

Founder's Fund Grant Application 2013-2014

Investigators:

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Title of Project: Teaching residents how to diagnose, treat, and manage pediatric patients with diabetic ketoacidosis using simulation based education

Specific Goals/Aims:

- 1.) Understand the pathophysiology of DKA and incorporating this into the management of DKA
- 2.) Provide a standard consensus for the diagnosis, treatment and management of DKA
- 3.) Provide the residents the opportunity to manage a patient with DKA in a controlled setting
- 4.) Educate residents on the potential complications that can arise during the treatment of DKA and how early recognition of these can decrease morbidity and mortality

Background:

Diabetic ketoacidosis (DKA) is a severe, potentially life threatening condition that can be seen in patients with both Type 1 diabetes and Type 2 diabetes (1-5). It results from a lack of insulin or a relative deficiency of insulin which occurs in patients who are newly diagnosed or do not take their prescribed insulin properly (3-5). Additionally, illness, trauma, or stress can increase the risk of DKA in patients with diabetes (3,4). When there is a lack of insulin or severe stress in combination with a relative lack of insulin, counterregulatory hormones including cortisol, glucagon, catecholamines, and growth hormone increase leading to an accelerated catabolic state. During this time, there is increased glucose production in the liver and kidney and impaired utilization of peripheral glucose causing hyperglycemia and hyperosmolarity. In addition, there is increased utilization of fats and protein (1-5). Lipolysis leads to the increased production of ketones including beta hydroxybutyrate and acetoacetate (3,5,6). This leads to ketosis and an anion gap metabolic acidosis. The combination of ketonemia and hyperglycemia leads to an osmotic diuresis, dehydration, and electrolyte abnormalities. If this is allowed to continue, these complications can become fatal (3,5,8). Fortunately, if treatment including insulin, electrolyte replacement, and fluids are administered appropriately, the catabolic process can be reversed and homeostasis restored (1,3,5).

DKA occurs in approximately 29% of patients with new onset diabetes mellitus (DM) Type 1 and in 10% of patients with new onset diabetes mellitus (DM) Type 2. The risk of DKA in established patients with Type 1 diabetes mellitus is 1-10% per patient per year (3,4). Mortality related to DKA has improved in the last several decades and is approximately 0.15 to 0.30%(5). The most likely cause for mortality is

reported as cerebral edema with 60-90% of DKA deaths related to this cause (5). However, there are other complications that can also increase morbidity and mortality. These complications and cerebral edema can occur upon presentation and during the management of DKA. Other problems include severe electrolyte abnormalities including hyperkalemia, hypokalemia, hypophosphatemia, hypoglycemia, peripheral venous thrombosis, rhinocerebral or pulmonary mucormycosis, pulmonary edema, ARDS, rhabdomyolysis, acute renal failure and acute pancreatitis (5,6). Early recognition of these conditions and appropriate administration of therapy can help decrease the consequences of these complications.

From November 2011 – October 2012, pediatric endocrinology at Children's of Alabama evaluated 1,991 children with Type 1 diabetes and 288 children with Type 2 diabetes. Of these patients, 217 patients were new onset diabetics. This demonstrates the need for physicians to be able to recognize, diagnose and manage children who present with DKA. Residents also care for these patients in a variety of settings including inpatient, the emergency department, and the intensive care unit. Currently, resident education for the diagnosis, treatment, and management of a child with DKA consists of lectures, reading articles, and informal instruction from senior pediatric residents or pediatric faculty. Medical education literature suggests simulation based learning is an effective hands-on learning tool, but it has not been used extensively to teach residents how to manage children with DKA (7,8). This project will allow residents the opportunity to diagnose, treat, and manage a patient in DKA using a standardized simulation programmed by the simulation center. IRB approval will be sought for this project as well.

Description of Project:

Residents on their pediatric endocrinology rotation will participate in the simulation exercise. The case will involve a new onset diabetic who is in DKA with hyperglycemia, acidosis, and ketosis. At this point residents will have to diagnose the patient and begin initial treatment as well as a plan for further evaluation during the course of treatment including medications and labs. During the course of treating the patient, the resident will have to decide on how to manage labs or clinical changes that occur. Once the patient has met criteria for transitioning, the resident will then safely transition the patient off the insulin drip. Following the case, there will be resident centered debriefing covering key points in the diagnosis, treatment, and management of DKA.

Outcome Measures:

The effectiveness of the simulation based education will be measured based on a pre- and post-test. The post-test will be given immediately after and 3 months after completion of the simulation to assess retention of knowledge. The outgoing 3rd year residents will perform this test as well as a control group using the current method of education as described above. The residents will be asked to perform the pre-test prior to their endocrine rotation. The test has been attached for your reference (Appendix A).

Significance of Project to Pediatric Education:

This project has several benefits to resident education. It will give residents the opportunity to better understand the pathophysiology behind DKA, which in turn lets them better understand the important

challenges in managing these patients. In addition, this simulation experience will offer residents a generally accepted consensus on the diagnosis and treatment of this condition. Residents will have the opportunity to have structured education during their pediatric endocrinology month. Most importantly, residents will better understand how to care for a complex, significantly ill child. Ultimately, better understanding of this condition's management and potential complications will lead to improved patient outcomes.

Proposed Detailed Budget of Project:

Item	Estimated Cost
Supplies	\$500
Study Coordinator	\$450
Poster Production	\$50
Total	\$1000

References:

1. American diabetes association. Hyperglycemia crises in diabetes. *Diabetes Care* 27; sup 1 (2004): S94-S102.
2. Klein, M., et. al. Recent Consensus statements in pediatric endocrinology: a selective review. *Pediatr Clin N Am* 58 (2011) 1301-1315.
3. Rewers, A. Current controversies in treatment and prevention of diabetic ketoacidosis. *Advances in Pediatrics* 57 (2010) 247-267.
4. Sherry, N. and L. Levitsky. Management of diabetic ketoacidosis in children and adolescents. *Pediatric Drugs* 10 (2008) 209-215.
5. Wolfsdorf, J. et. al. ISPAD clinical practice consensus guidelines compendium: Diabetic ketoacidosis in children and adolescents with diabetes. *Pediatric Diabetes*. 10; sup 12 (2009): 118-133.
6. Rosenbloom, A. The management of diabetic ketoacidosis in children. *Diabetes Ther* (2010) 1(2): 103-120.
7. Grant, S. and S. Marriage. Training using medical simulation. *Arch Dis Child*. (2012) 97(3):255-9.
8. Weinberg, E. et. al. The use of simulation for pediatric training and assessment. *Curr Opin Pediatr*. 2009 Jun;21(3):282-7

