

## **Insulin Pump Therapy During Ramadan Fasting**

Bassam Saleh Bin-Abbas, MD

Department of Pediatrics  
King Faisal Specialist Hospital and Research Center  
Riyadh, Saudi Arabia

### **Corresponding author:**

Bassam S. Bin-Abbas, MD  
Section of Pediatric Endocrinology  
Department of Pediatrics, MBC 58  
King Faisal Specialist Hospital and Research Center  
PO Box 3354, Riyadh 11211, Saudi Arabia

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*Introduction:*

Since the introduction of continuous subcutaneous insulin infusion (CSII) in the late 1970s, it has become apparent that the use of insulin pump therapy has many potential benefits for children and adolescents with type 1 diabetes. It improves the glycemic control, reduces hypoglycemia and decreases the episodes of recurrent diabetic ketoacidosis (DKAs) (1-3). Fasting during Ramadan has been uniformly discouraged by the medical profession for children and adolescents with type 1 diabetes especially those with brittle poorly controlled diabetes (4). Insulin pump therapy may help in controlling blood glucose during fasting and its continuous insulin infusion can be modified and adjusted instantaneously to avoid hypoglycemia and breaking the fast. To our knowledge, this is the first study that describes the use of insulin pump therapy in adolescents with type 1 diabetes and shows its efficacy and safety during Ramadan fasting.

#### *Objective:*

To assess the efficacy, effectiveness and safety of CSII through insulin pump therapy in type 1 diabetic Saudi adolescents during Ramadan fasting and to compare it with conventional insulin (CI) therapy.

#### *Methods*

CSII was initiated in 5 Saudi adolescents with type 1 diabetes mellitus through insulin pump therapy between October 2003 and June 2005.

All patients were followed at The Pediatric Endocrinology Clinic at The Specialized Medical Center Hospital, Riyadh, Saudi Arabia. These adolescents showed interest in fasting the Holy month of Ramadan in the Higi year of 1427 (between 23 September and 23 October 2006). The patients were trained on insulin pump programming and carbohydrates counting and started on continuous basal insulin infusion in addition to meal and high blood glucose correction insulin boluses. The results of blood glucose levels and the rate of hypoglycemic episodes were compared with those in 4 adolescents with type 1 diabetes who were on CI therapy. CI therapy is defined as 2 insulin injections per day; before breakfast and before dinner combining the intermediate- acting insulin (NPH) and the short-acting insulin (regular). The patients on CI therapy were trained on the exchange program for diet therapy and showed also interest in fasting Ramadan. All patients visited the clinic prior to the month of Ramadan to adjust insulin doses and they were instructed to check blood glucose more frequently especially during the fasting hours. The recommended times for blood glucose check-up were pre-sunset meal, 2 hours after, pre-dawn meal, 2 hours after, pre-school, after school and as needed.

#### *Results*

The patients included in the study had type 1 diabetes mellitus for a mean duration of 7 years (range from 5 to 9 years). The age of the adolescents ranged from 15 to 19 years. They were followed on insulin pump therapy for a mean duration of 18 months.

There was a significant reduction in HbA<sub>1c</sub>, mean blood glucose level and the frequency of hypoglycemic episodes in adolescents on insulin pump therapy in comparison to CI therapy during Ramadan fasting. The mean HbA<sub>1c</sub> was 7.8% (7.1-8.9%) in insulin pump group of adolescents in comparison to CI group which was 9.1% (8.3-10.6%) (p <0.001).

The mean blood glucose was 123 mg/dl (72-201) in insulin pump group in comparison to CI group which was 192 (122-394) (p <0.001).

The mean frequency of simple hypoglycemia (defined as blood glucose less than 60mg/dl) was 16 episodes (12-29) per patient per month in comparison to CI group which was 29 episodes (19-36) per patient per month (p <0.002). None of the patients developed severe hypoglycemia (defined as hypoglycemia associated with coma or convulsion) or DKA during Ramadan fasting. One month prior to Ramadan, the mean frequency of simple hypoglycemia in insulin pump group was 11 episodes per patient per month and the mean frequency of simple hypoglycemia in CI group was 18 episodes (p<0.001).

Three of adolescents on CI therapy had to break their fast during Ramadan once or twice because of hypoglycemia. However, none of the insulin pump group broke their fast. All adolescents on insulin pump therapy had to adjust their basal rate insulin infusion to avoid hypoglycemia prior to Ramadan fasting. Ten to 15% of the basal insulin infusion rate was reduced during the hours of fasting. One patient on insulin pump therapy suspended the pump for 2 hours to avoid hypoglycemia. The pre-dawn insulin dose was reduced 10 to 20% in CI group of patients. Total insulin dose requirement was 0.9 units/kg/day (0.8-1.2) in insulin pump group in comparison to 1.1units/kg/day (1.0-1.3) in CI group. One unit of the ultra-short acting insulin lispro (Humalog) was required to cover for 10 grams of carbohydrates and one unit of lispro insulin was required to cover for 50 to 100mg/dl of blood glucose above 100mg/dl as a correction bolus for high blood levels.

### *Discussion:*

Several reports (4) indicated that fasting in Ramadan is safe for the majority of diabetic patients with proper education and diabetes management. Most type 2 diabetics can fast safely during Ramadan. Occasionally patients with type 1 diabetes who insist on fasting during Ramadan can also fast if they are carefully managed. In this study, we compared the frequency of hypoglycemia and the blood glucose level in type 1 diabetic adolescents using insulin pump therapy with conventional insulin regimen. The frequency of hypoglycemia was significantly lower in CSII group. The ability to lower the basal insulin infusion rate in insulin pump or even suspend it helped diabetics to avoid major hypoglycemic attacks during fasting. Patients were able to continue fasting till the dawn

time by controlling and adjusting the basal rate. None of insulin pumpers broke their fast during Ramadan in comparison to the adolescents on CI therapy who had once or twice fasting breakthrough. Eating during the period of fasting in Ramadan may have a negative psychological effect on patients especially during the adolescence period. Adolescents may feel embarrassed to eat or drink and break their fast although they feel hypoglycemic. Insulin pump therapy helped these adolescents to feel more satisfied and confident.

*Conclusion:*

Insulin pump therapy improved the glycemic control in type 1 diabetic adolescents and decreased frequency of hypoglycemic episodes requiring breaking the fast during the holy month of Ramadan.

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