The Effects of Correction Insulin and Basal Insulin on Inpatient Glycemic Control

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Hospitalized patients with type 2 diabetes may benefit from tighter glycemic control to prevent hyperglycemia and its complications. The glycemic control of two groups of inpatients with diabetes receiving subcutaneous insulin via a basal-bolus approach or sliding scale was compared.

According to the Centers for Disease Control and Prevention (2011), diabetes mellitus (DM) affects 25.8 million people or 8.3% of the population of the United States, with type 2 DM (DM 2) composing 90%-95% of diagnosed cases. Glycemic control is challenging in healthy individuals with DM, and even more challenging in hospitalized patients. Insulin needs increase during periods of physiologic stress due to acute illness or surgery (Clement et al., 2004).

Because patients' insulin needs often fluctuate during acute illness, insulin dosages should be reevaluated frequently and tailored to meet individual needs (Browning & Dumo, 2004). Adverse outcomes associated with hyperglycemia in the hospital setting include increased rates of nosocomial infection and sepsis, longer periods of time requiring mechanical ventilation, increased risk of mortality after myocardial infarction or cardiac surgery, greater risk of acute renal failure and poor wound healing, and increased length of stay (Thompson, Dunn, Menon, Kearns, & Braithwaite, 2005). Tight glycemic control that is modified daily to match the specific clinical circumstances of each patient can reduce these adverse outcomes significantly (Clement et al., 2004).

Because the goal of glycemic management is to stabilize an individual's metabolism, insulin administration should be modeled after normal pancreatic insulin secretion to include both basal and bolus insulin to control plasma glucose levels for 24 hours (Bethel & Feinglos, 2005). The American Diabetes Association (ADA, 2007) recommends a combination of insulin therapies, including basal insulin, prandial insulin given with meals and adjusted based on bedside glucose results, and correction or supplemental insulin to lower premeal hyperglycemia.

A major barrier to tight glycemic control in the hospital is the potential for hypoglycemia (Cook et al., 2007; Garber et al., 2006; Hassan, 2007). Factors that place the hospitalized patient at risk for hypoglycemia include renal insufficiency, malnutrition, liver disease, sepsis, shock, pregnancy, dementia, congestive heart failure, steroid tapers, reduction of oral intake, interruption of enteral feedings, and inability to report symptoms (ADA, 2007; Braithwaite et al., 2004). Though most episodes of hypoglycemia are avoidable, physicians tend to undertreat hyperglycemia likely due to the potential consequences of severe hypoglycemic reactions, such as seizures, coma, and death (Cook et al., 2007; Garber et al., 2006).

According to the American College of Endocrinology/ADA consensus statement, hypoglycemic events can be avoided through intensive glucose management (Garber et al., 2006). Smith, Winterstein, Johns, Rosenberg, and Sauer (2005) found the most common causes of hypoglycemia were inadequate adjustments of insulin and oral diabetes medications when the patient's oral intake was decreased or altered. Braithwaite and colleagues (2004) suggested hypoglycemic events can be prevented by matching an individual patient's diabetes medication regimen with his or her oral intake, and by monitoring blood glucose diligently. To avoid hypoglycemia, daily assessments and revisions of insulin dosages are required (ADA, 2007; Browning & Dumo, 2004; Campbell & Braithwaite, 2004).

Overreliance on sliding scale insulin (SSI) also contributes to ineffective glycemic control during hospitalization. This therapy can lead to wide variations in blood glucose when it is given without regard to carbohydrate ingestion, previously administered SSI, or the patient's changing metabolic needs (Clement et al., 2004; Magee, 2007). In a review of use of SSI in hospitalized

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Background

Patients with a diagnosis of diabetes mellitus (DM) have more frequent hospital visits and are more likely to have longer hospitalizations than patients without DM. Adverse outcomes associated with hyperglycemia in the hospital setting include increased rates of nosocomial infection and sepsis, and length of stay. Tight glycemic control that is modified daily to match the specific clinical circumstances of each patient can significantly reduce the adverse outcomes patients with DM may experience while in the hospital.

Purpose

The purpose of this study was to describe the glycemic control of two groups of patients diagnosed with DM 2 receiving subcutaneous insulin via two different regimens. One group received correction insulin only via sliding scale, and the other group was treated with basal plus correction insulin. A secondary aim of this study was to describe the proportion of patients from these two groups receiving prandial insulin therapy.

Methods

This study used a descriptive, retrospective design, with 45 subjects enrolled. The main outcome variables were capillary blood glucose (CBG) less than 60 mg/dL (hypoglycemic events), CBG greater than 180 mg/dL (hyperglycemic events), and fasting blood glucose greater than 130 mg/dL (hyperglycemic events). Four blood glucose results were collected for each subject daily for 3 consecutive days.

Results

Twenty-two (49%) subjects received basal plus correction insulin and 23 (51%) received correction insulin only. Ten (22%) subjects in the total sample received prandial insulin therapy. Of 540 CBGs collected from subjects' records, 302 (56%) were classified as hyperglycemic blood glucose events (BGEs). In the basal plus correction insulin group, 185 (70%) of the CBGs were hyperglycemic BGEs, while in the correction insulin group, 117 (42%) of the CBGs were hyperglycemic BGEs. Only 4 (1%) hypoglycemic BGEs were noted.

Discussion

Greater than 50% of the CBGs collected were hyperglycemic, and blood glucose patterns indicated lack of blood glucose control as a problem throughout the day, and not an isolated event. A change in practice is needed for treatment of hospitalized patients with DM 2 that includes basal-bolus insulin therapy using a combination of basal, correction, and prandial insulin prescriptions to improve patients' glycemic control. Furthermore, nurses need to alert physicians to patterns of hyperglycemia so appropriate daily insulin adjustments are made. Nursing education should focus on subcutaneous insulin therapy and carbohydrate counting for the dosing of prandial insulin therapy. Finally, additional research needs to be conducted with medical-surgical patients with DM 2 on the effectiveness of basal-bolus and prandial insulin therapies.

patients, Umpierrez, Palacio, and Smiley (2007) concluded SSI as monotherapy is not associated with improved clinical outcomes. Yet, monotherapy SSI continues to be the most frequently prescribed insulin regimen for hospitalized patients.

Disadvantages of SSI as monotherapy include the failure of the health care provider to administer insulin routinely via a SSI regimen until the patient's capillary blood glucose (CBG) reaches 200 mg/dL, and the patient may experience hyperglycemia for an extended period. Also, SSI orders usually direct a physician to be contacted only after a CBG reaches an extremely high level (e.g., >400 mg/dL). As a result, the patient may experience dangerously high blood glucose for prolonged periods. Further, because SSI is administered only in response to hyperglycemia, it is a reactive approach to glycemic control (Clement et al., 2004).

Also, SSI is contrary to normal pancreatic physiology because it provides no basal insulin and thus promotes labile blood glucose instead of creating a steady state of glycemic control. In their review of the essential components of insulin therapy for hospitalized patients with diabetes, Unger and Marcus (2004) concluded insulin prescriptions should mimic normal physiology and should include basal, correction, and prandial components. Other authors agreed the use of SSI as monotherapy should be avoided because it is often ineffective and can result in a decline in glycemic control (Campbell & Braithwaite, 2004; Golightly, Jones, Hamamura, Stolpman, & McDermott, 2006; Hassan, 2007; Umpierrez, Palacio et al., 2007).

SSI often is not individualized. Preprinted insulin order sets are not tailored to a patient's body size, nutritional status, or home insulin regimen. Hassan (2007) discouraged the use of sliding scale insulin for the hospitalized patient because it is a reactive approach to glycemic control without consideration for the individual's condition, dietary intake, or insulin sensitivity. Hassan promoted the use of a basal-bolus approach, with bolus doses given before meals and adjusted to meet prandial insulin requirements for each meal. Scheduled insulin should be revised to a minimum of once daily, with consideration for the amount of insulin required in the past 24 hours, and the patient's glycemic response and nutritional status (Campbell & Braithwaite, 2004).

Limited research has compared the effectiveness of a basal-bolus insulin approach and SSI. In one of the few studies, Umpierrez, Smiley, and colleagues (2007) compared the effectiveness of two insulin regimens in a sample of medical-surgical patients with DM 2. One group (n=65) received insulin via a basal-bolus approach, with correction insulin given by sliding scale for blood glucose above 140 mg/dL. The other group (n=65) received regular insulin using only a sliding scale approach. Daily adjustments to each patient's insulin regimen were made as needed based on blood glucose measurements.

The majority (n=43, 66%) of patients in the basal-bolus group reached a blood glucose target of less than 140 mg/dL, compared to only 25 (38%) in the sliding scale insulin-only group. The basal-bolus group thus showed significantly greater improvement in glycemic control than the SSI group ($p<0.01$). Patients in the SSI group had higher mean fasting glucose ($p<0.01$), higher mean random glucose ($p<0.01$), and overall higher mean glucose ($p<0.001$) during their hospitalization. Only two patients in the basal-bolus group experienced episodes of hypoglycemia, defined as a blood glucose less than 60 mg/dL (Umpierrez, Smiley et al., 2007).

Schoeffler, Rice, and Gresham (2005) also compared two insulin regimens, one consisting of 70/30 insulin and the other of SSI, in two groups of hospitalized patients with DM 2. The doses of 70/30 insulin were tailored to each patient using an algorithm based on the current blood glucose and the dosage of insulin from the prior day. Patients treated with 70/30 insulin twice daily using the investigational algorithm achieved better glycemic control than those on SSI only ($p=0.042$).

Purpose

Because few studies have addressed tight glycemic control among hospitalized adult medical-surgical patients with DM 2, little is known about the effectiveness of a basal-bolus approach, including basal, correction, and prandial insulin therapies. This retrospective study examined glycemic control in two groups of patients diagnosed with DM 2 who were receiving subcutaneous insulin via two different regimens. One group was treated with correction insulin only via SSI, and the second group was treated with basal plus correction insulin. The proportion of patients receiving prandial insulin therapy also was examined. Records were selected from admissions to a 535-bed hospital that is part of a five-hospital health system located in the southeastern United States.

Methods

Sampling

Following institutional review board and HIPAA waiver approval from The University of North Carolina at Greensboro (NC) and the participating medical center, 90 randomly selected patient records were generated through a computer program that used a list of study inclusion and exclusion criteria. Records included in the study met the following criteria: admission to the hospital within the prior year, history of DM 2, length of stay (LOS) 4 days or greater, current inpatient insulin prescription, current oral diabetic medication prescription, and a diagnostic-related group (DRG) discharge code of selected medical conditions. Included DRG codes were as follows:

- DRG 89 (Simple Pneumonia and Pleurisy age >17 with Complications)
- DRG 121 (Circulatory Disorders with Acute Myocardial Infarction and Major Complications)
- DRG 127 (Heart Failure and Shock)
- DRG 138 (Cardiac Arrhythmia and Conduction Disorders with Complications)
- DRG 143 (Chest Pain)
- DRG 144 (Other Circulatory System Disorders with Complications)
- DRG 277 (Cellulitis age >17 with Complications)
- DRG 294 (Diabetes age >35)
- DRG 320 (Kidney and Urinary Tract Infections age >17 with Complications)
- DRG 576 (Septicemia without Mechanical Ventilation age >17)

Records were excluded from the study for the following reasons: admission for surgical procedure; inpatient prescriptions of steroids, thiazide diuretics, or niacin; receipt of enteral feeding or total parenteral nutrition; diagnosis of renal failure, liver failure, chronic obstructive pulmonary disease, diabetic ketoacidosis, or pancreatitis; admission to an intensive care unit; or inpatient prescription of intravenous insulin.

Data Collection Procedures

Data collected included subject age, weight, height, sex, race, date of admission, LOS, discharge DRG, inpatient oral diabetic medications and insulin prescriptions, blood glucose values, and home diabetic medications. Serial blood glucose data were collected over 3 consecutive days. All data were collected through retrospective chart reviews using an electronic chart documentation system. Blood glucose data were collected from the point-of-care testing database.

Variables

The main outcome variables were CBG results less than 60 mg/dL (hypoglycemic event), CBG greater than 180 mg/dL (hyperglycemic event), and fasting blood glucose (FBS) greater than 130 mg/dL (hyperglycemic event). According to the 2007 ADA Standards of Medical Care, pre-meal CBG in the non-critically ill medical-surgical patient should be 90-130 mg/dL, and postprandial CBG should be less than 180 mg/dL. In the current study, CBG less than 60 mg/dL was classified as a hypoglycemic event because it required treatment with a glucose source according to the hypoglycemia protocol used in the study institution.

FBS was recorded as the blood glucose from the morning laboratory blood sample collected from 4 to 7 a.m. or the first CBG collected before patient meal trays arrived on the nursing units. If a subject had a FBS value recorded, no pre-breakfast CBG was recorded. Only scheduled CBGs drawn before each meal and at bedtime were collected, for a total of four CBGs per day. Subjects' medical records with CBG prescriptions of every 4-hour or every 6-hour intervals were not included in the study, because these intervals did not coincide with meal times. Blood glucose events (BGE) were recorded as the number of hypoglycemic and/or hyperglycemic events per day. Data were collected for 3 days, beginning with the pre-breakfast CBG on the first day after insulin was ordered. Study data were analyzed using descriptive, t-test, and chi-square statistics.

Results

Sample Characteristics

From the original 90 medical records sampled and reviewed, 45 records met all study inclusion criteria. A total of 23 (51%) were in the group receiving correction insulin only, and 22 (49%) were in the group receiving basal plus correction insulin. Ten (22%) subjects received prandial insulin therapy during the 3-day study period. Of those, two (4%) received prandial insulin on days 2 and 3, and eight (18%) received prandial insulin all 3 days.

Subjects' age range was 30-70, with a mean of 55.6 years. Most subjects (n=28, 62%) were White, 16 (36%) were Black, and 1 (2%) was Asian. The majority (n=25, 56%) was female. The mean hospital LOS was 6.6 days, with a range of 4-19 days. A review of home diabetes medications revealed 14 (31%) subjects were prescribed insulin, 33 (73%) took one or more oral DM medications, 6 (13%) received both insulin and oral DM medications, and 4 (9%) took neither. The five most common discharge DRGs were heart failure and shock (n=10, 22%), cellulitis age over 17 with complications (n=8, 18%), kidney and urinary tract infections age over 17 with complications (n=7, 16%), diabetes age over 35 (n=6, 13%), and simple pneumonia and pleurisy age over 17 with complications (n=4, 9%). The groups did not differ significantly on age, hospital LOS, or body mass index.

Glycemic Control

A total of 540 CBGs were recorded, with 302 (56%) classified as hyperglycemic BGEs (see Table 1). Of these, 79 (15%) were greater than 250 mg/dL, 30 (6%) were greater than 300 mg/dL, and 10 (2%) were greater than 400 mg/dL. Only 4 (1%) of the CBGs were hypoglycemic, with levels of 33 mg/dL, 53 mg/dL, 57 mg/dL, and 58 mg/dL; all of these values occurred in the correction insulin group. Comparison between groups revealed the correction insulin group had significantly fewer hyperglycemic BGEs than the basal plus correction group ($p<0.01$), and no significance between groups was found for hypoglycemic events. Only three (7%) subjects in the total sample did not experience a BGE during the data collection period.

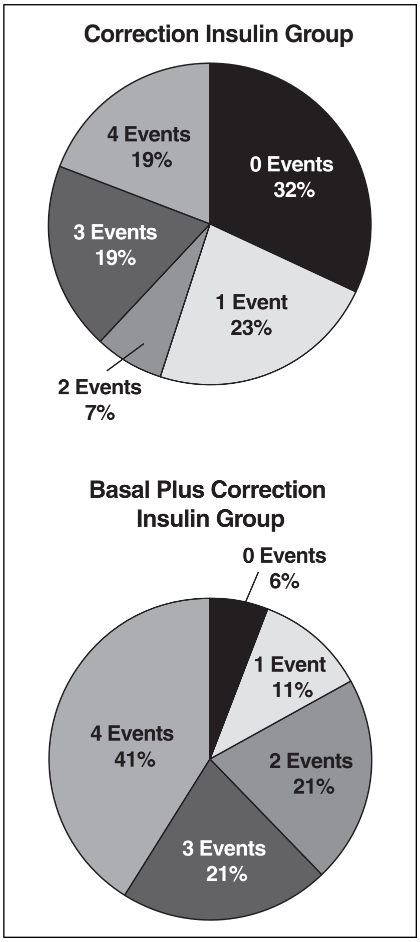
TABLE 1.
Frequency and Percentage of Blood Glucose Events

	SSI (n=23) (CBG = 276)	Basal + SSI (n=22) (CBG = 264)	Total Sample (N=45) (CBG = 540)
BGE (Hypergycemia)	117 (42%)	185 (70%)	302 (56%)
BGE (Hypoglycemia)	4 (2%)	0	4 (1%)

A total of 276 CBGs were collected from the group who received correction insulin only. Of those, 117 (42%) were hyperglycemic BGEs. See Figure 1 for the percentage of BGEs per day in the four daily CBGs (one event per day, two events per day, etc.). A majority of the BGEs for this group (n=38 events, 55%) were categorized as one event or less per day, indicating very good glycemic control, and 26 (38%) of the BGEs were three or four events per day.

A total of 264 CBGs were collected in the basal plus correction insulin group. Of these, 185 (70%) were hyperglycemic BGEs. The largest proportion of BGEs was four events in a day (n=27, 41%), indicating glycemic control was not achieved throughout the entire day. BGEs occurring two or three times a day were also common, representing 28 (42%) of the BGEs in this group. No hypoglycemic BGEs were recorded for the basal plus correction insulin group.

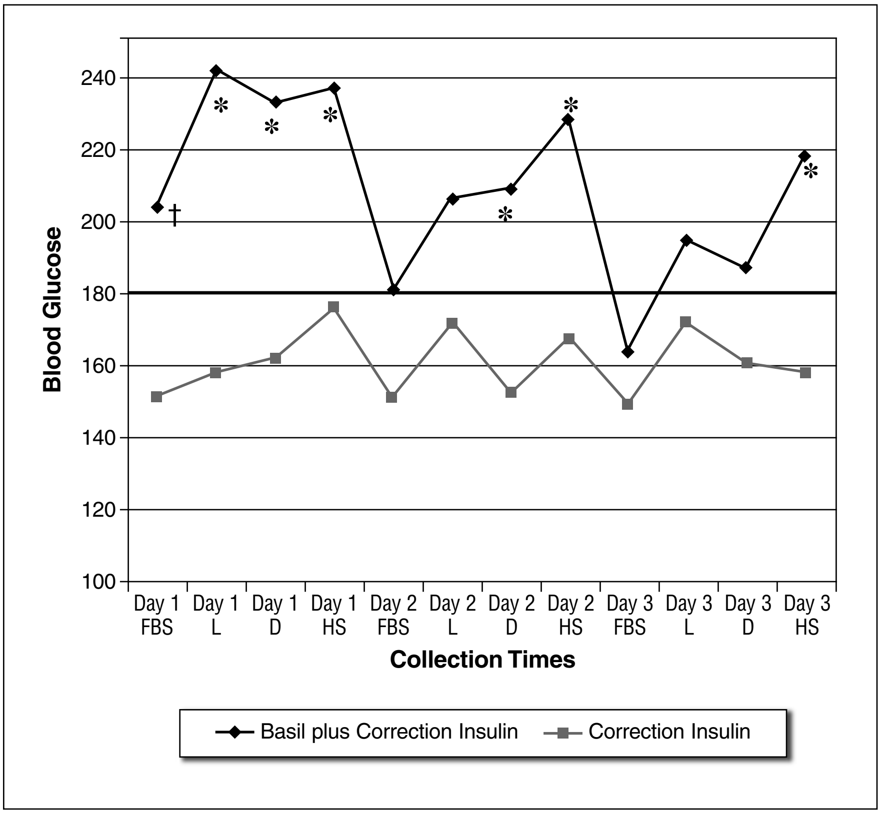
FIGURE 1.
Percentage of Blood Glucose Events per Day



Comparisons using chi-square analysis determined the groups had significantly different distributions of BGEs per day ($p<0.01$) (see Figure 1). The group with correction insulin only had a much smaller percentage of four BGEs per day (n=13, 19%), as compared to the group with basal plus correction insulin (n=27, 41%). The latter group also had a comparatively low occurrence of 1 or fewer BGEs per day (n=11, 17%), indicating poorer glycemic control.

Average blood glucose values for each collection time were determined for each group (see Figure 2). On average, blood glucose values were consistently higher in the basal plus correction group than in the correction insulin group, and the majority of the mean values was signifi-

FIGURE 2.
Average Blood Glucose Values for Each Group



FBS = Fasting Blood Sugar; L = Lunch; D = Dinner; HS = Hour of Sleep
Significant difference between groups: † ($p < 0.05$) ✻ ($p < 0.01$)

cantly higher ($p<0.01$). Average CBGs for the basal plus correction insulin group were quite labile, with a range of 164-242 mg/dL. A general pattern of increasing glucose levels was noted each day, with sharp declines in the overnight period. A significant decrease in average FBS was noted in this group between days 1 and 3 ($p<0.05$). Average blood glucose values for the group receiving correction insulin showed less lability with fluctuations around 160 mg/dL. No significant change in average FBS values was noted in that group.

Discussion

Despite literature that supports the use of a basal-bolus approach to insulin therapy, basal insulin was ordered for only 49% (n=22) of this sample, and only 22% (n=10) of subjects received prandial insulin therapy. Of those, two subjects received prandial insulin on days 2 and 3, and eight subjects received prandial insulin all 3 days of data collection. Clearly, it was not routine practice to prescribe basal or prandial insulin therapy, even when subjects' CBGs warranted additional insulin therapy.

One of the most problematic findings was the high incidence of hyperglycemia despite insulin therapy. Over 50% of the total CBGs recorded represented hyperglycemia according to ADA (2007) standards. Approximately 22% (n=119) of the CBGs were above 250 mg/dL. Furthermore, 40 (30%) of the BGEs for the sample were 4/4 events, indicating lack of blood glucose control was a problem throughout the day and not an isolated event. This finding is cause for concern because of the many adverse consequences associated with hyperglycemia. Not only are patients with uncontrolled blood glucose levels at risk for higher rates of infection, sepsis, cardiac mortality, atrial fibrillation, and prolonged LOS, but they are also at risk for higher rates of morbidity and mortality (Campbell, 2007; Thompson, Dunn, Menon, Kearns, & Braithwaite, 2005). These findings suggest improvement is needed in follow-up and daily adjustments to insulin regimens, in addition to a change in practice to promote the prescription of basal and prandial insulin therapy.

The high incidence of hyperglycemia reported here is similar to other findings in the literature. Penfold, Gouni, Hamilton, Richardson, and Kerr (2008), for example, found treatment of hyperglycemia in patients with DM 2 was suboptimal throughout hospitalization owing to physicians' lack of intensive glucose management, lack of awareness of the importance of treating hyperglycemia, and lack of consensus among junior medical staff on treatment options. Cook and colleagues (2007) also found a high incidence of inpatient hyperglycemia attributable to frequent use of short-acting insulin and suboptimal intensification of insulin therapy.

The group receiving basal plus correction insulin had a higher incidence of hyperglycemia, with 70% (n=185) of blood glucose values classified as hyperglycemic events compared to 42% (n=117) in the group receiving correction insulin. This difference could be explained by a difference between groups in the severity of diabetes. In the basal plus correction insulin group, 55% (n=12) of the subjects received insulin therapy at home, and 27% (n=6) of these subjects received both insulin and oral DM medications at home. Only 9% (n=2) of the correction insulin group received home insulin and 83% (n=19) of these were on oral diabetic medications. However, subjects in the correction insulin-only group required insulin in the hospital, indicating illness and possibly stress from hospitalization were worsening glycemic control and requiring subcutaneous insulin therapy. Further, subjects treated with correction insulin only had a high rate of hyperglycemia, indicating they needed additional insulin therapy in the form of basal and possibly prandial insulin. Umpierrez, Smiley, and colleagues (2007) found insulin-naïve patients with DM 2 experienced greater glycemic control with the addition of basal insulin than patients who only received SSI as monotherapy. Clearly practitioners need to re-evaluate and adjust patients' insulin regimens frequently to meet their changing metabolic needs during hospitalization.

In this study, a trend of increasing blood glucose during the day was noted in both groups, but was more pronounced in the basal plus correction insulin group. These patients may be good candidates for prandial therapy, which is dosed according to carbohydrate intake at each meal. The overall blood glucose values for the basal plus correction insulin group declined over the study period, suggesting this approach may have increasing effectiveness over several days. However, these individuals could benefit from an increase in the intensiveness of insulin regimens during the first few days of treatment, with daily adjustment as glycemic control is achieved. Intensification of therapy also may be necessary in the correction insulin group because more than 40% of blood glucose results recorded in this group were also hyperglycemic. For the basal plus correction insulin group, intensification of therapy could include increasing basal doses or adding prandial insulin. The correction-only group may benefit from the addition of a basal dose to their insulin regimens.

Hypoglycemia was an isolated event that occurred only in the correction insulin group. The addition of basal insulin did not place subjects at higher risk for episodes of hypoglycemia. These findings thus support the conclusions of several authors that the fear of causing hypoglycemia when basal insulin is used is unfounded (Cook et al., 2007; Garber et al., 2006; Hassan, 2007). However, consistent with the views of other researchers, all insulin regimens should be monitored closely and adjusted daily to prevent hypoglycemic events (Browning & Dumo, 2004; Campbell & Braithwaite, 2004; Clement et al., 2004; Hassan, 2007).

Study Limitations

This retrospective descriptive study had several limitations, the first of which was the sample size. Initially 90 patient records were selected randomly, but only 45 records met the study inclusion criteria. Records eliminated from the study might have shown different results in regard to glycemic control. Also, subjects were prescribed various oral medications, including sulfonylureas, biguanides, and thiazolidinediones, during hospitalization, and these various medications may have affected the CBG results. In addition, subjects had varying levels of severity of diabetes and differing admitting diagnoses, which could have affected their glycemic control. Other unmeasured variables that could have influenced subjects' blood glucose control included preexisting co-morbidities and physiologic stress during hospitalization. Despite the study limitations, the findings have important implications for nursing practice.

Implications for Nursing Practice and Research

Once a patient experiences hyperglycemia, nurses must alert the attending physician in a timely fashion and obtain appropriate insulin orders. Nurses should be aware of and report the patterns of hyperglycemia a patient experiences so the physician can make appropriate insulin adjustments. Sustained hyperglycemia may warrant the addition of basal insulin to the patient's medication regimen. Nurses also should be aware of situations that may place the hospitalized patient at risk for developing hyperglycemia (e.g., stress, high-dose steroids, and severe infection) (Clement et al., 2004). In addition, nurses should be aware of the potential for hypoglycemia and promptly alert physicians when episodes occur so insulin adjustments can be made. Nurses also should advocate for the prescription of basal-bolus insulin therapy instead of the use of SSI as a monotherapeutic approach to glycemic management.

Nurse educators should focus on the importance of subcutaneous insulin therapy for hospitalized patients with DM 2. Often staff nurses use their own judgment when deciding whether to give or hold a dose of insulin. Nurses may hold a dose of subcutaneous insulin when a patient is receiving nothing by mouth, has a poor appetite, or has a CBG within the normal range because of concern about hypoglycemia. However, the decision to hold insulin can lead to sustained levels of hyperglycemia throughout the day. To improve nurses' knowledge of glycemic management, nurse educators can teach them about the different types of insulin prescribed in the hospital. If nurses are knowledgeable about the profiles and purposes of the various types of insulin available, adverse patient outcomes may be avoided and glycemic control improved (Derr, Sivanandy, Bronich-Hall, & Rodriguez, 2007).

Nurses and nurse educators also could help improve glycemic control in hospitals with greater knowledge of carbohydrate counting. Many nurses do not feel confident dosing prandial insulin based on their assessment of a patient's carbohydrate consumption, and many physicians omit meal coverage insulin. Nurse educators can provide education to nurses and physicians about carbohydrate counting, which may in turn encourage physicians to order prandial insulin therapy more frequently (Magee, 2007).

Future research should focus on how and why nurses decide to hold subcutaneous insulin, and how nurse educators can help change this practice. While studies have reported the benefits of tight glycemic control for critically ill patients (Furnary et al., 2003; Horst et al., 2010; Krinsley 2004; Van den Berghe et al., 2003), little recent research has examined the benefits of tightly controlled blood glucose for hospitalized medical-surgical patients with DM 2. Only two studies have compared the effects of SSI regimens to other, more proactive insulin regimens on blood glucose control in medical-surgical patients with DM 2 (Schoeffler et al., 2005; Umpierrez, Smiley et al., 2007).

Nursing research on type 2 diabetes is focused frequently on the role of the diabetes nurse specialist (Carey, Courtenay, James, Hills, & Roland, 2008), nursing diabetes management in primary care (Davidson, Blanco-Castellanos, & Duran, 2010), and glycemic control behaviors of individuals with diabetes (Shi, Ostwald, & Wang, 2010). Additional nursing research is needed on various types of medical-surgical patients with DM 2 as well as effective measures to improve glycemic control in the hospital setting. The findings of this study revealed blood glucose control in a selected group of medical-surgical patients was poor; insulin therapies need to be intensified and adjusted more frequently to obtain better glycemic control and ultimately better health outcomes for hospitalized individuals with diabetes. MSN

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