart disease is the most common cause of death and is seen to be increasing due to high prevalence of risk factors like smoking, hypertension, diabetes mellitus, and alcoholism together with adverse life style changes. Ventricular arrhythmias occurring in the acute setting adds to its high mortality though preventable [3].

Recognition of patients developing high risk arrhythmias is a challenging job in coronary care units especially in setting of acute myocardial infarction. Increased QT prolongation and vulnerability of ventricular myocardium has been well studied and documented in earlier studies, nevertheless there is a need to develop more sophisticated and sensitive measures to identify it [5,6]. However there is a strong evidence for correlation between prolongation of QT interval and sudden cardiac death. Analysing QT dispersion will definitely be helpful as a simple, non invasive tool in predicting the arrythmogenecity of the

heart and aid in the treatment particularly in rural areas.

The present study evaluated QT dispersion in patients with acute myocardial infarction treated with early thrombolytic therapy (< 3hrs) and those with a delay (>3 hrs) after the onset of chest pain.

QT dispersion and myocardial infarction

In acute myocardial infarction ventricular repolarisation is inhomogeneous, a complex interaction exists between an ischemic myocardium and depolarised dying tissue affecting QT interval and thereby QT dispersion. There is a strong evidence for correlation between prolongation of QT interval and sudden cardiac death. Previous studies have proved beyond doubt that successful reperfusion decreases the QT dispersion and hence incidence of ventricular arrhythmias and mortality [6,7].

In our study, mean QT dispersion ranged from 40 milliseconds to 170 milliseconds with lower mean QT dispersion in early thrombolysed group than in the late thrombolysed group and the correlation was statistically significant which is very much in accordance with the previous studies. The maximum mean QT interval is high before and after thrombolysis & on the second day in the late group when compared to early group and is statistically significant ($p < 0.05$).

In our study QT dispersion was high at the time of admission before and after thrombolysis & on day 2, QT dispersion was highest. Thereafter, it was found to decrease in course of time and stabilising by 5^{th} day. The correlation between the QTd and time of reperfusion is statistically significant ($p<0.05$) in those taken before & after thrombolysis and on 2^{nd} day. There was no increase in the QT dispersion after 5^{th} day and not much of difference in the QT dispersion between 5^{th} day and 6^{th} week ECG.

Table-10: comparing mean QT maximum and qt minimum in early and late group at different time

Time of ECG	Early reperfused group		Late reperfused group	
	QT max	QT min	QT max	QT min
Before thrombolysis	0.4727	0.4220	0.5153	0.4163
After thrombolysis	0.4710	0.4230	0.5143	0.4370
2^{nd} day	o.5233	0.4080	0.5930	0.4213
5^{th} day	0.4647	0.419	0.4790	0.425

In summary QT dispersion is higher in AMI, and successful reperfusion either by thrombolysis or PCI reduces QT dispersion, ventricular inhomogenecity and occurrence of arrhythmias.

In our study, ventricular arrhythmias occurred in 2 cases in early reperfused group and in six cases of late reperfused group. There was higher QT dispersion in cases with arrhythmias comparing to those without in early reperfused group which was also statistically significant in those taken before and after thrombolysis, but there was no significant QT dispersion prolongation in late group. A higher incidence of ventricular arrhythmias among late reperfused group is seen, indicating earlier successful thrombolysis results in decreasing the occurrence of arrhythmias.

CONCLUSIONS

From our study we conclude that

- QT dispersion was higher among those who were reperfused later than 3 hours than those who were reperfused earlier.
- Incidence of arrhythmias was high among late group than early group indicating early successful thrombolysis reduces occurrence of arrhythmias.

QT dispersion was lower in those with successful thrombolysis during the recovery phase. Limitations of the study were

- Sample size was small so further studies with bigger sample size has to be done to further verify the results.
- Our study has excluded AMI with bundle branch block and atrial fibrillation and this may have produced an underestimation of arrhythmias and mortality.

REFERENCES

1. Chockalingam A, Balaguer-Vintr′o I, editors. Impending global pandemic of cardiovascular diseases: challenges and opportunities for the prevention and control of cardiovascular diseases in developing countries and economies in transition. Prous Science; 1999.
2. Haghjoo M, Kiani R, Fazelifar AF, Alizadeh A, Emkanjoo Z, Sadr-Ameli MA. Early risk stratification for arrhythmic death in patients with ST-elevation myocardial infarction. Indian pacing and electrophysiology journal. 2007 Jan;7(1):19.
3. Sahu P, Lim PO, Rana BS, Struthers AD. QT dispersion in medicine: electrophysiological holy grail or fool's gold?. Qjm. 2000 Jul 1;93(7):425-31.
4. Day CP, McComb JM, Campbell RW. QT dispersion: an indication of arrhythmia risk in patients with long QT intervals. Heart. 1990 Jun 1;63(6):342-4.
5. Sipahi I, Tuzcu EM, Schoenhagen P, Nicholls SJ, Chen MS, Crowe T, Loyd AB, Kapadia S, Nissen

SE. Paradoxical increase in lumen size during progression of coronary atherosclerosis: observations from the REVERSAL trial. Atherosclerosis. 2006 Nov 1;189(1):229-35.
6. Moreno FL, Villanueva T, Karagounis LA, Anderson JL. Reduction in QT interval dispersion by successful thrombolytic therapy in acute myocardial infarction. TEAM-2 Study Investigators. Circulation. 1994 Jul 1;90(1):94-100.
7. Nikiforos S, Hatzisavvas J, Pavlides G, Voudris V, Vassilikos VP, Manginas A, Hatzeioakim G, Foussas S, Iliodromitis EK, Hatseras D, Kremastinos DT. QT-interval dispersion in acute myocardial infarction is only shortened by thrombolysis in myocardial infarction grade 2/3 reperfusion. Clinical cardiology. 2003 Jun 1;26(6):291-5.
8. Parale GP, Adnaik AR, Kulkarni PM. Dynamics of QT dispersion in patients in Acute Myocardial Infarction. Indian Heart J 2003; 55(6): 628-31.
9. Day CP, McComb JM, Campbell RW. QT dispersion: an indication of arrhythmia risk in patients with long QT intervals. Heart. 1990 Jun 1;63(6):342-4.
10. Kautzner J, Yi G, Camm AJ, Malik M. Short-and long-term reproducibility of QT, QTc, and QT dispersion measurement in healthy subjects. Pacing and Clinical Electrophysiology. 1994 May;17(5):928-37.
11. Stone GW, Grines CL, Browne KF, Marco J, Rothbaum D, O'Keefe J, Hartzler GO, Overlie P, Donohue B, Chelliah N, Timmis GC. Predictors of in-hospital and 6-month outcome after acute myocardial infarction in the reperfusion era: the Primary Angioplasty in Myocardial Infarction (PAMI) trial. Journal of the American College of Cardiology. 1995 Feb 1;25(2):370-7.
12. Progress in Cardiovascular Diseases, Vol.42, No.5 (March/April), 2000: pp 311-324.
13. McLaughlin NB, Campbell RW, Murray A. Influence of T wave amplitude on automatic QT measurement. InComputers in Cardiology 1995 1995 Sep 10 (pp. 777-780). IEEE.
14. Kors JA, van Herpen G. Measurement error as a source of QT dispersion: a computerised analysis. Heart. 1998 Nov 1;80(5):453-8.
15. Murray A, McLaughlin NB, Bourke JP, Doig JC, Furniss SS, Campbell RW. Errors in manual measurement of QT intervals. Heart. 1994 Apr 1;71(4):386-90.
16. Doroghazi RM, Childers R. Time-related changes in the QT interval in acute myocardial infarction: possible relation to local hypocalcemia. American Journal of Cardiology. 1978 Apr 1;41(4):684-8.
17. MorenoFL V, Karag ounisL A. ReductioninQTintervaldispersionbysuccessfulthro mbolytictherapyinacutemyocardialinfarction. Circulation. 1994;90(1):94100.
18. *Nikiforos S, Hatzisavvas J, Pavlides G, Voudris V, Vassilikos VP, Manginas A, Hatzeioakim G, Foussas S, Iliodromitis EK, Hatseras D, Kremastinos DT. QT-interval dispersion in acute myocardial infarction is only shortened by thrombolysis in myocardial infarction grade 2/3 reperfusion. Clinical cardiology. 2003 Jun 1;26(6):291-5.*
19. Endoh Y, Kasanuki H, Ohnishi S, Shibata N, Hosoda S. Influence of early coronary reperfusion on QT interval dispersion after acute myocardial infarction. Pacing and clinical electrophysiology. 1997 Jun 1;20(6):1646-53.
20. PS R. A study on QT dispersion and thrombolytic therapy in acute myocardial infarction. The Internet Journal of Cardiovascular Research. 2010;7(2).