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Killip Classification and Glucose Levels in Patients with Acute Myocardial Infarction

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Abstract

Aim: Current study is designed to determine the significance of Killip classification and blood glucose levels in risk stratification of patients with Myocardial Infarction. *Method:* 100 patients admitted for the treatment of myocardial infarction during may 2011-2014. These patients were initially given diagnosis of acute MI upon admission to ED. Details regarding 2D echocardiography of the patient is noted. The details of any interventional strategies like CAG, PTCA, CABG were recorded. *Results:* Out of 100 patients 74 (74%) were males and 26 (26%) were females. Their mean age was 50.15 ± 14.04 years. data showing increase in the mean length of stay with increase in killips classification. Ventilator support is needed in killips classes III and IV patients when compared to killips classes Iand II. The need for ionotropic support increases as killips class advances from class II to IV. In IWMI 73.2% of the cases are of killips class I and 9.8% of the cases are of killips class IV. The high percentage of cases i.e 65.9% in killips class I under went coronary angiogram (CAG). Patients in killips class III has higher rates of readmission when compared to other classes i.e 33.3% of cases. Mortality is high in killips class III (42.9%) and class IV (57.1%). patients with initial high blood glucose values on admission have higher readmission rates. patients with initial high blood glucose values have high mortality rate. The mean age group in patients who were discharged home is 49.73 where as the mean age group in patients who were dead is 55.71. *Conclusion:* Patients with higher killip class on initial presentation have longer length of stay in hospital and high mortality rate. Combined together, killip classification & blood glucose levels are better indicators of morbidity and mortality than any one factor alone.

Keywords: Acute Myocardial Infarction; Killip classification; blood glucose levels.

Introduction

Myocardial infarction is one of the most common life threatening diagnoses in emergency hospital admissions. India is undergoing a rapid health transition with rising burden of coronary heart disease (CHD). Among adults over 20 yr of age, the estimated prevalence of CHD is around 3-4 per cent in rural areas and 8-10 per cent in urban areas, representing a two-fold rise in rural areas and a six-fold rise in urban areas [1]. Major risk factors dependent on socioeconomic levels are physical activity, dietary intake, smoking and tobacco use, overweight and obesity, high blood pressure, diabetes, cholesterol levels, the metabolic syndrome and psychosocial stress. In the last 30 years, the prevalence of hypertension and hypercholesterolemia has doubled while that of diabetes has trebled [1].

Myocardial infarction occurs when there is abrupt decrease in coronary blood flow following a thrombotic occlusion of a coronary artery previously narrowed by atherosclerosis. Most of the complications occur during the first few hours

while the patients are likely to be in the hospital. Although the mortality rate after admission for myocardial infarction has declined significantly over the last two decades but it still remains high [2]. Survival is markedly influenced by age of the patient, presence of different risk factors and complications that patients develop after myocardial infarction.

When patients with symptoms of MI are at first evaluated, clinicians make decisions based on the history, physical examination and ECG. ECG is generally the first investigation available for making a diagnosis in a patient presenting with acute severe chest pain. Tall T waves and ST elevation are the hallmarks of early presentation within minutes of onset of pain. Conventionally, AMI is diagnosed in the emergency based on ST segment elevation of more than 1.5 mm in 2 or more leads.

Criteria for MI [3] (European Society of Cardiologists), detection of a rise and/or fall of cardiac biomarker values [preferably cardiac troponin (cTn)] with at least one value above the 99th percentile upper reference limit (URL) and with at least one of the following:

a) Symptoms of ischaemia. b) New or presumed new significant ST-segment–T wave (ST–T) changes or new left bundle branch block (LBBB). c) Development of pathological Q waves in the ECG. d) Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality. e) Identification of an intracoronary thrombus by angiography or autopsy.

Serum levels of cardiac enzymes and isoenzymes are essential to the diagnosis or exclusion of myocardial damage [4]. Elevated serum levels of biomarkers such as troponin (cTn) or the MB fraction of creatine kinase (CKMB) reflect myocardial injury leading to necrosis of myocardial cells [5].

In patients with acute ST elevation myocardial infarction treated with thrombolysis, the factors like hemodynamics, age, infarct location, history of diabetes, hypertension or angina and time to reperfusion therapy, all have an independent influence on clinical outcome.

The Killip classification system, for clinical assessment of patients with acute myocardial infarction (MI), stratifies individuals according to the severity of their post-MI congestive heart failure. A patient's Killip classification is defined by the following parameters: Killip class I, no CHF; Killip class II, third heart sound, rales; Killip class III, pulmonary edema; and Killip class IV, cardiogenic shock. Early primary angioplasty has contributed to a decrease in mortality in Killip IV patients [6]. Thus, the Killip classification, demonstrated in past decades to be effective in the risk stratification and prognostic evaluation of patients with acute MI, I is still used widely in the era of primary reperfuson, despite the more recent identification of other predictive indices for evaluation of acute MI.

Diabetes Mellitus is another feature that increases the mortality in patients with acute myocardial infarctions. Patient with stress hyperglycemia have more adverse events including heart failure, arrhythmias, heart block, re-infarction and mortality [7]. However, patients with certain risk factors, clinical features and associated conditions are more prone to develop complications and have a higher mortality rate.

While optimal fibrinolysis restores normal coronary flow in 50% to 60% of subjects, PCI is able to achieve restored flow in >90% of subjects. Acute reperfusion therapy using PCI or fibrinolytic therapy in patients with STEMI restores flow in the infarct-related artery, limits infarct size, and translates into early mortality benefit that is sustained over the next decade. PCI also results in a decreased risk of intracranial hemorrhage and stroke, making it the reperfusion strategy of choice in the elderly and those at risk for bleeding complications.

Current study is to determine the significance of Killip classification and blood glucose levels in risk stratification of patients with MI.

Materials and methods

Study Design: In this retrospective cohort study, we studied the records of all cases of myocardial infarction presented to ED from our registry. The protocol was approved by the institutional ethical committee.

Data Collection: All the materials for this study has been taken from 100 patients who got admitted to Narayana medical college hospital for the treatment of myocardial infarction from may 2011-2014. The study course is for a period of 3 yrs i.e from may 2011-2014. Data collected from medical records department & ED register.

Inclusion criteria:

1. Age of patient<85 yrs
2. Window period from onset of chest pain<24 hrs
3. Patients with STEMI & NSTEMI

Exclusion criteria

1. Age <18 yrs
2. Sepsis
3. Lack of drawn blood glucose levels
4. Previous history of CAD
5. Post CABG status
6. Window period>24 hrs
7. CKD

Methods

The studied patients were initially given diagnosis of acute MI upon admission to ED. The standard 12 lead electrocardiography recorded. Initial assessment and management of victim done as per ACLS protocols and vital signs are recorded. Baseline investigations like blood glucose levels, complete blood picture, renal function test, serial estimation of cardiac enzymes, serum lipid profile noted. Thrombolytic therapy is instituted if the patients presence with in the window period of 12 hours and if there are no contraindications. The patients were assigned killips classes based on chest ausculatory findings and blood pressure values. Details regarding 2D echocardiography of the patient is noted. The patients were observed during the course of their stay in the hospital for any recurrence of symptoms. The details of any interventional strategies like CAG, PTCA, CABG were noted. Data collection forms include the above data and date of disposition.

Primary Data Analysis

For categorical variables, percentages were calculated. For continuous variables, the values were represented as Mean ± SD. Chi-Square test and student t test were used to evaluate the association between various categorical and continuous variables. All p values were 2- sided and considered significant at $p<0.05$. All statistical operations were performed using IBM SPSS Ver. 20.0 for Windows (SPSS Inc, Chicago, III).

Results

Out of 100 patients 74 (74%) were males and 26 (26%) were females. Their mean age was 50.15 ± 14.04 years.

The mean age of patients in killips class I (48.90 ± 14.39), class II (50.10 ± 14.36), class III (52.09 ± 14.05, class IV (56.22 ± 10.08) (Table 1).

Out of 74 male patients 48 (64.9%) are in killips class I, 11 (14.9%) in killips class II, (8(10.8%) in killips class III and 7 (9.5%) are in killips class IV. Out of 26 female patients class I are 12 (46.2%), class II are 9 (34.6%), class III are 3 (11.5%) and class IV 2 (7.7%).

Mean length of stay in killips classes

The mean length of stay in killips class 1 (5.73 ± 2.30), class II (7.20 ± 1.99), class III (8.27 ± 3.90) class IV (8.00 ± 5.07). This data showing increase in the mean length of stay with increase in killips classification. Maximum length of stay is in class III.

Mean Blood glucose values values in killips classes

Patients with higher killips classes have higher blood glucose levels when compared to lower Killip classes. Mean blood glucose values of killips class I (126.93 ± 29.73), class II (182.10 ± 65.14) class III (246.18 ± 38.86), class IV (277.22 ± 85.25).

There is a decrease in mean systolic and diastolic blood pressure, as killips class advances from I-IV Mean Systolic blood pressure values in killips class I (126.37 ± 20.7), class II (133.80 ± 32.25), class III (121.64 ± 35.30), class IV (78 ± 6.56) (Table 2).

Table 1: Demographic data – Mean age among killips classes

	Killips					
	I (N=60)	**II (N=20)**	**III (N=11)**	**IV (N=9)**	**F value**	**P value**
Age	48.90 ± 14.39	50.10 ± 14.36	52.09 ± 14.05	56.22 ± 10.88	0.78	0.505

Table 2: SBP, DBP values in killips classes

	Killips					
	I (N=60)	**II (N=20)**	**III (N=11)**	**IV (N=9)**	**F value**	**P value**
SBP	126.37 ± 20.77	133.80 ± 32.25	121.64 ± 35.30	78 ± 6.56	11.73	<0.0001
DBP	82.30 ± 12.11	80.70 ± 14.53	78.73 ± 18.49	51.11 ± 9.28	14.71	<0.0001

Mean diastolic blood pressure class I (82.30 ± 12.11), class II (80.70 ± 14.53), class III (78.73 ± 18.49), class IV (51.11 ± 9.28). killips class IV indicates cardiogenic shock.

Out of patients who needs ventilator support 43.8% are of killips class III and 56.3% of patients are of killips class IV. Ventilator support is needed in killips classes III and IV patients when compared to killips classes Iand II (Table 3).

Out of patients who needs ionotropic support, 5.9% are of killips class II, 41.2% are of killips class III and 52.9% of patients are of killips class IV. The need for ionotropic support increases as killips class advances from class II to IV (Table 4).

From Table 5 we can assess that there is no significant relationship between the incidence of diabetes in patients with MI and Killips classification as the p-value is 0.400.

ECG characteristics in relation with killips classification

From table 7 we can assess that there is no significant relationship between type of MI and Killip classes as P-value is not significant (0.218).

Table 3: Patients on ventilator support in relation with killips class

	Killips					
Vent	**I**	**II**	**III**	**IV**	**Chi-square**	**p-value**
Positive	0 (0%)	0 (0%)	7 (43.8%)	9 (56.3%)	81.061	<0.0001
Negative	60 (71.4%)	20 (23.8%)	4 (4.8%)	0 (0%)		

Table 4: Patients on ionotropic support in killips classes

	Killips					
	I	**II**	**III**	**IV**	**Chi-square**	**p-value**
Ionotropes	0 (0.0%)	1 (5.9%)	7 (41.2%)	9 (52.9%)	75.227	<0.0001
No ionotropes	60 (72.3%)	19 (22.9%)	4 (4.8%)	0 (0.0%)		

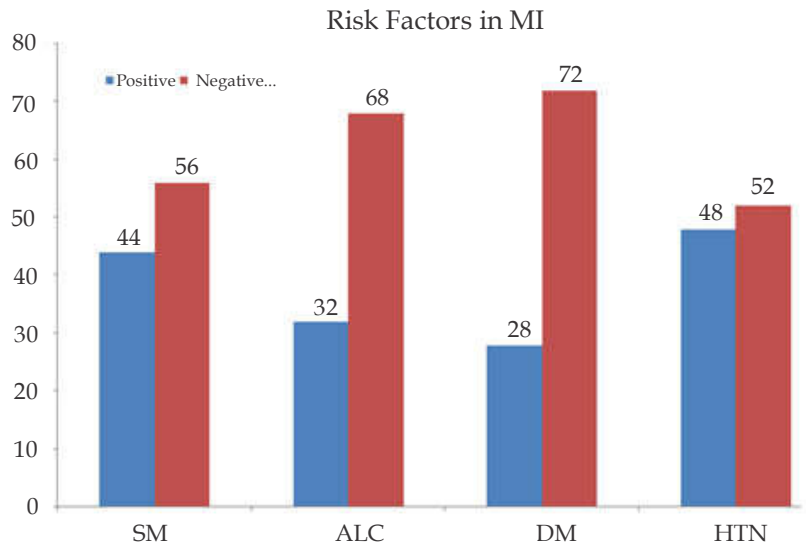

Fig. 1: Incidence of various risk factors

Killips classification in patients with Diabetis as risk factor

Table 5: Incidence of diabetes in killips classes

	Killips					
	I	**II**	**III**	**IV**	**Chi-square**	**p-value**
Diabetic	14 (50.0%)	7 (25.0%)	5 (17.9%)	2 (7.1%)	2.946	0.400
Non Diabetic	46 (63.9%)	13 (18.1%)	6 (8.3%)	7 (9.7%)		

In AWMI 46.2% of the cases are of killips class I and 11.5% of the cases are of killips class IV. In IWMI 73.2% of the cases are of killips class I and 9.8% of the cases are of killips class IV.

Relationship between killips classification and patients who subsequently under went CAG

The high percentage of cases i.e 65.9% in killips class I under went coronary angiogram (CAG). As the P-value is 0.001, the relation is highly significant.

Patients who subsequently underwent CAG in killips class I, 56 (65.9%), class II, 17 (20%), class III 8 (9.4%), class IV 4 (4.7%).

T-test paired sample t-test

Blood glucose values are compared with length of stay, triglyceride values and TIMI (Table 8).

A significant relation had been established between blood glucose values and length of stay.

Readmission in killips classes

There is a significant relationship between initial killips classification of the patient and readmission rates with killips class III as higher readmission rates.

Patients in killips class III has higher rates of readmission when compared to other classes i.e 33.3% of cases.

Relationship between killips classification and mortality

Mortality is high in killips class III (42.9%) and class IV (57.1%). Patients with higher killips classification has higher mortality rate. Maximum mortality is in killips class IV (Table 9).

Killips classification in patients with Hypertension as risk factor

Table 6: Incidence of Hypertension in killips classes

	Killips					
	I	**II**	**III**	**IV**	**Chi-square**	**p-value**
Hypertensive	27 (56.3%)	8 (16.7%)	5 (10.4%)	8 (16.7%)	6.786	0.79
Non Hypertensive	33 (63.5%)	12 (23.1%)	6 (11.5%)	1 (1.9%)		

Table 7: Type of MI and Killips classification

	Killips					
	I	**II**	**III**	**IV**	**Chi-square**	**p-value**
ALMI	6 (66.7%)	2 (22.2%)	0 (0%)	1 (11.1%)	18.914	0.218
ASMI	3 (60%)	1 (20%)	1 (20%)	0 (0%)		
AWMI	12 (46.2%)	6 (23.1%)	5 (19.2%)	3 (11.5%)		
ILMI	0 (0%)	0 (0%)	1 (100%)	0 (0%)		
IWMI	30 (73.2%)	6 (14.6%)	1 (2.4%)	4 (9.8%)		
NSTEMI	9 (50%)	5 (27.8%)	3 (16.7%)	1 (5.6%)		

Table 8: Relation between blood glucose, length of stay and triglycerides

		Mean ± SD	**t-value**	**p-value**
Pair 1	LOS	6.51 ± 2.92	-22.78	<0.0001
	CBG	164.61 ± 69.97		
Pair 2	CBG	164.61 ± 69.97	-1.25	0.215
	TGL	173.57 ± 36.08		

Table 9: Mortality rate in killips

	Killips					
	I	**II**	**III**	**IV**	**CHI-square**	**p-value**
Stable	60 (64.5%)	20 (21.5%)	8 (8.6%)	5 (5.4%)	32.350	< 0.0001
Death	0 (0.0%)	0 (0%)	3 (42.9%)	4 (57.1%)		

Table 10: Readmission with TIMI, TGL, BP, CBG, LOS

	Readmitted	No readmission	t-Value	P-value
TIMI	7.67 ± 2.456	5.33 ± 1.332	4.178	< 0.0001
TGL	182.05 ± 30.26	167.57 ± 33.87	1.763	0.081
SBP	127.43 ± 31.72	125.19 ± 26.03	0.329	0.743
DBP	80.67 ± 18.62	80.06 ± 13.98	0.163	0.871
CBG	199.29 ± 70.15	141 ± 44.9	3.598	0.001
LOS	7.95 ± 3.56	6.31 ± 2.59	1.975	0.059

Table 11: Disposition with TIMI, Age, LOS, BP, CBG, TGL

	Stable (N = 93)	Death (N= 7)	t-value	p-value
TIMI	5.86 ± 1.91	7.86 ± 1.77	-2.681	.009
AGE	49.73 ± 13.979	55.71 ± 14.773	-1.088	0.279
LOS	6.68 ± 2.901	4.29 ± 2.360	2.126	0.036
SBP	125.70 ± 27.249	86 ± 13.753	3.723	<0.0001
DBP	80.19 ± 15.04	60 ± 12.1	3.453	0.001
CBG	154.16 ± 56.8	303.4 ± 84.1	-6.470	<0.0001
TGL	170.84 ± 33.48	209.86 ± 51.2	-1.981	0.92

Table 12: Relation between TIMI risk score & Disposition

	Stable (N = 93)	Death (N= 7)	t-value	p-value
TIMI	5.86 ± 1.91	7.86 ± 1.77	-2.681	.009

The mean value of CBG in patients who were readmitted is 199.29 ± 70.15. Patients who were not readmitted is 141 ± 44.9 with the P value of 0.001. This shows that patients with initial high blood glucose values on admission have higher readmission rates (Table 10).

The mean TIMI in patients who were readmitted during follow period of one year is 7.67 while those who were not readmitted, the mean TIMI value is 5.33. This shows significant relation ship between TIMI and readmission.

The mean TIMI in killips class I is 5.57 ± 1.4, class II 5.90 ± 2, class III 6.64 ± 2, class IV 8.33 ± 2.29.

Out of 100 Patients, the mortality rate is 7%, the mean initial blood glucose values in patients with patients who were discharged home is 154.16 ± 56.8 while it is 303.4 ± 84.1 in patients who were dead. The P value is <0.0001. This shows that patients with initial high blood glucose values have high mortality rate (Table 11).

The mean age group in patients who were discharged home is 49.73 where as the mean age group in patients who were dead is 55.71.

The mean value of TIMI in patients who were discharged home is 5.86 where as in those who were dead is 7.86 (Table 12).

Discussion

Our study is a retrospective cohort study done in 100 patients of myocardial infarction who presented to Emergency Department of Narayana Medical college and Hospital. The patient s were initially stabilized according to ACLS protocols & evaluated.

Patients with acute myocardial infarction have abnormal glucose metabolism. Features adversely affecting in hospital mortality are Killips class on presentation, Age of patient, Initial blood glucose value.

Killip class was the most important variable in predicting death and survival after MI. Killips classification stratifies individuals according to the severity of their post-MI congestive heart failure.

Patients with hyperglycemia develop more adverse cardiovascular events as compared to patients with normal glucose tolerance. Patient s with elevated glucose levels could represent patients with increasing response to stress as seen in patient s with severe incidence of heart failure. We demonstrated positive relationship between initial glucose level & killip classification in acuteMI.

In our study, patients in killips class III and IV are older age group than those in killips class I and II, this is in accordance with the study conducted by Umesh. N. Khot. et al. [8]. In his study the mean age in Killips class I was 63 ± 11 & in killips class III & IV are 69 ± 11. In our study mean age in killips class I was 48 ± 14 and in class IV was 56 ± 10.

The mean age of patients with acute MI in our study is 50.15 ± 14.04 years. Mortality rate and

mean age was higher in killips class III and IV. This is in accordance with study conducted by Tesak. M et al. [9].

Out of 100 cases who suffered acute MI, 74 cases were males and 26 are females. This data indicates that myocardial infarction is more common in male gender.

Incidence of STEMI (82%) is more than NSTEMI (18%). In STEMI, IWMI (41 cases), AWMI (26 cases), ALMI (9 cases), ASMI (5 cases), ILMI (1 case).

Our study shows that out of 100 patients with myocardial infarction 40% of patients had heart failure while 60% of patients did not have heart failure, similar results were reported in the study done by Shahsawar. khan. Matiullah et al. [10]. In his study 37% had heart failure & 63% don`t have heart failure.

Out of patients who needs ventilator support 43.8% are of killips class III and 56.3% of patients are of killips class IV. Ventilator support is needed in killips classes III and IV patients when compared to killips classes Iand II.

Out of patients who needs ionotropic support, 5.9% are of killips class II, 41.2% are of killips class III and 52.9% of patients are of killips class IV. The need for ionotropic support increases as killips class advances from class II to IV.

The mean length of stay in hospital was increased in patients in killips class III (8.27 ± 3.9) & class IV (8.00 ± 5.07) when compared to class I (5.73 ± 2.30) & II (7.20 ± 1.99). In the study done by Hsien - Hung Cheng et al. [7] the mean length of stay in killips class I (7.9 ± 31), class II (7.1 ± 5.9) class III (13.1 ± 11.5) class IV (14.2 ± 10.2).

In our study, Patients with higher killips classification has high initial blood glucose levels i.e the mean blood glucose levels of killips class I (126.93 ± 29.73 mg/dl), Class II (182.10 ± 65.14 mg/dl), class III (246.18 ± 38.86 mg/dl), class IV (277.22 ± 85.28 mg/dl) is proved in the case study done by Hsien - hung Cheng. et al. [7]. In his study mean blood glucose valuesin class I (186.8 ± 82.5), class II (195.9 ± 76.7), class III (216.6 ± 121.9), class IV (236.2 ± 115.5) respectively.

In our study readmission rates are higher in killips class III when compared to class I and II. Killips class I and II showed a favourable prognostic parameter for 1 year survival, this is in accordance with study conducted by Amra-macic-Dzankovic et al. [11].

Patients with high initial blood glucose on admission had high morbidity rates. The mean blood glucose values in patients who are readmitted was 199.29 ± 70.15 mg/dl where as in patients who were not readmitted the mean blood glucose value was 141 ± 44.9 mg/dl.

Patients with high initial blood glucose levels have longer length of hospital stay and high data mortality, this is in accordance with study done by Hsien-hung Cheng et al. [7], Hong.pin Hsu et al. [12], Xue-Lian-Zhang et al. [13]. The similar data was proven in our study.

Patients with high TIMI has higher rates of readmission the mean value of TIMI in cases that were readmitted during 1 yr follow up is 7.67 ± 2.4 & in patients who are not admitted is 5.33 ± 1.3. patients with high TIMI has higher rates of readmission. In the studty done by R. J. Gumina et al. [14]. pt`s with mean value of TIMI >4 has worst long term prognosis than patients with mean TIMI <4.

Patients in higher killips classes have high TIMI risk score. The mean value of TIMI in killips class I (5.57 ± 1.484), II (5.90 ± 2.075), III (6.64 ± 2.461), IV (8.33 ± 2.29).

The mean blood glucose value in patients who are discharged home is 154.16 ± 56.8 mg/dl where as the mean blood glucose values in patients who are expired is 303 ± 84.1 mg/dl, this is in accordance with data collected by Damaris mudespacher et al. [15]. In this study mortality rates are high with initial blood glucose value on admission of 277.2 ± 72 mg/dl.

The relationship between killips classification and mortality was by Eftychio siniorakis et al. [16]. In his study mortality in killips class III was 19.3%, in killips class IV was 61.3%. In our study killips class III has mortality rate of 42.9%, class IV has mortality rate of 57.1%.

As killips classes advances from classes I to IV, the mean blood glucose value also increases. In our study survival rate is more in killips class I & II when compared to classes III & IV. Also 1 yr readmission rate is less in killips class I & II. Readmission rate is high in killips class III Readmission rate is decreased in killips class IV as mortality rate is high in this class (57.1%).

In the study of Ayman-El-Menyar et al. [17] patients with higher killips classification has higher mortality rate. The mortality rate in killips class III (27%). whereas in killips class IV it is 67% In our study also it is proven that mortality rates are high in killips class III (42%) and IV (57.1%).

In the setting of acute MI the patients with high

initial blood glucose levels develop more adverse cardiovascular events as compared to patients with normal glucose tolerance [18,19].

The results of our study indicate that Killip classification of patients at admission for acute MI continues to be a significant tool for early risk stratification and prediction of in-hospital and long-term survival. Patients in higher killips classification had higher morbidity, mortality, readmission rates. Patient s in higher killips classes had high initial blood glucose levels.

Conclusion

Patients with higher killips class on initial presentation have longer length of stay in hospital and high mortality rate. Patients with high initial blood glucose levels have high rates of readmission and mortality. Patients in higher killips classification have high blood glucose levels. Patients with high TIMI risk score are in higher killips classes. Combined together killip classification & blood glucose levels are better indicators of morbidity and mortality than any one factor alone.

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