Influence of nocturnal glycemia on ventricular repolarization and heart rate variability in prepubertal children with type 1 diabetes

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INTRODUCTION

The "Dead in Bed syndrome" is an established complication in childhood diabetes, The mechanism of this dramatic complication remains unknown.

Hypothese: nocturnal hypoglycemia could lead to arrhythmias related to abnormal ventricular repolarization.

Objective

Describe the relationship between spontaneous fluctuations of nocturnal glycemia, ventricular repolarization and heart rate variability (HRV) in prepubertal children with type 1 diabetes.

METHODS

Continuous glucose monitoring (CGM) coupled with Holter-ECG were performed for 2 nights at home in 29 prepubertal children with type 1 diabetes. QT apex length and HRV (linear methods: Mean RR, SDNN, rmssd, LF-HF frequency analysis and non linear methods: SD1 and SD2 of Poincaré plot analysis, fractal coefficient alpha1 and alpha2 of detrended fluctuation analysis) were compared between hypoglycemic and normoglycemic periods and between hyperglycemic and normoglycemic periods. We have also evaluated correlations between HRV-ventricular repolarization parameters recorded in a stable normoglycemic period and patient variables (age, sexe, BMI, duration of diabetes, HbA1c, frequency of hypoglycemia defined as the following ratio: number of glycemia < 0,6 g/l / number of glycemia performed over the past three months).

The studied population was divided in three tiertiles regarding the frequency of hypoglycemia and similarly regarding HbA1C. In both cases, the first tiertile was compared to the third tiertile.

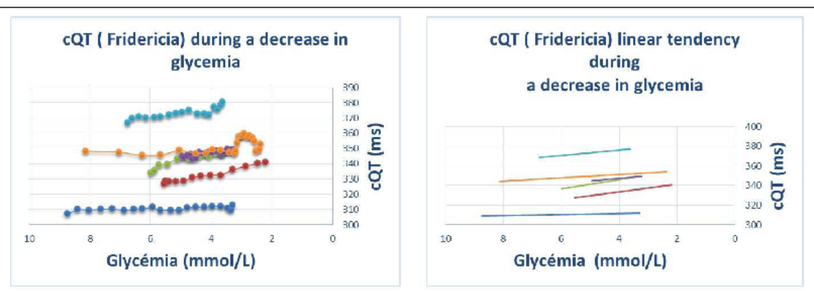

Figure 1:
Evolution of cQT during the decrease of the glycemia preceding the hypoglycemia

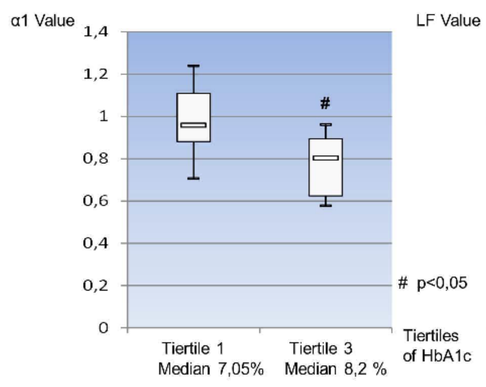

Figure 2:
Tiertile analysis: α1Values in function of HbA1c

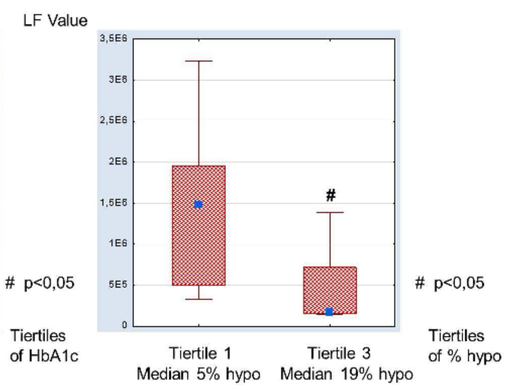

Figure 3:
Tiertile analysis: LF values in function of the frequency of hypoglycemia

RESULTS

Effects of acute nocturnal hypo and hyperglycemia

When compared to normoglycemic phases, no significant difference for cQT length or HRV parameters were found during hypoglycemia (n=6) or hyperglycemia (n=17). However an increase in cQT was observed in all cases during the decrease of the glycemia preceding the hypoglycemia (n=6, Fig 1).

Correlation of patient characteristics with basal HRV and cQT during normoglycemia (n=21)

- LF (Low frequency) (r=-0,47 ,p=0.03) and SD2 (r=-0,40, p=0,07) were correlated with the frequency of hypoglycemia and this was confirmed by tiertile analysis (p<0,05, Fig.2). Tiertile comparison analysis also found significant differences between children with high and low frequency of hypoglycemia in mean RR, SDNN, LF and SD2 (p<0.05).
- Alpha 1 (r=-0,47, p=0.03) and HF (High frequency) (r=0,44, p = 0.05) were correlated with HbA1c and this was confirmed by tiertile analysis (p<0,05). Tiertile comparison analysis also found significant differences between children with high and low HbA1c in rmssd and SD1 (p<0.05).

CONCLUSIONS

We observed that nocturnal glycemic variations, including hypoglycemia, induced minimal or no changes in ventricular repolarization and no changes in heart rate variability in prepubertal children with type 1 diabetes. However, frequent hypoglycemias over the past 3 months as well as high HbA1C have been associated with changes in HRV suggesting abnormal autonomic balance in those circumstances.

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