Original Research Article

A study of comparison of QT dispersion in acute myocardial infarction between early reperfusion and late reperfusion therapy

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Abstract

Introduction: Coronary artery disease has become a global pandemic and one of the leading causes of morbidity and mortality among non-communicable diseases. The complications leading to death in acute myocardial infarction such as malignant ventricular arrhythmias 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 in homogenous myocardium. Hence QT dispersion provides a cheap, simple, and non-invasive method to measure the underlying dispersion of ventricular excitability.

Aim of the study: 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 was an observational study conducted in the Government headquarters hospital, Ariyalur from 2019 to 2020 in the Department of Medicine for 1 year. A total of 30 early thrombolysed cases and 30 late thrombolysed cases were recruited for the study. QT dispersion was studied before thrombolysis, after thrombolysis, 2nd day, 5th day, and 6th -week post-thrombolysis in

both groups and later compared between both groups. Similarly, QTd was compared between treatment successful and failed cases.

Results: QTd was higher among those who were thrombolysed late as compared to the early group. QTd was lower in those with successful thrombolysis. Incidence of arrhythmias was high among t h e late group than early indicating early successful thrombolysis reduces the occurrence of arrhythmias.

Conclusion: There was significantly greater mean QT, QTc dispersions in the early hours of Acute Myocardial infarction. Patients with anterior acute myocardial infarction showed significantly greater QT parameters when compared with inferior acute myocardial infarction patients. There was a significantly greater reduction in QT, QTc dispersions after treatment with streptokinase than without it. QT, QTc dispersions are greatest in the early hours of acute myocardial infarction and fall with time and successful thrombolysis.

Key words

Coronary artery disease, Thrombolysis, QT depression.

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 epicardial coronary artery by a dynamic occlusion by thrombus or critical ischemia in a pre-existing diseased coronary artery. The disease burden is going to increase in the future thence cardiac deaths due to AMI [1]. The early 30-day mortality rate due to AMI is up to 30% with most of the deaths occurring in the first 24 hrs particularly in the first hour after MI before reaching the hospital. Most of these deaths are increasingly occurring among the young during the productive period of life [2]. The complications leading to death in acute myocardial infarction such as malignant ventricular arrhythmias (like ventricular tachycardia and ventricular fibrillation) are very much preventable. Despite the sobering statistics on the occurrence of AMI and its complications, there is a decline in deaths in the early hours after MI due to good treatment [3]. The use of a sophisticated battery of tests, like continuous Holter Monitoring, Microvolt T wave alternans, Domain ventricular late potentials are not available to most people. 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 in homogenous myocardium [4]. In other words, increased QT dispersion reflects the disparity of ventricular recovery times. Hence QT dispersion provides a cheap, simple, and non-invasive method to measure the underlying dispersion of ventricular excitability. There is an absolute need for the development of affordable parameters to detect and identify the risk of development of ventricular arrhythmias associated with acute myocardial infarction and to prevent sudden cardiac deaths associated with it [5, 6].

Materials and methods

This was an observational study conducted in the Government headquarters hospital, Ariyalur from 2019 to 2020 in the Department of Medicine for 1year. Among 60 patients studied 30 cases were those who were thrombolysed in less than 3 hours after the onset of chest pain and the rest 30 were those who presented late and thrombolysed later than 3 hours after onset of chest pain. Patients who fulfilled inclusion and exclusion criteria were enrolled for the study after obtaining written informed consent. Patients with complaints suggestive of acute myocardial infarction and 2 lead ECGs showing ST elevation were included in this study. The patients who are thrombolysed were included in the study. The age group included was every one above 18 years who had an acute myocardial infarction.

Exclusion criteria: Medical conditions and patients who were on drugs that prolong the QT interval were excluded from the study, Electrolyte imbalance, Patients in atrial fibrillation, Unmeasurable T waves, Patients with bundle branch block, Drugs affecting QT interval-anti-arrhythmics, macrolide antibiotics, cisapride, and other prokinetic drugs, Patients with contraindications to thrombolysis.

A detailed history was taken from the patients that include the onset of symptoms, past medical history, and thorough physical examination and systemic examination was done and entered in proforma specially designed for this study. In all patients with myocardial infarction, routine investigations like complete blood count and urine examination were done. Biochemical parameters like random blood sugar, fasting lipid profile, and cardiac enzymes like creatinine phosphokinase (CPK, CK-MB) were done. ECG recordings were done on admission before thrombolysis and 90 minutes after thrombolysis, day 2 & day 5 and 6 weeks of follow-up. ECG was recorded with an ECG recorder speed of 25 mm/sec. QT interval was measured in all leads from the beginning of the QRS complex to the end of the T wave. In the presence of a U wave, the QT interval was measured till the nadir of the 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 is "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''.

Statistical analysis

The obtained data were entered and tabulated in the Master chart and statistical analysis was done using SPSS software. Univariate analysis was done with paired t-test and Pearson product-moment correlation coefficient. P-value <0.05 was considered to be statistically significant.

Results

Out of 30 cases of early thrombolysed acute myocardial infarction studied 18 were men 12 were women. The average age of presentation of myocardial infarction among those who were thrombolysed early was 55.8 years. The maximum incidence of MI in men was seen in the age group of 41-50 years. The maximum incidence of MI among women is seen in the age group of 51-60 and 61-70 years equally in the study group. Out of 30 cases of late thrombolysed acute myocardial infarction studied 18 were men 12 were women. The average age of presentation of myocardial infarction among those who were thrombolysed late was 57.9 years. The maximum incidence in men was seen in the age group of 51-60 and 61-70 years equally. The maximum incidence among women is seen in the age group of 61-70 years. The mean age of presentation of acute myocardial infarction in the early reperfused group (55.8 years) and late reperfused group (57.9) in our study.

In our study involving 60 cases of acute myocardial infarction predominant risk factor for causation was smoking seen in 29 cases followed by diabetes mellitus (25 cases) and hypertension (18 cases). All three risk factors were present in 5 cases (**Table – 1**).

Table - 1: Risk factors for myocardial infarction.

Risk factors	Number of cases
Smoking	29
Hypertension	18
Diabetes mellitus	25

In the present study group, the number of various myocardial infarctions studied in both early and late reperfused groups was almost similar indicating no selection bias was done in recruiting the cases for the analysis of QT dispersion (**Table – 2**).

The above observation shows the mean maximum & minimum QT interval between the early and late groups. The correlation between

Maximum QT before and after reperfusion in the two groups was statistically significant ($p<0.05$) indicating significant prolongation of maximum Q-T interval in the late group on comparing with the early group (**Table – 3**).

Table - 2: Types of myocardial infarction included in the study group.

Type of MI		Group		Total
		Early	Late	
ASMI	Count	10	10	20
	% within Group	33.3%	33.3%	33.3%
AWMI	Count	7	5	12
	% within Group	23.3%	16.7%	20.0%
EXTAWMI	Count	1	0	1
	% within Group	3.3%	.0%	1.7%
Ext AWMI	Count	0	2	2
	% within Group	.0%	6.7%	3.3%
IWMI	Count	7	8	15
	% within Group	23.3%	26.7%	25.0%
IWMI+PWMI	Count	0	1	1
	% within Group	.0%	3.3%	1.7%
IWMI+PWMI+RVMI	Count	1	1	2
	% within Group	3.3%	3.3%	3.3%
IWMI + RVMI	Count	1	1	2
	% within Group	3.3%	3.3%	3.3%
LWMI	Count	3	2	5
	% within Group	10.0%	6.7%	8.3%
Total	Count	30	30	60
	% within Group	100.0%	100.0%	100.0%

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

Group		N	Mean QT	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 represents the mean and in the early and late thrombolysis groups, with the QT dispersion being higher in acute myocardial infarction among the late reperfused group than the early reperfused group. The correlation between the QTd and time of reperfusion was statistically significant ($p<0.05$) in those taken before and after thrombolysis and on the 2nd day (**Table – 4**).

In the above observation mean QT dispersion before thrombolysis (50.33 ms) and 2nd day after thrombolysis (112 ms) was compared in the early thrombolysed group and was found to be

significantly increased on 2nd day ($p<0.05$) as per **Table - 5**.

In the above observation mean QT dispersion, before thrombolysis (97.67 ms) and 2nd day after thrombolysis (167.67) in late reperfusion group is compared and is found to be significantly increased on 2nd day ($p<0.05$) as per **Table - 6**.

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

	Group	N	Mean QTd	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	

Table - 5: QT Dispersion before and after thrombolysis in early reperfusion.

Early Reperfusion	Mean QTd	N	Std. Deviation	P-value
Before thrombolysis	50.33	30	19.025	0.000
The second day after thrombolysis	112.00	30	40.802	

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

Late reperfusion	Mean QTd
Before thrombolysis	97.67
The second day after thrombolysis	167.67

Table - 7: Prevalence of ventricular arrhythmias in early and late group.

Group		Ventricular arrhythmias		Total
		Yes	No	
Early	Count	2	28	30
	%within	6.7%	93.3%	100.0%
Late	Count	6	24	30
	% within	20.0%	80.0%	100.0%
Total	Count	8	52	60
	% within	13.3%	86.7%	100.0%

In our study we had two cases of ventricular arrhythmias in the early reperfused group and six cases in the late reperfused group (**Table – 7**).

Table - 8 shows mean QT dispersion values of the arrhythmias group and no arrhythmias group before and after thrombolysis, 2nd day, and fifth-day post thrombolysis. There was a significant increase in QTd in those with arrhythmias compared to those without. This correlation was statistically significant in the ECGs taken before and after thrombolysis, and not in the ones taken on the 2nd& 5th days. This indicates significant

QT dispersion prolongation among those who had arrhythmias in the earlier phase of thrombolysis (**Table – 8**).

Table - 9 shows mean QT dispersion values in the 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) as per **Table – 9**.

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

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

Table - 9: Mean QTd in late reperfusion group with ventricular arrhythmias.

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

Table - 10: Mean QTd in successful and failed thrombolysis.

Status of the treatment		N	Mean QTd	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 was 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 was statistically significant in the one taken on 5^{th}-day post thrombolysis (**Table – 10**).

Discussion

Acute myocardial infarction in the spectrum of ischemic heart disease is the most common cause of death and is seen to be increasing in the present scenario both in a rural and urban areas in both developed and developing nations [7]. Due to the high prevalence of risk factors like

smoking, hypertension, diabetes mellitus, alcoholism together with adverse life style changes, it is increasing day by day. Ventricular arrhythmias occurring in the acute setting adds to its high mortality though preventable [8]. Recognition of patients developing high-risk arrhythmias is a challenging job in coronary care units especially in the 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 [9]. However, there is strong evidence for a 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. Analyzing QT dispersion will be helpful as a simple, non-invasive tool in predicting the arrhythmogenicity of the heart and aid in the treatment particularly in rural areas [10]. The present study evaluates 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. In acute myocardial infarction ventricular repolarisation is in homogeneous, acomplex interaction exists between an ischemic myocardium and depolarised dying tissue affecting QT interval and thereby QT dispersion. In our study, mean QT dispersion ranged from 40 milliseconds to 170 milliseconds with lower mean QT dispersion in the early thrombolysed group than in the late thrombolysed group and the correlation was statistically significant which is very much by the previous studies. The maximum mean QT interval is high before and after thrombolysis & on these condday in the late group when compared to the early group and is statistically significant ($p<0.05$) [11]. In our study QT dispersion was high at the time of admission before and after thrombolysis and on day 2, QT dispersion was highest. Thereafter, it was found to decrease in course of time and stabilizing by the 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 the 5^{th} day and not much of a difference in the QT dispersion between the 5^{th} day and 6^{th} week ECG [12]. Khaching Lehkan, et al. studied the Influence of early coronary reperfusion on QT dispersion in acute myocardial infarction. Similar to our study they studied in 51 patients out of which 28 were re-canalized early and the rest 23 were re-canalized late, study revealed significant QT dispersion reduction between acute and recovery phases. The incidence of PVC and arrhythmias were also reduced in the early group [13]. In our study, ventricular arrhythmias occurred in 2 cases in the early reperfused group and six cases in the late reperfused group. There was higher QT dispersion in cases with arrhythmias comparing to those without in the early reperfused group which was also statistically significant in those taken before and after thrombolysis, but there was no significant QT dispersion prolongation in the late group [14]. A higher incidence of ventricular arrhythmias among the late reperfused group is seen, indicating earlier successful thrombolysis results in decreasing the occurrence of arrhythmias. In our study, there were a total of 4 cases that were considered as treatment failure based on clinical grounds and ECG criteria, with persistent chest pain and reduction of ST-segment elevation not more than50% at 90^{th} minute after thrombolysis. Even though mean QT dispersion was higher among failed cases it was not statistically significant ($p>0.05$) in the earlier period post thrombolysis. However, with recovery (i.e. on the 5^{th}-daypost thrombolysis), the QTd was significantly lower in those with successful thrombolysis [15].

Limitations of the study

The sample size was small so further studies with a bigger sample size have 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 under estimation of arrhythmias and mortality.

Conclusion

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 the late group than early group indicating early successful thrombolysis reduces the occurrence of arrhythmias. QT dispersion was lower in those with successful thrombolysis during the recovery phase.

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