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Bariatric surgery in duodenal switch procedure: weight changes and associated nutritional deficiencies

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KEYWORDS

Bariatric surgery;
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Abstract

Introduction: Bariatric surgery using the duodenal switch procedure is considered to be one of the most effective treatments for achieving weight loss and decreasing comorbidity in patients with morbid obesity. However, this procedure may be associated with various nutritional deficiencies that should be known and adequately managed.

Objectives: To assess weight loss and the occurrence of nutritional deficiencies in morbidly obese patients undergoing bariatric surgery using a duodenal switch procedure.

Patients and methods: One hundred and twenty-eight morbidly obese patients underwent a duodenal switch procedure at Hospital General Universitario in Albacete. Weight changes and the most important nutritional deficiencies occurring after surgery were recorded.

Results: Median follow-up time was 30 months (interquartile range, 18 months). Body weight markedly decreased, with mean body mass index (BMI) decreasing from a preoperative value of 52.9 ± 7.7 kg/m² to 30.8 ± 5.2 kg/m² 18 months after surgery. Percent excess weight loss (%EWL) was $81.4 \pm 16.4\%$ in this period. Weight loss slowed down subsequently, reaching its lowest value 30 months after surgery (%EWL 82.1 ± 16.8 , BMI 30.2 ± 4.3 kg/m²) and tended to stabilize in patients with longer follow-up times. The most significant nutritional deficiencies requiring replacement therapy were found in some micronutrients such as iron (42.9%), zinc (38.3%), vitamin A (55.5%), and vitamin D (57.8%), amongst others.

Conclusions: Duodenal switch is a very effective surgical procedure for treating morbidly obese patients because it allows them to achieve a significant and sustained weight loss. Close lifetime monitoring is required in these patients because of the high prevalence of nutritional deficiencies during follow-up.

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PALABRAS CLAVE

Cirugía bariátrica;
Cruce duodenal;
Deficiencias
nutricionales;
Obesidad mórbida

Cirugía bariátrica mediante la técnica del cruce duodenal: evolución ponderal y deficiencias nutricionales asociadas**Resumen**

Introducción: La cirugía bariátrica mediante la técnica del cruce duodenal está considerada como uno de los tratamientos más efectivos para conseguir la pérdida de peso y la disminución de comorbilidades en pacientes obesos mórbidos. Derivada de su práctica se pueden producir deficiencias nutricionales que debemos conocer y tratar.

Objetivos: Valoración de la pérdida de peso y del desarrollo de síndromes carenciales en pacientes obesos mórbidos sometidos a cirugía bariátrica mediante la técnica del cruce duodenal.

Material y métodos: Se ha estudiado la evolución de 128 pacientes obesos mórbidos sometidos a cirugía bariátrica mediante la técnica del cruce duodenal en el Hospital General Universitario de Albacete. Se realizaron controles ponderales y de las deficiencias nutricionales más relevantes surgidas tras la intervención.

Resultados: El peso corporal desciende de manera acusada desde un índice de masa corporal (IMC) promedio de $52,9 \pm 7,7 \text{ kg/m}^2$ (40,7-78,5) hasta un IMC de $30,8 \pm 5,2 \text{ kg/m}^2$, con un porcentaje de exceso de peso perdido (%EPP) de $81,4 \pm 16,4\%$ a los 18 meses tras la intervención. La pérdida de peso se ralentiza en el seguimiento posterior, llegando a su valor más bajo a los 30 meses postintervención (%EPP del $82,1 \pm 16,8$; IMC de $30,2 \pm 4,3 \text{ kg/m}^2$) y tiende a estabilizarse en los pacientes con seguimiento más prolongado. Las deficiencias nutricionales más significativas que requirieron tratamiento sustitutivo se detectaron en algunos micronutrientes como el hierro (42,9%), zinc (38,3%) y vitaminas liposolubles A (55,5%) y D (57,8%), entre otros.

Conclusiones: El tratamiento de la obesidad mórbida mediante cruce duodenal es una técnica muy efectiva para conseguir una importante pérdida de peso de forma mantenida. La elevada presencia de déficits nutricionales durante el seguimiento obliga a realizar revisiones periódicas de forma indefinida.

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Introduction

Morbid obesity (MO) is a multifactorial chronic disease associated with significant physical and psychological complications contributing to an increased morbidity and mortality in patients with this condition¹. In Spain, 0.3% of males and 0.9% of females have MO, which causes very high health care costs².

Bariatric surgery (BS) is effective in the long term for the treatment for OM, and also reduces the comorbidities³ associated with it.

BS includes different surgical procedures^{4,5}. Mixed procedures combining restriction and malabsorption achieve very high weight losses, but are also associated with severe side effects. Nutritional deficiencies are proportional to the decrease in absorptive area and the weight loss achieved⁶.

We report weight changes over time in 128 morbidly obese patients undergoing bariatric surgery by the duodenal switch procedure, and also the nutritional deficiencies occurring after surgery.

Patients and methods

The results achieved with the duodenal switch procedure in the setting of the BS program of Hospital General Universitario de Albacete were analyzed.

Data were collected using Cirbar software from the Castile-La Mancha Society of Endocrinology, Nutrition and Diabetes (SCAMEND). Demographic and anthropometric data, pre- and

postoperative obesity-associated comorbidities, and surgical and nutritional complications were recorded.

From May 1998 to January 2009, 128 morbidly obese patients underwent BS. Complete postoperative follow-up data were available for all of them. A duodenal switch (DS) surgical procedure, consisting of tubular gastrectomy combined with biliopancreatic diversion⁷⁻¹⁰, was performed through laparotomy by the same surgical team in all cases. Cholecystectomy was performed in 117 patients (91.4%). Postoperative follow-up was performed by an endocrinologist and a dietician from the nutrition unit.

A descriptive statistical study was made of the different anthropometric variables, such as weight (kg), body mass index (BMI) (kg/m^2), weight loss (kg), and percent excess weight loss (%EWL), during postoperative follow-up. Results are shown in frequency or percentage tables, and measures of central tendency are given as mean and standard deviation (SD). When some variable was markedly skewed, the median and the geometric mean were respectively used as measures of central tendency in the event of a negative or positive skew¹¹. All statistical analyses were performed using SPSS v.15.0 software (SPSS Inc, Chicago, USA, 2007).

Results

Data are reported for 94 female patients (73.4%) and male patients (26.5%) with a mean age of 42.1 ± 10.2 years (range, 19-70). Median follow-up time was 30 months (interquartile range, 18 months).

Table 1 Changes in weight parameters during postoperative follow-up

Time (months)	Weight (kg)	BMI (kg/m ²)	Weight loss (kg)	%EWL
Pre-surgery (n = 128)	139.3 ± 22.3	52.9 ± 7.7		
1 (n = 127)	125.9 ± 20.5	47.8 ± 7.2	13.4 ± 5	18.8 ± 6.8
3 (n = 125)	114.3 ± 18.9	43.5 ± 7	25.8 ± 11.5	36.5 ± 17.4
6 (n = 118)	98.9 ± 17.2	37.7 ± 7.9	42.8 ± 17.3	59.3 ± 21.4
12 (n = 113)	86.1 ± 15.3	32.7 ± 5.2	54.7 ± 13.1	76.1 ± 18.6
18 (n = 104)	81.6 ± 15.9	30.8 ± 5.2	58.9 ± 15.1	81.4 ± 16.4
24 (n = 92)	80.1 ± 15.4	30.2 ± 4.7	60.3 ± 16	82.1 ± 17.7
30 (n = 70)	79.2 ± 14.7	30.2 ± 4.3	60.8 ± 15.8	82.1 ± 16.8
36 (n = 51)	82 ± 15.9	31.1 ± 4.3	58.9 ± 15.9	79.4 ± 13.3
48 (n = 30)	85.5 ± 16.4	32.2 ± 3.9	57.8 ± 17	75.4 ± 11.3
60 (n = 9)	81.4 ± 24.4	32.4 ± 10.9	52.3 ± 17.1	74.3 ± 8.3
72 (n = 4)	78.5 ± 34.4	32.3 ± 3.7	58 ± 25.3	75.1 ± 8.5

%EWL: percent excess weight lost; BMI: body mass index.

Mean patient body weight before surgery was 139.3 ± 22.3 kg (99-202), and mean preoperative BMI was 52.9 ± 7.7 kg/m² (40.7-78.5).

The most prevalent associated comorbidities included high blood pressure in 60 patients (46.9%); liver steatosis in 52 (40.6%); obstructive sleep apnea syndrome in 46 (35.9%); diabetes mellitus in 26 (20.3%); dyslipidemia in 26 (20.3%); and bone and joint pathology in 26 (20.3%).

Weight changes over time

Patients lost weight rapidly in the first 18 months after surgery, with a %EWL of 81.4 ± 16.4% and a BMI decrease to 30.8 ± 5.2 kg/m² (n = 104). Weight loss slowed down subsequently and reached a nadir at 30 months, with a %EWL of 82.1 ± 16.8 (n = 70) and a BMI of 30.2 ± 4.3 kg/m². BMI slightly increased then to 32.2 ± 3.9 kg/m² at 48 months (n = 30) and tended to stabilize in patients with the longest follow-up (Table 1). Figure 1 plots weight changes over time.

Nutritional deficiencies occurring after surgery

Deficiencies were found in vitamin A (71 patients, 55.5%), vitamin D (74 patients, 57.8%), iron (55 patients, 42.9%),

and zinc (49 patients, 38-3%). Deficiencies in B vitamins and magnesium were less common (Table 2).

Table 3 summarizes the nutritional supplements added to correct the above deficiencies.

Discussion

Duodenal switch is an alternative to the biliopancreatic diversion (BPD) of Scopinaro et al¹² in which distal gastrectomy is replaced by tubular gastrectomy, thus preserving gastric function. Some authors consider duodenal switch the procedure of choice in the subgroup of patients with higher BMI, who show a greater rate of associated comorbidities and/or metabolic syndrome. At reference centers, a long-term overweight reduction of up to 70% has been achieved with good patient quality of life and the disappearance of or a marked improvement in comorbidities. This represents results which are better and more stable over time as compared to other surgical procedures with no strict dietary limitations and a low mortality¹³⁻¹⁶.

Short-term results reported in a sample of 118 patients undergoing DS showed a mean weight loss of 25 kg in the first three months¹⁷. In a small series from a single center, a mean EWL of 84% was seen in 61 patients at 16 months of

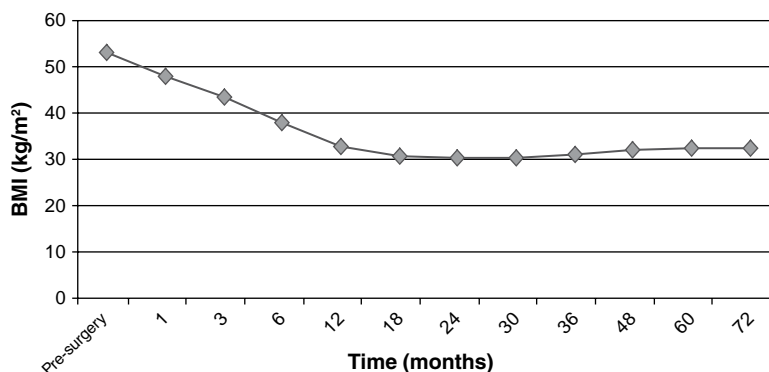


Figure 1 Change in body mass index (kg/m²) after surgery.

Table 2 Nutritional deficiencies after surgery

Deficiency	Number of patients	% of patients	Most common occurrence time
Vitamin D	74	57.8%	3-24 months
Vitamin A	71	55.5%	3-6 months
Iron	55	42.9%	3-24 months
Zinc	49	38.3%	6-24 months
Anemia	25	19.5%	3-24 months
Other B vitamins	18	14.1%	6-12 months
Folic acid	14	10.9%	3-12 months
Hypoalbuminemia	8	6.2%	6-12 months
Change in INR	6	4.9%	3 months
Vitamin E	5	3.9%	3-6 months
Vitamin B ¹²	5	3.9%	12-36 months
Magnesium	4	3.1%	6-36 months

INR: International normalized ratio for coagulation time.

surgery¹⁸. In larger studies including 701 patients with a mean initial BMI of 52.8 kg/m², a mean BMI of 31 kg/m² was achieved at 36 months, with a slight increase in the patient group with the longest follow-up¹⁹. These results are similar to those achieved in the 104 patients in our series for which follow-up was available following similar surgery.

BS induces anatomic and functional gastrointestinal changes resulting in food intake reduction and/or nutrient malabsorption which may compromise the nutritional status of patients, leading to protein-energy malnutrition and/or selective deficiency of some micronutrients²⁰. Such nutritional changes may be present in some cases before surgery^{21,22}. In order to minimize these complications, BS should be performed by a multidisciplinary team that includes experienced surgeons and applies strict rules for patient selection and long-term clinical follow-up^{23,24}.

The DS procedure may compromise the absorption of fat and liposoluble vitamins (A, D, E, K), iron and calcium, among other nutrients, and may also affect protein absorption and induce calorie-protein malnutrition in up to 3%-5% of patients²⁴. Vitamin A, K, and D and zinc deficiencies have been reported in more than 50% of patients at 12 months of surgery²⁵. These rates gradually increase, suggesting that intestinal adaptation allowing for the maintenance of a balance in the absorption of certain micronutrients still has not occurred four years after

duodenal switch surgery.^{26,27} Similar results were found in our series.

In a study comparing BPD and DS, Dolan et al¹⁵ found hypoalbuminemia in 18% of patients, anemia in 32%, iron deficiency in 23%, calcium malabsorption in 25%, and a mean deficit of almost 50% in vitamins A, D, E, and K. They also reported zinc, selenium, and magnesium deficiencies in 10.8%, 14.5%, and 4.8% of patients, with no significant differences between both procedures. In our series, hypoalbuminemia and anemia were less common, which could be attributed to the surgical procedure (greater length of the common limb) and/or to a close postoperative follow-up by the clinical nutrition unit.

BS using the DS procedure achieves good weight loss results in the middle term. However, the gradual occurrence of nutritional deficiencies in more than half of the patients mandates indefinite follow-up at the clinical nutrition clinic to reinforce new feeding habits, promote physical activity, prevent and treat nutritional deficiencies, diagnose late postoperative complications, and assess the need for correcting cosmetic sequelae after massive weight loss as an essential component in the recovery of patient quality of life and satisfaction.

Conflict of interest

The authors state that they have no conflict of interest.

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Table 3 Supplements administered to patients

Supplement	Number of patients (%)
Calcium and vitamin D	124 (96.9%)
Multivitamin preparation	122 (95.3%)
Specific (vitamins A and E, calcitriol/calcifediol, potassium, and zinc sulphate)	80 (62.5%)
Iron	45 (35.2%)
Folic acid	12 (9.4%)
Vitamin B ¹²	5 (3.9%)

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