PROGNOSTIC SIGNIFICANCE OF LOW QRS VOLTAGE ON THE ADMISSION ELECTROCARDIOGRAM IN ACUTE CORONARY SYNDROMES

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ABSTRACT

Background

Myocardial infarction is one of the most common causes of mortality in middle and older age groups, especially in ventricular arrhythmia. Patients will be identified as having low QRS Voltage when peak-to-peak QRS complex voltage is less than 0.5 mV in all limb leads and less than 1.0 mV in all precordial leads.

Objectives

To find the correlation between low QRS voltage in the hospital and one-month outcome of patients presenting with the acute coronary syndrome.

Patients and Methods

A prospective longitudinal study was performed on 400 patients admitted with the confirmed acute coronary syndrome and underwent percutaneous coronary intervention.

Results

The mean age was 61. ± 11.8years ranged from 22 to 90 years. Male was 67.8%, and 32.3% were female. The percentage of hypertension, diabetes mellitus, and previous myocardial infarction were 66.3%, 32.8% and 12.3%, respectively. Low QRS voltage was found in 17 patients (4.3%). Most of our patients (43.5%) had an anterior myocardial infarction, of which the culprit lesion was the Left Anterior Descending artery. An ejection fraction of more than 50% on echocardiography was found in 68.3% of them; additionally, 84.7% had a Killip Class of one. Therefore, in-hospital death was 4.8%. Furthermore, the total death from admission to a month post-myocardial infarction was 9%. Fourteen patients had re-admission within that period for cardiac events.

Conclusion

Low QRS in presenting electrocardiogram patients with the acute coronary syndrome will be significantly associated with hospital and one-month morbidity and mortality.

Keywords: *Acute Myocardial Infarction, Low QRS complex, Electrocardiography.*

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INTRODUCTION

The electrocardiogram (ECG) is essential in diagnosing acute myocardial infarction. It should be obtained and interpreted within 10 minutes after admission as it is the world's number one cause of morbidity and mortality [1].

Up to now, several parameters in ECG are of great value in diagnosing different conditions, including pre-existing myocardial infarction. Prevention of the adverse outcome from myocardial infarction is early detection of the myocardial tissue at risk of ischemia. An additional currently available diagnostic procedure indicating further myocardial injury development can be simple and very quick—the amplitude of R wave changes concerning myocardial infarction. While R wave amplitude can decrease in acute Anterior wall myocardial infarction patients [2]. It can increase substantially in precordial leads of ECG when the ischemic period is short in transmural ischemia [3]. Furthermore, it may increase again after revascularization of the culprit lesion in acute anterior infarction.[4]. Another possibility in diagnosing myocardial infarction is when small or absent initial R waves are found in the anterior chest leads, which can lead to resulting in poor R wave progression or QS complexes. [5].

In the pre-thrombolytic era, Low QRS voltage on presentation with acute myocardial infarction is associated with dysfunction of the left ventricle and mortality was increased in short- and long-term follow-up [6]. Furthermore, the amplitude of the relation of R-wave to the amount of viable myocardium has been reported [7]. However, since the development of the percutaneous coronary intervention, the evolution of the significance of low QRS voltage has been poorly undertaken.

PATIENTS AND METHODS

A prospective longitudinal study was performed on 400 patients admitted to the Sulaimani cardiac hospital with the confirmed acute coronary syndrome and underwent percutaneous coronary intervention from March 2021 to September 2021.

After taking consent from the patients, all information from the patient was taken, including the history of presentation, risk factors, physical examination, hemodynamics, patient's demographic data, the results of laboratory tests, and admission ECG and Echocardiography as well as the report of percutaneous coronary intervention, the participant was also contacted after one month to check the patient's outcome. Electrocardiograms were obtained by using GE MAC 1600 ECG in the addition unit of our hospital,

Patients will be identified as having low QRS Voltage when peak-to-peak QRS complex voltage is less than 0.5 mV in all limb leads and less than 1.0 mV in all precordial leads) [8]. Patients were followed up to find them in-hospital course, and after one month, they were checked by telephone to find their outcome, as the proposed time of the study was short.

Our exclusion criteria were known ischemic heart disease, confirmed left ventricular dysfunction by echocardiogram, and having bundle branch block or a paced rhythm.

Statistical Package for the Social Sciences (SPSS) version 25 analyses collected data. The Shapiro–Wilk test will be used to investigate the normal distribution of the data. Continuous data will be given as mean ± standard deviation (SD). Categorical data will be given as a percentage (%). Statistical significance for low QRS voltage and its association with the outcomes will be checked through multivariable logistic regression. The Kruskal–Wallis H test (one-way ANOVA) will be used to analyze the cases for three or more groups. Pearson chi-square, Pearson and Fisher's chi-square tests will be used to analyze the cross-tabulations. Furthermore, a P-value of ≤ 0.05 is considered statistically significant. Study acceptance was gained for ethical consideration from Kurdistan Board for Medical Specialties, Directorate of Training Affairs, and Ethical and Scientific Research Units.

RESULTS

Four hundred participants were evaluated at the end of the study with no missed cases. The mean age was 61. ± 11.8years ranged from 22 to 90 years. Of all participants, 67.8% were male, and 32.3% were female. Twenty-seven per cent were active smokers. The percentage of hypertension and diabetes mellitus were 66.3% and 32.8%, respectively. Chest pain was the most common (92.5%) presentation to our hospital, and the majority (68.5%) of our patients reached the hospital within the first 4 hours. The mean systolic and diastolic blood pressure was 138.6 ± 30.5and 83.3 ± 20, respectively.

Although the mean heart rate was 94.2 ± 25bpm, most patients had tachycardia (60.3%). Low QRS voltage was found in 17 patients (4.3%). Most of our patients

(43.5%) had anterior MI, of which the culprit lesion was LAD. An ejection fraction of more than 50% on echocardiography was found in 68.3% of them; additionally, 84.7% had a Killip Class of one. In the hospital, the death was 4.8%. Furthermore, the total death from admission to a month post-myocardial infarction was 9%. Fourteen patients had readmission within that period for cardiac events. Those findings are illustrated in Table 1.

A significant positive correlation between having a low QRS score and active smoker, mean heart rate, blood pressure, number of diseased vessels, ejection fraction, Killip Classification, in-hospital death, readmission and death within the first month, Table2.

Table 1. Demographic and cardiovascular risk factors of the Participants.

Parameter (n=400)		**Value**
Mean age ± SD (years)		**61. ± 11.8**
Gender	Male (%)	67.8
	Female (%)	32.3
Smoking status	Active smoker (%)	27
	Non-smokers (%)	73
Hypertension	hypertensive	66.3
	normotensive	33.8
Diabetes Mellitus	Diabetic	32.8
	Non-diabetic	67.3
Presenting complain	Chest pain	92.5
	Epigastric pain	5
	Shortness of breath	2.5
Blood pressure	Systolic	138.6 ± 30.5
	Diastolic	83.3 ± 20
Heart rate (mean: 94.2 ± 25)	Normal	28.7
	Tachycardia	60.3
	bradycardia	11
Time from complaint to hospital arrival	<4 hours	68.5
	>4 hours	31.5
Low QRS voltage	Yes	4.3
	No	95.7
Location of MI	Anterior	43.5
	Lateral	15.5
	Inferior	40.8
Number of diseased vessels	Single vessel disease (%)	57
	Two vessels disease (%)	39
	Three vessels disease (%)	4
Culprit lesion	LAD	43.5
	LCX	18.3
	RCA	38.2
Ejection Fraction	>50%	68.3
	40%-50%	24
	<40%	7.8
Killip Classification	1	84.7
	2	10.5
	3	4.3
	4	0.5
Killip Classification	>1	84.7
	≤1	15.3
In-hospital death	Yes (19 patients)	4.8
	No (381 patients)	95.2
Cumulative death within the first months	Yes (36 patients)	9
	No (364 patients)	91
Re-admission within the first month	Yes (14 patients)	3.5
	No (386 patients)	95.5

Table 2. Correlation of different variables with low QRS Voltage.

Parameter (n=400)		Low QRS Voltage		QR at 95% CI
		YES (n=17)	NO (n=383)	
Mean age ± SD (years)		63.88±17.5	60.9±11	P 0.3
Gender	Male (%)	14(82.4%)	257(67.1%)	P 0.1
	Female (%)	3(17.6%)	126(32.9%)	OR 2.28 (0.8-8.1)
Smoking status	Active smoker	11(64.7%)	97(25.3%)	P 0.001
	Non-smoker	6(35.3%)	286(74.7%)	OR 5.4(1.9-15)
Hypertension	hypertensive	10(58.8%)	255(66.6%)	P 0.5
	normotensive	7(41.2%)	128(33.4%)	
Diabetes Mellitus	Diabetic	2(11.8%)	129(33.7%)	P 0.06
	Non-diabetic	15(88.2%)	254(66.3%)	
Presenting complain	Chest pain	16(94.1%)	354(92.4%)	
	Epigastric pain	0(0.0%)	20(5.2%)	P 0.4
	Shortness of breath	1(5.9%)	9(2.3%)	
Blood pressure	Systolic	112.9±16	139.7±30	P<0.001
	Diastolic	69.7±12	83.9±20	P 0.004
Heart rate	(mean ±SD)	104.2±23	93.7±25	P 0.014
Heart rate	Normal	2(11.8%)	113(29.5%)	
	Tachycardia	13(76.5%)	228(59.5%)	P 0.2
	bradycardia	2(11.8%)	42(11%)	
Time from complaint to hospital arrival	<4 hours	12(70.6%)	262(68.4%)	P 0.8
	>4 hours	5(29.4%)	121(31.6%)	
Location of MI	Anterior	11(64.7%)	163(42.6%)	
	Lateral	5(29.4%)	158(41.3%)	P 0.1
	Inferior	1(5.9%)	62(16.2%)	
Number of diseased vessels	Single vessel disease (%)	2(11.8%)	226(59%)	P <0.001
	Two vessels disease (%)	6(35.3%)	150(39.2%)	
	Three vessels disease (%)	9(52.9%)	7(1.8%)	
Culprit lesion	LAD	11 (64.7%)	163 (42.6%)	
	LCX	2 (11.8%)	71 (18.5%)	P 0.19
	RCA	4 (23.5%)	149 (38.9%)	
Ejection Fraction	>50%	3(17.6%)	270(70.5%)	
	40%-50%	11(64.7%)	85(22.2%)	P<0.001
	<40%	3(17.6%)	28(7.3%)	
Killip Classification	1	3(17.6%)	336(87.8%)	
	2	10(58.8%)	32(8.4%)	P <0.001
	3	4(23.5%)	13(3.4%)	
	4	0(0.0%)	2(0.5%)	
Killip classification	>1	14 (82.4%)	39 (10.2%)	P<0.001
	≤1	3 (17.6%)	344 (88.8%)	OR 442(90-2166)
In-hospital death	Yes (19 patients)	4 (23.5%)	15(3.9%)	P 0.006
	No (381 patients)	13 (76.5%)	368 (96.1%)	OR 7.5(2.1-259)
Cumulative death within the first months	Yes (36 patients)	7 (41.2%)	29(7.6%1)	P<0.001
	No (364 patients)	10(58.8%)	354(92.4%)	OR 8.5(3-24)
Re-admission within the first month	Yes (14 patients)	5 (29.4%)	9(2.3%)	P<0.001
	No (386 patients)	12 (70.6%)	374(97.7%)	OR 17(5-59)

DISCUSSION

A decrease in the magnitude of the QRS complex in cases of acute myocardial infarction was noted to have an association with adverse outcomes since 1923[9]. however, many other reports support the importance of low QRS complex in pre-thrombolytic and pre-coronary intervention time. However, few reports are available for the current coronary intervention era.

In the current clinical era, after acute myocardial infarction, a decrease in R-wave amplitude in precordial leads is regarded as myocardial damage. On the contrary, reports also confirmed a significantly lower R wave was noted in all precordial leads of patients with prior anterior myocardial infarction, and there is an inverse proportion between that the sum of R-wave in all precordial leads and the size of myocardial infarct, on the other hand, it is positively related with left ventricular function. [10].

In our study, we found that 17 patients (4.8) of our study population had low QRS voltage. Although however, it is very close to the tan et al. (3.5%) [11]; it is significantly lower than what is recorded (19%) by Kobayashi et al. [12]; this could be the fact that only anterior STEMI were included by the latter.

Advanced age is a great predictor of adverse cardiovascular outcomes in patients with the acute coronary syndrome [13]. The mean age in our study was higher for patients with low QRS voltage than those with normal voltage; although not significant, the same proportion was found in the previous study where their mean age for low QRS complex was higher than those without it (64 vs 59 years) [12].

The mean systolic and diastolic blood pressures were significantly lower in the low QRS voltage group; it was also found by tan et al. to be significant for systolic blood pressure, which was 142 mmHg vs 136 mmHg. This, together with having a significantly lower class of systolic Left Ventricular function (ef less than 50%) and also significantly higher Killip class in these patients together with significantly more patients with the multi-vessels disease, leading to having a larger area of infarction in this group, being in line with multiple previous studies would support our results more; Tan et al. found that a higher proportion of their patients who had systolic left ventricular dysfunction 63.1% had a low QRS voltage(p 0.001). Furthermore, Kobayashi et al. found a higher class of Killip in the low QRS voltage group, for Killip class >1 27% vs 18%, and a significant percent of their patients with low QRS voltage had multi vessel coronary artery disease 76% vs 52%. p 0.01 [11-12]

Our patients with low QRS voltage are within very high risky groups of acute coronary syndrome cases, having significantly lower blood pressure and tachycardia on presentation, significantly higher Killip classification together with lower ejection fraction and multi-vessels coronary artery diseases, making this group have the worst outcome which calculated to be significantly associated with in-hospital and one-month mortality as well as re-admission within the first month. The same result was also recorded from previous studies [11-12].

In conclusion, being an active smoker, higher mean heart rate, lower blood pressure, a higher number of diseased coronary vessels, low ejection fraction and higher Killip Classification were associated significantly with low QRS voltage and significantly correlated with in-hospital and one-month morbidity and mortality.

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