Improving Accuracy and Safety of Inpatient Hypoglycemia Workup

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Problem Definition

Glucose metabolism is a complex process consisting of several physiologic mechanisms that function to regulate serum glucose levels and maintain them within a fairly narrow range in healthy individuals. Hypoglycemia is characterized by a reduction in plasma glucose concentration to a level low enough, typically less than 60 mg/dL, to cause symptoms or systemic effects, classically adrenergic stimulation or altered mental status. Hypoglycemia is most frequently seen in patients with diabetes following insulin injection or intake of oral hypoglycemic agents. In the patient without diabetes, hypoglycemia is much less common and often warrants further investigation to determine the cause.

Hospitalized patients are high risk for hypoglycemia because acute and chronic illness can cause altered counterregulatory responses and the development of life-threatening sequelae. Controlling blood glucose in hospitalized patients is important as both hyperglycemia and hypoglycemia are associated with increased cost, length of stay, morbidity and mortality. Avoidance and recognition of hypoglycemia is essential to patient safety and studies have confirmed higher mortality rates with spontaneous rather than iatrogenic hypoglycemia. Therefore, hypoglycemia of unclear cause may be viewed as a biomarker systemic disease and mandates appropriate investigation to determine the etiology.

Aims For Improvement

It is the aim of our quality improvement project to create a standardized method to appropriately assess and treat hypoglycemia in the inpatient setting such that the needed components of the diagnostic evaluation can be obtained in an expedited, cost-effective and patient safety-oriented manner. We plan to design of an inpatient hypoglycemia order set which can be used as an easily accessible reference and clinical tool.

Intervention

In reviewing data from hypoglycemia evaluations performed within our institution it is appears that the workup is often incomplete or yields uninterpretable results.

While this data is limited and represents a very small subset of patients, it is supportive of the need for a standardized institutional 'hypoglycemic diagnostic protocol' that will allow for staff to obtain all relevant laboratory data needed to complete the diagnostic workup without delaying treatment. We are confident that implementation of this simple, user-friendly and cost-effective protocol will lead to improved patient outcomes and institutional quality measures.

Measurement and Results

In review of charts of 11 patients recently admitted to Thomas Jefferson University Hospital (TJUH) for whom a complete biochemical evaluation of hypoglycemia was obtained:

- 2/11 (18%) of evaluations yielded clinically significant data, 82% of initial testing was inconclusive (Fig 1.)
- 1/11 (9%) of patients for whom the workup was performed had true hypoglycemia (<60ngdL)
- 4/11 patients (36%) lacked confirmatory blood glucose levels (Fig 2)

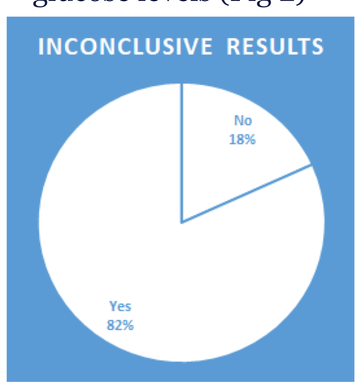

Fig 1.

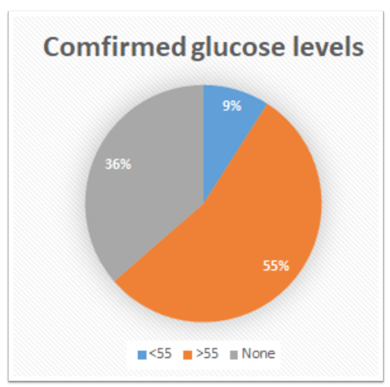

Fig 2.

- In almost half of all cases, testing had to be repeated. (Fig 3.)

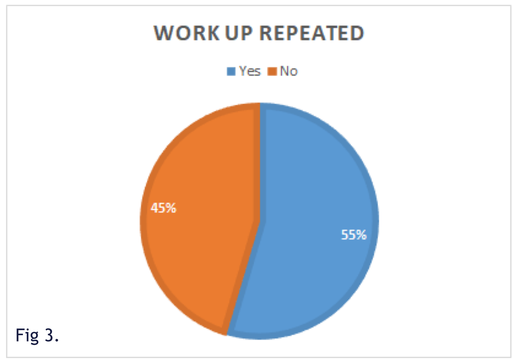

Fig 3.

Next Steps and Lessons Learned

To improve patient safety and diagnostic value of testing, we propose a provider-driven protocol for testing needed in evaluation of true hypoglycemia. The narrow investigative window in such instances, while blood glucose is still low prior to temporizing measures, often limits the opportunity to obtain the appropriate diagnostic testing. It is critically important to confirm that the plasma glucose is indeed low (<60 mg/dL). Serology for additional testing should be obtained simultaneously for use/analysis if hypoglycemia is confirmed. Whipple's triad of low plasma glucose, symptoms of hypoglycemia at the time of the low glucose, and symptom relief with treatment of hypoglycemia should also be confirmed on all patients.

Such additional laboratory testing is directed at evaluation for potential hormone and metabolic imbalances, toxic ingestions, and/or enzymatic defects. This can be done via immediate blood draw of at least two gold-top tubes and labs ordered via protocol (as below).

<u>Advanced testing, as included in our proposed order set, should include the following:</u>

- **Basic Metabolic Panel** (plasma glucose, electrolytes)
- **Plasma insulin levels, Pro-insulin levels, C-peptide levels**
- **Serum lactate and ketones (**beta-hydroxybutyrate where available), **Urine ketones.**
- **Thyroid, adrenal** (random cortisol), **liver function tests**
  - We recommend obtaining both **TSH and Free T4**
  - **Cortisol** level at the time of hypoglycemia is appropriate if >14 mcg/dL
- **Spot sulfonylurea screen** (send out)
- **Toxicology screen** (UDS, ethanol, salicylates), as appropriate.