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Correlations of Admission Heart Rate and in Hospital Outcome in Patients with ST Elevation Myocardial Infarction

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ABSTRACT

Background: Heart rate (HR) is a basic cardiovascular parameter. The relationship between heart rate and cardiovascular mortality and morbidity has been indicated in clinical trials and epidemiological studies.

Objective: To evaluate of the relationship between Admission HR and in-hospital out come in a groups of patients with ST elevation myocardial infarction.

Methods: The study assessed (100) patients (pts) were admitted to cardiac care unit in Ibn-Sena teaching Hospital with ST elevation myocardial infarction from(1st September 2014 to 31 March 2015) The patients were classified upon hospital admission into subgroups according to HR: < 60 bpm (60-69)bpm , (70-79) bpm, (80-89) bpm, (90-99) bpm, and ≥ 100 bpm. Patients with atrioventricular blocks and arrhythmias, Also drugs taken prior to admission that lowering the HR B-Blockers and calcium channel blockers (verapamil, Deltiazem and digoxin) were excluded from the analysis. Early mortality and co-existing diseases were evaluated in the study population.

Results: patients with heart rate ≥ 90 bpm demonstrated heart failure considerably more often than patients with heart rate of 60-69bpm (p 0.0010). In-hospital mortality was significantly higher in patients with heart rate of more than 90 bpm and bradycardia ≥ 60 bpm. Relationship between HR and cardiovascular mortality is shown with a J-shaped curve.

Conclusions:

1. 1.Heart rate is strictly correlated with the early cardiovascular mortality in a population of patients with STEMIL.
2. Relationship between Heart rate and early mortality is demonstrated by the J- shaped curve.

Keywords: Beat per minute (bpm), Heart rate (HR), ST segment elevation myocardial infraction (STEMIL).

INTRODUCTION

Resting heart rate (HR) is one of the basic cardiovascular meters which can be easily measured. A normal HR ranges from 60 to 100 bpm (beats per minute) [1]. It is regulated by the activity of autonomic nervous system with the involvement of nitric dioxide as one of the transmitters [1]. Some available data provides evidence that resting HR can also be influenced by genetic factors [2]. My study revealed that the increased HR, even within the normal range is related to increased cardiovascular risk. Therefore, the reduction of HR is one of the therapeutic goals in case of patients with

CAD or heart failure [2], The objective of the present study was to evaluate Correlations of Admission HR and in hospital outcome among patients with ST elevation myocardial infarction (STEMI), The impact of increased HR on pathophysiology of CAD is related to basic metabolism of cardio myocytes. Myocardium is provided with oxygen mainly during the diastole phase (up to 80%). The increase of HR leads to both the augmented oxygen demand and the reduction of its supply caused by the reduction of diastole duration. Moreover, the increased HR in CAD, patients may also result in coronary vasoconstriction leading to the impairment of additional oxygen supply [7]. Consequently, CAD patients may develop angina symptoms. It is also possible that the mechanism of exacerbated ischemia is responsible for the extension of infarction.

Previous observations demonstrated that the incidence of ischemic episodes in a group of patients with HR>80 bpm was twice as high as that among pts with HR values below 70 bpm [8] The pathophysiology of a worse outcome in the population with heart failure and tachycardia is related to the limited oxygen consumption due to the shortened diastole, which leads to impaired coronary blood flow. The elevated HR is also linked to the decrease of myocardial contractile function in the course of heart failure, Such relationship was also demonstrated in experimental studies [9]. Thereby reducing the cla Statistical analysis: Continuous data is presented as a mean standard deviation, whereas categorical data is demonstrated in form of percentages and frequencies. Differences in baseline characteristics. Multivariate analysis was performed to evaluate the relationship between HR upon hospital admission and in-hospital mortality. Parameters used in the multivariate analysis were established taking into account the univariate statistical significance and clinical judgement. Age and hypertension were taken into account in the multivariate analysis. ROC analysis was performed to indicate HR values which constitute curve inflection points for increased cardiovascular mortality. All statistical tests were two-sided-value <0.05 was considered to be statistically significant.

MATERIALS AND METHODS

The cohort study of 100 consecutive ST elevation myocardial infraction (STEMI) patients (67 male and 33 female), the mean age was (62 + 13) hospitalized in the cardiac care unit in Ibn-Sena Teaching Hospital in year (1st September / 2014-31 March 2015) was carried out. The mean time of hospitalization was 7+5 days. The patients were classified on the basis of heart rate, were obtained in 12 lead electrocardiography (ECG) performed upon hospital admission 60 bpm(9 patients) , 60-69bpm(27 patients) ,70-79 bpm(25 patients), 80-89 bpm (23 patients) , 90-99 bpm (7patients), and ≥ 100 bpm(9 patients). This particular range was determined on the basis of the standard definition of a normal HR (lower limit) as well as clinical studies which revealed the increase of cardiovascular risk at HR value above 70 bpm (upper limit).

Patients with second or third degree atrioventricular block and those with supraventricular or ventricular arrhythmias, Blockers and Ca-chanal Blockers and digoxin were excluded from the analysis. The occurrence of dyslipidaemias, excessive body weight, nicotine abuse and diabetes were evaluated in the study population. Excessive bodyweight was defined as follows: overweight - BMI 25-29 kg/m2 and obesity BMI 30kg/m2. [3] hypercholesterolemia (LDL 2 3.0 mmol/L (115 mg/d), ineffective lipid lowering treatment in patients with CAD LDL ≥ 2.5mmoll(100mg/dl) or triglyceride level ≥ 1.7 mmoll (150mg/dl) [4]. The definition of heart failure was based on the NYHA Class, with the presence of abnormalities in clinical examination and echocardiography.

The study follows up for 6 subgroups of patients of both sex for about 6 months some of them has no risk factors, and the other has risk factors (one or more than one risk factors), these risk factors proved by taken history from the patients, and by doing investigations, also the study does table (figure 1), and it puts all data in that table(Age, Sex, and the risk factors), and the study follows up for these patients Echocardiography to see the relationship between the admission heart rate and the occurrence of heart failure.

Also, the study does follow up to see the mortality rate among those patients, I do J curve to demonstrate the relationship between the admission heart rate and the mortality rate.

Statistical analysis:

Continuous data is presented as a mean ± standard deviation, whereas categorical data is demonstrated in form of percentages and frequencies. Differences in baseline characteristics. Multivariate analysis was performed to evaluate the relationship between HR upon hospital admission and in-hospital mortality. Parameters used in the multivariate analysis were established taking into account the univariate statistical significance and clinical judgement. Age and hypertension were taken into account in the multivariate analysis. ROC analysis was performed to indicate HR values which constitute curve inflection points for increased cardiovascular mortality. All statistical tests were two-sided-value<0.05 was considered to be statistically significant.

RESUTLS

Basic characteristics of the study group are present in (table 1). The left ventricle ejection fraction (EF) was significantly lower only in a group of patients with HR2100 bpm (p-0.0012). Cardiogenic shock occurred more frequently in a group of patients with tachycardia (HR2100 bpm); p-0.021. Bradycardia (HR<60bpm) occurred in 9 pts (9%) and tachycardia (HR2100bpm) in 9 pts (9%). Heart failure symptoms occurred least often in a group of patients with HR of 60-69 bpm. The occurrence of these symptoms significantly increased when HR raised to the value of 90 bpm or above (p-0.001) (Figure 1). Nonetheless, the occurrence of heart failure did not correlate with increased cardiovascular death frequency (p-0.72) in the multivariate analysis the number of occurrences of past myocardial infarction in the examined subgroups was similar. No differences were observed in terms of the frequency of dyslipidaemias, diabetes, smoking, abnormal body weight. In hospital mortality was significantly higher in a group of patients with bradycardia and those with HR value of over 90 bpm. In-hospital mortality in this study subpopulations was as follows: <60 bpm (1 pt. , 10.6%), p-0.0397 60-69 bpm (1 pt. 3.6%):70-79 bpm (1 pt. 4%), p-0.79; 80-89 bpmi (2 pts. 8.7%), p-0.062; 90-99 bpm(1 pt. 15%), p-0.00082 100 bpm (2 pt. 23.5%), p<0.0001 (Figure 2). The multivariate analysis after taking into consideration factors, such as age, hypertension showed that HR constituted an independent risk factor for in-hospital cardiovascular death. Cardiovascular mortality in this study population was shown with a J-curve with the lowest mortality in the reference group (HR 60- 69 bpm), and showed tendency to rise towards both the lower and higher values of HR ROC analysis was performed to determine the HR values which indicate the inflection points on that curve. In the group with higher HR, a significant increase in cardiovascular death was observed at HR>88 bpm, while in the group of patients with bradycardia the same phenomenon was noticed at HR value below (41) bpm. In-hospital mortality was the lowest in patients with HR of (60-90)bpm.

Table 1 : The left ejection fraction (EF) was significantly lower in a group of patient with HR ≥ 100 bpm

	HR $< 60\ bpm$ $N = 9pts$	HR 60-69 bpm N=27 pts	HR 70-79BPM N=25 pts	HR 80-89 bpm N=23 pts	HR 90-99 bpm N=23 pts	HR $\geq 100bpm$ N= 9 pts
Age	62 ±10	63 ±11	64 ±11	64 ±11	60 ±13	62 64 ±12
Male and female gender	62 ±10	63 ±11	18 (12M-6F) (72%)	13 (8M-5F) (64%)	4 (3M-1F) (57%)	5 (3M-2F) (55%)
Diabetes	1 (11%)	6 (22%)	5 (20%)	6 (22%)	2 (28%)	2 (22%)
Hypertension	6 (66%)	18 (66%0	19 (76%)	14 (60%)	5 (71%)	7 (77%)
Smoking	5 (55%)	16 (56%)	16 (56%)	11 (47%)	3 (42%)	3 (33%)
BMI ≥ 25 kg/m^2	1 (11%)	5 (18%)	4 (16%)	6 (26%)	1 (14%)	2 (22%)
Dysplipidemia	5 (55%)	19 (70%)	18 (72%)	15 (65%)	4 (57%)	5 (55%)
Heart failure	3 (33%)	7 (33%)	10 (40%)	9 (39%)	4 (57%)	6 (66%)
EF	46.8%	48.4%	45.9%	46.3%	45.3 %	41.3 %

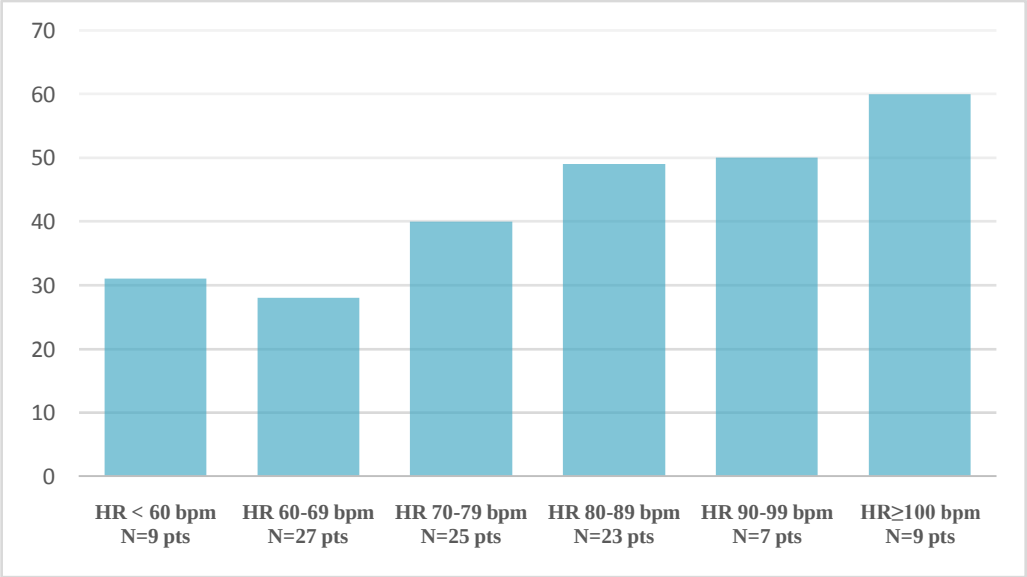
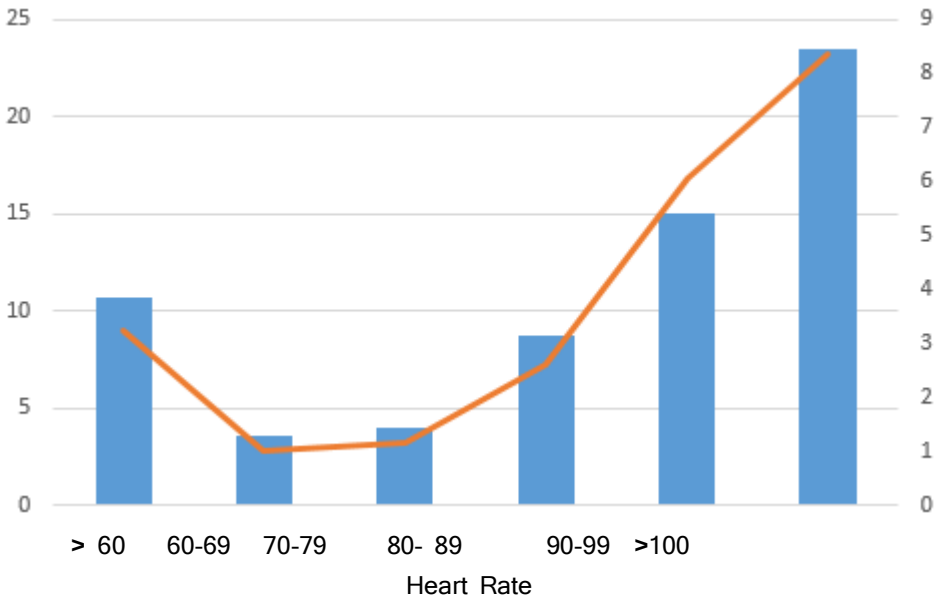


Figure 1 **: Occurrence of Heart failure symptoms depending on HR upon hospital admission in patients with ST elevation MI**



death%	10.67	3.6	4	8.7	15	23.5
Odds ratio	3.24	1	1.16	2.6	6.06	8.34

***Figure 2*: In-hospital mortality depending on HR upon hospital admission in patients with ST elevation MI**

DISCUSSION

In this clinical study, it is demonstrated that there is close relationship between admission heart rate and outcome in patients with ST elevation myocardial infarction, and the study finds the least mortality and morbidity in those patients who has heart rate between (60-69) beat per minutes, And the study supports the clinical study by the following studies: Davidovic et al. performed a follow up of 140 patients with anterior wall STEMI. The multivariate analysis showed that only HR > 80 bpm and decreased level of HDL cholesterol counted as independent factors related to the fatal outcome. Similar relationship was also observed among the participants of the PAMISCA study [10]. A group of 1054 patients with acute coronary syndrome was subject to analysis (43.5%) with ST segment elevation and (56.5%) without it. The authors of the study provided HR that a group of patient with heart rate $\geq$ 70 bpm after acute coronary syndrome had higher cardiovascular and non- cardiovascular mortality rates. These patients were hospitalized due to heart failure more often than patients HR <70 bpm. in the BEAUTIFUL study [11]. The results showed that patients with HR$\geq$70 bpm had a higher risk of cardiovascular death hospitalization due to congestive heart failure than patients with HR<70 bpm. The evidence that a group of patients with advantages of HR decrease caused by beta-blockers and calcium channel blockers were presented in meta-regression of 14 randomized clinical trials performed by Cucherat [12]. In these studies, a correlation between the use of HR lowering agents and the reduction of all-cause and cardiovascular mortality as well as the recurrence of non-fatal myocardial infarction were observed. Meta regression performed by the author implies that the main advantages in these trials resulted from the lowering of HR.(16) The above mentioned studies describe a linear correlation between and increased cardiovascular risk.

Contrary to that pattern, a non-linear model of the relationship between resting HR and cardiovascular risk was observed in the INVEST study [13]. The presented results showed that the correlation between resting HR is a -Shaped relationship with nadir at 59 bpm for the entire study population. The results obtained for the last subgroup of the INVEST trial are similar to those obtained in my study, i.e.:the increased HR and bradycardia were related to the increased early cardiovascular mortality.

Antoni et al. analyzed the relationship between discharge HR and mortality among 1453 patients with STEMI undergoing primary PCI [15]. In the study group HR at discharge was a predictor for all-cause and cardiovascular mortality after 4-year follow-up. The authors noticed that the difference between admission heart rate and heart rate on discharge was not related to all cause or cardiovascular mortality A J-curve relationship between HR and the cardiovascular outcome was also described by Bangalore et al. in the analysis of the association of HR on admission to hospital and in hospital cardiovascular events among participants of the CRUSADE initiative [16] .HR on hospital admission is a factor which is also used in risk stratification in the course of acute coronary syndrome on GRACE scale [17]. This model assumes risk increase by 30% for every HR increase by 30 bpm. In this study the occurrence of heart failure symptoms was observed significantly more often among patients with elevated resting HR. Similar outcomes were presented by Mulder et al, who used a murine model of heart failure to demonstrate that decreased resting HR

results in improved LV systolic function and increased stroke volume [19]. In the SHIFT trial a better outcome in a population of patients with heart failure was observed among patients whose HR decreased to the value below 70 bpm after the administration of ivabradine, a selective HR reducing agent [20]. In this group cardiovascular death or re hospitalization due to the exacerbation of heart failure occurred less frequently than in patients with a higher HR value.

Study limitations:

The administration of beta-blockers and Ca-chanal blockers and digoxin prior to the admission to hospital (which could affect HR upon admission) has not been taken in this study, The HR values during hospitalization have not been analysed for the same reason, Also patients with second or third degree Atrioventricular block and those with SVT or VT have not been analysed.

CONCLUSION

1. Heart rate is strictly correlated with the early cardiovascular mortality in a population of patients with STEMIL.
2. Relationship between Heart rate and early mortality is demonstrated by the J- shaped curve.

RECOMMONDATION

The heart rate has close relationship with prognosis in the patients with ST elevation myocardial infraction, so the study suggests that the heart rate must kept between (60-80 bpm), to reduce mortality, as this rate associated with least mortality rate.

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