Comparison of the Effects of Sibutramine and Orlistat on Obese, Poorly-Controlled Type 2 Diabetic Patients

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Background: We assessed and directly compared weight loss effects of sibutramine and orlistat treatment in a group of obese, poorly-controlled type 2 diabetic patients.

Methods: This study recruited 34 diabetic subjects [glycohemoglobin (HbA_{1c}) > 8%] with a body mass index of at least 27 kg/m^2. A 36-week, three-phase, prospective, randomized, cross-over comparative study was conducted. In phase 1, 34 patients were randomly divided into two groups. One group received sibutramine for 3 months, then completed a 3 month wash-out period and, finally, shifted to orlistat for another 3 months. The second group followed the same procedure but received orlistat first and then sibutramine. The efficacy measures were rate of weight reduction, glycemic control, insulin sensitivity and cardiovascular risk factors, including waist circumference, lipid profiles and blood pressure.

Results: The sibutramine-treated group achieved 2.0 kg (2.5%) weight loss with observable but not statistically significant changes in insulin sensitivity, glycemic control, and cardiovascular risk factors. There were no significant changes in systolic or diastolic blood pressure. The weight reduction in the orlistat-treated group was only 0.8 kg (0.9%), which was significantly less than that of the sibutramine group. There were significant differences in total cholesterol, low density lipoprotein cholesterol and HbA_{1c}. Direct comparative analysis revealed no significant differences between these two groups.

Conclusion: This study indicates that sibutramine treatment produced greater reduction in weight than orlistat in obese, poorly-controlled type 2 diabetic patients. However, no significant differences in waist circumference, and lipid or glucose levels were found between the two groups.

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Key words: sibutramine, orlistat, weight reduction, obesity, type 2 diabetes mellitus

Obesity is rapidly becoming a major health problem worldwide[1] and is complicating the management of diabetes, particularly the goal of achieving tight glycemic control.[2-4] Weight reduction has

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been demonstrated to significantly improve plasma glucose, blood pressure, total cholesterol, low density lipoprotein cholesterol (LDL-C) and cardiovascular risk factors associated with insulin resistance in obese, type 2 diabetic patients.[5] The management of obese diabetic patients remains a challenge for the clinician[6] but several studies have demonstrated that even modest weight reduction can markedly improve glycemic control in such patients.[7] Weight reduction should be considered as a key goal for obese, poorly-controlled type 2 diabetic patients.[8] Lifestyle modifications with diet and exercise are essential for managing obese diabetic patients.[9] The above measures alone are frequently insufficient, and concomitant pharmacological therapy is generally required to achieve glycemic and weight control.[10]

Weight loss appears more difficult in type 2 diabetic patients than in non-diabetic subjects.[9,11] Diet and exercise can provide particular challenges for type 2 diabetic patients.[12] However, using anti-obesity drugs to reduce weight may provide an alternative method of improving glycemic control in obese, poorly-controlled type 2 diabetic patients who are unwilling to receive insulin injections. Many studies have shown that the anti-obesity agents sibutramine and orlistat (the only two approved anti-obesity drugs in Taiwan) can be used to achieve weight loss in obese, type 2 diabetic patients.[13-15] Modest weight reduction can improve metabolic control.[7] However, no studies have shown whether sibutramine or orlistat is more suitable for obese, type 2 diabetic patients.

To compare the efficacy of sibutramine and orlistat in obese, poorly-controlled type 2 diabetic patients, a prospective, randomized, cross-over, comparative investigation was performed at Chang Gung Memorial Hospital (CGMH), Keelung, Taiwan. The study analyzed the effects of the two anti-obesity drugs on weight loss, glycemic control, lipid parameters, insulin sensitivity, caloric intake and adverse effects.

METHODS

Subjects

Thirty four (5 men and 29 women) obese, poorly-controlled diabetic subjects with glycohemoglobin (HbA_{1c}) > 8%, ages ranging between 20 to 65 years and body mass indexes (BMI, calculated as weight in kilograms divided by the square of height in meters) of at least 27 kg/m^2 were recruited from the medical outpatient clinics at CGMH, Keelung. Their mean ± standard deviation (SD) age was 49 ± 12 years and mean duration of diabetes was 10.6 years. The percentage of patients with hypertension was 77.4%, hypercholesterolemia (treated with statin) was 41.2% and hypertriglyceridemia (treated with fenofibrate) was 14.7%. Medications for glycemic control, hypertension, hypercholesterolemia and hypertriglyceridemia were not changed during the weight reduction program. Eight out of the 34 participants were treated with combined oral anti-diabetic drugs (OADs) and insulin, and 26 were treated with OADs alone. All subjects had received the same advice on dietary restriction and lifestyle modification prior to being prescribed the anti-obesity agent but remained obese, with stable weight for at least 6 months. All subjects had written informed consent.

Exclusion criteria included poorly controlled hypertension [systolic blood pressure (SBP) > 160 mmHg or diastolic blood pressure (DBP) > 95 mmHg] and renal function impairment (serum creatinine > 1.4 mg/dl).

Study design

This study was designed as a two-treatment, two-period (3 phases) crossover study (Figure 1). A 36-week, three-phase, prospective, randomized, cross-over comparison study was performed from March, 2004 to March, 2005 at the division of Metabolism and Endocrinology, Department of Internal Medicine, CGMH, Keelung, Taiwan. During phase 1, 34 obese, poorly-controlled type 2 diabetic patients were randomly allocated into two groups. In addition to their usual medical agents, one group (n = 20) received sibutramine 10 mg once daily for 3 months, then entered a 3-month wash-out period and finally shifted to orlistat 120 mg three times daily for another 3 months. The other group (n = 14) followed exactly the same procedure but received orlistat first followed by sibutramine. Screening included a physical examination comprising vital signs (blood pressure and heart rate), physical measurements (weight, height and waist circumference) and clinical laboratory tests [fasting and postprandial plasma glucose, fasting plasma insulin, HbA_{1c}, total cholesterol, triglyceride, LDL-C and high density lipoprotein cholesterol (HDL-C)]. During the study, vital signs,

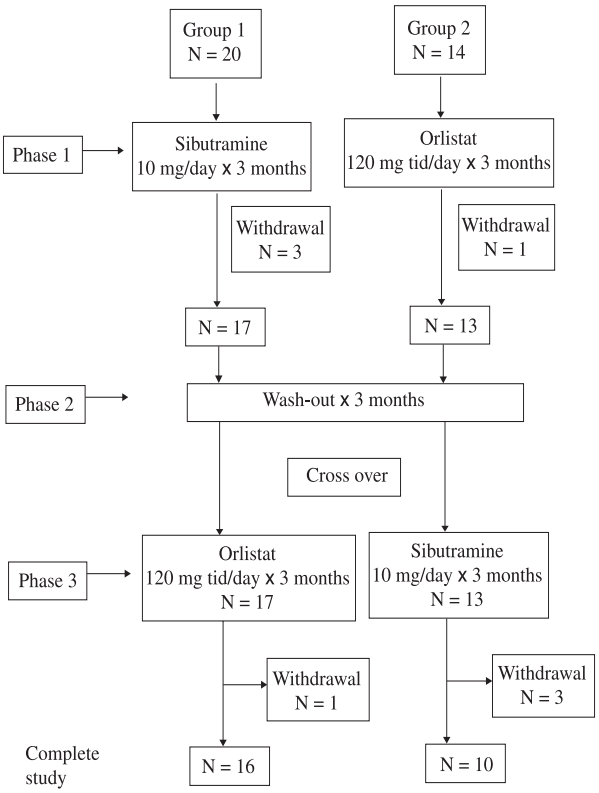

Fig. 1 Study design flow chart.

weight and waist circumferences were measured monthly. Clinical laboratory tests were performed at both the start and end of the study. Blood samples were drawn in the morning following an overnight fast.

Diet

Participants maintained their daily diet during the weight loss program. Daily caloric intake was checked by a dietitian at both the beginning and end of the study.

Efficacy parameters

The primary efficacy parameter was change in weight. Secondary parameters included changes in fasting and postprandial glucose, plasma insulin, HbA_{1c}, total cholesterol, triglyceride, HDL-C, LDL-C, SBP, DBP, heart rate and waist circumference.

Laboratory measurements

All samples were analyzed by a central laboratory. Plasma glucose concentration and total cholesterol were measured using an auto-analyzer (Hitachi 7250 Special; Hitachi, Tokyo, Japan). HbA_{1c} was measured by means of an automatic ion-exchange chromatographic method. Serum HDL-C levels were assessed using an enzymatic cholesterol assay method. Serum LDL-C concentrations were calculated using the Friedewald formula. The determination of serum triglyceride following enzymatic splitting with lipoprotein lipase was assayed with an auto-analyzer. Finally, plasma insulin concentrations were determined via automated immunoassay (Access; Beckman Instruments, Fullerton, CA, USA). Insulin resistance (IR) was determined by homeostasis model assessment (HOMA), and calculated using the fasting glucose and fasting insulin levels of each participant, as follows:

HOMA-IR = [fasting plasma glucose (mmol/l) x fasting plasma insulin (μU/ml)]/22.5[9]

Waist circumference was measured to the nearest 0.1 cm midway between the iliac crest and the lower rib margin using an insertion tape. It was measured by the same nurse at baseline and then monthly until the last study visit.

Statistical analysis

All statistical analysis followed the principle of intention-to-treat. Laboratory and anthropometric measurements were collected at both the beginning and end of each period, and for each group. Statistical analysis was performed using the paired Student's t-test to determine the effects of sibutramine and orlistat, and the chi-squared test was used to make between-group comparisons. All subjects' data were ordered by either treatment or period, and followed Grizzle's design.[16] The cross-over analysis was done to check the treatment, period and carry-over effect using SAS PROC GLM (general linear model) control language, SAS version 9.1 (SAS Institute, Inc., Cary, NC, USA). The carry-over effects were checked by the test of treatment with period interaction. The level of significance was set at $p < 0.05$.

RESULTS

We conducted a 36-week, three-phase, prospective, randomized, cross-over comparative study (Figure 1). In phase 1, 34 obese, poorly-controlled

type 2 diabetic patients were randomly divided into two groups, with 20 participants in group 1 receiving sibutramine and 14 participants in group 2 receiving orlistat for 3 months. Seventeen participants in the sibutramine group and 13 participants in the orlistat group completed phase 1 of the study. They then entered a 3-month wash-out period (phase 2). In phase 3, the above 2 groups were switched, with 13 participants receiving sibutramine and 17 participants receiving orlistat for another 3 months. Ten participants in the sibutramine group and 16 participants in the orlistat group completed phase 3. Twenty-seven (82.8%) subjects in the sibutramine group and 29 (93.5%) in the orlistat group successfully completed the study. The withdrawal rate of the sibutramine group was 18.2%, while that of the orlistat group was 6.5% ($p = 0.0043$).

Weight regain in the wash-out period was 75% in the sibutramine group and 50% in the orlistat group. Mean weight gain was 1.5 kg in the sibutramine group and 0.3 kg in the orlistat group. Greater weight reduction and greater weight regain were found in the sibutramine group but there was no significant difference between the 2 groups ($p = 0.238$).

Table 1 shows the characteristics of the two study groups. There were 18 females and 2 males in group 1 and 11 females and 3 males in group 2. Both biochemical and physical information at baseline were not significantly different between the two groups, including the major evaluations of weight and waist circumference. Table 2 shows the metabolic variables of the participants treated with sibutramine at baseline and at the end of the investigation. The changes in weight (from 83.4 ± 16.4 to 81.3 ± 17.0 kg, $p = 0.0002$) and caloric intake (from 1680 ± 303 to 1500 ± 376 Kcal/day, $p = 0.0024$) were statistically significant. Waist circumference, fasting and postprandial plasma glucose, lipid parameters and insulin sensitivity did not change significantly. However, recordings of heart rates revealed that sibutramine induced a small but significant increase (from 85 ± 10 to 91 ± 10 beats/min, $p = 0.0002$).

Table 3 reveals the metabolic variables for the participants treated with orlistat at baseline and 3-months after treatment. There were significant changes in weight (from 82.8 ± 15.5 to 82.0 ± 15.3 kg, $p = 0.0211$), HbA_{1c} (from 9.6 ± 1.4 to 9.1 ± 1.4%, $p = 0.0063$), total cholesterol (from 200 ± 40 to 182 ± 28 mg/dl, $p = 0.0083$), LDL-C (from 141 ± 31 to 125 ± 27 mg/dl, $p = 0.0202$) and caloric intake (from 1862 ± 567 to 1538 ± 435 Kcal/day, $p = 0.007$). However, no significant changes were observed in waist circumference, fasting and postprandial plasma glucose, triglyceride, HDL-C, insulin sensitivity, blood pressure and pulse rate.

Table 1. Characteristics of the Study Groups

Variable	Group 1	Group 2	*p* value
Case number	20	14	
Gender (F/M)	18/2	11/3	0.3544
BW (kg)	83.53 ± 16.21	87.26 ± 17.41	0.5254
Waist (cm)	98.90 ± 15.79	100.79 ± 11.71	0.7183
AC glucose (mg/dl)	191.60 ± 55.90	204.29 ± 58.72	0.5281
PC glucose (mg/dl)	227.55 ± 52.62	248.93 ± 65.71	0.3005
HbA_{1c} (%)	9.24 ± 1.03	9.99 ± 1.27	0.0659
T. chol (mg/dl)	200.33 ± 43.61	206.92 ± 34.75	0.6556
TG (mg/dl)	117.22 ± 62.85	145.31 ± 84.57	0.2968
LDL-C (mg/dl)	147.82 ± 39.22	141.00 ± 31.70	0.6128
HDL-C (mg/dl)	31.82 ± 8.16	36.92 ± 15.84	0.3047
HOMA-IR	11.10 ± 7.66	18.39 ± 29.64	0.4028
SBP (mmHg)	138.75 ± 15.91	142.07 ± 19.25	0.5555
DBP (mmHg)	79.32 ± 11.09	80.57 ± 8.28	0.7241
PR (beats/min)	87.79 ± 8.13	82.00 ± 9.53	0.0696

Abbreviations: BW: body weight; AC: fasting; PC: postprandial; HbA_{1c}: glycohemoglobin; T. chol: total cholesterol; TG: triglyceride; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; HOMA-IR: homeostasis model assessment-insulin resistance; SBP: systolic blood pressure; DBP: diastolic blood pressure; PR: pulse rate

Table 4 shows the results of direct comparative analysis involving the participants who received both sibutramine and orlistat sequentially. Weight circumference was considerably reduced following sibutramine treatment compared to orlistat treatment. The overall weight reduction was 2.0 kg (95% confidence interval 1.1-2.9) for sibutramine treatment vs. 0.8 kg (95% confidence interval 0.2-1.4) for orlistat treatment ($p = 0.0308$) (carry-over effect test $p = 0.4817$). There were no significant differences in waist circumference, LDL-C and glycemic control between the 2 groups. In addition to the main effects of treatment, we performed tests for the carry-over effect by

Table 2. Clinical and Biochemical Characteristics of Obese, Poorly-controlled Type 2 Diabetes Patients before and after Three-Months' Treatment with Sibutramine

Variable	Initial (mean ±SD)	Final (mean ±SD)	Reduction (mean ±SD)	*p* value
BW (kg)	83.4 ±16.4	81.3 ±17.0	2.0 ±2.6	0.0002
Waist (cm)	98.0 ±14.3	96.8 ±14.5	1.2 ±3.6	0.0938
AC glucose (mg/dl)	195.7 ±57.6	197.7 ±59.3	+2.0 ±49.6	0.8266
PC glucose (mg/dl)	219.6 ±59.1	225.1 ±73.7	+5.5 ±74.9	0.6885
HbA_{1c} (%)	9.3 ±1.2	9.1 ±1.6	0.2 ±1.0	0.1843
T. chol (mg/dl)	199.7 ±38.9	198.7 ±38.6	1.0 ±42.6	0.9037
TG (mg/dl)	126.4 ±66.5	125.1 ±79.7	1.3 ±48.3	0.8879
LDL-C (mg/dl)	143.1 ±34.5	140.2 ±31.6	2.9 ±38.3	0.6927
HDL-C (mg/dl)	32.7 ±10.5	34.9 ±13.7	+2.1 ±6.7	0.1001
HOMA-IR	9.6 ±4.4	9.7 ±3.8	+0.1 ±3.5	0.9336
SBP (mmHg)	137.7 ±15.1	136.5 ±13.6	1.2 ±15.0	0.6673
DBP (mmHg)	78.5 ±10.3	78.9 ±10.4	+0.4 ±8.9	0.8365
PR (beats/min)	85.0 ±10.0	91.0 ±10.0	+6.0 ±7.4	0.0002

Abbreviations: SD: standard deviation; BW: body weight; AC: fasting; PC: postprandial; HbA_{1c}: glycohemoglobin; T. chol: total cholesterol; TG: triglyceride; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; HOMA-IR: homeostasis model assessment-insulin resistance; SBP: systolic blood pressure; DBP: diastolic blood pressure; PR: pulse rate

Table 3. Clinical and Biochemical Characteristics of Obese, Poorly-controlled Type 2 Diabetes Patients before and after Three Months' Treatment with Orlistat

Variable	Initial (mean ±SD)	Final (mean ±SD)	Reduction (mean ±SD)	*p* value
BW (kg)	82.8 ±15.5	82.0 ±15.3	0.8 ±1.7	0.0211
Waist (cm)	97.2 ±12.8	97.5 ±11.6	+0.3 ±5.5	0.7874
AC glucose (mg/dl)	195.8 ±57.4	196.9 ±50.1	+1.1 ±64.2	0.9239
PC glucose (mg/dl)	239.9 ±69.1	228.6 ±93.7	11.4 ±72.7	0.3899
HbA_{1c} (%)	9.6 ±1.4	9.1 ±1.4	0.6 ±1.1	0.0063
T. chol (mg/dl)	200.0 ±40.0	182.0 ±28.0	18.6 ±34.6	0.0083
TG (mg/dl)	118.2 ±69.6	110.4 ±67.9	7.9 ±42.2	0.3327
LDL-C (mg/dl)	141.0 ±31.0	125.0 ±27.0	15.5 ±33.2	0.0202
HDL-C (mg/dl)	34.0 ±11.8	32.7 ±8.6	1.3 ±6.0	0.2555
HOMA-IR	15.4 ±22.7	16.5 ±31.8	+1.1 ±11.6	0.6443
SBP (mmHg)	142.9 ±16.1	141.2 ±14.1	1.7 ±19.6	0.6443
DBP (mmHg)	79.1 ±7.7	78.3 ±7.4	0.8 ±10.1	0.6681
PR (beats/min)	84 .0 ±9.0	85.0 ±12.5	+1.3 ±12.7	0.5786

Abbreviations: SD: standard deviation; BW: body weight; AC: fasting; PC: postprandial; HbA_{1c}: glycohemoglobin; T. chol: total cholesterol; TG: triglyceride; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; HOMA-IR: homeostasis model assessment-insulin resistance; SBP: systolic blood pressure; DBP: diastolic blood pressure; PR: pulse rate

Table 4. Direct Comparative Analysis of Sibutramine and Orlistat

Reduction	Orlistat (95% CI)	Sibutramine (95% CI)	*p* value	Carry-over effect test (*p* value)
BW reduction (kg)	0.8 (0.2-1.4)	2.0 (1.1-2.9)	0.0308	0.4817
BW reduction (%)	0.9 (0.1-1.7)	2.5 (1.4-3.6)	0.0193	0.5459
Waist circumference reduction (cm)	+0.1 (+2.0-1.8)	1.3 (–0.2-2.7)	0.2760	0.2588
AC glucose reduction (mg/dl)	+1.1 (+23.3-21.2)	+2.0 (–19.4-15.5)	0.9521	0.5588
HbA_{1c} reduction (%)	0.6 (0.2-0.9)	0.2 (–0.1-0.6)	0.2114	0.9181
HbA_{1c} reduction percent (%)	5.1 (1.1-9.0)	3.9 (0.2-7.6)	0.6755	0.6296
T. chol reduction (mg/dl)	11.0 (–10.9-32.7)	4.0 (–11.1-19.1)	0.6097	0.7753
LDL-C reduction (mg/dl)	15.5 (3.2-27.8)	2.9 (–11.3-17.1)	0.1941	0.5554

Abbreviations: CI: confidence interval; BW: body weight; AC: fasting; HbA_{1c}: glycohemoglobin; T. chol: total cholesterol; LDL-C: low density lipoprotein cholesterol

treatment and period interaction to check whether the first time period treatment persisted into the second period or not. The carry-over effect test results for all variables were not significant (Table 4).

DISCUSSION

Many reports have been published regarding the effects of anti-obesity drugs in the management of obese patients with type 2 diabetes[8,14,17] but there have been no direct comparative analyses of sibutramine and orlistat in Asia. In this study, we observed the participants who sequentially used these two anti-obesity agents.

Sibutramine can increase energy expenditure and inhibit food intake by acting on the central nervous system and causing weight loss.[13,17] Sibutramine can increase pulse rate, blood pressure and sympathetic tone via its norepinephrine reuptake inhibitory effect.[18-20] However, recent meta-analysis of controlled trials revealed no clear evidence to support the influence of sibutramine treatment on SBP and DBP.[17] In the present study, no significant increases in SBP and DBP occurred in sibutramine-treated patients, probably because these effects were masked or abolished by the decrease in weight, which often causes a reduction in blood pressure. Heart rate, which can serve as a surrogate index of sympathetic activity, significantly exceeded the baseline values in the sibutramine group. In early treatment, the most common adverse effects associated with orlistat were related to the gastrointestinal systems, and were mild to moderate and generally transient. Six participants in the sibutramine-treated group and two participants in the orlistat-treated group dropped out during the study. Sibutramine tolerability was significantly less than that for orlistat, with a dropout rate of 18.2% (6/33) for the former group compared to 6.5% (2/31) for the latter (p = 0.0043).

Our results demonstrated that the sibutramine-treated group achieved 2.5% weight loss compared to baseline, similar to the finding of Huang et al.[11] but less than the 5.4% shown in other previous studies.[18,21] Baseline weight, ethnicity, diet modification and treatment period may cause differences in weight reduction. Weight loss in type 2 diabetic patients appears to be more difficult than in non-diabetic subjects.[9,11] The sibutramine-treated group displayed insignificant changes in insulin sensitivity, glycemic control, and total cholesterol and LDL-C levels. These results may be due to insufficient weight reduction during this investigation.

Orlistat, a semisynthetic derivative of lipstatin,[8] is a potent and selective inhibitor of pancreatic and gastric lipases.[22] When administered together with fat containing foods, orlistat can reversibly inhibit hydrolysis of triglycerides to monoglycerides and free fatty acids.[23] The orlistat-treated group displayed only a 0.9% weight reduction, very different from the 3.3% shown in a previous study.[9] In addition to accentuating weight loss, orlistat has exerted beneficial effects on lipid parameters in obese type 2 diabetic patients.[24] In our study, weight loss was sig-

nificantly less in the orlistat group than in the sibutramine group. However, orlistat treatment significantly reduced total cholesterol and LDL-C, and improved glycemic control. This may be due to the pharmacological effect of orlistat, which can covalently bind to gastric and pancreatic enzymes, resulting in inhibition of the absorption of ingested fat in the lumen of the stomach and small intestine.[10] Orlistat reacts with a specific substrate, the serine residue of these lipases, and at therapeutic doses halts the hydrolysis process allowing the triglyceride content to pass out of the body minimally degraded.[22]

Through a direct comparative analysis, we demonstrated significant weight reduction with both anti-obesity agents (sibutramine 2.0 kg, $p < 0.0002$ and orlistat 0.8 kg, $p = 0.0211$) and a significant difference between these two groups ($p = 0.0308$). However, no significant differences were identified between the 2 groups in terms of changes in waist circumference, lipids and glycemic control.

Certain limitations in this investigation should be considered. First, diet, exercise and behavioral modification were not standardized. Second, the number of participants and the study duration may not provide adequate assessment of efficacy and safety. In previous studies, the number of participants was more than 100 and treatment duration was more than six months. In our study, the smaller sample size and 3 month treatment period may have caused the results that were different from those of previous studies. Moreover, the participants in previous studies received sibutramine 15 mg once daily but we used only 10 mg once daily in this study. Further research with a longer study period and a larger body of outcome data is required to study the extent of weight reduction and maintenance.

This investigation confirmed the efficacy of orlistat and sibutramine in reducing weight among obese, poorly-controlled type 2 diabetic patients. The modest weight loss achieved without a hypocaloric diet may also offer the benefits of improved glycemic control and lipid parameters in orlistat-treated patients.

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比較諾美婷與羅氏鮮對肥胖且血糖控制不良的第二型糖尿病患的臨床治療效果

周桂美 黃碧玉 范姜仁廣 陳志宏

背 景： 評估及比較使用諾美婷及羅氏鮮的減重效果對血糖控制不良的肥胖第二型糖尿病患之血糖控制、心血管危險因子及胰島素敏感性的影響。

方 法： 此研究納入 34 位血糖控制不良 (糖化血色素 > 8%) 及肥胖 (身體質量指數 > 27 kg/m^2) 的病患，期間爲 36 週 (3 個階段) 前瞻性，隨機分組並交叉分析研究。phases 1 中 34 位，病患隨機分爲 2 組。第一組，先接受諾美婷 10 mg 一天一次，治療 3 個月，停藥 3 個月後，改投予羅氏鮮 120 mg 一天三次，治療 3 個月；第 2 組以相同程序，但先受羅氏鮮治療，停藥後再改投予諾美婷治療。效果監測有體重下降的比率、血糖控制、胰島素的敏感性及心血管危險因子，包括腰圍、血脂肪及血壓。

結 果： 諾美婷治療組體重下降 2.0 kg (2.5%)，但胰島素敏感性、血糖控制、總膽固醇及低密度膽固醇並無統計學意義之改變，收縮壓及舒張壓也沒有明顯改變。羅氏鮮組體重下降僅有 0.8 kg (0.9%)，明顯比諾美婷組少，但總膽固醇、低密度膽固醇及血糖都有顯著改善，並具統計學意義。在直接比較分析時，兩組之間的腰圍、血脂肪及血糖改善方面並沒有統計學的意義。

結 論： 此研究結論爲諾美婷在肥胖且血糖控制不良之第二型糖尿病患的減重效果較羅氏鮮佳，但兩者之間對腰圍、血脂肪或血糖控制並無顯著差異。

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關鍵詞： 諾美婷，羅氏鮮，減重，肥胖，第 2 型糖尿病

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