Effects of Application of Multiple Dose Insulin and Treatment with Insulin Pump On The Insulin Sensitivity Factor

Multipl Doz İnsülin Uygulamasının ve İnsülin Pompası ile Tedavinin İnsülin Duyarlılık Faktörü Üzerine Etkileri

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Abstract

Objective: Insulin sensitivity factor is defined as amount of blood glucose (mg/dl) decreased by 1 unit of rapid or short acting insulin.

Methods: There are 2 frequently used methods to establish insulin sensitivity factor. They are called rule of 1500 and rule of 1800. The present study included a total of 30 patients including 22 women and 8 men who were admitted to our clinic with brittle type I diabetes patients between 2001 and 2003.

Result: In the present study, we observed that 1 unit of insulin reduced blood glucose by 38.60 ± 11.29 mg/dl in the group of patients using multiple dose insulin therapy (MIT); it was observed that 1 unit of insulin reduced blood glucose by 55.93 ± 37.78 mg/dl in the same group of patients when treatment with insulin pump (IP) was applied to these patients. Total insulin dose decreased by 16% and insulin sensitivity factor increased by 44% with passing to IP from MIT.

Conclusions: It has been shown that IP therapy provides better insulin sensitivity factor than MIT therapy with brittle type I diabetics patients. *Turk Jem 2007; 11: 111-3*

Key words: Type I Diabetes Mellitus, Insulin sensitivity factor

Özet

Amaç: İnsülin duyarlılık faktörü 1 ünite hızlı veya kısa etkili insülin ile kan glikoz düzeyindeki azalma miktarı olaraktanımlanmıştır.

Yöntem: İnsulin duyarlılık faktörünü belirlemede sık kullanılan 2 yöntem, 1500 kuralı ve 1800 kuralı olarak adlandırılmıştır. Bu çalışma 2001 ve 2003 yılları arasında kliniğimize "brittle" tip diyabet tanısı ile başvuran, 22 kadın, 8 erkek, toplam 30 hastada gerçekleştirilmiştir.

Bulgular: Bu çalışmada, multipl insülin injeksiyonu uygulanan grupta, 1 ünite insülin, kan glikozunu 38.60±11.29 mg/dl azaltmıştır. Aynı gruba, insülin pompası uygulandıktan sonra, 1 ünite insülin, kan glikozunu 55.93±37.78 mg/dl azaltmıştır. Multipl doz insülin injeksiyonundan, insülin pompasına geçiş, total insülin dozunun %16 azaldığını; insülin duyarlılık faktörünün %44 artışı ile birliktedir.

Sonuç: İnsülin pompası uygulaması, multipl doz insülin injeksiyonuna oranla, "brittle" tip 1 diyabetik hastalarda, daha iyi insülin duyarlılık faktörüne ulaşılmasını sağlar. *Turk Jem 2007; 11: 111-3*

Anahtar kelimeler: Tip 1 Diyabetus mellitus, insülin duyarlılık faktörü

Introduction

Insulin sensitivity factor is defined as amount of blood glucose (mg/dl) decreased by 1 unit of rapid or short acting insulin. Amount of insulin to lower blood glucose levels to target values can be calculated by this method before meals. Insulin sensitivity factor is also called correction factor or addition factor [1, 2]. Does insulin sensitivity factor in type 1 diabetics using multiple dose intensive (MIT) insulin change after passing to insulin pump (IP).

Material and Method

The present study included a total of 30 patients including 22 women and 8 men who were admitted to our clinic with brittle type I diabetes between 2001 and 2003 and whose mean age was 31.23 ± 9.97 years, mean duration of diabetes was 8.66 ± 7.95 years and mean body-mass index (BMI) was 22.76 ± 2.47 kg/m^2. All patients were using multiple dose insulin (MIT) therapy prior to admission. The patients were inserted portable external insulin pump (IP) following completion of their training.

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The patients were evaluated 3 months after discharge from hospital. In order to calculate insulin sensitivity factor, rule of 1500 (1500/total insulin dose) was used for those patients using short acting insulin and rule of 1800 (1800/total insulin dose) was used for those using short acting insulin. Of the patients using MIT 16 were using regular insulin, 14 short acting insulin prior to IP whereas 10 were using regular insulin and 20 short acting insulin following IP. There are 2 frequently used methods to establish insulin sensitivity factor. They are called rule of 1500 and rule of 1800. Rule of 1500 was developed by an endocrinology specialist Dr.Paul Davidson. Diabetes educator John Wash, who gained expertise on use of insulin pump following widespread use of short acting insulin proposed rule of 1800 by modifying the rule of 1500. Whereas the rule of 1500 is used for the individuals using short acting insulin or in those patients with resistance to insulin, the rule of 1800 is used for those patients using short acting insulin or those responsive to insulin [1-3].

$$\text{Insulin Sensitivity factor} = \frac{1500 \text{ or } 1800}{\text{Total Insulin Dose (U/day)}}$$

Statistical Analysis

Compare means T test in SPSS software for windows (version 11.0) was used to compare parametrical data between groups. The values were expressed as mean ± 1 standard deviation. P values < 0.05 were considered as statistically significant.

Results

Total insulin doses, insulin sensitivity factors of the patients were shown in the table below.

Discussion

Insulin sensitivity factor is defined as amount of blood glucose (mg/dl) decreased by 1 unit of rapid or short acting insulin. Insulin dose may be adjusted using insulin sensitivity factor. It is important to determine target values for blood glucose unique to each diabetic individual. When adjusting insulin dose using insulin sensitivity factor, one should know how much the level of blood glucose is higher or lower than previously determined target values.

Another way recommended for use when insulin dose is increased: 1 unit of short-acting or rapid-acting insulin lowers the blood glucose 50 mg/dl. 1 unit of insulin is recommended when the blood glucose level is between 100 and 150 mg/dl and 2 units of insulin when the blood glucose level is between 151 and 200 mg/dl. If the level of blood glucose before meal is within the limits targeted, no new adjustment is necessary. If the blood glucose is lower than targeted values, adjustment in insulin bolus is required before the meal.

Hyperglycemia may occur as a consequence of unbalanced or excessive ingestion of foods or incorrect dose adjustments before meals. Additionally, for the diabetic individuals having a meal containing excessive protein and fat and delayed gastric emptying due to diabetic gastroparesis or inappropriately adjusted insulin doses before meals may also cause hyperglycemia. Information on blood glucose values, carbohydrate ingestion and insulin dose should be re-evaluated if hyperglycemia is found before the meals. Insulin dose should be re-adjusted if appropriate amount of carbohydrate is ingested. Dose of insulin may be increased 1 to 2 units. Less carbohydrate may be recommended and baseline insulin dose may be increased for 1 unit of insulin if hyperglycemia is detected.

Hypoglycemia may be due to unbalanced or less than required ingestion of food, taking excessive amounts of insulin bolus or inappropriately high dose of baseline insulin, alcohol ingestion or increased physical activity. Furthermore, taking insulin boluses with frequent intervals, having a meal containing excessive protein and fat and delayed gastric emptying due to diabetic gastroparesis or inappropriately adjusted insulin doses before meals may also cause hypoglycemia. In this case, the dose of insulin and insulin application times should be reviewed if carbohydrate ingestion is appropriate. Insulin dose may be decreased 1 to 2 units. More carbohydrate is advised and baseline dose of insulin may be reduced for 1 unit of insulin if hypoglycemia is detected. This method suggested for the treatment of hypoglycemia may be appropriate for the diabetic individuals without any problem with body weight. However, consuming more foods than required means ingesting more energy than required. Thus, reducing insulin dose rather than increasing ingestion of foods may be a better solution in obese diabetic individuals [1-5].

By the means of insulin sensitivity factor, the amount of insulin required to lower the level of blood glucose to targeted values before the meal may be calculated. In the present study, we observed that 1 unit of insulin reduced blood glucose by 38.60 ± 11.29 mg/dl in the group of patients using MIT; it was observed that 1 unit of insulin reduced blood glucose by 55.93 ± 37.78 mg/dl in the same group of patients when treatment with IP was applied to these patients. Total insulin dose decreased by 16% and insulin sensitivity factor increased by 44% with passing to IP from MIT.

Table 1. Results of the MIT and IP with type 1 diabetics groups

	Total Insulin Dose	Insulin Sensitivity Factor
	(U/day)	
MIT	45.13 ± 10.75	38.60 ± 11.29
IP	38.00 ± 16.45	55.93 ± 37.78
P VALUE	0.005	0.006

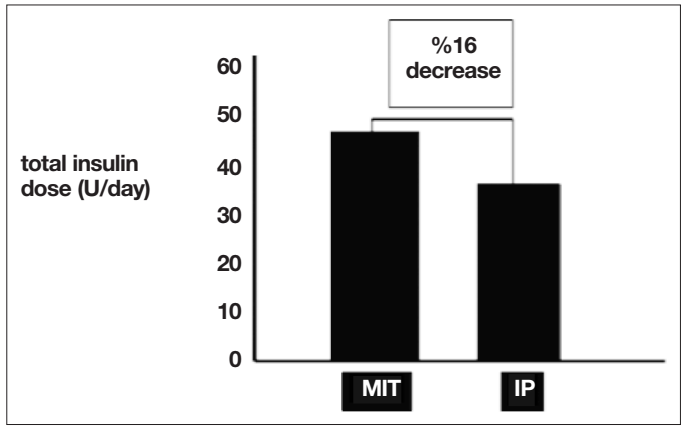

Figure 1. Total insulin doses in the MIT and IP with type 1 diabetics groups

It has been shown that intensive insulin therapy provides better glycemic control than conventional insulin therapy in both type 1 and type 2 diabetics. Currently, the method mimicking pancreatic secretion physiology best is applications of insulin pump. For the applications of insulin pump (IP), basal secretion of insulin can be adjusted hourly and a separate dose of insulin can be adjusted for each meal. The individual may inject extra bolus insulin if required [6-11]. 60% of members of American Diabetes Association preferred application of insulin pump in a survey on their preference on MIT or IP in treatment of type I diabetes. This is because IP mimics physiological insulin secretion as well as causes least complication rates, least pain, least weight gain with the lowest possible insulin doses, least severe hypoglycemia attacks and best quality of life compared to the other treatment modalities [12]. Application of IP, in addition to these advantages may provide more reduction in post-prandial blood glucose levels with lower doses of insulin compared to MIT.

References

1. Davidson P: Bolus & Supplemental İnsulin. The Insulin Pump Therapy Book. Ed Skyler JS. Minimed Technologies, California chapter 1995; 6: 59-71.
2. Skyler JS, Seigler DE, Reeves ML: Optimizing pumped insulin delivery. Diabetes Care, 1982; 5: 135-9.
3. Brackenridge BP, Hamilton J: Counting Carbohydrates. The Insulin Pump Therapy Book. Ed Skyler JS. Minimed Technologies, California chapter 1995; 7: 73- 83.
4. American Diabetes Association: Standarts of medical care for patients with diabetes mellitus.Diabetes Care 2003; 26 (Supply 1): 35-50.
5. American Diabetes Association: Evidence –based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications.Diabetes Care 2003; 26 (Supply 1): 51-61.
6. The Diabetes Control and Complications Trial Research Group: The effect of Intensive Treatment of Diabetes on the Development and Progression of Long-Term Complications in IDDM. N Engl J Med 1993; 329: 977-86.
7. UK Prospective Diabetes Study (UKPDS) Group: Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS33). Lancet 1998; 352: 837-53.
8. Yki-Jarvinen H, Kauppila M, Kujansuu E, et al.: Comparison of insulin regimens in patients with non-insulin dependent diabetes mellitus. N Engl J Med 1992; 327: 1426-31.
9. Bruce W Bode. Pumping protokol: A physician's guide to insulin pump therapy initiation. Atlanta Diabetes Associates. Supported by an educational grant from Medtronic Minimed 2003.
10. Lori Laffel, Cindy Pasquarello and Margaret Lawlor: Treatment of the child and adolescent with diabetes. Joslin's Diabetes Mellitus, fourteenth edition. Ed C Ronald Kahn, Gordon C weir, George L King, Alan M Jacobson, Alan C Moses, Robert J Smith. Lippincott Williams&Wilkins. Chapter 2005; 42: 711-36.
11. John C.Pickup. Alternative forms of insulin delivery. Textbook of Diabetes 2. Ed. Pickup J, Williams G. 3rd edition,Blackwell Science volume 2003; 2: 44.1-15.
12. Graff M, Rubin R, Walker E: How diabetes specialist treat their own diabetes:finding from a study of the AADE and ADA membership. The Diabetes Educator 2000; 26: 460-67.