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" TO STUDY GLYCEMIC STATUS AND ITS IMPACT IN PATIENTS ADMITTED WITH ACUTE CORONARY SYNDROME."

Medicine

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ABSTRACT

In patients of acute coronary syndrome, Hyperglycemia has been shown to be predictor of immediate andlong term Cardiovascular mortality. Stress hyperglycemia dueto myocardial infarction is associated with a increasedrisk of in-hospital in patients with diabetes mellitus. Thisprospective studywasdone atSir T. Hosiptal, Government Medical College Bhavnagarover a period ofoneyear. The study included 100 patients with Clinical and ECG evidence of acute coronary syndrome admitted in our hospital. In this study, we evaluate the symptoms , risk factors, biochemical parameters and complications in patients of acute coronary syndrome with hyperglycaemic and normoglycemic patients. The morbidity and mortality increased in hyperglycaemic patients.We observed that incidence of death is much higher in hyperglycaemic patients as compared to normoglycemic patients. Hence blood glucose level and HbA1c levels should be routinely measured in every patients of acute coronary syndrome.

KEYWORDS

Acute Coronary Syndrome, Stress Hyperglycemia, Diabetes Mellitus

Introduction:

In patients with acute coronary syndrome (ACS)[1], hyperglycemia has been shown to be a predictor of immediate and long-term cardiovascular mortality[2]. Abnormal glucose regulation is present in the majority of ACS patients and is unrecognized in up to half of the cases[3]. Recent studies have addressed the impact of abnormal glucose metabolism in the acute phase of patients ACS and without diabetes[4]. The entity of impaired fasting glucose (IFG) is not only an independent factor of cardiovascular mortality, it has also been associated with a doubling of the risk of in-hospital mortality in ACS[5,6]. It has also been found that stress hyperglycemia due to myocardial infarction is associated with an increased risk of in-hospital mortality in patients with or without diabetes[7]. Recent trials have shown that in patients with ACS, the combination of fasting blood sugar (FBS) more than 110 mg/dl and on admission random blood sugar (RBS) of more than 140 mg/dl identifies patients who are prone to developing Diabetes later[8,9].

Aims & Objectives:

To STUDY Glycemic status in patients admitted with Acute Coronary Syndrome

To study IMPACT of Hyperglycemia and its complications in Acute Coronary Syndrome Patients.

To ASSESS the glycemic status of the patients with diabetes and patients without a past history of Diabetes Mellitus on admission with Acute Coronary Syndrome.

To study the IMPACT of Hyperglycemia on Coronary Vascular Disease.

2To decide the MANAGEMENT for patients of Acute Coronary Syndrome with Hyperglycemia.

To study the PROGNOSIS of patients of Acute Coronary Syndrome with Hyperglycemia.

Methodology:

The Study was carried out on patients admitted in Medicine Ward Sir Takhatsinhji General Hospital, Bhavnagar, after taking permission from IRB (HEC), Government Medical College, Bhavnagar.

-Study design: prospective study
-Duration of Study: 10 Months (November 2016 to April 2017)
-Total number of patients: 100 patients

INCLUSION CRITERIA

Age >18 years giving informed consent for the study.

Patients having parameters such as Random Blood Sugar >140mg/dl and Fasting Blood Sugar >110.

Patient with Acute Coronary Syndrome with or without past history of Ischemic Heart Disease and Diabetes Mellitus.

EXCLUSION CRITERIA

Patient not giving consent. Patient <18 years.

- Informed consent was taken and patients was assessed clinically.
- Detailed history and physical examination was carried out in each patient. Investigations like complete hemogram, Random Blood sugar, Fasting Blood Sugar, Post Prandial Blood Sugar, Glycosylated Hemoglobin [HbA1c], Lipid profile, Renal function tests; Electrocardiogram was carried out in each patient.
- Special investigations like Oral Glucose Tolerance Test, 2D-Echocardiogram, Cardiac Markers (CPK-MB, Trop-I) was carried out as & when required.
- Details of every patient was recorded in separate proforma.

Results and Statistics:

In the present study, our results show that acute coronary syndrome is higher in age group 51-60 years (34%) & in age group 41-50 years (28%). The mean age is 51.79±9.76 years. The mean age of hyperglycemic patients with acute coronary syndrome is 51.67±8.48 years and of normoglycemic patients with acute coronary syndrome is 51.91±11.07. Thus the mean age of hyperglycemic patients is not significant to normoglycemic patient

Table 1: Age Wise Distribution

Age in years	Hyperglycemi c Patients	Normoglycemi c Patients	No of patients
31-40	7 (13.46%)	11 (22.91%)	18 (18%)
41-50	15 (28.86%)	13 (27.08%)	28 (28%)
51-60	22 (42.30%)	12 (25.00%)	34 (34%)
61-70	8 (15.38%)	11 (22.91%)	19 (19%)
>70	0	01 (02.08%)	01 (01%)
Total	**52 (100%)**	**48 (100%)**	**100 (100%)**
Mean Age	51.67 ± 8.48	51.91 ± 11.07	P = 0.9026

In the present study, our result shows that the Acute Coronary Syndrome is higher in Male (66%) as compare to Female (34%) which is statistically not significant (p=0.1716).

Table 2: Sex Wise Distribution

Sex	Hyperglycemic Patients	Normoglycemic Patients	Total no of patients	P value
Male	38 (73.07%)	28 (58.33%)	66 (66%)	0.1791
Female	14 (26.92%)	20 (41.66%)	34 (34%)	
Total	**52**	**48**	**100**	

In the present study, our results show that chest pain (94%), sweating and breathlessness (76%) are higher in acute coronary syndrome. In this study, all symptoms except vomiting are higher in hyperglycemic patients while vomiting is higher in normoglycemic patients (55.81%).

Table 3: Symptoms Wise Distribution

Symptoms	Hyperglycemic Patients	Normoglycemic Patients	Total
Chest pain	48 (51.06%)	46 (48.93%)	94 (94%)
Sweating	40 (52.63%)	36 (47.36%)	76 (76%)
Breathlessness	39 (51.31%)	37 (48.68%)	76 (76%)
Palpitation	30 (54.54%)	25 (45.45%)	55 (55%)
Vomiting	19 (44.18%)	24 (55.81%)	43 (43%)
Giddiness	21 (55.26%)	17 (44.73%)	38 (38%)
Abdominal pain	04 (80.00%)	01 (20.00%)	05 (05%)

In the present study, patients with past history of diabetes mellitus are 16%, hypertension are 33%, smoking addiction are 32% and family history is present in 39%.

In this study, hypertension (63.6%), family history (56.4%) and diabetes mellitus (56.2%) are more common in hyperglycemic patients while smoking is more common in normoglycemic patients.

Table 4: Past History Wise Distribution

Past History	Hyperglycemic Patients	Normoglycemic Patients	Total
Diabetes mellitus	09 (56.2%)	07 (43.8%)	16 (16%)
Hypertension	21 (63.6%)	12 (36.3%)	33 (33%)
Smoking	14 (43.7%)	18 (56.2%)	32 (32%)
Family History	22 (56.4%)	17 (43.5%)	39 (39%)

In the present study, as a general examination, mean BMI of patients with acute coronary syndrome is $24.82 \pm 2.53 kg/m^2$.

In this study, body mass index of hyperglycemic patients with acute coronary syndrome is more than normoglycemic patients which is statistically significant (P=0.0008).

Table 5: General Examination Wise Distribution

General Examination	Hyperglycemc Patientsi	Normoglycec Patientsmi	Total (n=100)	P value
BMI	25.44 ± 2.61	23.84 ± 1.91	24.82 ± 2.53	**0.0008**
Pulse Rate	100.34 ± 20.22	98.75 ± 18.17	99.58 ± 19.19	0.6810
Systolic Blood Pressure	111.23 ± 14.30	113.37 ± 21.57	113.22 ± 20.50	0.5573
Diastolic Blood Pressure	72.38 ± 9.22	72.91 ± 13.77	72.64 ± 11.54	0.8203

In the present study, as a Lipid profile examination, total cholesterol and HDL is higher in normoglycemic patients which is statistically significant (P=0.0138 and P=0.0280 respectively).

Table 9: Lipid Profile Wise Distribution

Lipid Profile	Hyperglycemic Patients	Normoglycemic Patients	P value
Total Cholesterol	159.03 ± 44.48	183.93 ± 54.62	**0.0138**
Triglyceride	121.97 ± 55.77	139.55 ± 60.83	0.1348
HDL	35.83 ± 8.03	40.05 ± 10.79	**0.0280**
LDL	91.97 ± 69.31	94.93 ± 55.50	0.8151

In the present study, glycosylated hemoglobin level (HbA1c) is higher in hyperglycemic patients with acute coronary syndrome compared to normoglycemic patients which is statistically significant (P= <0.0001).

In addition, random blood sugar of hyperglycemic patients is higher which is statistically significant (P= <0.0001).

Table 10: Blood Sugar Wise Distribution

Blood Sugar	Hyperglycemic Patients	Normoglycemic Patients	P value
Hb1AC	7.91 ± 0.78	5.04 ± 0.71	**<0.0001**
RBS	243.57 ± 30.47	167.43 ± 19.50	**<0.0001**

In the present study, hyperglycemic patients have more incidence of NSTEMI (57.14%) and STEMI (61.0%) compare to Normoglycemic patients which is statistically not significant.

Table 11: Ecg Wise Distribution

ECG	Hyperglycemic Patients	Normoglycemic Patients	P value
NSTEMI	8 (57.14%)	6 (42.86%)	0.8875
STEMI	25 (61.0%)	16 (39.0%)	0.1963
Unstable Angina	19 (42.2%)	26 (57.8%)	0.1168
Total	52	48	

In the present study, arrhythmia is the most common complication in normoglycemic patients (69%).

While cardiac arrest(75%) and death(74%) is most common in hyperglycemic patients which is statistically significant (P=< 0.05).

Table 12: Complication And Death Incidence

Complication	Hyperglycemic Patients	Normoglycemic Patients	P value
Arrhythmia	9 (31%)	20 (69%)	**0.0138**
Shock (Carcinogenic)	13 (44.8%)	16 (55.2%)	0.4839
Cardiac Arrest	12 (75%)	4 (25%)	0.2655
Acute LVF	18 (50%)	18 (50%)	0.9203
Death	17(74%)	6(26%)	**0.0309**
Total	52	48	

Discussion:

Out of 100 patients of ACS, Mean age for hyperglycemic patients was 51.67 years and for normoglycemic patients was 51.91 years.

Males are more susceptible to develop ACS in both the groups.

Chest pain (51.06%), Sweating (52.63%), Breathlessness (51.31%), Palpitation (54.54%), Giddiness (55.26%) were almost equal in Normoglycemic & Hyperglycemic patients. However Abdominal pain was observed in 4 patients with hyperglycemia and only 1 patient with normoglycemia.

Out of 100 patients, 52 patients who are hyperglycemic, but at admission time hyperglycemia > 200 mg/dL with HbA1c < 6.5% is labeled as stress hyperglycemia. Their blood sugar came to normal levels on 2nd/3rd day.

Remaining 48 patients who are diabetic, but at admission time hyperglycemia > 200 mg/dL with HbA1c > 6.5%, they has uncontrolled sugar levels (i.e. diabetics with poor glycemic control).

Patients with hyperglycemia had history of 56.2% diabetes mellitus, 63.6% hypertension; 43.7% current smoker and 56.4% family history which was higher than normoglycemic patients

Incidence of STEMI (15.3%) and NSTEMI (48.1%) is more in hyperglycemic patients than normoglycemic (12.5% & 33.3%). In contrast, incidence of Unstable Angina (54.1%) is more in normoglycemic than hyperglycemic patients (36.5%).

Complications like Arrhythmia (41.6%) and Cardiogenic Shock (33.3%) are more in non-diabetics than in diabetics. Cardiac arrest (23.1%) and Death (32.7%) are more in diabetics than non-diabetics. Acute LVF (34.6%) is equally common in both diabetics and non-diabetics.

Deaths are more due to Cardiogenic shock, Cardiac arrest and Acute LVF in diabetics compare to non-diabetics.

7 patients who are diabetic with controlled HbA1c i.e. HbA1c < 6.5%, but had admission time hyperglycemia developed arrhythmias.

CONCLUSION:

Incidence of complications is higher (Surprisingly) in normoglycemic as compared to hyperglycemic patients.

Incidence of death is much higher in hyperglycemia as compared to normoglycemic with stress hyperglycemia (on admission). Hence, blood glucose level and HbA1c levels should be routinely measured in every patient with Acute Coronary Syndrome.

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References

1. Russell V. Luepker, Fred S. Apple, Robert H Christension, Richard S. Crow, Stephen P. Fortmann, David Goff, et al. Case Definitions for Acute Coronary Heart Disease in Epidemiology and Clinical Research Studies. A Statement From the AHA Council on Epidemiology and Prevention. Circulation 2003; 108: 2543-2549
2. Malmberg K, Rydén L. Myocardial infarction in patients with diabetes mellitus. Eur Heart J 1988; 9:259–264
3. Coutinho M, Gerstein HC, Wang Y, Yusuf S. The relationship between glucose and incident cardiovascular events: a meta regression analysis of published data from 20 studies of 95,783 individuals followed for 12.4 years. Diabetes Care 1999;22:233–240
4. Deedwania P, Kosiborod M, Barrett E, Ceriello A, Isley W, Mazzone T, Raskin P. Hyperglycemia and acute coronary syndrome: a scientific statement from the American Heart Association Diabetes Committee of the Council on Nutrition, Physical Activity, and Metabolism. Anesthesiology2008; 109(1):14-24.
5. Chih S, McQuillan BM, Kaye J, Beilby JP, Hung J. Abnormal glucose regulation in an Australian acute coronary syndrome population: a prospective study. Diabetes Res Clin Pract 2008; 81(3):303-9. Epub 2008 Jun 20.
6. Rioufol G, Zeller M, Oudot A, L'Huillier I, Buffet P, Beer JC, et al. Predictive value of glycemia in acute coronary syndromes. Arch Mal Coeur Vaiss. 2004 Dec; 97 Spec No 3:47-50.
7. Capes SE, Hunt D, Malmberg K, Gerstein HC. Stress hyperglycemia and increased risk of death after myocardial infarction in patients with and without diabetes: a systematic overview.Lancet 2000; 355(9206):773- 8.
8. Hadjadj S, Coisne D, Mauco G, Ragot S, Duengler F, Sosner P, et al. Prognostic value of admission plasma glucose and HbA in acute myocardial infarction. Diabet Med 2004; 21(4):305-10. 10
9. Okosieme OE, Peter R, Usman M, Bolusani H, Suruliram P, George L,Evans LM. Can admission and fasting glucose reliably identify undiagnosed diabetes in patients with acute coronary syndrome? Diabetes Care 2008;31(10):1955-9.
10. Braunwald's Heart Disease :A textbook of cardiovascular medicine 8th edition page 1207.
11. Braunwald's Heart Disease: A textbook of cardiovascular medicine 9th edition page 1259.
12. Harrison's principle of internal medicine .19th edition page no1602
13. Manual of cardiovascular medicine 4th edition by Brian P. Griffin page no2
14. Collins AJ, Foley RN, Herzog C, et al. US Renal Data System 2012 Annual Data Report. Am J Kidney Dis 2013; 61: 1-476.
15. Diagnosis and classification of diabetes mellitus. Diabetes Care 2012, 35 Suppl 1:S64-71.
16. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, Lin JK, Farzadfar F, Khang YH, Stevens GA et al: National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants. Lancet 2011, 378(9785):31-40.
17. Age- and sex-specific prevalence of diabetes and impaired glucose regulation in 13 European cohorts. Diabetes Care 2003, 26(1):61-69.
18. Borch-Johnsen K, Colagiuri S, Balkau B, Glumer C, Carstensen B, Ramachandran A, Dong Y, Gao W: Creating a pandemic of prediabetes: the proposed new diagnostic criteria for impaired fasting glycaemia. Diabetologia 2004, 47(8):1396-1402.
19. Alberti KG, Zimmet PZ: Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med 1998, 15(7):539-553.
20. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia. Geneva, World Health Organization, 2006. In.
21. Use of Glycated Haemoglobin (HbA1c) in the Diagnosis of Diabetes Mellitus. Abbreviated Report of a WHO Consultation. Geneva, World Health Organization, 2011. In.
22. Selvin E, Crainiceanu CM, Brancati FL, Coresh J: Short-term variability in measures of glycemia and implications for the classification of diabetes. Archives of internal medicine 2007, 167(14):1545-1551. 11
23. Sacks DB: A1C versus glucose testing: a comparison. Diabetes Care 2011, 34(2):518-523.
24. Fogh-Andersen N, Wimberley PD, Thode J, Siggaard-Andersen O: Direct reading glucose electrodes detect the modality of glucose in plasma and whole blood. Clin Chim Acta 1990, 189(1):33-38.
25. Will new diagnostic criteria for diabetes mellitus change phenotype of patients with diabetes? Reanalysis of European epidemiological data. DECODE Study Group on behalf of the European Diabetes Epidemiology Study Group. BMJ 1998, 317(7155):371-375.
26. Artnik M, Ryden L, Malmberg K, Ohrvik J, Pyorala K, Standl E, Ferrari R, Simoons M, Soler-Soler J: Oral glucose tolerance test is needed for appropriate classification of glucose regulation in patients with coronary artery disease: a report from the Euro Heart Survey on Diabetes and the Heart. Heart 2007, 93(1):72-77.
27. Hu DY, Pan CY, Yu JM: The relationship between coronary artery disease and abnormal glucose regulation in China: the China Heart Survey. Eur Heart J 2006, 27(21):2573-2579.
28. de Vegt F, Dekker JM, Ruhe HG, Stehouwer CD, Nijpels G, Bouter LM, Heine RJ: Hyperglycemia is associated with all-cause and cardiovascular mortality in the Hoorn population: the Hoorn Study. Diabetologia 1999, 42(8):926-931.
29. Mooy JM, Grootenhuis PA, de Vries H, Kostense PJ, Popp-Snijders C, Bouter LM, Heine RJ: Intra-individual variation of glucose, specific insulin and proinsulin concentrations measured by two oral glucose tolerance tests in a general Caucasian population: the Hoorn Study. Diabetologia 1996, 39(3):298-305.
30. de Vegt F, Dekker JM, Stehouwer CD, Nijpels G, Bouter LM, Heine RJ: Similar 9-year mortality risks and reproducibility for the World Health Organization and American Diabetes Association glucose tolerance categories: the Hoorn Study. Diabetes Care 2000, 23(1):40-44.
31. Goldstein DE, Little RR, Lorenz RA, Malone JI, Nathan D, Peterson CM, Sacks DB: Tests of glycemia in diabetes. Diabetes Care 2004, 27(7):1761-1773.
32. International Expert Committee report on the role of the A1C assay in the diagnosis of diabetes. Diabetes Care 2009, 32(7):1327-1334.
33. Saudek CD, Herman WH, Sacks DB, Bergenstal RM, Edelman D, Davidson MB: A new look at screening and diagnosing diabetes mellitus. J Clin Endocrinol Metab 2008, 93(7):2447-2453. 12
34. Hoelzel W, Weykamp C, Jeppsson JO, Miedema K, Barr JR, Goodall I, Hoshino T, John WG, Kobold U, Little R et al: IFCC reference system for measurement of hemoglobin A1c in human blood and the national standardization schemes in the United States, Japan, and Sweden: a method-comparison study. Clin Chem 2004, 50(1):166-174.
35. Wang W, Lee ET, Howard BV, Fabsitz RR, Devereux RB, Welty TK: Fasting plasma glucose and hemoglobin A1c in identifying and predicting diabetes: the strong heart study. Diabetes Care 2011, 34(2):363-368.
36. Santaguida PL BC, Hunt D, Morrison K, Gerstein H, Raina P, Booker L, Yazdi H.: Diagnosis, Prognosis, and Treatment of Impaired Glucose Tolerance and Impaired Fasting Glucose. Evidence Report/Technology Assessment No. 128. (Prepared by the McMaster University Evidence-based Practice Center under Contract No. 290-02-0020). AHRQ Pub. No 05-E026-2. Rockville, MD: Agency for Healthcare Research and Quality. September 2005. In.
37. Soderberg S, Zimmet P, Tuomilehto J, de Courten M, Dowse GK, Chitson P, Stenlund H, Gareeboo H, Alberti KG, Shaw J: High incidence of type 2 diabetes and increasing conversion rates from impaired fasting glucose and impaired glucose tolerance to diabetes in Mauritius. J Intern Med 2004, 256(1):37-47.
38. Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio E, Ingelsson E, Lawlor DA, Selvin E, Stampfer M et al: Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. Lancet 2010, 375(9733):2215-2222.
39. Haffner SM, Lehto S, Ronnemaa T, Pyorala K, Laakso M: Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. N Engl J Med 1998, 339(4):229-234.
40. Hu FB, Stampfer MJ, Solomon CG, Liu S, Willett WC, Speizer FE, Nathan DM, Manson JE: The impact of diabetes mellitus on mortality from all causes and coronary heart disease in women: 20 years of follow-up. Arch Intern Med 2001, 161(14):1717-1723.
41. Bulugahapitiya U, Siyambalapitiya S, Sithole J, Idris I: Is diabetes a coronary risk equivalent? Systematic review and meta-analysis. Diabetic medicine: a journal of the British Diabetic Association 2009, 26(2):142-148.
42. Deedwania P, Kosiborod M, Barrett E, Ceriello A, Isley W, Mazzone T, Raskin P: Hyperglycemia and acute coronary syndrome: a scientific statement from the American Heart Association Diabetes Committee of the Council on Nutrition, Physical Activity, and Metabolism. Circulation 2008, 117(12):1610-1619. 13
43. Okosieme OE, Peter R, Usman M, Bolusani H, Suruliram P, George L, Evans LM: Can admission and fasting glucose reliably identify undiagnosed diabetes in patients with acute coronary syndrome? Diabetes Care 2008, 31(10):1955-1959.
44. Capes SE, Hunt D, Malmberg K, Gerstein HC: Stress hyperglycemia and increased risk of death after myocardial infarction in patients with and without diabetes: a systematic overview. Lancet 2000, 355(9206):773-778.
45. Ishihara M, Kojima S, Sakamoto T, Kimura K, Kosuge M, Asada Y, Tei C, Miyazaki S, Sonoda M, Tsuchihashi K et al: Comparison of blood glucose values on admission for acute myocardial infarction in patients with versus without diabetes mellitus. Am J Cardiol 2009, 104(6):769-774.
46. Kosiborod M, Rathore SS, Inzucchi SE, Masoudi FA, Wang Y, Havranek EP, Krumholz HM: Admission glucose and mortality in elderly patients hospitalized with acute myocardial infarction: implications for patients with and without recognized diabetes. Circulation 2005, 111(23):3078-3086.
47. Kolman L, Hu YC, Montgomery DG, Gordon K, Eagle KA, Jackson EA: Prognostic value of admission fasting glucose levels in patients with acute coronary syndrome. Am J Cardiol 2009, 104(4):470-474.
48. Otten R, Kline-Rogers E, Meier DJ, Dumasia R, Fang J, May N, Resin Y, Armstrong DF, Saab F, Petrina M et al: Impact of pre-diabetic state on clinical outcomes in patients with acute coronary syndrome. Heart 2005, 91(11):1466-1468.
49. Sinnaeve PR, Steg PG, Fox KA, Van de Werf F, Montalescot G, Granger CB, Knobel E, Anderson FA, Dabbous OH, Avezum A: Association of elevated fasting glucose with increased short-term and 6-month mortality in ST-segment elevation and non-ST-segment elevation acute coronary syndromes: the Global Registry of Acute Coronary Events. Arch Intern Med 2009, 169(4):402-409.
50. Suleiman M, Hammerman H, Boulos M, Kapeliovich MR, Suleiman A, Agmon Y, Markiewicz W, Aronson D: Fasting glucose is an important independent risk factor for 30-day mortality in patients with acute myocardial infarction: a prospective study. Circulation 2005, 111(6):754-760.
51. Kosuge M, Kimura K, Ishikawa T, Shimizi T, Hibi K, Toda N, Tahara Y, Kanna M, Tsukahara K, Okuda J et al: Persistent hyperglycemia is associated with left ventricular dysfunction in patients with acute myocardial infarction. Circ J 2005, 69(1):23-28.
52. Goyal A, Mahaffey KW, Garg J, Nicolau JC, Hochman JS, Weaver WD, Theroux P, Oliveira GB, Todaro TG, Mojcik CF et al: Prognostic significance of the change in 14 glucose level in the first 24 h after acute myocardial infarction: results from the CARDINAL study. Eur Heart J 2006, 27(11):1289-1297.
53. van der Horst IC, Nijsten MW, Vogelzang M, Zijlstra F: Persistent hyperglycemia is an independent predictor of outcome in acute myocardial infarction. CardiovascDiabetol

2007, 6:2.
54. Kosiborod M, Inzucchi SE, Krumholz HM, Xiao L, Jones PG, Fiske S, Masoudi FA, Marso SP, Spertus JA: Glucometrics in patients hospitalized with acute myocardial infarction: defining the optimal outcomes-based measure of risk. Circulation 2008, 117(8):1018-1027.
55. Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M, Gregoratos G, Klein G, Moss AJ, Myerburg RJ et al: ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: a report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (developed in collaboration with the European Heart Rhythm Association and the Heart Rhythm Society. Europace 2006, 8(9):746-837.
56. Curb JD, Rodriguez BL, Burchfiel CM, Abbott RD, Chiu D, Yano K: Sudden death, impaired glucose tolerance, and diabetes in Japanese American men. Circulation 1995, 91(10):2591-2595.
57. Balkau B, Jouven X, Ducimetiere P, Eschwege E: Diabetes as a risk factor for sudden death. Lancet 1999, 354(9194):1968-1969.
58. Herlitz J, Bang A, Gunnarsson J, Engdahl J, Karlson BW, Lindqvist J, Waagstein L: Factors associated with survival to hospital discharge among patients hospitalized alive after out of hospital cardiac arrest: change in outcome over 20 years in the community of Goteborg, Sweden. Heart 2003, 89(1):25-30.
59. Arsson M, Thoren AB, Herlitz J: A history of diabetes is associated with an adverse outcome among patients admitted to hospital alive after an out-of-hospital cardiac arrest. Resuscitation 2005, 66(3):303-307.
60. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. N Engl J Med 1993, 329(14):977-986.
61. Reichard P, Nilsson BY, Rosenqvist U: The effect of long-term intensified insulin treatment on the development of microvascular complications of diabetes mellitus. The New England journal of medicine 1993, 329(5):304-309. 15
62. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. Lancet 1998, 352(9131):837-853.