

Case Report

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## Metabolic and cardiovascular improvements after biliopancreatic diversion in a severely obese patient

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### Abstract

**Background:** Severe obesity is associated with important morbidity and increased mortality. The successes of lifestyle modifications and drug therapy have been partial and mostly unsustainable in reducing obesity and its comorbidities. Bariatric surgery, particularly biliopancreatic diversion with duodenal switch reduces efficiently excess body weight and improves metabolic and cardiovascular functions.

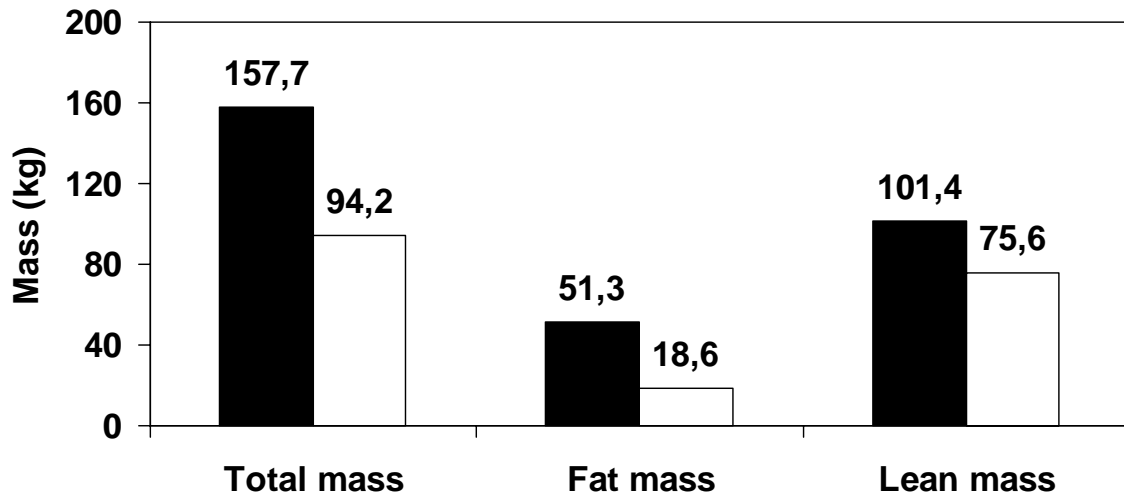
**Case presentation:** A 56-year-old man with severe clinical obesity underwent a biliopancreatic diversion with a duodenal switch after unsuccessful treatment with weight loss pharmacotherapy. He had diabetes, hypertension and sleep apnea syndrome and was on three medications for hypertension and two hypoglycemic agents in addition to > 200 insulin units daily. Eleven months after the surgery, he had lost 40% of his body weight. The lipid profile showed great improvement and the hypertension and diabetes were more easily controlled with no more insulin needed. The pseudonormalized pattern of left ventricular diastolic function improved and ventricular walls showed decreased thickness.

**Conclusion:** Biliopancreatic diversion may bring metabolic and cardiovascular benefits in severely obese patients from a cardiovascular perspective.

### Case presentation

A 56-year-old man was referred for biliopancreatic diversion with a duodenal switch (BPD-DS) for intractable complications associated with morbid obesity. He had been unable to lose weight with orlistat 120 mg three

times a day for three months. The patient had diabetes mellitus for twenty years associated with hypertension, "mal perforant" and hepatic steatosis. He had all features of the metabolic syndrome and was treated for sleep apnea with a nocturnal continuous positive airway



**Figure 1**  
Anthropometric variables before and after biliopancreatic bypass surgery

pressure device (C-PAP). His body mass index (BMI) at the time of the surgery was  $48.7 \text{ kg/m}^2$ , weighting 157.7 kg.

The patient's blood tests showed normal electrolytes and a creatinine of  $110 \text{ } \mu\text{mol/L}$ . The hemoglobin level was  $134 \text{ g/L}$ , white blood cell and platelet counts were normal. The glycated hemoglobin was 7.1% (normal range 4.4–6.5%) with fasting glucose values ranging from 7 to 11 mmol/L. A 24-hour blood pressure monitoring was normal under medication. His total cholesterol was  $4.41 \text{ mmol/L}$ , the triglyceride level was  $1.74 \text{ mmol/L}$  with LDL-cholesterol and HDL-cholesterol levels of 2.63 and  $0.99 \text{ mmol/L}$  respectively. The total cholesterol/HDL ratio was 4.45. Rest and exercise electrocardiograms were normal as well as a cardiac dobutamine stress echocardiography. A pseudonormalized pattern of left ventricular filling was present on a standard echocardiogram and a 24-hour Holter was normal except for a slight decrease in heart rate variability. His medications before surgery consisted of metformin 850 mg TID, rosiglitazone 8 mg daily, irbesartan 300 mg daily, diltiazem 120 mg daily, orlistat 120 mg TID and furosemide 20 mg every other day. He was on insulin Humalog TID (42–46 U) with insulin NPH 90 U at bed time, for a total of > 200 U of insulin daily.

He underwent a modified Scoparino's biliopancreatic diversion with a duodenal switch [1-5]. Appendicectomy

and cholecystectomy were concurrently performed. The patient had an hemodynamically stable pulmonary emboli on the day 12 after surgery and was anticoagulated. Otherwise he had no other complication. Anthropometric measurements before and eleven months after the surgery are presented in the Table 1 and Figure 1 and metabolic improvements and echocardiographic findings are depicted in Tables 2 and 3 respectively. Eleven months after the surgery, the medication consisted of metformin 850 mg TID, irbesartan 150 mg daily, 50 000 U of vitamin D2, ferrous sulfate 300 mg daily, 25 000 U of vitamin A, calcium 500 mg and one tablet of vitamins and mineral supplements daily (Centrum Forte®). No insulin was needed anymore to control his metabolic profile.

### Discussion

Obesity is associated with an increased risk of coronary artery disease (CAD) and mortality [6-8]. Morbidity and mortality rates rise proportionally to the degree of obesity in men and women and the impact of excess body fat is more significant in younger subjects than older ones [9-12]. In a 10-year follow-up, men and women with a BMI  $\geq 35.0 \text{ kg/m}^2$  had a relative increased risk of developing diabetes of  $\sim 23$  and  $\sim 17$  fold respectively compared to a control group with a BMI between  $18.5$  and  $24.9 \text{ kg/m}^2$  [13]. Independently of the BMI, the relative risk of developing diabetes mellitus increases with weight gain as shown in the Nurse's Health Study [14]. Moreover, in that

**Table 1: Anthropometric variables before and after biliopancreatic diversion surgery**

	Before	11 months later	Changes (%)
BMI (kg/m <sup>2</sup> )	48.7	28.8	-40.9%
Waist circumference (cm)	146.5	109	-25.6%
Body fat (%)	33.6	19.7	-41.4%
Hydric mass (kg)	74.2	55.3	-25.5%

Anthropometric measurements were assessed using a bioimpedance balance (Tanita TBF 350®)

**Table 2: Metabolic profile before and after biliopancreatic diversion surgery**

	Before	11 months later	Changes (%)
Fasting glucose (mmol/L)	7.9	5.8	-26.6%
Total cholesterol (mmol/L)	4.41	2.64	-40.1%
HDL cholesterol (mmol/L)	0.99	0.87	-12.1%
LDL cholesterol (mmol/L)	2.63	0.92	-65.0%
Triglyceride (mmol/L)	1.74	1.87	+7.5%

**Table 3: Blood pressure and echocardiographic variables before and after biliopancreatic diversion surgery**

	Before	11 months later	Variability (%)
Systolic BP (mmHg)	120	125	+4.4%
Diastolic BP (mmHg)	70	74	+5.7%
LV mass index (g/m <sup>3</sup> ) <sup>1</sup>	128	108	-15.5%
EF (%)	62	65	+4.8%

BP: blood pressure EF: ejection fraction <sup>1</sup>From [42]

study, women who voluntarily lost more than 5.0 kg reduced their risk of diabetes by 50%. Weight loss also lowers blood pressure. In a 3-year follow-up of non-morbidly obese patients with a mean BMI of 31 kg/m<sup>2</sup>, patients who maintained a 4.5 kg weight loss had a relative risk of hypertension of 0.35 or, a reduction of 0.45 mmHg in systolic blood pressure and 0.35 mmHg in diastolic pressure per kg of weight lost [15].

Heart function is directly influenced by excess body fat [16]. In addition to higher cardiac output in obese patients, left ventricular volume and filling pressures are higher than normal. This usually results in the development of left ventricular strain, which leads to hypertrophy, often of the eccentric type [17,18]. Left ventricular diastolic function is thus frequently impaired [17,19].

Weight loss has a beneficial impact on the functional and the structural cardiac status. In a study of obese patients

with a mean BMI of 32.7 kg/m<sup>2</sup>, weight loss of 8 kg over a period of 25 weeks was associated with a significant decrease in left ventricular mass [20]. Weight loss lowers oxygen consumption at any given work rate, decreases cardiac output and blood pressure while left ventricular filling pressures decreased as left ventricular stroke volume diminishes [21,22]. In a study of obese patients with a BMI > 40 kg/m<sup>2</sup> in whom surgical weight loss with vertical gastric banding (VGB) induced a decrease in body weight of 20% at six months, left ventricular wall thickness, particularly the septal and posterior walls, decreased [23].

The National Institutes of Health (NIH) suggested that surgical therapy be proposed to those patients with a BMI level > 40 kg/m<sup>2</sup> or > 35 kg/m<sup>2</sup> with serious medical conditions including hypertension and obstructive sleep apnea [24]. Surgical intervention, when indicated, brings significant improvement such as a decrease in excess weight and comorbidities; these include hypertension,

**Table 4: Mitral Doppler at rest and during the Valsalva maneuver before and after biliopancreatic diversion surgery**

	Before	11 months later	Changes (%)
<b>BASELINE</b>			
E wave (cm/s)	70	66	-5.7%
A wave (cm/s)	54	82	+50.8%
E/A	1.3	0.8	-37.6%
<b>VALSALVA</b>			
E wave (cm/s)	53	43	-18.8%
A wave (cm/s)	67	54	-19.4%
E/A	0.8	0.8	-0.6%
Diastolic function	Pseudonormal pattern	Abnormal spontaneously	

E wave: early transmitral filling velocity A wave: transmitral atrial filling velocity E/A: early/atrial transmitral filling velocity

diabetes, dyslipidemia [3,14,25-28] and sleep-related disorders [18,29]. One can expect a mean reduction of 60 to 75% of excess body weight with biliopancreatic diversion which can persist for 4 to 8 years after surgery [3-5,30,31]. The duodenal switch operation, introduced by Hess in 1988 [5], variant of the biliopancreatic diversion of Scopinaro [1,2], helps in preserving normal eating habits, and the majority of patients undergoing the procedure will have normalization of glucose levels, triglyceride levels and blood pressure early weeks after the surgery [3-5]. Indeed, in a review of 440 obese patients (mean weight of 183 kg) who underwent biliopancreatic diversion with duodenal switch, all of the 36 type 2 diabetic patients discontinued their medication over a 7-year follow-up period [5]. Operative mortality is between 0.5% and 2% [3,5,30,32] and early complications include pulmonary embolus (0.5%) and anastomotic leaks (1-2.5%) [3,4,32,33]. Late complications presents in the form of anemia, anastomotic ulcerations, bone demineralization, neurological complications and protein malabsorption; all of which can be addressed with appropriate supplements. Moreover, significant nutritional and metabolic complications may be less frequent than previously thought [30]. Surgical revisions are needed in 0.1% to 4% of cases [3,5].

Eleven months after the surgery, our patient had lost 40% of his body weight, and body fat mass was reduced by 41% (Figure 1). The medication was greatly lightened while the patient maintained fasting glucose values ranging from 5 to 7 mmol/L and a blood pressure less than 130/80 mmHg (Table 2). Indeed, rosiglitazone was discontinued, the insulin that averaged > 200 U daily was no more necessary, diltiazem was discontinued and the dose of irbesartan was halved. The 25% decreased in waist circumference is probably clinically significant [34,35] albeit waist circumference may be less reliable in patients with a BMI > 35 kg/m<sup>2</sup> [36]. Finally, sleep apnea syndrome improved as the patient was no longer on C-PAP.

Left ventricle hypertrophy is recognized as a strong independent risk factor for cardiovascular morbidity and death and changes in cardiac structure following surgical weight loss have been observed [37,38]. In the present case, the left ventricle mass index decreased by 15% and the thickness of the septal and posterior walls of the left ventricle were reduced (Table 3). Moreover, using Doppler mitral flow velocity with the E/A ratio, we demonstrated that left ventricular diastolic dysfunction actually improved. Before the operation, the E/A ratio was higher than 1 with a significant decrease during the Valsalva maneuver which corresponds to a pseudonormal ventricular filling or grade 2 filling pattern [39,40]. After the operation, the E/A ratio was smaller than 1 indicating a delayed relaxation of grade 1 filling pattern, representing an improvement in the diastolic function [39,41] (Table 4).

This case report emphasizes the improvement in cardiovascular parameters, including the diastolic function (demonstrated by a pseudonormal ventricular filling or grade 2 filling pattern) and sleep apnea syndrome, following weight loss-induced by the biliopancreatic diversion with duodenal switch.

### Competing interests

None declared.

### Authors' contributions

PP envisioned the paper and PW, PP prepared the initial draft of the article. The other authors critically revised the manuscript for important intellectual content. All authors read and approved the final version of the manuscript.

### List of abbreviations

BPD-DS: biliopancreatic diversion with a duodenal switch

C-PAP: continuous positive airway pressure device

BMI: body mass index

VGB: vertical gastric banding

NIH: National Institutes of Health

E/A ratio: early/atrial transmitral filling velocity

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