

## The Prognostic Significance of QRS Duration in Patients with ST-Segment Elevation Myocardial Infarction Receiving Thrombolytic Therapy

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### Abstract

Prolongation of the QRS duration has been shown to be associated with adverse outcomes post-myocardial infarction (MI). The relation to thrombolytic therapy was not widely studied before. The study included 30 patients with ST-segment elevation myocardial infarction who were given thrombolytic therapy. Results: ST segment deviation score (STD score) ranged from 5 to 23 with a mean of 14. ECG one hour after thrombolysis showed: Number of patients with successful thrombolytic therapy was sixteen (53.3%). ECG one day after thrombolysis showed: ST segment deviation score ranged from 0 to 10. QRS minimum duration ranged from 84 to 117 msec with a mean of 100. QRS maximum duration ranged from 85 to 118 msec with a mean of 102 msec. ECG measurements were repeated after thrombolytic therapy by one hour, 1 day, 2 days and on discharge. The 30 patients included in this study were divided into three groups according to the QRS maximum duration. The relation between QRS max before thrombolysis and the incidence of successful thrombolysis: Number of patients with successful thrombolytic therapy was not different in relation to QRS duration. QRS duration was compared with complications. Comparison between the success of the thrombolysis and the change of the QRS max before thrombolysis and before discharge showed that the shortening of the QRS duration in patients with successful thrombolysis was significant. Conclusion: improvement of QRS duration is a marker of successful thrombolysis. The incidence of complications (arrhythmias, heart failure, shock, pulmonary edema, mortality) increases with the increase of the QRS duration.

**Keywords:** Fibrinolytic therapy; QRS duration; Reperfusion; ST-Segment Elevation Myocardial Infarction

## Introduction

Impaired reperfusion after acute myocardial infarction (MI), known as the no-reflow phenomenon, is associated with greater left ventricular dysfunction and increased risk of death [1]. So, differentiation of a subgroup of acute MI patients who did get successful fibrinolytic therapy by means of a non-invasive diagnostic tool is of practical importance.

The post fibrinolysis electrocardiogram (ECG) has shown promise as a non-invasive reperfusion marker, electrocardiographic assessment of reperfusion is mostly based solely on changes of the ST segment. In contrast, a poor prognostic value of QRS prolongation in acute STEMI settings has been shown in previous studies [2]. There are few reports evaluating the relationship of QRS duration with myocardial reperfusion [3].

## Aim of the Work

The aim of this study is to evaluate the importance of the QRS duration and its relations to the mechanical performance of the heart as well as its prognostic significance in patients presented to Critical Care Department with ST-segment elevation MI who received thrombolytic therapy.

## Patients and Methods

**Patients:** This prospective study included 30 adult patients of both sexes with ST-segment elevation myocardial infarction who were admitted to The Critical care department in Alexandria main university hospital. Informed consent was taken from every patient included in the study or from his or her relatives.

Inclusion criteria:

1. presence of ST segment elevation (at least 1 ml) in two contiguous leads anatomically related to certain artery
2. Patients with typical chest pain of more than 30 minutes and within 6 hours from the onset of pain.
3. Absence of contraindications of thrombolytic according to practice guidelines published by the American college of cardiology and American heart association (ACC/AHA)

Absolute contraindications

- History of any intracranial hemorrhage.
- History of ischemic stroke within the preceding three months, with the important exception of acute ischemic stroke seen within three

hours which may be treated with thrombolytic therapy.

- Presence of a cerebral vascular malformation or a primary or metastatic intracranial malignancy.
- Symptoms or signs suggestive of an aortic dissection.
- A bleeding diathesis or active bleeding, with the exception of menses; thrombolytic therapy may increase the risk of moderate bleeding, which is offset by the benefits of thrombolysis.
- Significant closed-head or facial trauma within the preceding three months.

Relative contraindications:

History of chronic, severe, poorly controlled hypertension or uncontrolled hypertension at presentation (blood pressure < 180 mmHg systolic and/ or < 110 mmHg diastolic; severe hypertension at presentation can be an absolute contraindication in patients at low risk.

- History of ischemic stroke less than three months previously.
- Dementia.
- Any known intracranial disease that is not an absolute contraindication.
- Traumatic or prolonged (< 10 min) cardiopulmonary resuscitation.
- Major surgery within the preceding three weeks.
- Internal bleeding vascular punctures.
- Pregnancy.
- Current warfarin therapy – the risk of bleeding increases with increased INR.
- For streptokinase or anistreplase – a prior exposure (more than five days previously) or allergic reaction to these drugs.

Exclusion criteria:

1. Patients with left bundle branch block.
2. Grade three atrioventricular block.
3. Patients on temporary or permanent pacemaker.
4. Pre-excitation syndrome.
5. Electrolyte disturbance.

Then the 30 patients included in this study were divided into three groups According to QRS maximum duration as follows:

- (Group A): Patients with QRS max less

than 90 msec.

- (Group B): Patients with QRS max between 90 to 110 msec.
- (Group C): Patients with QRS max more than 110 msec.

## Methods

1. On admission every patient had been subjected to:
  - a. History taking: name, age, sex, and preliminary diagnosis.
  - b. Clinical data: vital signs including pulse, temperature, blood pressure, and respiratory rate.
  - c. Routine laboratory data: Complete blood picture, prothrombin time, partial thromboplastin time, INR (International Normalized Ratio), NA, K, AST, ALT, urea, creatinine.
  - d. Radiological evaluation: plain X-ray chest film.
  - e. Electrocardiogram: 12-lead electrocardiogram at 25 mm/s and 50 mm/s with 1 mV/cm standardization.
  - f. CK-MB and troponin measurement.

## 2. Monitoring

Patients had been monitored and followed up till discharge regarding:

- a. Vital signs, chest and heart examination.
- b. Electrocardiogram: Standard resting 12-lead electrocardiograms every 12 hours with a comment on changes of QRS duration.
- c. Cardiac enzymes: CK, CK-MB, Troponin.
- d. Chest x-ray.

## 3. Electrocardiogram

\* Standard resting 12-lead electrocardiograms were obtained at the time of admission, after receiving thrombolytic therapy, daily and before discharge at 25 mm/s and 50 mm/s and 1 mV/cm standardization, the widest QRS complex, narrowest QRS complex and the QTc segment duration in standard leads was manually measured. Only leads without extreme ST segment deviation will be considered.

\* Parameters of MI: leads that showed ST-segment elevation, the extent of elevation in these leads and ST segment deviation score (the sum of ST-segment deviation in all 12 leads).

## 4. Echocardiographic measurements

In all subjects, two-dimensional, M-mode pulsed and Parasternal long- and short – axis, apical four, and two chamber views were obtained echocardiographic examinations were

performed. Internal left ventricular (LV) end-diastolic and end – systolic diameters and interventricular septal and posterior wall thickness at end-diastole, and left atrial dimension were measured from parasternal long axis window in M-mode echocardiography. The ejection fraction of the left ventricle was obtained using modified Simpson's method.

## 5. Hospital course and complications:

In-hospital complications have been documented, including cardiac arrhythmia, congestive heart failure, cardiogenic shock, cardiac arrest, and death.

The study was approved by the local ethics committee of the institution, and all patients gave written informed consent. The data was collected in spreading sheets then they had been analyzed statistically in a diagrammatic way.

The success of the thrombolysis was based upon the following:

- More than 50 percent ST-segment resolution.
- Resolution of the chest pain taking into consideration the use of analgesics.
- Presence of reperfusion arrhythmias particularly accelerated idioventricular escape rhythm.

## Results

### Demographic Data

This study was conducted on 30 patients who were admitted to a critical care unit at Alexandria main university hospital with the diagnosis of ST-segment elevation MI. Nineteen patients (63.3%) were males and eleven patients (36.7%) were females. The age of the patients ranged from 38 to 70 years with a mean age of  $55.8 \pm 8.1$  years. The incidence of risk factors: Smoking in 56%, dyslipidemia in 66%, diabetes in 76%, hypertension in 80%, previous MI in 20%.

Presentation: The main presenting symptom(s) was classical chest pain. The duration of the complaint on presentation ranged from 2 to 6 hours with a mean of  $4.5 \pm 1.1$  hours.

The systolic blood pressure on admission ranged from 60 to 170 mmHg with a mean of  $131.0 \pm 27.9$  mmHg and the diastolic blood pressure ranged from 30 to 140 mmHg with a mean of  $86.0 \pm 22$  mmHg. Signs of left heart failure were observed in eight (26.7%) patients on admission.

Investigations: CK MB and troponin was done for all patients before thrombolytic therapy. CK MB was ranging from 30 to 160 with a mean of 89. Troponin was ranging from 0.60 - 14.00 with a mean of [7].

N.B. (Troponin normal reference is  $\leq 0.01$  micro/L), (CK-MB normal reference is up to 25 U/L)

ECG findings on presentation (Table 1)

ECG was done for all patients on presentation and before thrombolysis and showed:

- Heart rate ranged from 60 to 130 beat per minute, mean  $88.77 \pm 17.6$ .
- Site of infarction was anterior in 19 patients (63 %), inferior in 7 patients (23 %) and lateral in 4 patients (13 %).

ST segment deviation score (the sum of ST segment deviation in all 12 leads).

- (STD score) was calculated for all patients and it ranged from 5 to 23 with a mean of  $14.83 \pm 4.24$
- QRS complex parameters were measured for all cases. QRS minimum duration ranged from 84 to 117 msec with a mean of  $101 \pm 11$ . QRS maximum duration ranged from 85 to 118 msec with a mean of  $102 \pm 11$  msec.
- QTc was measured ranged from 0.400 to 0.440 sec with a mean of  $0.420 \pm 0.01$  sec.

ECG findings one hour after thrombolysis (table 1):

ECG was done for all patients one hour after thrombolysis and showed:

- Number of patients with successful thrombolytic therapy was sixteen (53.3%).
- Heart rate ranged from 60 to 110 beat per minute with a mean of 80 bpm.

ST segment deviation score (STD score) ranged from 1 to 19 with a mean of 7.

- QRS minimum duration ranged from 84 to 117 msec with a mean of 101 and QRS maximum duration ranged from 85 to 118 msec with a mean of 102 msec.

ECG findings one day after thrombolytic (table 1): ECG was done for all patients one day after thrombolysis and showed:

- Heart rate ranged from 60 to 110 beat per minute with a mean of 79 beat per minute.
- ST segment deviation score (STD score) ranged from 0 to 10 with a mean of 1.83
- QRS minimum duration ranged from 84 to 117 msec with a mean of  $100 \pm 11$

QRS maximum duration ranged from 85 to 118 msec with a mean of 102 msec.

QTc was measured ranged from 400 to 440 msec with a mean of 420 msec.

ECG findings two days after thrombolytic (table 1): ECG was done for all patients two days after thrombolysis and showed:

- Heart rate ranged from 60 to 120 beat per minute with a

mean of 78.

- ST segment deviation score (STD score) ranged from 0 to 6 with a mean of 1.23

- QRS minimum duration ranged from 84 to 117 msec with a mean of 100

QRS maximum duration ranged from 85 to 118 msec with a mean of 101

- QTc was measured ranged from 40 to 44 msec with a mean of  $42.0 \pm 1.0$  msec.

ECG findings before discharge (table 1): ECG was done for all patients before discharge and showed:

- Heart rate ranged from 60 to 120 beat per minute with a mean of 77.

- ST segment deviation score (STD score) ranged from 0 to 2 with a mean of 0.67

- QRS minimum duration ranged from 84 to 117 msec with a mean of 100.

QRS maximum duration ranged from 85 to 118 msec with a mean of 101

QTc was measured ranged from 40 to 44 msec with a mean of 42 msec.

- Echo on admission Table (2):

-EF (ejection fraction) ranged from 24 to 62% with mean of  $48 \pm 10$

-ESD (end systolic diameter) ranged from 2.4 to 6.1 cm with mean of  $4.1 \pm 0.91$  cm.

-EDD (end diastolic diameter) ranged from 4 to 6.9 cm with a mean of  $5.7 \pm 0.7$  cm.

- Left atrium diameter ranged from 34 to 42 mm with a mean of 37.

- Echo before discharge Table (2):

0 EF (ejection fraction) ranged from 24 to 62% with mean  $49.27 \pm 9.41$

0 ESD (end systolic diameter) ranged from 2.4 to 6.1 cm with mean  $4.06 \pm 0.89$  cm.

0 EDD (end diastolic diameter) ranged from 4 to 6.9 cm with a mean  $5.70 \pm 0.76$  cm.

0 Left atrium diameter ranged from 34 to 42 mm with a mean  $37.43 \pm 7.9$  mm.

Out of 30 patients 10 (33.3%) patients had arrhythmia four (13.3%) patients in the form of premature ventricular contractions (PVCs), three patients (10%) had ventricular tachycardia (VT), one patient (3.3%) had first degree heart block, another patient (3.3%), had paroxysmal atrial fibrillation and another patient (3.3%) had ventricular fibrillation. Thirteen patients (43.3%) show signs of left heart failure, four

patients (13.3%) developed pulmonary edema, two patients (6.7%) became shocked and 2 patients (6.7%) died.

The 30 patients included in this study were divided into three groups according to the QRS maximum duration:

- (Group A): patients with QRS max less than 90 msec (11 =5).
- (Group B): patients with QRS max between 90 to 110 msec (n=17).
- (Group C): patients with QRS max more than 110 msec (n=8).

Relation between QRS max before thrombolysis and gender:

- There was statistically insignificant difference between the three groups as regards the gender of patients ( $p = 1.000$ ).

Relation between QRS max before thrombolysis and risk factors: Comparison between the three groups before the thrombolytic therapy as regards the risk factors revealed that

:there was statistically insignificant difference between the three groups as regards the history of smoking ( $p=0.212$ ). There was statistically insignificant difference between the three groups as regards the history of dyslipidemia ( $p=0.249$ ). There was statistically significant difference between the three groups as regards the history of diabetes mellitus, more patients with DM were found in group C ( $p=0.049$ ).

- There was statistically insignificant difference between the three groups as regards the history of previous MI ( $p=0.202$ ). There was statistically insignificant difference between the three groups as regards the history of hypertension ( $p=0.085$ ).

Relation between the site of infarction and QRS max and QRS min before thrombolytic therapy:

Seven patients had inferior MI in six (85.7%) patients the leads that shows maximum duration of QRS complex was in anterior chest leads (V1,6) and in one of them (14.3%) was in inferior leads (II, III, aVF), while the leads that shows minimum duration of the QRS complex was four (57.1%) in inferior leads (II, III, AVF) and three (42.9%) in lateral leads (LI, aVL). Four patients had lateral MI in all of them the leads that shows maximum duration of QRS complex was in anterior chest leads (VM) while the leads that shows minimum duration of the QRS complex was two (50%) in inferior leads (II, III, aVF) and two (50%) in lateral leads (I, aVL).

Comparison between the site of the infarction and the QRS max and the QRS min before thrombolysis revealed that: There was statistically insignificant relation between the site of the infarction and leads that shows maximum duration of the QRS complex in ECG before thrombolysis ( $p=0.372$ ).

- And also there was statistically insignificant relation between the site of the infarction and leads that shows minimum duration of the QRS complex in ECG before thrombolysis

( $p=0.795$ ).

So leads that show the QRS min or QRS max had no relation to the site of infarction.

Relation between QRS max before thrombolysis and the incidence of successful thrombolysis: Number of patients with successful thrombolytic therapy in (group A) was three (18.8%), in (group B) was ten (62.5%), while in (group C) was three (18.8%). There was statistically insignificant difference between the three groups as regards the number of patient with successful thrombolytic therapy ( $p = 0.603$ ).

Relation between the success of the thrombolysis and the change of the QRS max before thrombolysis and before discharge. (Table 3)

The duration of the QRS max before thrombolytic therapy in patients with failed thrombolysis ranged from 88.0 to 118.0 msec with a mean of  $106 \pm 10$  msec and before discharge ranged from 88.0 to 118.0 msec with a mean  $105 \pm 10$  msec.

The duration of the QRS max before thrombolytic therapy in patients with successful thrombolysis ranged from 85.0 to 118.0 msec with a mean of  $106.14 \pm 10.52$  msec and before discharge ranged from 85.0 to 116.0 msec with a mean  $98.75 \pm 11$  msec.

- There was statistically significant difference between the QRS max before thrombolysis and before discharge in patients with successful thrombolysis ( $p=0.041$ ). The shortening of the QRS duration in patients with successful thrombolysis is statistically significant.

- There was statistically insignificant difference between the QRS max before thrombolysis and before discharge in patients with failed thrombolysis ( $p=0.174$ ).

Relation between the three groups as regard the ECG parameters before thrombolytic therapy:

Heart rate ranged from 60.0 to 98.0 b/sec with a mean of 79.60  $\pm 15.19$  in (group A), it ranged from 60.0 to 95.0 b/sec with a mean of  $81.18 \pm 10.68$  in (group B) while in (group C) it ranged from 95 to 113 b/sec with a mean of  $110.63 \pm 12.08$  b/sec.

Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.795$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p<0.001$ ), between (group B) and (group C) ( $p<0.001$ ) and between the three groups ( $p<0.001$ ). (Patients in group C are more tachycardiac). Correlation test was done and showed a positive correlation between the QRS max and heart rate and was statistically significant ( $r= 0.656$   $p<0.001$ ). STDS (ST segment deviation score) ranged from 10.0 to 15.0 with a mean of  $12.0 \pm 1.87$  in (group A), it ranged from 5.0 to 18.0 with a

mean of 13.53 ± 3.84 in (group B) while in (group C) it ranged from 16.0 to 23.0 with a mean of 19.38 ± 2.33.

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.366$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p<0.001$ ), between (group B) and (group C) ( $p<0.001$ ) and between the three groups ( $p<0.001$ ). (Patients in group C had the highest score). Correlation test was done and showed a positive correlation between the QRS max and STDS and was statistically significant ( $r= 0.712$   $p<0.001$ ). The corrected QT interval (QTc) ranged from 0.40 to 0.44 sec with a mean of 0.41 ± 0.02 sec in (group A), it ranged from 0.41 to 0.44 sec with a mean of 0.42 ± 0.01sec in (group B) while in (group C) it ranged from 0.40 to 0.43 sec with a mean of 0.42 ± 0.01sec.

> Comparison between the three groups revealed that there was no statistical difference between (group A) and (group B) ( $p=0.168$ ), between (group A) and (group C) ( $p=0.372$ ), between (group B) and (group C) ( $p=0.640$ ) and between the three groups ( $p=0.378$ ). A F Correlation test was done and showed a slight positive correlation between the QRS max and QTc and was statistically insignificant ( $r= 0.133$   $p=0.551$ )

Relation between QRS max and cardiac biomarkers on admission:

Ck MB ranged from 36 to 160 in group A with a mean 77.20 ± 50.98, from 30 to 160 in group B with a mean 87.65 ± 47.60 and ranged from 30 to 150 in group C with a mean 102.25 ± 43.36. \_\_\_

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.844$ ), between, (group A) and (group C) ( $p=0.378$ ), between (group B) and (group C) ( $p=0.481$ ) and between the three groups ( $p=0.675$ ). > Correlation test was done and showed a slight positive correlation between the QRS max and CK-MB and was statistically insignificant ( $r= 0.113$   $p=0.552$ ) Troponin ranged from 0.6 to 13 in group A with a mean 4.52 ± 4.09, from 2.0 to 14 in group B with a mean 7.53 ± 4.24 and ranged from 4.0 to 13.0 in group C with a mean 7.50 ± 3.38.

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.156$ ), between (group A) and (group C) ( $p=0.077$ ), between (group B) and (group C) ( $p=1$ ) and between the three groups ( $p=0.244$ ).

> Correlation test was done and showed a slight positive correlation between the QRS max and Troponin and was statistically insignificant ( $r= 0.175$   $p=0.355$ )

Relation of QRS max before thrombolysis and Echo on admission:

Ejection fraction in (group A) range from 50 to 60% with a mean 56.60 ± 4.45 in (group B) ranged from 40 to 62% with a mean 51.76 ± 7.41 and in (group C) EF ranged from 24 to 48% with a mean 36.38 ± 6.72.

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.178$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p<0.001$ ), between (group B) and (group C) ( $p<0.001$ ) and between the three groups ( $p<0.001$ ). (Patients in group C had the lowest EF).

P Correlation test was done and showed a negative correlation between the

QRS max and EF and was statistically significant ( $r=- 0.879$   $p<0.001$ )

ESD in (group A) range from 2.4 to 4.8cm with a mean 3.68 ± 1.086cm in (group B) ranged from 2.6 to 5.4cm with a mean 3.85 ± 0.79cm and in (group C) ESD ranged from 4.1 to 6.1cm with a mean 4.98 ± 0.63cm.

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.671$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p=0.006$ ), between (group B) and (group C) ( $p=0.002$ ) and between the three groups ( $p=0.004$ ). (Patients in group C had the longest ESD).

> Correlation test was done and showed a positive correlation between the QRS max and ESD and was statistically significant ( $r= 0.629$   $p<0.001$ ) EDD in (group A) range from 4.0 to 6.4cm with a mean 5.34 ± 0.90cm in (group B) ranged from 4.3 to 6.9cm with a mean 5.59 ± 0.75cm and in (group C) EDD ranged from 5.5 to 6.8cm with a mean 6.15 ± 0.48cm.

> Comparison between the three groups revealed that there was no statistically difference between (group A) and (group B) ( $p=0.491$ ), between (group A) and (group C) ( $p=0.057$ ), between (group B) and (group C) ( $p=0.081$ ) and between the three groups ( $p=0.110$ ). (Patients in group C had the longest EDD).

> Correlation test was done and showed a positive correlation between the QRS max and EDD and was statistically significant ( $r= 0.473$   $p=0.008$ ). In (group A) two patients (40%) had mild MR, in (group B) eight patients (47.1%)

had mild MR and two patients (11.8%) had moderate MR, in (group C) two patients (25%) had mild MR, four patients (50%) had moderate MR and one patient (12.5%) had severe MR. > The comparison between the three groups revealed that there was no statistically significant difference between the three groups as regards the degree of MR ( $p = 0.111$ ).

Left atrial diameter in (group A) ranged from 31 to 37mm with a mean  $34.60 \pm 2.51$ mm in (group B) ranged from 33 to 43mm with a mean  $36.65 \pm 2.67$ mm and in (group C) ranged from 39 to 45mm with a mean  $41.75 \pm 2.25$ mm.

> Comparison between the three groups revealed that there was no statistically significant difference between (group A) and (group B) ( $p=0.219$ ), between (group A) and (group C) ( $p=1.000$ ), between (group B) and (group C) ( $p=0.135$ ) and between the three groups ( $p=0.219$ ).

Correlation test was done and showed a slight positive correlation between the QRS max and left atrial diameter and was statistically insignificant ( $r = 0.189$   $p=0.316$ ).

Relation of QRS max before discharge and Echo before discharge: Table 4

Ejection fraction in (group A) ranged from 50 to 60% with a mean  $56.60 \pm 4.45$  in (group B) ranged from 40 to 62% with a mean  $52.41 \pm 6.64$  and in (group C) EF ranged from 24 to 48% with a mean  $38.0 \pm 6.89$ .

> Comparison between the three groups revealed that there was no statistically significant difference between (group A) and (group B) ( $p=0.212$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p<0.001$ ), between (group B) and (group C) ( $p<0.001$ ) and between the three groups ( $p<0.001$ ). (Patients in group C had the lowest EF).

> Correlation test was done and showed a negative correlation between the QRS max and EF and was statistically significant ( $r = -0.702$   $p<0.001$ ) ESD in (group A) range from 2.4 to 4.8cm with a mean  $3.68 \pm 0.86$ cm in (group B) ranged from 2.6 to 5.4cm with a mean  $3.79 \pm 0.77$ cm and in (group C) ESD ranged from 4.1 to 6.1cm with a mean  $4.88 \pm 0.66$ cm. Comparison between the three groups revealed that there was no statistically significant difference between (group A) and (group B) ( $p=0.781$ ), on the other hand there was statistically significant difference between (group A) and (group C) ( $p=0.010$ ), between (group B) and (group C) ( $p=0.002$ ) and between the three groups ( $p=0.005$ ). (Patients in group C had the longest ESD).

P Correlation test was done and showed a positive correlation between the QRS max and ESD and was statistically significant ( $r = 0.495$   $p=0.005$ ) EDD in (group A) range from 4.0 to 6.4cm with a mean  $5.34 \pm 0.90$ cm in (group B) ranged from 4.3 to 6.9cm with a mean  $5.59 \pm 0.75$ cm and in (group C) EDD ranged from 5.5 to 6.8cm with a mean  $6.16 \pm 0.50$ cm. Comparison between the three groups revealed that there was no statistically significant difference between (group A) and (group B) ( $p=0.494$ ), between (group A) and (group C) ( $p=0.055$ ), between (group B) and (group C) ( $p=0.077$ ) and between the three groups ( $p=0.105$ ). (Patients in group C had the longest EDD).

> Correlation test was done and showed a positive correlation between the QRS max and EDD and was statistically significant ( $r = 0.379$   $p=0.039$ ).

In (group A) two patients (40%) had mild MR, in (group B) eight patients (47.1%) had mild MR and two patients (11.8%) had moderate MR, in (group C) two patients (25%) had mild MR, four patients (50%) had moderate MR and one patient (12.5%) had severe MR.

The comparison between the three groups revealed that there was no statistically significant difference between the three groups as regards the degree of MR ( $p = 0.111$ ).

Left atrial diameter in (group A) range from 31 to 37mm with a mean  $34.60 \pm 2.51$ mm in (group B) ranged from 33 to 43mm with a mean  $36.65 \pm 2.67$ mm and in (group C) ranged from 39 to 45mm with a mean  $41.75 \pm 2.25$ mm.

F Comparison between the three groups revealed that there was no statistically significant difference between (group A) and (group B) ( $p=0.205$ ), between (group A) and (group C) ( $p=1.000$ ), between (group B) and (group C) ( $p=0.135$ ) and between the three groups ( $p=0.219$ ). Correlation test was done and showed a positive correlation between the QRS max and left atrial diameter and was statistically insignificant ( $r = 0.189$   $p=0.316$ ) Relations between QRS max before thrombolysis and complications: (Table 5)

No patient had arrhythmias in (group A) while three patients had arrhythmias in (group B) (17.6%) and seven patients (87.5%) in (group C).

No patient had signs of left heart failure in (group A) while five patients had left heart failure in (group B) (29.4%) and eight patients (100%) in (group C). No patient became shocked in (group A) and (group B), while two patients (25%) became shocked in (group C).

No patient had developed pulmonary edema in (group A) and

(group B), while four patients (50%) had developed pulmonary edema in (group C). No patient had arrhythmias in (group A) while three patients had arrhythmias in (group B) (17.6%) and seven patients (87.5%) in (group C).

No patient had died in (group A) and (group B) while two patients (25%) died in (group C).

- There was statistically significant difference between the three groups as regards the incidence of arrhythmias ( $p=0.001$ ). Heart failure was more with wider QRS ( $p<0.001$ ).
- There was statistically significant difference between the three groups as regards the incidence of shock ( $p=0.093$ ).
- There was statistically significant difference between the three groups as regards the incidence of developing pulmonary edema ( $p=0.003$ ).
- There was statistically insignificant difference between the three groups as regards the incidence of mortality ( $p=0.084$ ).

And with doing a comparison test (student t test) to show the difference between the means of the QRS max in patients with and patients without complications we found that: There is a statistically significant difference between the mean of the QRS max in patients with and patients without complications with p value ( $<0.001$ ), as the incidence of complications (arrhythmias, heart failure, shock, pulmonary edema and mortality) increases with the increase in the QRS max (table 5).

There is a statistically significant difference between the mean of the QRS max in patients with and patients without complications with p value ( $<0.001$ ), as the incidence of complications (arrhythmias, heart failure, shock, pulmonary edema and mortality) increases with the increase in the QRS max

## Discussion

Effect of thrombolytic therapy on the QRS max:

Comparing the ECG before discharge with the ECG on admission in our study, there was a significant change of the QRS duration (shortening) in patients with successful thrombolysis while there was no significant difference between the QRS duration before thrombolytic therapy and before discharge in patients with failed thrombolytic therapy.

Orhan et al, [13] in a study to show the effect of successful reperfusion on QRS duration conducted on ninety-two consecutive patients with acute ST-segment elevation myocardial infarction who underwent successful primary

angioplasty. They found improvement in QRS in reperfusion group, and they suggested the use of QRS changes for assessment of cellular reperfusion [13].

Tsukahara et al, [2] studied the clinical implications of intermediate QRS prolongation in the absence of bundle-branch block in patients with ST-segment-elevation acute myocardial infarction conducted on 534 consecutive patients. Resolution of intermediate QRS prolongation within 24 h of successful reperfusion tended to be associated with lower 6-month mortality than did persistent intermediate QRS prolongation [2].

Other studies have reported that QRS duration is prolonged by occlusion of the proximal and middle segments of major arteries during PCI [14].

On the other hand, in the study of the Valsartan in acute myocardial infarction (VALIANT) trial (Pfeffer et al. [15]) A Baseline QRS duration was measured offline from single-lead electrocardiographic (ECG) tracings read from the echocardiograms. Patients were divided according to baseline QRS duration ( $< 75$  ms, 75-88 ms, 89-108 ms,  $> 108$  ms), and these groups were related to clinical outcomes, as well as to changes in LV size and function.

Lakshmi Narayan Y, et al [16]. found that a prolonged QRS duration at baseline was associated with larger ventricular volumes and reduced systolic function [15-16].

Another study was done by Schinkel et al, [17] to show the Prognostic Significance of QRS Duration in Patients with Suspected Coronary Artery Disease Referred for Noninvasive Evaluation of Myocardial Ischemia. A QRS duration  $\geq 120$  ms at rest was a strong predictor of cardiac death and the combined endpoint cardiac death/nonfatal infarction [17].

## Conclusion

- In patients with STEMI, the QRS duration is a useful indicator of left ventricular systolic function and dimensions and it is easily measured.
- QRS duration is a good predictor of outcome in patients with STEMI.
- Shortening of a prolonged QRS complex is a useful parameter for identifying successful thrombolysis in patients with acute STEMI. To our knowledge, this is one of the few studies that showed improvement of QRS duration with successful thrombolysis.



## Recommendations

Electrophysiological studies focusing on identifying the exact mechanisms of QRS prolongation and its relation to the infarct segment may help to increase the value of QRS complex duration as a prognostic tool.

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	ECG				
	Before thrombolysis	After thrombolysis			Before discharge
		1 hour	1 day	2 days	
Heart rate					
Range	60.0 - 130.0	60.0 - 110.0	60.0 - 110.0	60.0 - 120.0	60.0 - 120.0
Mean $\pm$ SD	88.77 $\pm$ 17.61	80.13 $\pm$ 12.25	79.73 $\pm$ 13.10	78.93 $\pm$ 13.88	77.13 $\pm$ 13.08
STDS					
Range	5.0 - 23.0	1.0 - 19.0	0.0 - 10.0	0.0 - 6.0	0.0 - 2.0
Mean $\pm$ SD	14.83 $\pm$ 4.24	7.03 $\pm$ 4.35	1.83 $\pm$ 2.59	1.23 $\pm$ 1.45	0.67 $\pm$ 0.71
QRS max					
Range	85.0-118.0	85.0 -118.0	85.0-118.0	85.0-118.0	85.0-118.0
Mean $\pm$ SD	102.20 $\pm$ 11.25	102.20 $\pm$ 11.25	102.0 $\pm$ 11.07	101.77 $\pm$ 11.01	101.77 $\pm$ 11.01
QRS min					
Range	84.0 -117.0	84.0-117.0	84.0-117.0	84.0-117.0	84.0-117.0
Mean $\pm$ SD	101.17 $\pm$ 11.27	101.17 $\pm$ 11.27	100.97 $\pm$ 11.10	100.73 $\pm$ 11.04	100.73 $\pm$ 11.04
QTc					
Range	0.40- 0.44sec	0.40-0.44sec	0.40 - 0.44sec	0.40- 0.44sec	0.40- 0.44sec
Mean $\pm$ SD	0.42 $\pm$ 0.01	0.42 $\pm$ 0.01	0.42 $\pm$ 0.01	0.42 $\pm$ 0.01	0.42 $\pm$ 0.01

Table 1: Descriptive analysis of studied cases according to ECG (n=30)

	Echo	
	on admission	on third day
<b>EF</b>		
Range	24.0% – 62.0%	24.0% – 62.0%
Mean ± SD	48.47 ± 10.10%	49.27 ± 9.41%
<b>ESD</b>		
Range	2.40cm – 6.10cm	2.40cm – 6.10cm
Mean ± SD	4.12 ± 0.91cm	4.06 ± 0.89cm
<b>EDD</b>		
Range	4.0cm – 6.90cm	4.0cm – 6.90cm
Mean ± SD	5.70 ± 0.75cm	5.70 ± 0.76cm
<b>Valves</b>		
No	11 (36.7%)	11 (36.7%)
Mild MR	12 (40.0%)	12 (40.0%)
Moderate MR	6 (20.0%)	6 (20.0%)
Severe MR	1 (3.3%)	1 (3.3%)
<b>Left atrium</b>		
Range	34.0mm– 42.0mm	34.0mm– 42.0mm
Mean ± SD	37.27 ± 2.0mm	37.43 ± 1.79mm

Table (2): Descriptive analysis of studied cases according to Echo (n=30).

	Echo	
	on admission	on third day
<b>EF</b>		
Range	24.0% – 62.0%	24.0% – 62.0%
Mean ± SD	48.47 ± 10.10%	49.27 ± 9.41%
<b>ESD</b>		
Range	2.40cm – 6.10cm	2.40cm – 6.10cm
Mean ± SD	4.12 ± 0.91cm	4.06 ± 0.89cm
<b>EDD</b>		
Range	4.0cm – 6.90cm	4.0cm – 6.90cm
Mean ± SD	5.70 ± 0.75cm	5.70 ± 0.76cm
<b>Valves</b>		
No	11 (36.7%)	11 (36.7%)
Mild MR	12 (40.0%)	12 (40.0%)
Moderate MR	6 (20.0%)	6 (20.0%)
Severe MR	1 (3.3%)	1 (3.3%)
<b>Left atrium</b>		
Range	34.0mm– 42.0mm	34.0mm– 42.0mm
Mean ± SD	37.27 ± 2.0mm	37.43 ± 1.79mm

Table (3): Relation between the success of the thrombolysis and the change of the QRS max before thrombolysis and before discharge.

- t: Paired t-test
- \*: Statistically significant at  $p \leq 0.05$

		QRS max before discharge						r (p)
		<90 (n = 5)		90-100(n = 17)		>110 (n = 8)		
Echo on the third day.	<b>EF</b>							
	Range	50.0 – 60.0		42.0 – 62.0		24.0 – 48.0		-0.702* (<0.001)
	Mean ± SD	56.60 ± 4.45		52.41 ± 6.64		38.0 ± 6.89		
	<b>F (p)</b>	17.550* (<0.001)						
	<b>P<sub>1</sub></b>			0.212		<0.001*		
	<b>P<sub>2</sub></b>					<0.001*		
	<b>ESD</b>							
	Range	2.40 – 4.80		2.60 – 5.40		4.10 – 6.10		0.495* (0.005)
	Mean ± SD	3.68 ± 0.86		3.79 ± 0.77		4.88 ± 0.66		
	<b>F (p)</b>	6.367* (0.005)						
	<b>P<sub>1</sub></b>			0.781		0.010*		
	<b>P<sub>2</sub></b>					0.002*		
	<b>EDD</b>							
	Range	4.0 – 6.40		4.30 – 6.90		5.50 – 6.80		0.379* (0.039)
	Mean ± SD	5.34 ± 0.90		5.59 ± 0.75		6.16 ± 0.50		
	<b>F (p)</b>	2.458 (0.105)						
<b>P<sub>1</sub></b>			0.494		0.055			
<b>P<sub>2</sub></b>					0.077			
<b>Valves</b>	No.	%	No.	%	No.	%	MCp=0.111	
No	3	60.0	7	41.2	1	12.5		
Mild MR	2	40.0	8	47.1	2	25.0		
Moderate MR	0	0.0	2	11.8	4	50.0		
Severe MR	0	0.0	0	0.0	1	12.5		
<b>Left atrium</b>								
Range	36.0 – 40.0		35.0 – 40.0		34.0 – 42.0		0.129 (0.496)	
Mean ± SD	37.80 ± 1.48		37.12 ± 1.36		37.88 ± 2.70			
<b>F (p)</b>	0.593 (0.560)							
<b>P<sub>1</sub></b>			0.468		0.943			
<b>P<sub>2</sub></b>					0.340			

F: F test (ANOVA)

Table (4): Relation of QRS max before discharge and Echo on the third day.

	QRS max before thrombolysis						MCp
	<90 (n = 5)		90-110 (n = 17)		>110 (n = 8)		
	No.	%	No.	%	No.	%	
<b>Arrhythmia</b>	0	0.0	3	17.6	7	87.5	0.001*
<b>Signs of HF</b>	0	0.0	5	29.4	8	100.0	<0.001*
<b>Shock</b>	0	0.0	0	0.0	2	25.0	0.093
<b>Pulmonary edema</b>	0	0.0	0	0.0	4	50.0	0.003*
<b>Mortality</b>	0	0.0	0	0.0	2	25.0	0.084

Table (5): Relation between QRS max before thrombolysis and complications.

MCp: p for Monte Carlo test

## References

- Ito H, Maruyama A, Iwakura K, Takiuchi S, Masuyama T, Hori M, et al. (1996) Clinical implications of the 'no-reflow' phenomenon: A predictor of complications and left ventricular remodeling in perfused anterior wall myocardial infarction. *Circulation* 93: 223–228.
- Tsukahara K, Kimura K, Kosuge M, Shimizu T, Sugano T, Hibi K, et al. (2005) Clinical implications of intermediate QRS prolongation in the absence of bundle-branch block in patients with ST-segment-elevation acute myocardial infarction. *Circ J* 69: 29 – 34.
- Fehmi Kacmaz, Orhan Maden, Cagın Ureyen, et al. (2008) Relationship of Admission QRS Duration and Changes in QRS Duration with Myocardial Reperfusion in Patients with Acute ST-Segment Elevation Myocardial Infarction (STEMI) Treated with Fibrinolytic Therapy. *Circ J* 72: 873–879.
- Radek Pudil, Micha S Feinberg, Hanoch Hod, Valentina Boyko, et al. (2001) The prognostic significance of intermediate QRS prolongation in acute myocardial infarction. *International Journal of Cardiology* 78:233–239.
- Elhendy A, Hammill S.C, Mahoney D.W, Pellikka P.A (2005) Relation of QRS duration on the surface 12-lead electrocardiogram with mortality in patients with known or suspected coronary artery disease. *Am J Cardiol* 96:1082-1088.
- Pudil R, Feinberg M.S, Hod H, Boyko V, Mandelzweig L, Behar S (2001) The prognostic significance of intermediate QRS prolongation in acute myocardial infarction. *Int J Cardiol* 78:233-239.
- Hathaway W.R, Peterson E.D, Wagner G.S, et al. (1998) Prognostic significance of the initial electrocardiogram in patients with acute myocardial infarction. GUSTO-I Investigators. *Global Utilization of Streptokinase and t-PA for Occluded Coronary Arteries. JAMA* 279:387-391.
- Brilakis E.S, Mavrogiorgos N.C, Kopecky S.L, et al. (2002) Usefulness of QRS duration in the absence of bundle branch block as an early predictor of survival in non-ST elevation acute myocardial infarction. *Am J Cardiol* 89:1013-1018.
- C-K Wong, W Gao, R A H Stewart, J K French, P E G Aylward (2009) H D White. Relationship of QRS duration at

baseline and changes over 60 min after fibrinolysis to 30-day mortality with different locations of ST-elevation myocardial infarction: results from the Hirulog and Early Reperfusion or Occlusion-2 trial. *Heart* 95: 276-282.

10. A A Cantor, B Goldfarb, R Ilia (2000) QRS prolongation: a sensitive marker of ischemia during percutaneous transluminal coronary angioplasty. *Catheterization and Cardiovascular Interventions* (Impact Factor: 2.51). 50:177-83.

11. Lakshmi Narayan Yerra, Nagesh Anavekar, MD, Hicham Skali, MD, Steve Zelenkofske, DO Eric Velazquez, MD, et al. (2006) Association of QRS duration and outcomes after myocardial infarction: the VALIANT trial. *Heart Rhythm* Volume 3: 313–316.

12. Schinkel AF, Elhendy A, van Domburg RT, Biagini E, Rizzello V, Veltman CE, et al. (2009) Prognostic significance of QRS duration in patients with suspected coronary artery disease referred for noninvasive evaluation of myocardial ischemia. *Am J Cardiol.* 104:1490-1493.

13. M Orhan, Kacmaz F, Alyan O, Atak R, Senen K, Balbay Y, et al. (2007) A new electrocardiographic marker of successful myocardial reperfusion in patients undergoing primary angioplasty: resolution of QRS prolongation. *Journal of Electrocardiology* 40:51.

14. Cantor AA, Goldfarb B, Ilia R (2000) QRS prolongation: A sensitive marker of ischemia during percutaneous transluminal coronary angioplasty. *Cathet Cardiovasc Intervent* 50: 177-183.

15. Pfeffer MA, McMurray JJ, Velazquez EJ, Rouleau JL, Kober L, et al. (2003) For the Valsartan in Acute Myocardial Infarction Trial Investigators. Valsartan, captopril, or both in myocardial infarction complicated by heart failure, left ventricular dysfunction, or both. *N Engl J Med* 349:1893-906.

16. Lakshmi Narayan Y, Anavekar NS, Velazquez E, McMurray JJ, Skali H, Califf R, et al. (2004) Association of QRS duration and outcomes after myocardial infarction: The VALIANT trial. *Circulation* 110: III-725.

17. Schinkel FL, E Abdou, Domburg RT, Biagini E, Rizzello V, Veltman CE, et al. (2009) Prognostic Significance of QRS Duration in Patients With Suspected Coronary Artery Disease Referred for Noninvasive Evaluation of Myocardial Ischemia. *Am J Cardiol* 104:1490 – 1493.

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