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Significance of QRS Duration in Non-ST Elevation Myocardial Infarction

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Several studies have examined the significance of prolonged QRS duration, in the absence of bundle branch block (BBB), for predicting mortality in patients post ST elevation myocardial infarction (STEMI).^{1, 2} Few have studied this relationship in the non ST elevation myocardial infarction (NSTEMI) population, especially in the post thrombolytic era. The primary endpoints of this study were to determine whether prolonged admission QRS in the absence of BBB predicts 30 day and one year mortality in NSTEMI patients. A secondary endpoint was to determine the relationship between prolonged QRS and occurrence of in-patient ventricular tachyarrhythmias after NSTEMI.

One thousand nine hundred and sixty patients admitted to Einstein Medical Center, Philadelphia from August 1, 2006 to August 31, 2011 with a diagnosis of NSTEMI were screened. The study protocol was approved by the Einstein Institutional Review Board. The author(s) of this manuscript have certified that they comply with the principles of ethical publishing in the International Journal of Cardiology³.

NSTEMI was diagnosed on the basis of cardiac symptoms and electrocardiographic changes consisting of ST depression in two contiguous leads and positive troponins in accordance with existing guidelines⁴. Patients with known prior QRS ≥ 110 ms, BBB, paced rhythm or incomplete data sets were excluded. Admission EKGs, as well as telemetry data, were reviewed to determine QRS duration and development of inpatient ventricular arrhythmias (ventricular tachycardia (VT) and ventricular fibrillation (VF)) during the index hospital stay. QRS durations from fifty random EKGs were measured by both manual and electronic means and then compared to ascertain accuracy and reliability of the electronic method of collection which was eventually used for EKG measurements ($R^2=0.96$, $P<0.0001$). Data on patient demographics, clinical characteristics, baseline hemodynamic parameters, ejection fraction (obtained from transthoracic

echocardiogram reports) and type of intervention performed (percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG)) were collected. Mortality at 30 days and one year were determined from hospital records and the publicly accessed social security death index website.

Baseline characteristics of patients with a prolonged QRS ≥ 110 ms versus those with a QRS < 100 ms were compared using independent-sample *t* tests for continuous variables and chi-square for discrete variables. Multivariate Cox proportional hazards regression models were used to evaluate independent predictors of mortality. Kaplan-Meier method was used for generating survival curves and compared using the log-rank test. Effect of each variable was expressed as an odds ratio (OR) and confidence interval (CI). A *p* value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS, version 22.

The final cohort consisted of 1539 patients with mean age of 66 ± 14 year, 51% were female and the average QRS for the entire cohort was 90.5 ± 13.5 ms. Demographics, clinical and hemodynamic characteristics are listed in Table 1. A cut off of QRS ≥ 110 ms was used as it yielded the best specificity, negative predictive value and accuracy for predicting mortality (91%, 91% and 84%, respectively). On multivariate analysis, patients with QRS ≥ 110 ms had increased 30-day mortality (HR=1.9, 95%CI 1.10-3.23; *p*=0.02) (Table 1) and one-year mortality (HR=1.44, 95%CI 1.002-2.059; *p*=0.05) (Table 1), even after adjusting for known coronary artery disease risk factor variables, chronic kidney disease and revascularization. Chronic kidney disease was predictive of one year mortality, but not for 30 day mortality (Table 1). Kaplan-Meier curves stratified by QRS ≥ 110 ms versus QRS < 110 ms showed an increase in both 30 day and one-year mortality in patients with prolonged QRS (Figure 1).

During hospitalization of NSTEMI patients with QRS ≥ 110 ms, 21.8% experienced VT and 3.2%

had VF compared to 10.3% and 0.9% of patients with QRS <110ms. The odds of having inpatient ventricular tachycardia and ventricular fibrillation was 2.4 (OR=2.4, 95%CI 1.5-3.8) and 3.6(OR=3.6, 95%CI 1.2-11.2) times higher in patients with QRS \geq 110ms compared to patients with QRS <110ms.

Studies have shown that prolonged QRS duration due to the presence of bundle branch block increased short term mortality in patients presenting with ST elevation myocardial infarction (STEMI)^{5, 6}. Even in the absence of bundle branch block, prolonged QRS has been shown to predict increased mortality in STEMI patients^{2, 7}. Several hypotheses have been put forward to explain this finding. Some postulated that QRS prolongation might be due to scar tissue formation affecting the conduction system, which could predispose to reentry and ultimately ventricular arrhythmias^{8, 9}. Others hypothesized that QRS prolongation post STEMI may be due to late potentials which are large enough to affect the surface EKG and they point to extensive infarcts and involvement of the interventricular system and hence, increased mortality⁷. Few studies have examined this relationship in NSTEMI patients.

Our study demonstrates that a QRS \geq 110ms in patients presenting with NSTEMI is associated with increased short and long term mortality in the absence of bundle branch block. We believe that the initial QRS duration measured upon presentation with NSTEMI can help with stratification of this patient population as we demonstrated that patients with NSTEMI and QRS \geq 110ms have a 90% increased risk of dying within 30 days. Given that only 14 patients need to be aggressively treated to save one life at 30 days post NSTEMI, it is not unreasonable to use the QRS duration as a tool to stratify at risk patients into a group that might benefit from more aggressive care. For example these patients could be discharged with a wearable cardioverter defibrillator to help terminate ventricular arrhythmias and therefore prevent sudden

cardiac death versus having them routinely followed up¹⁰.

Study limitations included knowing the specific cause of death after patients left the hospital, such that 30 day mortality was all cause mortality, which is less reliable in demonstrating a direct cause and effect relationship. Finally, our subject population was predominantly black which might limit generalizing our results to other populations.

In conclusion, QRS duration ≥ 110 ms, in the absence of a BBB, is an independent predictor of 30-day and one-year mortality after NSTEMI. A QRS duration ≥ 110 ms after NSTEMI is also associated with increased occurrence of in-patient ventricular arrhythmias.

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Table Legends

Table 1: Multivariate Analysis for $QRS \geq 110\text{ms}$ and:

- (a) 30 day all-cause mortality
- (b) One year all-cause mortality

Figure Legends

Figure 1: Kaplan-Meier Survival Estimates (30 Day Mortality and One Year Mortality)

Table 1**Multivariate predictors for QRS \geq 110ms and 30 day or 1 year all-cause mortality**

30 DAY MORTALITY	HR (95% CI)	P value
QRS duration on admission	1.88 (1.10-3.23)	0.02
Age	1.04 (1.02-1.06)	0.01
Revascularization	0.24 (0.13-0.45)	0.00
Ejection Fraction	0.27 (0.76-0.95)	0.04
1 YEAR MORTALITY	HR (95% CI)	P value
QRS on admission	1.44 (1.002-2.059)	0.05
Age	1.05 (1.04-1.06)	0.00
Chronic Kidney Disease	1.60 (1.25-2.06)	0.00
Ejection Fraction	0.30 (0.14-0.63)	0.00
Revascularization	0.38 (0.28-0.51)	0.00

Figure 1

Kaplan-Meier Survival Estimates (30 Day Mortality and One Year Mortality)

