



Pediatric Clips

*Management of diabetic ketoacidosis –
Amit Vobra, MD*

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Pediatric Clips from The Children's Medical Center of Dayton are quick reviews of common pediatric conditions.

Dayton Children's is the region's pediatric referral center for a 20-county area. As the only facility in the region with a full-time commitment to pediatrics, Dayton Children's offers a wide range of services in general pediatrics as well as in 35 subspecialty areas for infants, children and teens. We welcome your inquiries about services available – call 937-641-3666 or e-mail marketing@childrensdayton.org.



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CASE

A five-year-old previously healthy girl presented to an outside emergency room unresponsive and dehydrated. She was given an intravenous fluid bolus, urgently in-

tubated and then transported to The Children's Medical Center of Dayton for admission to the pediatric intensive care unit. The child's parents reported that she had been evalu-

ated for vomiting and abdominal pain on two recent occasions and treated symptomatically. She had a weight loss of ten pounds.

CASE DISCUSSION

TREATMENT

Her blood glucose level was 1748 mg/dl, blood urea was 88 and creatinine 3.3. Her blood gas pH was 6.99 with a base deficit of minus 28. In the intensive care unit, she received insulin drip and IV fluids titrated to allow a controlled decline of the blood glucose. She was extubated successfully when her mental status improved. Her acidosis, hyperglycemia, dyselectrolytemia and dehydration improved after two days of intensive treatment. The diabetes care team provided further care and education for new onset diabetes.

DISCUSSION

Diabetic ketoacidosis (DKA) is a life-threatening manifestation of severe insulin deficiency in type 1 diabetes. In children without a history of diabetes, the early symptoms of hyperglycemia such as polyuria, polydipsia and weight loss are often not recognized, leading to a delay in diagnosis. Too often, an illness such as pneumonia, reactive airway disease or viral syndrome is the incorrect presumption and subsequently the child presents in frank DKA. In children with established diabetes, DKA is caused by omission of insulin, either deliberately or inadvertently¹.

The clinical manifestations of DKA include signs of dehydration, deep sighing respirations and progressive

obtundation leading to coma. Severity of DKA may be defined by the degree of acidosis: mild, venous pH 7.2 to 7.3; moderate, pH 7.1 to 7.2; and severe, pH <7.1. Factitious hyponatremia is commonly observed. An increased white blood count in response to stress is characteristic of DKA and is not indicative of infection.

Successful management of the child with DKA requires meticulous monitoring of the patient's clinical and biochemical response to treatment so that timely adjustments in treatment can be made when indicated by the patient's clinical or laboratory data.

FLUID AND ELECTROLYTE THERAPY

Fluid losses often range between five to 10% of body weight. Normal saline 10-20cc/kg over the first hour can be used to restore circulating volume. Avoidance of excessive rates of fluid administration so as not to exacerbate the risk of cerebral edema is important. Half normal saline at 3000 ml/m²/24 hours can usually provide for maintenance and slow replacement of fluid deficits. Potassium replacement is provided usually at a total of 40mEq/L, half as chloride and half as phosphate. Blood samples should be obtained to measure serum glucose, electrolytes, urea nitrogen,

creatinine, blood gas, complete blood count, calcium, phosphorus, magnesium, HbA1c and β-hydroxybutyrate concentration. Reassessment of electrolytes every two to six hours is required¹.

INSULIN THERAPY

The initial saline bolus may decrease the blood glucose considerably because of a dilution phenomenon. This should not impact provision of insulin therapy. A continuous infusion of insulin at a rate of 0.1 unit/kg/hr may be started as soon as the first fluid bolus is completed. An intravenous insulin bolus is unnecessary and should not be used at the start of therapy. Adding glucose to the rehydration fluid is appropriate once the blood glucose decreases to 300 mg/dl or earlier to control the rate of drop of blood glucose to approximately 100 mg/dl/hr.¹

CEREBRAL EDEMA

Symptomatic cerebral edema is a serious complication with an incidence of approximately 0.5-1% of DKA episodes. The majority of deaths are due to this complication and survivors may have serious neurological morbidity. Children and adolescents presenting to the emergency department with a greater degree of dehydration, acidosis and hyperglycemia appear to be at higher risk². Symptoms often develop after

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therapy is started and close neurological monitoring is warranted.

Treatment of cerebral edema includes slowing the rate of fluid administration and administering either mannitol or hypertonic saline. Respiratory arrest or coma is an indication to intubate and ventilate. Careful attention should be directed to the partial pressure of arterial CO₂ after intubation. Hyperventilation beyond what would normally occur in response to metabolic acidosis should likely be avoided. Cranial imaging is recommended to rule out other causes of neurological deterioration but should not delay therapy. Treatment of acidosis in DKA with bicarbonate has been as-

sociated with increased risk of cerebral edema and should be avoided except in life-threatening hyperkalemia and depressed cardiovascular function^{1,2}.

In conclusion, the severity of DKA at presentation is correlated with outcome. Published consensus guidelines should be incorporated in clinical management¹. For severe cases the resources of a pediatric intensive care unit may be required. Prevention of DKA by early recognition of childhood diabetes combined with proper education of the patient/family in diabetes management and appropriate follow-up care by a diabetes team with a 24-hour telephone helpline are key to good outcomes at the community level.

REFERENCES

1. Wolfsdorf J, Glaser N et al. Diabetic ketoacidosis in infants, children, and adolescents: A consensus statement from the American Diabetes Association. *Diabetes Care*. 2006 May;29(5):1150-9.
2. Glaser N, Barnett P et al. Risk factors for cerebral edema in children with diabetic ketoacidosis. The Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics. *N Engl J Med*. 2001 Jan 25;344(4):264-9.

FEATURED SPECIALIST



Amit Vohra, MD, is board certified in pediatric critical care medicine and board certified in pediatrics. He completed a pediatric critical care fellowship at Baylor College of Medicine. Dr. Vohra brought a new sedation service to Dayton Children's,

which allows children to be sedated more quickly and with less anxiety.

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CRITICAL CARE AT DAYTON CHILDREN'S

Dayton Children's pediatric intensive care unit (PICU) is part of the Wallace Critical Care Complex, which set a new standard of care for the region's critically ill or injured children when it opened in June 2006. The PICU is staffed 24 hours a day by board-certified pediatric intensivists who serve critically ill or injured infants, children and adolescents. These specialists are available 24 hours a day by phone to assist in the emergency stabilization of children in the region. Specialized

monitoring, high-frequency ventilation and bedside dialysis are available in the PICU. The pediatric intensivists at Dayton Children's have a particular interest in research on the improvement of outcome after shock, neuroresuscitation and respiratory failure.

CONTACT INFORMATION

To contact Critical Care Medicine at Dayton Children's call 937-641-5168.



For further information about The Children's Medical Center of Dayton or its specialists contact us at 937-641-3666 or marketing@childrensdayton.org.



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