Glucose management… a "must have"

Computerized software systems help boost outcomes, reduce costs.

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Glucose fluctuations, hypoglycemia, and hyperglycemia all contribute to adverse outcomes in hospitalized patients, including increased mortality, morbidity, and length of stay (LOS).[1-7] The effects of dysglycemia also increase costs to hospitals when patients require more intensive care or longer hospital stays.[6] It may be obvious that patients with diabetes are at risk, but a retrospective review in an Atlanta community hospital showed that newly diagnosed diabetes was an independent risk factor for morbidity and increased hospital LOS, and carried a higher admission rate to the ICU.[8]

Patients whose glucose levels fluctuate as a result of surgery or other trauma may also have compromised outcomes.[8-10] Hyperglycemia in the hospital is common and, whatever its etiology, associated with poor outcomes.[11] One analysis showed that prevalence of hyperglycemia was 46% for patients in the ICU and 31.7% for non-ICU patients.[12] Careful glucose management may help reduce the clinical and financial impact of impaired glycemic control.

United Regional Health Care System

United Regional Health Care System (URHCS) is the major hospital in Wichita Falls, Tex., with 325 beds and a full range of services, including a Lead Level III trauma center, a 16-OR surgical suite, and Joint Commission-certified primary stroke and wound-care centers. As an active community participant, URHCS offers education programs for breast cancer awareness, a child passenger safety check, health screenings for seniors, and numerous other services. State-of-the-art surgical, information (including computerized provider order entry, knowledge-based medication administration, and knowledge-based charting), and diagnostic technology are integral to enhancing the quality of patient care at this institution. In keeping with that philosophy, administrators decided to implement a computerized glucose management software system (CGMSS) to help reduce the incidence of surgical site infections (SSIs) and improve glucose control, especially among the coronary artery bypass graft (CABG) and valve repair/replacement surgery population.

For patients receiving I.V. insulin, the CGMSS uses mathematical modeling to automatically individualize dosing. The computer software calculates the appropriate insulin infusion rate based on a patient's previous four blood glucose readings and the rate of change of blood glucose concentrations. These calculations are repeated by the software every 30 minutes to 2 hours (depending on the pattern of glucose levels), which results in a patient-specific, physiologic, insulin-dosing curve that helps minimize episodes of hyperglycemia and hypoglycemia. Calculation errors are reduced, as are the time and effort required for effective glucose management.[13]

The CGMSS was implemented in April 2008 in the ICU, CCU, and step-down/transitional care units. To determine the effectiveness of the system in achieving the institution's goals, the hospital maintained and analyzed detailed records about its use. This included hypoglycemia and hyperglycemia rates, incidence of SSIs, and patient glucose control throughout the perioperative period.

Before the CGMSS

Until June 2007, URHCS used a sliding scale protocol to monitor glucose levels in CABG and valve repair/replacement patients. The average overall blood glucose for this population was 154 mg/dL during this time, and patients were on insulin for an average of 16 hours postoperatively. From July 2007 to April 2008, blood glucose management was conducted using a paper protocol. The average blood glucose level was 132 mg/dL in CABG/valve patients receiving insulin infusion therapy (of these, 37.6% were diagnosed with diabetes); these patients spent an average of 34 hours receiving insulin therapy.

From April 2008 to June 2012

Physicians at URHCS are committed to patient safety and were early adopters of the CGMSS. The paper protocol was labor-intensive for nurses and subject to calculation errors, which prompted nurse management to champion CGMSS implementation as well. A multidisciplinary team that included a diabetes clinical nurse specialist, pharmacist, physicians, and nurses created the new protocols, and nurses received about 4 days of training with the new system, which was piloted in the ICU/CCU and step-down units in CABG/valve patients. Although not everyone initially perceived the need for improved glucose management, the system was well received after it was in place.

Since April 2008, in the ICU, CCU, and step-down units, the new software has been effective in reducing the incidence of SSIs among 777 CABG/valve procedures. (From implementation through June 2012, there have been only two cases of mediastinitis (0.26%). No new deep sternal wound infections have been reported since May 2011. The average glucose levels taken at 6 a.m. on postoperative day (POD) 1 among this patient group dropped from 154 mg/dL to 120 mg/dL. Average levels at 6 a.m. on POD 2 dropped from 157 mg/dL to 112 mg/dL.

Average overall blood glucose level (from admission to discharge, including time on the CGMSS) in these patients has decreased from 156 mg/dL to 135 mg/dL. Since implementation, patients "in range" (70 to 180 mg/dL) increased from 72.7% to 86.1%. The overall rate (from admission to discharge) of hyperglycemia (more than 180 mg/dL) decreased from 26.6% to 12.4%. The time on insulin treatment increased from 16 to 56.7 hours. This is likely due to the ability of the CGMSS to tightly control glucose levels while patients receive the insulin therapy they need, and is consistent with the recommended time on a CGMSS of at least 48 hours postoperatively.[14] Although there was an increase in the overall rate of clinical hypoglycemia (less than 70 mg/dL) from 0.6% to 1.2%, this is likely reflective of the closer scrutiny available with the CGMSS and with the significant increase in the patient population evaluated (from 107 to 777 patients). The Texas Medical Foundation's Health Quality Institute has recognized URHCS as one of the top 10% of hospitals in the state with effective glucose management protocols.

January to June 2012

Because of the positive experience with the CGMSS in the CCU, ICU, and step-down units, the software system was implemented on January 16, 2012, in the hospital's progressive care unit (PCU). Admission criteria for the PCU include patients with mild diabetic ketoacidosis, systemic inflammatory response syndrome (SIRS), simple hyperglycemia, and similar conditions. Close monitoring of glucose levels was undertaken from that date to July 16, 2012. Among PCU patients (n = 95, those who qualified for the CGMSS) the rate of hypoglycemia (less than 70 mg/dL) decreased from 3.9% of patients to 0.74% postimplementation, and the rate of severe hypoglycemia (less than 50 mg/dL) decreased from 0.9% to 0.09%. The percentage of patients "in range" (70 to 180 mg/dL) increased from 70.8% to 81.2%. Average time to goal range (less than 140 mg/dL) was 4.9 hours with the CGMSS. Using a PCU sepsis/SIRS protocol and the CGMSS, the mortality was 0.9% (excluding those who expired under hospice care, with a rate of 5.5%).

For the 3 months before the use of the CGMSS, the overall mean glucose level for the first 24 hours after the initiation of the PCU sepsis protocol was 157

mg/dL, when glucose levels were primarily dealt with reactively and inconsistently from physician to physician. The mean glucose level within the first 24 hours of protocol initiation dropped to 147 mg/dL in the first 3 months after CGMSS implementation. This is especially noteworthy because the CGMSS isn't initiated in PCU patients until blood glucose levels reach 150 mg/dL. Using a standardized screening tool (PCU sepsis bundle orders) to identify appropriate patients, the CGMSS helps reach and maintain the target glucose levels much faster than previously. Ultimately, this helps decrease overall LOS as shown by the 95 patients in this evaluation who avoided an ICU/CCU visit or prolonged LOS on a medical-surgical unit due to sepsis/SIRS.

Cost containment

Costs are an important part of every institution's management concerns. With the new software, savings were calculated at more than $91,136 in the PCU over the 6-month evaluation period. The overall savings were based on a comparison of the ICU/CCU bed and nursing costs, which is where the PCU patients would previously have been admitted.

Another reason for close glucose management: As of July 31, 2008, hospital-acquired manifestations of poor glucose control, which are considered a preventable events, will no longer be covered by the Centers for Medicare and Medicaid Services. This is based on the view that effective glucose management can be achieved with evidence-based guidelines and sound medical practice in the hospital setting.[15] A CGMSS can help avoid the costs of poor glucose control in hospitals.

Future plans

The CGMSS has been enthusiastically received by the nurses and physicians at URHCS. The institution is pleased with the improved outcomes in at-risk patients, and with the ease with which data can be collected and analyzed to influence patient management. Other units in the institution have observed the results that have been achieved so far and are interested in adding the system to their capabilities. ■

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