Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 2, No. 11, p. 46-51, 2012
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

The effect of a cycling test on glucose and serum ghrelin in diabetic patients

Mehdi kasbparast JR*, Hamid reza keshavarzi, Maryam Rostami, Saba Masoumi

Department of Physical Education and Sport Science, Karaj Branch, Islamic Azad University, Karaj, Iran

Received: 03 November 2012
Revised: 20 November 2012
Accepted: 22 November 2012

Keywords: Type II diabetic, ghrelin, glucose, exercise test.

Abstract

Previous studied have been shown higher serum ghrelin in diabetic patients than those without diabetic symptoms. In this study, we investigated serum ghrelin in response to an acute exercise test in adult men with type 2 diabetes. For this purpose, serum ghrelin, glucose and beta cell function were measured before and after a cycling test in nine males with type 2 diabetic (age 43 ± 7 yrs, body weight 91 ± 7 Kg). Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise test in studied patient. A p-value < 0.05 was considered to be statistically significant. Cycling exercise test resulted in significant decrease in ghrelin (0.012). Beta cell function was also increased after exercise test (0.038). Glucose concentration was decreased by exercise test in studied patients (0.008). Finally, it should be acknowledged that acute exercise with moderate intensity even for short-time can be decrease serum Ghrelin that is associated with an improvement in glucose in beta cell function in diabetic patients.

***Corresponding Author:** Mehdi kasbparast JR ✉ kasbparast@yahoo.co.uk

Introduction

Increased visceral obesity and extreme insulin resistance are associated with early-onset type 2 diabetes, although the physiopathological mechanisms underlying these associations are largely unknown. On the other hand, accumulating evidence indicates that Insulin resistance and pancreatic ß-cell dysfunction are important contributors to the pathogenesis of type 2 diabetes (Kahn *et al.,* 2006; Ferrannini *et al.,* 2003; Bergman *et al.,* 2006).

Imbalance in secretion of certain peptide hormones, by adipose tissue such as cytokines or ghrelin level can not be ignored in increasing blood glucose in diabetic patients (Ariga *et al.,* 2008; Ueno *et al.,* 2007). Among them, ghrelin is a hormone implicated in hunger and long-term regulation of body weight (Harsch et al., 2009). Recent evidence has shown that blood ghrelin levels play important role in regulating insulin and glucose metabolism in diabetic patients (Pulkkinen *et al.,* 2010). These authors noted that ghrelin reduces insulin secretion from beta cells in obesity-induced type 2 diabetic (Sun *et al.,* 2006).

In diabetic patients, hyperinsulinaemic is occurred on the one hand because of insulin resistance in body tissues such as skeletal muscle, liver and adipose tissue and on the other hand, due to the inability of pancreatic beta cells to compensate this resistance (Kahn, 1998). Recently, several reports have identified a role for ghrelin in insulin secretion.In this area, some previous studies have reported an inverse relation between ghrelin and insulin levels (Broglio *et al.,* 2004; Harsch *et al.,* 2009). It is concluded that ghrelin has an inhibitory effect on insulin secretion from pancreatic beta cells (Salehi *et al.,* 2004; Dezaki *et al.,* 2006).

A number of studies have demonstrated high correlation between the level of daily physical activity and the incidence of type 2 by the results from several prospective epidemiological studies (Manson *et al.,* 1992; Manson *et al.,* 1991). Some studies suggested that exercise training can be decreases serum ghrelin and increases beta cell function in diabetic patients (Kelishadi *et al.,* 2008). But Studies on the effect of a short-time exercise for one session on serum ghrelin or inductive markers of type 2 diabetic has received limited attention. Therefore, this study is focused on the effect of single bout cycling test on serum ghrelin and beta cell function in males with type 2 diabetic.

Material and methods

The present study aims to examine the effect of a single bout cycling test on serum Ghrelin and beta cell function in type II diabetic patients. To achieve the above mentioned purposes, serum Ghrelin, glucose and beta cell function were measured before and immediately a single bout cycling test in nine males with type 2 diabetic (age 43 ± 7 yrs, body weight 91 ± 7 Kg). After the nature of the study was explained in detail, informed consent was obtained from all participants.

Inclusion criteria for study group were determined as existing type 2 diabetic for at least 2 years. The exclusion criteria were as follows: Patients with known history of acute or chronic respiratory infections which may interfere with lung function tests, cardiopulmonary disease and neuromuscular disease. Those that were unable to avoid taking hypoglycemic drugs or insulin sensitivity-altering drugs for 12 hours before blood sampling were also barred from participating in the study. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months.

All studied patients were asked to complete questionnaires on anthropometric characteristics, general health, smoking, alcohol consumption, and present medications. Anthropometric measurements were performed in all study participants before breakfast, with the subject wearing light clothing without shoes.Weight was measured by an electronic balance and height by a stadiometer. Body mass index was calculated as body mass (in kilograms)

divided by height squared (in square meters).Abdominal and hip circumferences were measured with a soft tape in the standing position following normal expiration.

The subjects were advised to avoid any physical activity or exercise 48 hours before the blood sampling. These blood samplings used for measuring serum ghrelin, insulin, glucose and beta cell function. Blood samples were collected before and after exercise test. Cycling exercise test was a YMCA standard test on leg ergometery cycle (Tunturi, made in Finland). This protocol was performed in 5 continues stage without rest between stages. Each stage lasted 3 minute (Mullis *et al.,* 1999). Beta cell function was assessed using the homeostasis model assessment for insulin resistance formula derived from fasting insulin and glucose levels. Glucose was determined by the oxidase method (Pars Azmoon kit, Tehran). Serum insulin was determined by ELISA method (Demeditec, Germany) and the intra- assay and inter-assay coefficient of variation of the method were 2.6% and 2.88 respectively. The intra-assay and inter-assay coefficient of variation of ghrelin (Biovendor, Austria) were 8.10% and 8.3% respectively.

Table 1. The descriptive anthropometric and biochemical features of studied patients.

	N	Minimum	Maximum	Mean	Std. Deviation
Age (year)	9	32	52	43.11	6.846
Height (cm)	9	167	177	173.44	3.087
Weight (kg)	9	80	97	90.78	6.924
Systole (mmHg)	9	10	15	12.78	1.394
Diastole (mmHg)	9	8	10	8.44	.726
Abdominal (cm)	9	94	117	104.11	7.672
Hip (cm)	9	99	107	103.33	2.828
WHO	9	.90	1.08	.9811	.05555
BMI (kg/m2)	9	27	33	30.22	2.386
Body fat (%)	9	20	33	28.11	4.833
Visceral Fat	9	9	17	12.78	2.167
Glucose (mg/dL)	9	136	375	227.89	70.138
Insulin (µIU/ml)	9	6.40	10.20	8.3222	1.53523
Ghrelin (pg/ml)	9	49	65	55.44	4.720
Beta-Cell Function	9	8.50	34.00	21.2000	8.86115
Valid N (listwise)	9				

Statistical analyses

All values are represented as mean ± SD. Data were analyzed by computer using SPSS software version 15.0. Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise test in studied patient. A p-value < 0.05 was considered to be statistically significant.

Results

response to exercise test in studied diabetic patients (55.4 +/- 4.7 versus 52.3 +/- 3.3 pg/ml, P = 0.012, Fig 1). Compared with pre exercise in studied patients, glucose concentration decreased significantly after exercise test (228 +/- 70 versus 211 +/- 66 mg/dl, P = 0.008). Furthermore we observed a significant increase in beta cell function after exercise test when compared to baseline values (21.2 +/- 8.9 versus 25.7 +/- 11.6, P = 0.038, Fig 2).

Discussion

Current study investigated serum ghrelin and beta cell function in response to acute exercise in adult men with type II diabetic. The statistical data showed a significantly decrease in serum ghrelin and glucose concentration in studied patients. Decreased serum

ghrelin in present study was accompanied with an improvement in beta cell function after exercise test. On the other hand, exercise test led to increase in beta cell function. Some previous studies have also showed that exercise training even for one session can be improves beta cell function in this population (Eizadi *et al.,* 2011). It is well known effects on feeding behavior, fat mass, and GH secretion, ghrelin has recently been implicated in the regulation of glucose homeostasis (Broglio *et al.,* 2001; Sun *et al.,* 2007).

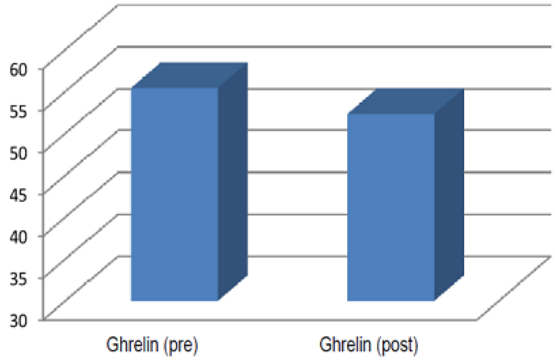

Fig. 1. The changes pattern of serum Ghrelin at baseline in baseline and after cycling test in studied patients.

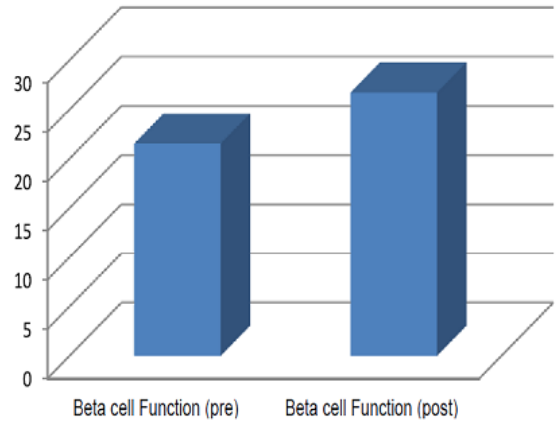

Fig. 2. The changes pattern of Beta Cell Function at baseline in baseline and after cycling test in studied patients.

Review of research evidence shows that exercise delays or prevents the development of type 2 diabetes in at-risk populations (Knowler *et al.,* 2002; Tuomilehto *et al.,* 2001). It has been demonstrated that short-term exercise training increased insulin sensitivity by more than 50% in obese middle-aged patients (mean age 45 years) with type 2 diabetes (O'Gorman *et al.,* 2006). Although it is generally accepted that Insulin release from pancreatic islet ß-cells is stimulated by glucose. But it is important to note glucose-induced insulin release is potentiated or suppressed by hormones and neural substances. A number of studies have demonstrated that ghrelin has a role in the development of metabolic syndrome and type 2 diabetes (Ukkola *et al.,* 2009).

It has been previously reported that low plasma ghrelin levels are associated with elevated fasting insulin levels, insulin resistance, and obesity. A number of studies have demonstrated that ghrelin suppresses glucose-induced insulin release via Gαi2 subtype of GTP-binding proteins and delayed outward K+ (Kv) channels, representing a novel signaling mechanism, and that the ghrelin originating from islets regulates insulin release and thereby glycemia (Yada *et al.,* 2008). In recognition of Contents, It was observed that pharmacological, immunological and genetic blockades of ghrelin in pancreatic islets all markedly augment glucose-induced insulin release, suggesting that islet-derived ghrelin is a physiologic attenuator of insulin release in rodents (Yada *et al.,* 2008).

On the other hand, it was reported that Small portion of the blood ghrelin levels is secreted by pancreas beta cell. In an animal study, release of ghrelin from pancreatic islets was assessed by comparing the ghrelin level in the pancreatic vein (splenic vein) with that in the pancreatic artery (celiac artery) in anaesthetized rats. This previous study showed that the concentrations of both acylated-ghrelin and desacyl-ghrelin in the pancreatic vein were significantly higher than those in the pancreatic artery, suggesting that ghrelin is released from pancreas (Dezaki *et al.,* 2006). On the other hand, scientific studies suggest that ghrelin expression in pancreatic beta cells is variable depending on some condition such as illnesses or age in human or animal. Generally speaking, based on the findings of previous studies it can be concluded

that both ghrelin and insulin or glucose by some means influence the regulation of blood circulating levels. So it seems that increased expression of ghrelin in pancreatic beta cells or an increase in serum ghrelin levels are associated with reduced insulin secretion from pancreatic cells, and this situation is more dominant in some diseases such as diabetes that are associated with impaired insulin secretion. Undoubtedly reduced insulin secretion from pancreatic cells, the role of ghrelin some previous studies have regarded to be involved in it, plays an important role in hyperglycemia or increased blood glucose levels in fasting state or in other hours during day or night. Besides it is not unexpected that changes in blood ghrelin levels caused by some external stimulus are associated with changes in insulin or glucose concentrations. The findings of this study indicate that a session of cycling exercise with moderate intensity and relatively short period of time led to a significant reduction in serum ghrelin and the decrease in serum ghrelin was associated with a significant increase of beta-cell function and significant reduction of glucose in diabetic patients. Although all these changes apparently occur in response to exercise in the present study to state a definitive conclusion about the relationship between these changes requires further experimental studies in this field.

References

Ariga H, Imai K, Chen C, Mantyh C, Pappas TN, Takahashi T. 2008. Does ghrelin explain accelerated gastric emptying in the early stages of diabetes mellitus? Am J Physiol Regul Integr Comp Physiol **294(6),** 1807-12.

Bergman R. Banting Lecture. 2006. Orchestration of glucose homeostasis: from a small acorn to the California Oak. Diabetes **56,** 1489–1500.

Broglio F, Arvat E, Benso A, Gottero C, Muccioli G, Papotti M, van der Lely AJ, Deghenghi R, Ghigo E. 2001. Ghrelin, a natural GH secretagogue produced by the stomach, induces hyperglycemia and reduces insulin secretion in humans. J Clin Endocrinol Metab **86,** 5083–5086.

Broglio F, Gianotti L, Destefanis S, Fassino S, Abbate Daga G, Mondelli V. 2004. The endocrine response to acute ghrelin administration is blunted in patients with anorexia nervosa, a ghrelin hypersecretory state. Clin Endocrinol (Oxf) **60(5),** 592-599.

Dezaki K, Sone H, Koizumi M, Nakata M, Kakei M, Nagai H, Hosoda H. 2006. Blockade of pancreatic islet-derived ghrelin enhances insulin secretion to prevent high-fat diet-induced glucose intolerance. Diabetes **55(12),** 3486–3493.

Eizadi M, Khorshidi D, Dooaly H, Samarikhalaj H. 2011. Effects of exercise on glycemic control and insulin action in type II diabetes mellitus. International Journal of Biosciences **1(6),** 147-154.

Ferrannini E, Gastaldelli A, Miayzaki Y, Matsuda M, Pettiti M, Natali A, Mari A, DeFronzo R. 2003. Predominant role of reduced beta-cell sensitivity to glucose over insulin resistance in impaired glucose tolerance. Diabetologia **46,** 1211–1219.

Harsch IA, Koebnick C, Tasi AM, Hahn EG, Konturek PC. 2009. Ghrelin and Obestatin Levels in Type 2 Diabetic Patients With and Without Delayed Gastric Emptying. Dig Dis Sci **54(10),** 2161-6.

Harsch IA, Koebnick C, Tasi AM, Hahn EG, Konturek PC. 2009. Ghrelin and Obestatin Levels in Type 2 Diabetic Patients With and Without Delayed Gastric Emptying. Dig Dis Sci. **54(10),** 2161-6.

Kahn BB. 1998. Type 2 diabetes: when insulin secretion fails to compensate for insulin resistance. Cell **92(5),** 593–596.

Kahn S, Hull R, Utzschneider K. 2006. Mechanisms linking obesity to insulin resistance and to type 2 diabetes. Nature **444,** 840-46.

Kelishadi R, Hashemipour M, Mohammadifard N, Alikhassy H, Adeli K. 2008. Short- and long-term relationships of serum ghrelin with changes in body composition and the metabolic syndrome in prepubescent obese children following two different weight loss programs. Clin Endocrinol (Oxf). [Epub ahead of print].

Knowler WC, Barrett-Connor E, Fowler SE. 2002. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med **346.** 393–403.

Manson JE, Nathan DM, Krolewski AS, Stampfer MJ, Willett WC, and Hennekens CH. 1992. A prospective study of exercise and incidence of diabetes among United States male physicians. JAMA **268,** 63–67.

Manson JE, Rimm EB, Stampfer MJ, Colditz GA, Willett WC, Krolewski AS, Rosner B, Hennekens CH, and Speizer FE. 1991. Physical activity and incidence of non-insulin-dependent diabetes mellitus in women. Lancet **338,** 774–7781.

Mullis R, Campbell IT, Wearden AJ, Morriss RK, Pearson DJ. 1999. Prediction of peak oxygen uptake in chronic fatigue syndrome. British Journal of Sports Medicine **33(5)**, 352-6.

O'Gorman DJ, Karlsson HK, McQuaid S. 2006. Exercise training increases insulin-stimulated glucose disposal and GLUT 4 (SLC2A4) protein content in patients with type 2 diabetes. Diabetologia **49,** 2983–2992.

Pulkkinen L, Ukkola O, Kolehmainen M, Uusitupa M. 2010. Ghrelin in Diabetes and Metabolic Syndrome. Int J Pept. **3,** 1-11.

Salehi A, Dornonville de la Cour C, Hakanson R, Lundquist I. 2004. Effects of ghrelin on insulin and glucagon secretion: a study of isolated pancreatic islets and intact mice. Regul Pept **118(3),** 143–150.

Sun Y, Asnicar M, Saha PK, Chan L, Smith RG. 2006. Ablation of ghrelin improves the diabetic but not obese phenotype of ob/ob mice. Cell Metab **3,** 379–386.

Sun Y, Asnicar M, Smith RG. 2007. Central and peripheral roles of ghrelin on glucose homeostasis. Neuroendocrinology **86,** 215–228.

Tuomilehto J, Lindstrom J, Eriksson JG. 2001. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Engl J Med **344,** 1343–1350.

Ueno H, Shiiya T, Mizuta M, Mondal SM, Nakazato M. 2007. Plasma ghrelin concentrations in different clinical stages of diabetic complications and glycemic control in Japanese diabetics. Endocr J **54(6),** 895-902.

Ukkola O, Kunnari A, Jokela M, Päivänsalo M, Kesäniemi YA. 2009. Ghrelin and metabolic disorders. Current Protein and Peptide Science **10 (1),** 2–7.

Yada T, Dezaki K, Sone H, Koizumi M, Damdindorj B, Nakata M, Kakei M. 2008. **Ghrelin regulates insulin release and glycemia: physiological role and therapeutic potential.** Curr Diabetes Rev 4(1), 18-23.