ISSN: 2320 - 4230

Journal of Drug Discovery and Therapeutics

Available Online at www.jddt.in

CODEN: - JDDTBP (Source: - American Chemical Society)

Volume 3, Issue 31, August, 2015, 63-69

Research Article

Prospective cohort study of the temporal profile of QT dispersion in acute myocardial infarction

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Received 10 August 2015; Accepted 23 August 2015

INTRODUCTION

Coronary artery disease has become the prime killer of man today. The absolute number of patients who will have MI is expected to increase in the future. Accordingly, sudden cardiac death after MI will continue to be a significant clinical problem. Identification of MI patients with preserved LVEF >40% at risk of dying suddenly, however, is an unresolved clinical challenge [(1).]

The mortality rate in acute myocardial infarction is approximately 30% within first month. It is all the more important as 50% of these deaths are sudden cardiac deaths and affects people in most productive period of life[(2).]

Within the acute complications of Acute Myocardial Infarction, ventricular arrhythmias are a very important yet preventable cause of death [(3).]

Sophisticated tests like Microvolt T wave alternans, domain ventricular late potentials, non sustained ventricular tachycardia on Holter monitoring have been well studied, but are unavailable to most people [(4).]

There is a need to define reliable and affordable parameters to measure or stratify the risk of ventricular arrhythmia in the setting of acute myocardial infarction .The incidence of ventricular arrhythmia following MI is approximately 2 to 4 %.Mortality of patient with ventricular arrhythmia following MI is increased as compared to patients with MI but without ventricular arrhythmia.

QT variation and QT dispersion may provide a potentially simple, cheap and non invasive method of measuring underlying dispersion of ventricular excitability [(5),(6)].

Several studies have shown that the mean QT dispersion is significantly higher in patients of Acute MI as compared with controls.

This study is done to find out if there is a significant increase in QT dispersion following Acute MI and if it can be used as a good predictor of incidence of ventricular arrhythmia following Acute MI

Aims and objectives

A prospective cohort study of the temporal profile of QT Dispersion in Acute

Myocardial infarction

1. To study the temporal profile of QT dispersion recorded by surface electrocardiography in patients admitted with Acute Myocardial Infarction, and comparing them with controls.
2. To study the correlation of QT dispersion with the incidence of in-hospital ventricular arrhythmias

Materials & Methods

STUDY POPULATION

This was a Prospective Cohort study of 50 Patients who were admitted to the Apollo Hospital, Hyderabad with diagnosis of Acute Myocardial Infarction between 1st November 2010 to 31st October 2011.

A control group of 50 normal subjects,matched according to age and sex, with the cases were also studied.

Patients who fulfil the inclusion and exclusion criteria were enrolled for the study after getting written informed consent

INCLUSION CRITERIA:

Hospital admitted patients above 18 yrs diagnosed as Acute MI on the basis of clinical presentation, electrocardiographic criteria and elevated cardiac enzymes (CKMB).

EXCLUSION CRITERIA:

Medical conditions that could affect QT interval, such as Electrolyte imbalance, Left & Right Bundle Branch Block, Atrial fibrillation.

Patients taking drugs that affect QT interval: amiodarone, cisapride, macrolide antibiotics, etc.

DATA COLLECTION:

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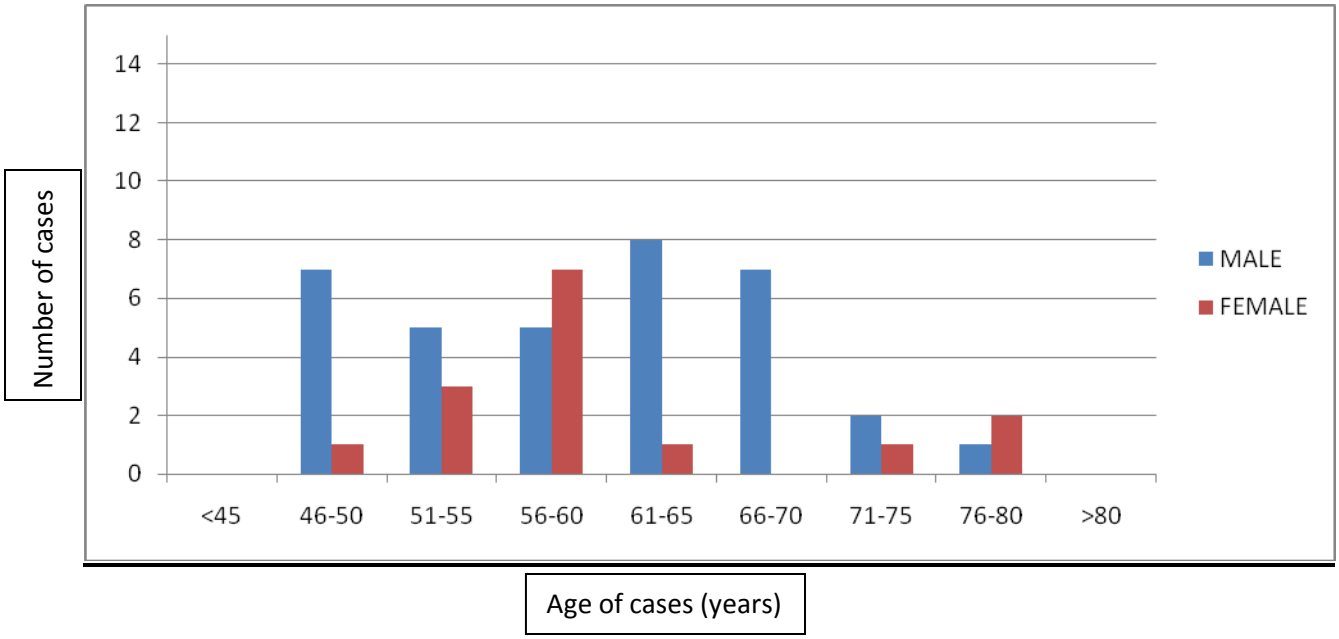
Detailed history was taken from the patients. Thorough General Physical Examination and systemic examination was carried out in each patient and entered in Proforma.

STATISTICAL ANALYSIS

The data is given as mean ± standard deviation. The data's were entered in the Master chart and Tests of significance (Student's T test and p value) was applied to the data to observe statistical significance. p value < 0.05 was considered to be statistically significant

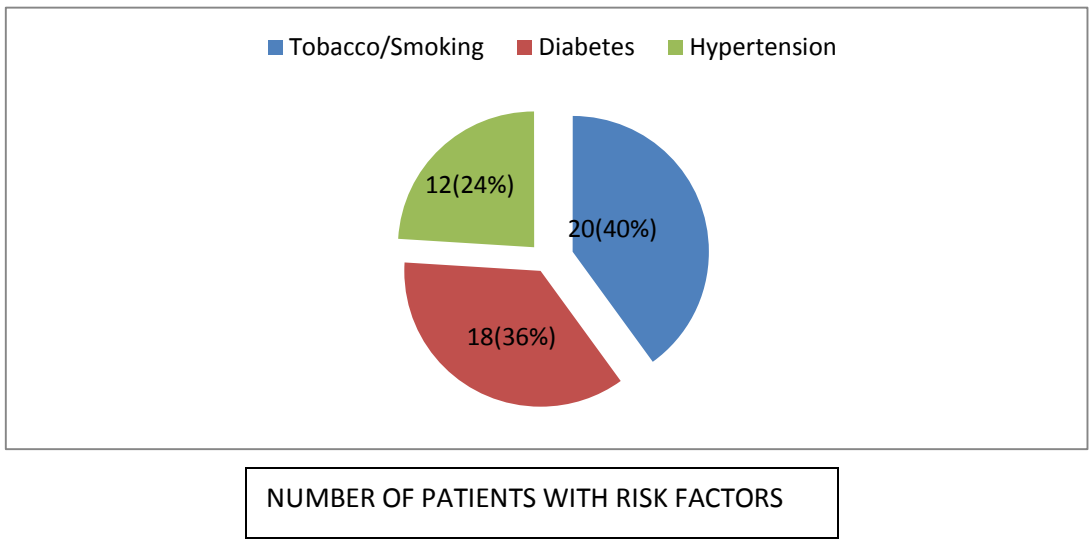
Results and observations

CHART-1 AGE AND SEX DISTRIBUTION OF CASES



The average age of men with Myocardial Infarction=60.45(+/- 9.55SD)
The average age of women with Myocardial Infarction=61.13(+/- 9.25SD)
The maximum incidence in the male patients was seen in the age group of=61-65years (22.85%)
The maximum incidence in the female patients was in the age group of=56-60years (46.66%)

CHART-2 RISK FACTORS FOR MYOCARDIAL INFARCTION



Out of 50 cases of Myocardial Infarction the predominant risk factor was smoking/tobacco 20(40%),followed by Diabetes 18(36%),Hypertension 12(24%) .All three risk factors were seen in 5(10%) of the patients.

TABLE- 1 QT DISPERSION IN CASES AND CONTROLS

	NO	QT-DISPERSION IN Ms	P-VALUE
MI	50	108±63.0	<0.0001
NORMAL PATIENTS	50	64±36.3	

QT Dispersion was high in patients (108±63.0 ms) with myocardial infarction than in controls (64±36.3 ms) and the difference was statistically highly significant P < 0.001

TABLE-2 QT DISPERSION IN PATIENTS WITH ACUTE MI

DAY1	DAY2	DAY5
108±63.0	91±64.0	90±58.6

- After 24 hours QT dispersion was (91±64.0ms), however when compared to admission QT dispersion (108±63.0ms) the difference was not statistically significant (p=O.128).
- AT Day 5, QT dispersion was(90±58.6),which was also statistically not significant(p=0.172)

TABLE-3 QT DISPERSION AND VENTRICULAR ARRHYTHMIA

	NUMBER	DAY1	DAY2	DAY5
VENTRICULAR ARRHYTHMIA	05	150±60.8	110±53.1	122±99.5
NO ARRHYTHMIA	45	105±63.5	94±65.3	87±52.8
STUDENTS T-TEST (t-value)		1.329	17.33	0.766
p-VALUE		0.2546	<0.0001	0.486

- QT Dispersion remained consistently high in Ventricuar Arrhythmic group from Day1 to Day5 compared to Non Arrhythmic group with statistically highly significant value at Day2 (p=<0.0001).

TABLE-4 COMPARISON OF QT DISPERSION BETWEEN HEALTHY SUBJECTS AND PATIENTS OF ACUTE MI,THROMBOLYSED AND NON THROMBOLYSED,ARRHYTHMIC AND NON ARRHYTHMIC GROUP.

GROUP	N	ADMISSION (DAY1)	DAY2	DAY5
CONTROL	50	64±36.3	---	---
AMI	50	108±63.0	91±64.0	90±58.6
ARRHYTHMIC GROUP	05	150±60.8	110±53.1	122±99.5
NON ARRHYTHMIC GROUP	45	105±63.5	94±65.3	87±52.8

Discussion

Within the acute complications of Acute Myocardial Infarction, ventricular arrhythmias are a very important yet preventable cause of death.[3] Identification of patients at high risk of life-threatening ventricular tachyarrhythmias represents one of the most challenging issues in patient care, especially after acute myocardial infarction (AMI). Experimental data have demonstrated a strong link between the vulnerability of the ventricular myocardium to serious tachyarrhythmias and increased temporal dispersion of refractoriness.[7],[8],[9] The clinical significance of QT interval prolongation has been the subject of much debate, with the evidence till date favoring an association between a proloned QT interval or an increased QTd, and an increased risk of sudden death due to arrhythmia.[10]

Cowan and Colleagues et al[11] first proposed that interlead variability of QT intervals in 12-lead electrocardiogram-QT dispersion (defined as the difference between maximum and minimum QT interval duration) reflects dispersion of ventricular recovery time, thus providing a conventional tool for clinical studies. The increased QT dispersion results in prolongation of the vulnerable period and thereby enhanced susceptibility to ventricular arrhythmias. QT dispersion is found to be increased in AMI and is associated with increased susceptibility to ventricular arrhythmias.[12],[13],[14]

Since patients are at increased risk of arrhythmic death after myocardial infarction (MI), assessment of ventricular depolarization could have important clinical implications. Sophisticated tests like Microvolt T wave alternans, domain ventricular late potentials, non sustained ventricular tachycardia on Holter monitoring have been well studied, but are unavailable to most people.[4] There is a need to define reliable and affordable parameters to measure or stratify the risk of ventricular arrhythmia in the setting of acute myocardial infarction.[15] QT variation and QT dispersion may provide a potentially simple, cheap and non invasive method of measuring underlying dispersion of ventricular excitability.[5],[6]

The present prospective cohort study aimed to examine QT Dispersion in 50 patients of AMI and an equal number of ages and sex matched healthy individuals.

QT Dispersion in Normal individuals:

In normal individuals a low QT dispersion was observed (64±36.3).In our study, the mean QTd noted in controls was in the nearly same range as that established for healthy subjects in the studies by Sylven et al.[16](54±27ms), Mirvis et al.[17](59±12.9ms), Cowan et al.[11](48±18ms),and Moreno et al.[18](54±20ms).

Extensive body surface mapping have also been used to disparities in ventricular repolarization in healthy persons and has revealed difference in QT duration of upto

60ms[18]. Taken together these finding suggest that a range of QT dispersion between 30 and 60 ms appear to represent normal limits of this parameter.

QT Dispersion in AMI:

QT dispersion in patients with AMI ranged from 40 ms to 160 ms with QT dispersion of(108±63.0ms) which was significantly higher (P< 0.001) than in normal healthy individuals (64±36.3ms) at admission. Our results are similar to that reported in other studies.[5],[13],[14]

Patients with MI may have an in homogenous ventricular repolarization process. In the setting of AMI, the interplay between ischemic living tissue and relatively depolarized dying tissue would create a complex transition period affecting QT interval dispersion. In early stage of AMI, increase of QT dispersion would be primarily due to local shortening of action potential. However, within few hours prolongation of QT interval could become the dominant feature governing QT dispersion.[12]

In Acute MI QT dispersion was found to be highest at the time of admission 108±63.0ms and was found to decrease with the course of time, 91±64.0ms at Day2 and 90±58.6ms at Day5, though the difference observed was not statistically significant.

Similar observations have been made earlier.[6],[19] However, in a large study of 316 consecutive patients, Newby et al could not find significant differences in QT dispersion assessed at admission or after 2 and 3 days.

TABLE-5 COMPARISON OF QT DISPERSION IN ACUTE MI

Studies		Normal	MI
Present study	Number QTD	50 64±36.3ms	50 108±63.0 at admission& 90±58.6 at discharge
Andreas Van de Loo et al[123]	Number QTD QTCD	50 QTD 30±10 QTCD 34±11	77 56±23 65±24
Uppal et al[129]	Number QTD	40 23.3±9.1	84 54.4±17.8

QT dispersion and ventricular arrhythmias

In the present study, QT dispersion of patients who did not have arrhythmias n=45 was compared them to patients who developed arrhythmias n=05. QT Dispersion remained consistently high in Ventricuar Arrhythmic group compared to Non Arrhythmic group on Admission(150±60.8ms v/s 105±63.5ms),Day2(110±53.1ms v/s 94±65.3ms) and at Day5(122±99.5 v/s 87±52.8) with statistically highly significant difference on Day2(p<0.001).

A graded relationship has been found between the low grade (Modified) of ventricular arrhythmia on 24 hours monitoring and QT dispersion 88±17 ms in VT, 60±14ms in monomorphic VPB and 43±8 ms in controls[20]. These data therefore suggest that QT dispersion increase in post MI period may relate to arrhythmias, and is decreased by measures that relieve ischemia or decrease arrhythmia incidence. This suggests that QT dispersion should relate to prognosis in post AMI patients, and indeed that has been found in one major post MI study (AIREX study) wherein those with AMI who had complicating heart failure, QT dispersion (measured on days 5) was found to be an independent (albeit rather weak) predictor of death[21]. The study may not be applicable to all post MI patients as it looked at only those with heart failure complicating AMI.

However study by Tomassoni et al assessed QT dispersion in 543 consecutive patients enrolled in the TAMI-9 or the GUSTO-1 study: 43 of these patients suffered from VF. QT dispersion was repeatedly measured in the electrocardiograms taken at 2, 24 and 48 hours after the infarct. At all three time intervals there were no significant differences in QT dispersion between patients with and without primary VF Methodological problems in assessing QT dispersion may atleast in part be responsible for the observed discrepancy between the various studies addressing this question.

TABLE-6 Comparison of QT Dispersion with Ventricular and without Ventricular Arrhythmia

Studies		With arrhythmia	Without arrhythmia	Remarks
Present study	Number	5	45	
	Day1	150±60.8ms	105±63.5ms	Not significant
	Day2	110±53.1ms	94±65.3ms	Significant
	Day5	122±99.5	87±52.8	Not significant
Aitchison JD et al	Number	149	8	
		66±29	74±24	Not Significant
Parale et al	Number	13	87	
	Admission	148.57±32.36	105.85±20.24	Significant
	Day3	125.71±29.92	77.07±19.40	Significant
	Day7	120±35.77	70.48±16.09	Significant
Zabal et al	Number	19	261	
		58±20	65±29	Not Significant

Since there is disagreement between studies, larger studies or meta-analysis may be needed to find out the predictive value of QT dispersion in arrhythmia and in patients with myocardial infarction.

Conclusion

- QT dispersion was increased in patients of acute myocardial infarction compared to age and sex matched controls which was statistically highly significant (p=<0.0001).
- This increased QT dispersion in acute myocardial infarction started to decrease after 48 hours,however, it did not return to normal even on 5th day.
- QT Dispersion remained consistently high in Ventricuar Arrhythmic group from Day1 to Day5.
- QT Dispersion was significantly increased in Ventricular Arrhythmic group at Day 2 compared to Non Arrhythmic group (p=<0.0001),indicating that there is a high risk of development of Ventricular Arrhythmias within 48 hrs of Acute Myocardial Infarction.
- The changes in the QTd are dynamic, and may reflect the changing pattern of ventricular excitability.Thus QTd measurement may provide a potentially simple ,cheap and non invasive msethod of identification of patients of Acute myocardial infarction at risk of development of ventricular arrhythmias and also relates to the prognosis in AMI patients and in the future may prove to be an independent predictor of death.

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