



Blood glucose levels in children with Type 1 diabetes attending A residential diabetes camp: A two year review



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Abstract

We retrospectively analyzed blood glucose (BG) levels of children attending a week-long residential camp for children with type 1 diabetes mellitus during 2009 and 2010. Between 2009 and 2010, we instituted the following interventions in order to improve glucose control in campers: 1) Daily, BG levels were highlighted by color according to "high" (>180mg/dL), or "low" (<70mg/dL), giving the endocrinologists a visual pattern on which to make daily insulin adjustments; 2) Low glycemic index foods were used; and 3) campers in 2010 estimated the number of carbohydrates they would eat before a meal and gave a pre-meal bolus of insulin, whereas in 2009 campers gave insulin boluses after the meal. Our objective was to evaluate our overall diabetes management and to determine if these specific interventions were effective in lowering average BG among our campers.

BG records were obtained from three camp sessions in 2009 and three in 2010. We included 255 total campers from 2010 and 237 total campers from 2009. Five BG values per day, pre-meal, pre-evening snack, and midnight values, were analyzed. A total of 13,267 BGs were included in the analysis. Mean BG was significantly lower in 2010 compared with 2009 (166mg/dL v. 181 mg/dL, p<0.001). Percentage of BGs in a pre-defined target range (100-200) also improved (50% v. 45%, p<0.01). There were no severe hypoglycemic episodes in either year. There was no association between average BG for each camper and sex, HbA1C, or date of diagnosis.

Our study is the largest conducted at a residential diabetes camp. Moreover, the average BGs were lower than published studies. These data show that average BGs of 166 can be achieved with minimal risk of severe hypoglycemia. Although a direct cause and effect relationship between our interventions and the improvement in BG cannot be proven, pre-meal insulin bolusing and low glycemic meals should be encouraged. This study will help establish benchmarks for comparison among camps and begin to identify best-practices.

Objectives

- To provide experiential data to reinforce current summer camp guidelines with respect to blood glucose monitoring and insulin dosing
- To determine whether our specific interventions implemented between 2009 and 2010 may contribute to improved average BG among our campers without increasing risk of hypoglycemia.

Methods

- This study was a retrospective review, approved by the Emory University Institutional Review Board.
- Records of blood glucose values were reviewed from a random selection of children from six 1-week camp sessions, three each in 2009 and 2010.
- 5 BG values per day were analyzed (pre-meal, breakfast, lunch, dinner, pre-evening snack, and midnight values). The number of BG levels in target was recorded. Our target range for BG was 100-200mg/dL.
- Sex, age, date of diagnosis of Type 1 diabetes, last HbA1C, and type of insulin therapy (multiple daily injections [MDI], insulin pump and pumpers on long-acting insulin [POLI]) were recorded
- Average BG values were divided into four categories based on frequency quartiles (<146, between 146 and 173, between 173 and 198, and >198). Chi-square analysis for categorical variables and Spearman's Rank correlation analysis for continuous variables were used to determine whether mean BG reported in each camper was associated with gender, age, cabin clinician, or camp session. The association between the time since diagnosis and average BG was evaluated only for children who had diabetes >1 year to prevent bias from children who are still in the "honeymoon" phase.
- A multivariate logistic regression model was used to evaluate age as a predictor of average BG, independent of factors that were found significant by univariate analysis (p<0.1).

Results

Characteristics of campers at Camp Kudzu in 2009 and 2010.

	2009	2010
Total # of Campers	237	255
Mean age (range)	12 (8-17)	13 (8-17)
% Male	59%	40%
Mean duration of diabetes in years (range)	5.2 (0.1-14.8)	5.0 (0.1-14.4)
Mean Hgb A1c (range)(%)	7.9 (5.2-13.6)	8.2 (5.2-14)
% on insulin pump	53	49
% on multiple daily injections	45	45
% on pump and long-acting insulin injections (POLI)	2	6

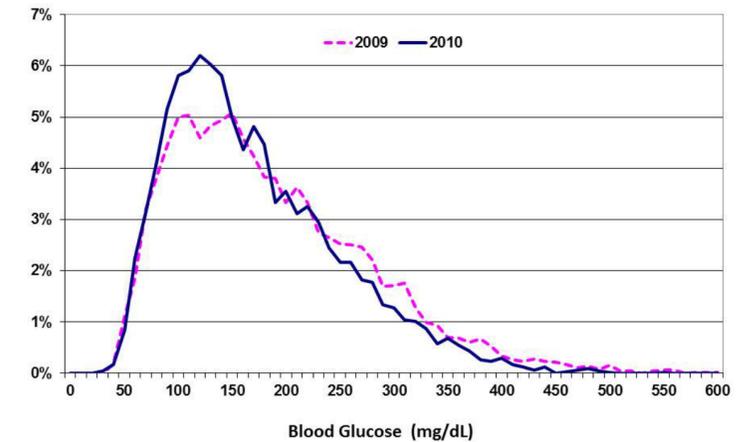
Mean, standard deviation, and percent of blood glucose values in specific ranges for each year. P-values are shown for comparison between years (NS=non-significant).

	2009	2010	p
# of BG values	6638	6629	
Mean BG (mg/dL)	181	166	<0.001
Standard deviation (mg/dL)	90	70	NS
% in target (100-200 mg/dL)	45%	50%	<0.01
% below target (<100 mg/dL)	19%	21%	NS
% above target (>200 mg/dL)	36%	28%	<0.001
% extreme lows (<70 mg/dL)	6%	8%	NS
% extreme highs (>300 mg/dL)	11%	7%	NS

P-values for Spearman's Rank Correlation tests between average blood glucose and camper characteristics (NS=non-significant).

	2009	2010	2009-10 combined
Age	<0.001	<0.001	<0.001
Gender	0.43	0.61	NS
Hb A1c	0.28	0.02	NS
Duration of diabetes	0.37	0.22	NS
Cabin	0.33	0.78	NS
Clinician	0.50	0.72	NS
Session	0.50	0.37	NS
Shots/Pump/POLI	0.46	0.26	NS

Frequency distribution of recorded blood glucose (BG) values by year.



Conclusions

- There were no severe hypoglycemic episodes requiring glucagon injection during either year of camp.
- Older age was associated with lower BG average, even when controlling for gender and duration of diabetes. Psychosocial maturity and experience with diabetes management may play a substantial role in glycemic control during childhood.
- There was a significant improvement in BG control between 2009 and 2010 both in mean BG and percentage of BGs in the target range.
 - We cannot attribute a cause and effect relationship, we made three significant changes between 2009 and 2010 including pre-meal bolusing, low glycemic meals, highlighting high and low BGs in the BG logs
 - Limitations: 1) retrospective study design, limiting our ability to test specific interventions. 2) No analysis was done of type and frequency of insulin adjustments during camp. 3) Only five BGs per day were analyzed, we were unable to accurately quantify daily BG variability in each camper, which may correlate better with diabetes control and management than A1C alone

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