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Perioperative management of the diabetic patient

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Diabetes mellitus is a significant global public health problem and is a major source of morbidity and mortality in the world today. Type 2 diabetes mellitus is the predominant form of diabetes worldwide and represents approximately 90% of all cases. There is an epidemic of type 2 diabetes mellitus in the world today in both developed and developing countries. Globally, it is expected that the number of people with diabetes will increase from the current 150 million to 220 million by the year 2010 and to 300 million by the year 2025. In addition, there has been an alarming increase in the incidence of type 2 diabetes in children and adolescents. It is therefore increasingly likely that diabetic patients will appear for dental and oral maxillofacial surgical treatment in both the office and ambulatory surgery clinic setting. Surgical stress often produces hyperglycemia in the perioperative period. Hyperglycemia has been shown to cause a significant increase in perioperative morbidity and mortality. It is the general consensus that strict glycemic control is beneficial and should be achieved for diabetic patients in the perioperative period. Preoperative, intraoperative, and postoperative management protocols for improved perioperative glycemic control of both type 1 and type 2 diabetics are presented. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:731-7)**

Diabetes mellitus is a significant global public health problem and is a major source of morbidity and mortality in the world today. Type 2 diabetes mellitus is the predominant form of diabetes worldwide and represents approximately 90% of all cases.[1,2] In the United States, the Centers for Disease Control and Prevention reported that 10.3 million people had diabetes in 1997 and estimated an additional 5.4 million people had undiagnosed diabetes mellitus. Furthermore, it reported that direct medical expenditures attributable to diabetes mellitus were 44.1 billion dollars.[3] There is an epidemic of type 2 diabetes mellitus in the world today in both developed and developing countries. Globally, it is expected that the number of people with diabetes will increase from the current 150 million to 220 million by the year 2010, and 300 million by the year 2025.[2] Sex, age, and ethnicity are risk factors for the development of type 2 diabetes mellitus. Women are more likely to develop the disease than men are. The incidence of type 2 diabetes is 7% in persons 45 to 64 years of age, but the proportion increases significantly in persons 65 and older. In addition, ethnicity is a significant factor. Hispanics, Native Americans in the US and Canadia, Pacific and Indian Ocean Islanders, and Australian Aborigines have a much higher incidence than European white populations. There has also been a significant increase in various Chinese groups. Furthermore, in the past decade, there has been an alarming increase in prevalence of type 2 diabetes mellitus in children and adolescents.[4] In the past, it was believed that the overwhelming majority of children with diabetes had type 1 diabetes mellitus, with only 1% to 3% of children considered to have type 2 or other rare forms of diabetes. Today, type 2 diabetes mellitus accounts for up to 45% of new cases worldwide. Concurrent with the increased incidence of type 2 diabetes in children and adolescents is the increased incidence of obesity in this age group. The Surgeon General of the United States reported in the year 2000 that 16% of American youth were categorized as being obese, defined as a body mass index greater than the 95th percentile for age and sex.[5] Researchers from the National Center for Health Statistics compared the incidence of obesity in diabetics (all groups) diagnosed in the year 2002-2003 with that of 1997-1998. They found an increase in incidence in the prevalence of obesity, rising to 59.7% in

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2002-2003 from 51.6% in 1997-1998.[6] There is a strong correlation of obesity and type 2 diabetes mellitus.[7,8] Therefore, it is increasingly likely that maxillofacial surgeons and dentists will be treating diabetic patients. In addition, more and more surgical procedures, both minor and major, are being performed outside the hospital in ambulatory surgery clinics and private offices. It is essential that maxillofacial surgeons and dentists be familiar with the pathophysiology of diabetes mellitus and the management of these patients.

OVERVIEW AND CLINICAL FINDINGS

Diabetes mellitus is a group of metabolic diseases of impaired glucose homeostasis characterized by hyperglycemia as measured by increased fasting plasma glucose and impaired glucose tolerance. Type 1 diabetes mellitus is characterized by immune-based pancreatic beta cell destruction, usually leading to an absolute deficiency of insulin. In type 2 diabetes mellitus, the impaired glucose homeostasis is due to a triad of defects: increased insulin resistance (higher concentration of insulin is necessary to produce the same physiologic effects), defects in insulin secretion by the pancreatic beta cells, and increased endogenous glucose production, primarily by the liver.

Normally, plasma glucose concentration is between 70 and 100 mg/dL before meals and rarely is >140 to 150 mg/dL after meals. The central nervous system is almost totally dependent on glucose as its metabolic energy source. Consequently, severe hypoglycemia can impair brain function and, if prolonged, can cause irreversible brain damage. To protect against this eventuality, a series of homeostatic processes have evolved to prevent hypoglycemia. The control mechanisms primarily involve the neuroendocrine system and in particular the hormones insulin and glucagon; cortisol, growth hormone, and epinephrine play much less important roles. Insulin, produced by the pancreatic beta cells, acts to suppress endogenous production of glucose by inhibiting primarily hepatic glycogenolysis and gluconeogenesis. Insulin also stimulates glucose uptake by components of the splanchnic bed (liver and gut), muscle cells, and adipocytes. Glucagon produced by the pancreatic alpha cells—and to a lesser extent epinephrine, cortisol, and growth hormone—collectively act as counter-regulatory hormones to oppose the effects of insulin.

Surgical procedure and anesthesia cause a neuroendocrine stress response characterized by increased release of the counter-regulatory hormones cortisol, glucagon, epinephrine, and growth hormone. These hormones, by stimulating the processes of gluconeogenesis and glycogenolysis, acutely shift carbohydrate, protein, and fat metabolism to provide increased levels of glucose, which is necessary as a major fuel source to the vital organs.[9-11] In addition, resistance to the effects of insulin increase. Consequently, the diabetic patient has an increased potential of developing hyperglycemia—and even ketosis—in the perioperative period. Diabetic ketoacidosis occurs infrequently in patients with type 2 diabetes mellitus, but hyperglycemic, hyperosmolar, nonketotic states frequently occur, characterized by volume depletion and associated changes in mental status, weakness, hypotension, tachydysrhythmias, and abnormal thermal regulation.[12] Furthermore, hyperglycemia inhibits host defenses against infection by suppressing many leukocyte functions and impairs wound healing due to its detrimental effects on collagen formation.[13-15]

Questions arise for diabetic patients undergoing surgery: (1) Does the perioperative period of transient acute increased insulin resistance and hyperglycemia cause a significant increase in postoperative morbidity and mortality, or are the postoperative complications due primarily to the long-term microvascular and macrovascular diseases caused by the toxic effects of chronic hyperglycemia and increased insulin resistance? (2) Does strict glycemic control reduce the incidence of postoperative morbidity and mortality? Several studies have shown that diabetes is an independent predictor of postoperative myocardial ischemia in patients undergoing a noncardiac surgical procedure and an independent predictor of postoperative pulmonary complications in patients undergoing an abdominal surgical procedure.[16,17] Golden et al.[18] showed that postoperative hyperglycemia was an independent predictor of postoperative infection in diabetic patients undergoing coronary artery bypass surgery. Another study demonstrated that maintaining postoperative blood glucose levels below 200 mg/dL significantly reduced the incidence of wound infections in patients undergoing open heart surgery.[19] Finally, several studies have demonstrated that strict glycemic control improves the outcomes of the patients, reducing perioperative mortality and morbidity in critically ill patients.[20-22] Although still controversial, it is the general consensus that strict glycemic control is beneficial and should be achieved in the perioperative period for diabetic patients.

PREOPERATIVE ASSESSMENT AND LABORATORY TESTS

Perioperative management includes preoperative assessment of the patient. Consequently, management of the diabetic patient undergoing elective surgical procedures begins preoperatively. Potential problems should be identified and corrected or stabilized before the surgical procedure. In addition to serum glucose levels, the percent of glycosylated hemoglobin (HbA1c) test is