

Clinical Evidence Supporting the Need for Glycemic Control in the Hospital Setting
“The Case for Tight Glycemic Control
in Hospitalized Patients”

References and Key Readings

1. Ainla T, Baburin A, Teesalu R, et al. The association between hyperglycaemia on admission and 180-day mortality in acute myocardial infarction patients with and without diabetes. *Diabet Med.* 2005;22:1321-1325.
2. **American College of Endocrinology Task Force on Inpatient Diabetes and Metabolic Control. ACE Position Statement on Inpatient Diabetes and Metabolic Control. *Endocr Pract.* 2004;10:77-82.**
3. **American College of Endocrinology Task Force on Inpatient Diabetes and Glycemic. ACE Position Statement on Inpatient Diabetes and Metabolic Control. *Endocr Pract.* 2006;12:3-13.**
4. **Antman EM, Anbe DT, Armstrong PW, et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction--executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). *Circulation.* 2004;110:588-636.**
5. **Baker EH, Janaway CH, Philips BJ, et al. Hyperglycaemia is associated with poor outcomes in patients admitted to hospital with acute exacerbations of chronic obstructive pulmonary disease. *Thorax.* 2006;61:284-289.**
6. Bartnik M, Ryden L, Ferrari R, et al. The prevalence of abnormal glucose regulation in patients with coronary artery disease across Europe. The Euro Heart Survey on diabetes and the heart. *Eur Heart J.* 2004;25:1880-1890.
7. **Bhattacharyya A, Christodoulides C, Kaushal K, et al. In-patient management of diabetes mellitus and patient satisfaction. *Diabet Med.* 2002;19:412-416.**
8. Bochicchio GV, Sung J, Joshi M, et al. Persistent hyperglycemia is predictive of outcome in critically ill trauma patients. *J Trauma.* 2005;58:921-924.
9. Bolk J, van der Ploeg T, Cornel JH, et al. Impaired glucose metabolism predicts mortality after a myocardial infarction. *Int J Cardiol.* 2001;79:207-214.
10. Braunwald E. Shattuck lecture—cardiovascular medicine at the turn of the millennium: triumphs, concerns, and opportunities. *N Engl J Med.* 1997;337:1360-1369.
11. Capes SE, Hunt D, Malmberg K, et al. Stress hyperglycemia and prognosis of stroke in non diabetic and diabetic patients: a systematic overview. *Stroke.* 2001;32:2426-2432.

12. 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;355:773-778.
13. Cheung NW, Wong VW, McLean M. The Hyperglycemia: Intensive Insulin Infusion in Infarction (HI-5) study: a randomized controlled trial of insulin infusion therapy for myocardial infarction. *Diabetes Care*. 2006;29:765-770.
14. Cheung NW, Napier B, Zaccaria C, et al. Hyperglycemia is associated with adverse outcomes in patients receiving total parenteral nutrition. *Diabetes Care*. 2005;28:2367-2371.
15. Conaway DG, O'Keefe JH, Reid KJ, et al. Frequency of undiagnosed diabetes mellitus in patients with acute coronary syndrome. *Am J Cardiol*. 2005;96:363-365.
- 16. Donihi AC, Raval D, Saul M, et al. Prevalence and predictors of corticosteroid-related hyperglycemia in hospitalized patients. *Endocr Pract*. 2006;12:358-362.**
17. Estrada CA, Young JA, Nifong LW, et al. Outcomes and perioperative hyperglycemia in patients with or without diabetes mellitus undergoing coronary artery bypass grafting. *Ann Thorac Surg*. 2003;75:1392-1399.
18. Frontera JA, Fernandez A, Claassen J, et al. Hyperglycemia after SAH: predictors, associated complications, and impact on outcome. *Stroke*. 2006;37:199-203.
- 19. Furnary AP, Wu Y, Bookin SO. Effect of hyperglycemia and continuous intravenous insulin infusions on outcomes of cardiac surgical procedures: the Portland Diabetic Project. *Endocr Pract*. 2004;10 (suppl 2):21-33.**
- 20. Furnary AP, Zerr KJ, Grunkemeier GL, et al. Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiac surgical procedures. *Ann Thorac Surg*. 1999;67:352-360. Discussion 360-362.**
- 21. Furnary AP, Gao G, Grunkemeier GL, et al. Continuous insulin infusion reduces mortality in patients with diabetes undergoing coronary artery bypass grafting. *J Thorac Cardiovasc Surg*. 2003;125:1007-1021.**
- 22. Furnary AP, Wu Y. Clinical effects of hyperglycemia in the cardiac surgery population: the Portland Diabetic Project. *Endocr Pract*. 2006;12 Suppl 3:22-6.**
23. Furnary AP, Zerr KJ, Grunkemeier A, et al. Hyperglycemia: a predictor of mortality following CABG in diabetics [abstract]. *Circulation*. 1999;(Suppl);100:I591.
24. Gandhi GY, et al. Intensive Intraoperative Insulin Therapy versus Conventional Glucose Management during Cardiac Surgery. *Ann Intern Med*. 2007;146:233-243.

- 25. Garber AJ, Seidel J, Armbruster M. Current standards of care for inpatient glycemic management and metabolic control: is it time for definite standards and targets? *Endocr Pract.* 2004;10 Suppl 2:10-2.**
26. Golay A. GAMI: Glucose Abnormalities in patients with Myocardial Infarction – prevalence, diagnosis and prognostic implications. Presented at: European Society of Cardiology Congress 2004; August 28 - September 1, 2004; Munich, Germany.
27. Gray CS, et al. The United Kingdom Glucose Insulin in Stroke Trial (GIST-UK): Final Results. Abstract presented at: American Stroke Association Annual Meeting 2007; Abstract LB2.
28. Grey NJ, Perdrietz GA. Reduction of nosocomial infections in the surgical intensive-care unit by strict glycemic control. *Endocr Pract.* 2004;10 Suppl 2:46-52.
- 29. Hirsch IB. Effect of insulin therapy on nonglycemic variables during acute illness. *Endocr Pract.* 2004;10 Suppl 2:63-70.**
- 30. Hirsch IB. Inpatient diabetes: review of data from the cardiac care unit. *Endocr Pract.* 2006;12 Suppl 3:27-34.**
31. Ishihara M, Kojima S, Sakamoto T. Japanese Acute Coronary Syndrome Study Investigators. Acute hyperglycemia is associated with adverse outcome after acute myocardial infarction in the coronary intervention era. *Am Heart J.* 2005;150:814-820.
32. Korytkowski M, DiNardo M, Donihi AC, et al. Evolution of a diabetes inpatient safety committee. *Endocr Pract.* 2006;Suppl 3:91-99.
- 33. Kosiborod M, Rathore SS, Inzucchi S et al. Admission glucose and mortality in elderly patients hospitalized with acute myocardial infarction: implications for patients with and without recognized diabetes. *Circulation.* 2005;111:3078-3086.**
- 34. Krinsley JS. Association between hyperglycemia and increased hospital mortality in a heterogeneous population of critically ill patients. *Mayo Clin Proc.* 2003;78:1471-1478.**
35. Krinsley JS. Effect of intensive glucose management protocol on the mortality of critically ill adult patients. *Mayo Clin Proc.* 2004;79:992-1000.
36. Latham R, Lancaster AD, Covington JF, et al. The association of diabetes and glucose control with surgical site infection among cardiothoracic surgery patients. *Infec Control Hosp Epidemiol.* 2001;22:607-612.
37. Lazar HL, Chipkin SR, Fitzgerald CA, et al. Tight glycemic control in diabetic coronary artery bypass graft patients improves perioperative outcomes and decreases recurrent ischemic events. *Circulation.* 2004;109:1497-1502.

38. Levetan CS. Effect of hyperglycemia on stroke outcomes. *Endocr Pract.* 2004;10 Suppl 2:34-9.
39. Lewis EF, Moye LA, Rouleau JL; CARE Study. Predictors of late development of heart failure in stable survivors of myocardial infarction: the CARE study. *J Am Coll Cardiol.* 2003;42:1446-1453.
40. Lukins MB, Manninen PH. Hyperglycemia in patients administered dexamethasone for craniotomy. *Anesthesia & Analgesia.* 2005;100:1129-1133.
- 41. Malmberg K. Role of insulin-glucose infusion in outcomes after acute myocardial infarction: the diabetes and insulin-glucose infusion in acute myocardial infarction (DIGAMI) study. *Endocr Pract.* 2004;10 Suppl 2:13-6.**
42. Malmberg K, Ryden L, Wedel H; DIGAMI 2 Investigators. Intense metabolic control by means of insulin in patients with diabetes mellitus and acute myocardial infarction (DIGAMI 2): effects on mortality and morbidity. *Eur Heart J.* 2005;26:650-661.
- 43. Malmberg K, Ryden L, Efendic S, et al. Randomized trial of insulin-glucose infusion followed by subcutaneous insulin treatment in diabetic patients with acute myocardial infarction (DIGAMI study): effects on mortality at 1 year. *J Am Coll Cardiol.* 1995;26:57-65.**
- 44. Malmberg K, Norhammar A, Wedel H, et al. Glycometabolic state at admission: important risk marker of mortality in conventionally treated patients with diabetes mellitus and acute myocardial infarction: long-term results from the Diabetes and Insulin-Glucose Infusion in Acute Myocardial Infarction (DIGAMI) study. *Circulation.* 1999;99:2626-2632.**
45. Malmberg K, Ryden L. Myocardial infarction in patients with diabetes mellitus. *Eur Heart J.* 1988;9:259-264.
46. Malmberg K. Prospective randomized study of intensive insulin treatment on long-term survival after acute myocardial infarction in patients with diabetes mellitus. *BMJ.* 1997;314:1512-1515.
- 47. McAlister FA, Majumdar SR, Blitz S, et al. The relation between hyperglycemia and outcomes in 2,471 patients admitted to the hospital with community-acquired pneumonia. *Diabetes Care.* 2005;28:810-815.**
48. Mehta SR, Yusuf S, Diaz R; CREATE-ECLA Trial Group Investigators. Effect of glucose-insulin-potassium infusion on mortality in patients with acute ST-segment elevation myocardial infarction: the CREATE-ECLA randomized controlled trial. *JAMA.* 2005;293:437-446.

49. Moghissi E. Hospital Management of Diabetes “Beyond the Sliding Scale.” *Cleve Clin J Med.* 2004;71:801-8.
50. Moghissi ES, Hirsch IB. Hospital management of diabetes. *Endocrinol Metab Clin North Am.* 2005;34:99-116.
51. Moghissi ES, Kongable GL, Abad VJ, et al. Current state of inpatient diabetes burden and care, and goal of the conference. *Endocrine Practice* 2006;12(suppl 3):1-10.
52. Mukamal KJ, Nesto RW, Cohen MC, et al. Impact of diabetes on long-term survival after acute myocardial infarction: comparability of risk with prior myocardial infarction. *Diabetes Care.* 2001;24:1422-1427.
53. Norhammar A, et al. Diabetes mellitus: the major risk factor in unstable coronary artery disease even after consideration of the extent of coronary artery disease and benefits of revascularization. *J Am Coll Cardiol.* 2004;43:585-591.
54. Norhammar A, Malmberg K, Ryden L; Register of Information and Knowledge about Swedish Heart Intensive Care Admission (RIKS-HIA). Under utilisation of evidence-based treatment partially explains for the unfavourable prognosis in diabetic patients with acute myocardial infarction. *Eur Heart J.* 2003;24:838-844.
55. Norhammar A, Tenerz A, Nilsson G, et al. Glucose metabolism in patients with acute myocardial infarction and no previous diagnosis of diabetes mellitus: a prospective study. *Lancet.* 2002;359:2140-2144.
56. Olson L, Muchmore J, Lawrence CB. The benefits of inpatient diabetes care: improving quality of care and the bottom line. *Endocr Pract.* 2006;12 Suppl 3:35-42.
57. Pittas AG, Siegel RD, Lau J. Insulin therapy for critically ill hospitalized patients: a metaanalysis of randomized, control trials. *Arch Inter Med.* 2004;164:2005-2011.
58. Pomposelli JJ, et al. Early postoperative glucose control predicts nosocomial infection rate in diabetic patients. *J Parenter Enteral Nutr.* 1998;22:77-81.
59. Preiser JC. Intensive glycemic control in med-surg patients (European Glucontrol trial). Presented at: Critical Care Congress of the Society for Critical Care Medicine; February 19, 2007; Orlando, FL.
60. Rady MY, Johnson DJ, Patel BM, et al. Influence of individual characteristics on outcome of glycemic control in intensive care unit patients with or without diabetes mellitus. *Mayo Clin Proc.* 2005;80:1558-1567.
61. Sala J, Masia R, Gonzalez de Molina F-J, et al. Short-term mortality of myocardial infarction patients with diabetes or hyperglycemia during admission. *J Epidemiol Community Health.* 2002;56:707-712.

62. Schmeltz LR, Desantis AJ, Schmidt K, et al. Conversion of intravenous insulin infusions to subcutaneously administered insulin glargine in patients with hyperglycemia. *Endocr Pract.* 2006;12:641-650.
63. **Timmer JR, van der Horst IC, Ottervanger JP, et al. Prognostic value of admission glucose in non-diabetic patients with myocardial infarction. *Am Heart J.* 2004;148:399-404.**
64. **Trence DL, Kelly JL, Hirsch IB. The rationale and management of hyperglycemia for in-patients with cardiovascular disease: time for change. *J Clin Endocrinol Metab.* 2003;88:2430-2437.**
65. **Umpierrez GE, Isaacs SD, Bazargan N, et al. Hyperglycemia: an independent marker of in-hospital mortality in patients with undiagnosed diabetes. *J Clin Endocrinol Metab.* 2002;87:978-982.**
66. **Van den Berghe GH. Role of intravenous insulin therapy in critically ill patients. *Endocr Pract.* 2004;10 Suppl 2:17-20.**
67. **Van den Berghe G, Wouters PJ, Bouillon R, et al. Outcome benefit of intensive insulin therapy in the critically ill: Insulin dose versus glycemic control. *Crit Care Med.* 2003;31:359-366.**
68. Van den Berghe G, Wouters PJ, Kesteloot K, et al. Analysis of healthcare resource utilization with intensive insulin therapy in critically ill patients. *Crit Care Med.* 2006;34:612-616.
69. **Van Den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in critically ill patients. *N Engl J Med.* 2001;345:1359-1367.**
70. Van den Berghe G, Wilmer A, Hermans G, et al. Intensive insulin therapy in the medical ICU. *N Engl J Med.* 2006;354:449-461.
71. Van den Berghe G, Schoonheydt K, Becx P, et al. Insulin therapy protects the central and peripheral nervous system of intensive care patients. *Neurology.* 2005;64:1348-1353.
72. Vanhorebeek I, Langouche L, Van den Berghe G. Intensive insulin therapy in the intensive care unit: update on clinical impact and mechanisms of action. *Endocr Pract.* 2006;12 Suppl 3:14-22.
73. Wahab NN, Cowden EA, Pearce NJ; ICONS Investigators. Is blood glucose an independent predictor of mortality in acute myocardial infarction in the thrombolytic era? *J Am Coll Cardiol.* 2002;40:1748-1754.
74. Yendamuri S, Fulda GJ, Tinkoff GH. Admission hyperglycemia as a prognostic indicator in trauma. *J Trauma.* 2003;55:33-38.

75. Young B, Ott L, Dempsey R, et al. Relationship between admission hyperglycemia and neurologic outcome of severely brain-injured patients. *Ann Surg.* 1989;210:466-472. Discussion 472-473.
76. Zerr KJ, Furnary AP, Grunkemeier GL, et al. Glucose control lowers the risk of wound infection in diabetics after open heart operations. *Ann Thorac Surg.* 1997;63:356-361.