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Duodenal Switch: Long-Term Results

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Background: This report summarizes our 15-year experience with duodenal switch (DS) as a primary procedure on 1,423 patients from 1992 to 2005.

Methods: Within the last 2 years, follow-up of these patients, including clinical biochemistry evaluation by us or by their local physician is 97%.

Results: Survival rate was 92% after DS. The risk of death (Excess Hazard Ratio (EHR)) was 1.2, almost that of the general population. After a mean of 7.3 years (range 2-15), 92% of patients with an initial BMI ≤50 kg/m^2 obtained a BMI <35 and 83% of those with an initial BMI >50 obtained a BMI <40. Diabetes was cured (i.e. medication was discontinued) in 92% and medication decreased in the others. The use of the CPAP apparatus was discontinued in 90%, medication for asthma was decreased in 88%, and the prevalence of a cardiac risk index >5 was decreased by 86%. Patients' satisfaction in regard to weight loss was graded 3.6 on a basis of 5, and 95% of patients were satisfied with the overall results. Operative mortality was 1% which is comparable with gastric bypass surgery. The need for revision for malnutrition was rare (0.7%) and total reversal was exceptional (0.2%). Failure to lose >25% of initial excess weight was 1.3%. Revision for failure to lose sufficient weight was needed in only 1.5%. Severe anemia, deficiency in vitamins or bone damage were exceptional, easily treatable, preventable and no permanent damage was documented.

Conclusion: In the long term, DS was very efficient in terms of cure rate for morbid obesity and its co-morbidities. In terms of risk/benefit, DS was very sucessful with an appropriate system of follow-up.

Key words: Morbid obesity, bariatric surgery, duodenal switch, long-term results

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Introduction

Duodenal switch (DS) is an improved version of the initial biliopancreatic diversion Scopinaro type (BPD-SC) where the distal gastrectomy was replaced by a sleeve gastrectomy for preserving gastric function and the common channel was lengthened to increase the role of biliopancreatic secretions.[1,2]

The goal in diverting bile and pancreatic juice was to decrease caloric and fat absorption while preserving normal alimentation. Later additional benefits were discovered. Because food was bypassing the proximal intestine and reaching directly the distal intestine, the intestinal hormone secretions were altered, which in itself contributed to preventing diabetes and obesity.[3-5]

Previously, any attempt to change the physiological pathway had always raised concern regarding future outcome. Previous experience in the 1960s with an operation called "intestinal bypass", which has caused great frustration after initial good results, has exacerbated this fear, and the guideline has remained that other alternative must be tried before changing the anatomical routing to treat morbid obesity.

As time went by, new evidence now describes morbid obesity as a serious disease, possibly due to a disturbed physiology. Changing the physiology became not only more attractive but even a must for assuring a more permanent result.[6]

After 10 years experience with the original BPD-SC,[7] we changed to DS,[2] due to fewer side-effects and improved absorption of both protein and fat-soluble vitamins without compromising weight loss. Now, for 15 years, DS has been the primary procedure used for all our morbidly obese patients of all sizes.

Patient and care-provider satisfaction has remained

high; thus, the same procedure has been maintained without any change, ever since. Up to 2005, the procedure was done by laparatomy and the technique is described elsewhere.[2] This consists of a 65% sleeve gastrectomy, a duodeno-ileostomy and the construction of a 250-cm total alimentary tract including a 100-cm common tract.

Follow-up

From 1992 to 2005, DS was used in 1,423 consecutive patients, with a mean follow-up of 7.3±3.7 (range 2-15) years. All data concerning these patients have been accumulated in a data bank. From 1992 to 1998, preoperative information was gathered from patient's charts. Subsequently, information was obtained from an extensive written questionnaire completed by all patients before surgery.

Follow-up consisted of an annual visit with clinical biochemistry analysis conducted through our clinic or by a family doctor who sent the results to us. Nursing staff maintained contact with these patients and their family doctor. This required an average of 6 calls per year per patient. Nearly 97% of surviving patients have visited the clinic or their family doctor with at least partial laboratory work during the 2 years preceding our review.

Information collected by postoperative written questionnaires mailed at 5-year intervals in 1997, 2002 and 2006 and completed by 93, 86 and 43% of patients respectively was also collected. All information concerning hospitalization or complications obtained by phone was entered in the register.

Characteristics of this Study

The particularity of this study was that it consisted of an unselected group of patients. With seven bariatric surgeons practising under a public health system, free of charge, the waiting list far exceeds the resources. Except for medical reason, we functioned on the basis of "first come, first serve". Morbid obesity was considered a disease in itself, requiring treatment independent of other concomitant disease, if the risk was reasonable.

Exceptionally, (about 1%) a patient was refused. Many manifested with psychological difficulties: 37.3% with history of depression, 19% used a psychiatric drug, and 6 had Prader-Willi syndrome. Other aggravating factors included: 7% using narcotics; 3% using illegal drug; 20% smokers; 9% using daily alcohol and 36% on social security.

Anthropometric Data and Co-Morbidities

Mean age for the group was 40.1±10.5 (range 15-70) years; mean BMI 51.5±9.9 (range 33-103); mean weight 140±31.4 (range 79-325) kg; 28% were men. Co-morbidities included: 28% diabetes, 6% using insulin, 50.4% on antihypertensive drugs, 46% using a CPAP, 31% with a cardiac risk index >5 and 2.5% had unsuspected cirrhosis.

Maintenance Treatment

Patients were prescribed five daily oral supplements, consisting of: iron (300 mg); calcium (500 mg); vitamin D (50,000 U); vitamin A (20,000 U) and one multivitamin. These supplements were adjusted as needed. To control malodorous or loose stools, patients were encouraged to frequently ingest yogurt and probiotics. When necessary, they were to use "metronidazole" for a few days. For prevention of ulcers, medication was made available when they left the hospital and later on demand.

Statistical Analysis

Results were expressed as mean ± SD or percentage for continuous and categorical variables respectively. Categorical variables were expressed in percent and analyzed using the Chi-square test. Unpaired observations were analyzed using the Student's *t*-test. The Student's paired *t*-tests were performed to analyze paired observations. To validate the influence of time on parameters, the length of time was used as covariate. The survival function was obtained from the Nelson-Aalen estimator of the cumulative hazard rate. The estimation of excess mortality was obtained using the relative mortality model, where the hazard rate at time t is a multiple of the reference hazard rate. The reference survival data were from the Quebec population 2006. The results were considered significant with *P*-values ≤0.05. The data were analyzed using the statistical package program SAS v9.1.3 (SAS Institute Inc., Cary, NC).

Global Results

Survival

During the 15 years of follow-up, 67/1423 died including 16 (1.1%) operative deaths for an annual mortality rate of 0.5%. Survival rate at 15 years was 92%, a greater success rate than that reported by Flum et al[8] for a similar series of 3,328 patients after Roux-en-Y gastric bypass (RYGBP) and followed for an equivalent period. They reported a survival rate of 88.2% after RYGBP and 83.7% for morbidly obese subjects without operation. The risk of dying (EHR: Excess Hazard Ratio) for morbidly obese patients after DS was 1.2, comparable to the normal Quebec population.[9] Mortality risk has been reported to be three times greater (EHR: 3) for the Canadian morbidly obese population.[10]

Effect on Obesity

At last evaluation, among 1,356 living patients (990 women, 366 men), mean weight loss was 55.4±23.0 kg (range 3-186) and the percent initial excess weight loss (%IEWL) using the Metropolitan tables was 73.0±19.0 (range 5-138). The loss in terms of BMI was 20.3±7.8 kg/m^2 (range 1-62). Weight loss could also be expressed in terms of success or cure rate. Success, defined as a loss >50% IEW, was 82%. Failure, defined as losing <25% IEW, was only 1%. Success, defined as reaching a BMI ≤40 kg/m^2, was 91% or, for attaining a BMI <35 kg/m^2, was 76%.

Our preference was to define success as "cure rate", meaning a patient was no longer morbidly obese. For a patient with an initial BMI >50 kg/m^2 to reach a BMI <40 kg/m^2 should be attained; for a patient with an initial BMI <50, the target was a BMI <35. Using this definition, cure rate was 83% (544/659) for the first group and 92% (637/694) for the second.

"Weight change" is another way to express weight loss. In their most recent report, the Swedish Obesity Study group[11] after 15 years of observation has found a weight change of 13±14% after banding and 27±12% after RYGBP. We have found after a similar period of observation a greater weight change of 38.6±10.6% after DS.

Globally, weight loss was maintained over the years: mean %IEWL was 77% for patients followed for <5 years (n 618); 69.4% for patients followed, 5 to 10 years (n 451), and 68.9% for the group followed for more than 10 years (n 284). Repeat surgery for insufficient weight loss or weight regain was necessary in 20 patients (1.5%) and caused an additional loss of 14 kg on average.

Effect on Co-Morbidities

Prior to surgery, among 1,356 patients, 377 were diabetic with 76 treated with diet, 81 using insulin and 220 treated by oral medication only. From the most recent assessment of those using medication, 97% (292/301) had decreased their medication and 92% had ceased it. Among those using insulin and oral hypoglycemic agents, 98% had ceased the use of insulin and 61.3% (27/44) had also ceased oral medication. Using the 2006 questionnaire, among 199 (40%) patients using CPAP before surgery, only 14 were still using it; among 138 patients with asthma, 90% indicated that their condition had been improved. Before surgery, 30% (315/1032) had a cardiac risk index (CTO/CHD) >5, while after surgery only 8% (93/1186) remained with an index >5.

Metabolic Improvement

To evaluate the effect of the procedure on metabolic syndrome, each patient's pre-surgery and most recent postoperative clinical biochemistry profile were compared. There was a significant decrease in blood glucose, total cholesterol, low-density cholesterol and triglyceride. High-density cholesterol was not significantly changed but tended to increase with time. The cardiac risk index had decreased by 34% (Table 1). There was a decrease in the prevalence of hyperglycemia by 85%, hypertriglyceridemia by 65%, and high cardiac risk index by 86%.

Nutritional Markers

Comparing each patient's pre-surgery and most recent postoperative test, levels of albumin, calcium and hemoglobin were slightly decreased by 1.9%, 2.6% and 4.5% respectively. A majority of patients remained within the normal limit, 20% were below normal, and 1% were deficient. The decrease in vitamin A was more pronounced: 2% were deficient (Table 2) and needed vitamin A supplements readjusted. On the other hand, levels of folic acid, vita-

Table 1. Metabolic improvement: comparison between measures taken before and after surgery

	n**	Before	After	Influence of time
FBS g/l	899	6.5 ± 2.4	4.9 ± 2.3*	Stable
CTO mmol/l	804	5.1± 1.0	3.4 ±0.8*	Decrease*
CLD mmol/l	734	3.1 ± 0.9	1.7 ± 0.7*	Decrease*
TRI mmol/l	720	2.1 ± 1.4	1.2 ± 0.6*	Decrease*
HDL mmol/l	745	1.18 ± 0.49	1.21± 0.37	Increase*
CTO/CHD	710	4.50 ± 1.4	2.96 ± 0.98*	Decrease**

*P<0.001. **Patients with both measures (preop and postop) available.
CTO: total cholesterol; CLD: Low-density lipoprotein; HDL: High-density lipoprotein; TRI: serum triglycerides; CTO/CHD: cardiac risk index.

min B12, iron and vitamin D were increased by 70%, 74%, 3.6% and 10.7% respectively (Table 3).

Side-effects

Information was obtained from the last written questionnaire 6.7±3.4 years post-surgery and revealed the following: number of daily stools was 3.2, stools were loose more than 3 times a week in 30% and constipation was present in 12%. The two main complaints were frequent abdominal bloating (48%), and annoyance caused by odor of stool and gas (70%). Over 90% considered their eating habits as normal.

Patients' Satisfaction

When patients were asked to grade on a scale of 1 to 5 (5 being excellent) their degree of satisfaction in regards to the weight loss itself, the mean grade was 3.6, indicating a 77.4% satisfaction level. The level of satisfaction with the overall treatment results, taking all factors into consideration, was 95.1%. However, it appeared that the level of satisfaction tended to decrease with time. Among 91 patients who had completed three successive questionnaires (5 years apart), dissatisfaction increased from 6.5% to 11% to 30%. This may be explained by the small weight gain over the years (average 16.5±10.5 kg), weight loss representing the most important factor influencing the degree of satisfaction.[12]

Risks and Complications

The second part of this report will deal with "Risks and Complications" which are the major source of concern for the procedure. This includes operative mortality, need for revision, risk of anemia, risk of vitamin deficiency, risk of bone and liver damage, kidney stones, intestinal obstruction, and incisional hernia.

Operative Mortality

The 30-day operative mortality was 1.1% (16/1423) and the 90-day mortality was 1.3%. This is within the range of what has been reported for RYGBP. A recent publication by DeMaria et al[13] has emphasized the effect of preoperative risk factors on postoperative mortality after RYGBP. Using a scoring system, one point was given for each risk factor, including male gender, BMI ≥50, arterial hypertension, age ≥45 and the presence of a particular risk for pulmonary embolism. This study of 2,075 gastric bypass surgeries was comparable to our present study in terms of risk factors. They reported an operative mortality similar to our DS (Table 4).

Risk of Long-Term Death

Excluding the 16 operative deaths, there were an additional 51 deaths during the 15 years of observation (mean 7.3±3.7 years (range 2-15). These deaths occurred an average of 4.5±3.6 years (range 0.8-12) after surgery. Ten of these were related to the bariatric surgery: malnutrition (3), delayed operative death (2), re-operation (2), intestinal obstruction (1), and GI hemorrhage (1). The additional 41 deaths after examination appeared not to be related to the surgery: cancer (13), trauma (7), suicide (6), cardiac (4), pulmonary insufficiency (3), CVA (3), pneumonia (2), pulmonary embolus (2), and sudden death (1). Because of the presence of circumstantial factors,

such as alcoholism, drug abuse, and non-compliance, the role of surgery in these deaths was not always clear. However, considering the global improvement (by three times) in survival of morbidly obese patients with DS versus the non-operated patients, the contribution of surgery-related mortality has less impact.

Risk of Malnutrition

Malnutrition was a risk after DS, but it was uncommon and preventable. Mean serum albumin was slightly lower after surgery ($P<0.001$) but within normal limits (from 41.1±3.8 to 40.3±3.8 g/l) and it remained constant over time. Patients with moderate hypoalbuminemia (i.e. 30-36 g/l) increased from 4.6% (preop) to 8.5% (postop) and the presence of severe hypoalbuminemia was the same before and after surgery (0.9%). Appropriate medical attention was required due to patient vulnerability when facing protein loss or dietary stress. About 10% (n 132) presented with acute hypoalbuminemia which was reversed by dietary adjustment; 5% (n 70) of patients were hospitalized once for malnutrition, including 2% (n 25) more than once. Revision for malabsorption or diarrhea was required in 9 (0.7%), and both the alimentary and common channel were lengthened and in 3 the diversion was reversed. The risk is real, but with appropriate follow-up, it is minimal. In the present study, the revision rate of 0.6% was less than the 4.7% reported by Hamoui et al[14] also following DS. This difference may be due to the length of the common channel which was in many patients only 50 cm,[14] instead of the 100 cm in our operation. It is known that the shorter the common channel, the greater the risk of needing revision.

Risk of Anemia

The prevalence of anemia was increased after surgery. Hemoglobin level of 1114 patients decreased from 138.3±12.7 g/l to 131.9±12.3 g/l ($P<0.001$). This occurred despite an increase in the serum levels of folic acid, B12 and iron (Table 3). Moderate anemia (Hg 100-120 g/l) increased from 5.7% (preop) to 14% (postop); severe anemia remained <1% but increased from 0.2% preop to 0.8% after surgery. The tendency for anemia, particularly with dysmenorrhea, required surveillance, counselling and adjustment of supplements. Polytransfusion was never used except for surgical preparation.

Risk of Liposoluble Vitamin Deficiency

After surgery, the serum level of vitamin A decreased and vitamin D was increased. Vitamin E was not measured before surgery and only rarely after surgery. Vitamin K was not measured.

Table 2. Blood elements decreased after surgery: comparison between before and after surgery

		Before	After	Relation/Time
Albumin mean (N >36 g/l)		41.1 ± 3.8	40.3 ± 3.8*	Stable
(n 1,028)	Insufficiency (36-30)	4.6%	8.5%	
	Deficiency (<30)	0.9%	0.9%	
Hemoglobin mean (N > 120 g/l)		138.3 ± 12.7	132.1 ± 12.3*	Stable
(n 1,142)	Insufficiency (120-100)	5.7%	14%	
	Deficiency (<100)	0.2%	0.8%	
Calcium mean (N > 2.15 g/l)		2.29 ± 0.11	2.23 ± 0.12*	Stable
(n 1,000)	Insufficiency (2.15-2)	6.4%	20.7%	
	Deficiency (<2)	0.4%	1.3%	
Vitamin A mean (N > 1.4)		2.48 ± 0.84	1.89 ± 0.70*	Decrease*
(n 807)	Insufficiency (1.4-0.7)	7.6%	21.2%	
	Deficiency (<0.7)	0.1%	1.9%	

*P <0.001

Table 3. Blood elements increased after surgery

		Before	After	Relation/time
Folic Acid mean (N >9.5 nmol/l)		19 ± 9.0	32.3 ± 5.1*	Increase *
n 913	Insufficiency (9.5-4.5)	13.4%	2.5 %	
	Deficiency (<4.5)	1.5%	0.3%	
B12 mean (N > 145 pmol/l)		248.7 ± 96.7	432.9 ± 204.8*	Stable
n 942	Insufficiency (145-110)	8.6%	2.5%	
	Deficiency (<110)	3.0%	1.0%	
Iron mean (N >10 mmol/l)		13.8 ± 5.1	14.3 ± 7.8	Stable
n 807	Insufficiency (10-4)	20	0.3	
	Deficiency (<4)	18.7	0.9	
Vitamin D mean (N >75 n/ml)		60.1 ± 28.4	81.2 ± 47.4	----
n 49 before, 531 after	Insufficiency (75-40)	47%	40%	
	Deficiency (<40)	29%	15%	

*P <0.001

Vitamin A: In 807 patients, mean level decreased from 2.48 ± 0.84 to 1.89 ± 0.70 (P<0.001). Patients with levels below normal (0.7-1.4 mmol/l) increased from 7.6% (preop) to 21.2% (postop). Deficiency (<0.7 mmol/l) increased from 0.1 to 1.9% (preop versus postop). Adjustment with oral supplement was sufficient and intramuscular administration was rare.

Vitamin D: Measurement of vitamin D has been evaluated routinely only recently (last few years); thus a control group was used for comparison. The postoperative levels of 531 patients were compared with the preoperative levels of 49 patients. Vitamin D was increased after surgery (60.1±28.4 to 81.2±47.4 nmol/l). Patients with levels below normal (40-70 nmol/l) decreased from 47% (preop) to 40% (postop). Deficiency (<40 nmol/l) decreased by half from 29% to 13%. Low levels of vitamin D, both before and after surgery, were no different than the level for the general population in USA. A recent report indicated that almost 60% of the hospitalized population had a level <50 nmol/l.[15]

Vitamin E: Vitamin E was measured in patients with malnutrition (n 29) and found to be normal (>13 n/l) in 70% of them, a much better result than expected for a risky group.

Vitamin K: Vitamin K was never measured. Exceptionally, vitamin K was given when INR was above 1.4 or in preparation for surgery.

Risk of Bone Damage

The decreased calcium absorption after DS is a concern for potential bone damage. While it has been shown that even a partial gastrectomy can be detrimental to bone,[16] on the other hand, it has also been shown that bone is relatively resistant even with severe malabsorption caused by "intestinal bypass" (a procedure now abandoned). We have previously reported[17] that bone damage was

Table 4. Operative mortality related to preoperative risk factors: comparison between duodenal switch and gastric bypass

Risk factors*	Duodenal Switch				Gastric Bypass			
	n	%	Deaths	Rate	n	%	Deaths	Rate
0-1	688	48	2	0.29	957	46	3	0.31
2-3	652	46	10	1.50	999	48	19	1.90
4-5	83	6	4	4.80	119	6	9	7.56
Total	1423		16	1.12	2075		32	1.54

*Risk factors: male gender, BMI ≥50, arterial hypertension, age ≥45, risk of pulmonary embolism.

Table 5. Markers of bone metabolism: comparison between before and after surgery

		Before	After	Relation/Time
PTH mean (N< 75ng/l)**	n 720	45.7	66.8	Increase
	moderate increase (75-100)	11.3%	31.9%	
	marked increase (>100)	5.0%	16.8%	
ALP mean (N<130 u/l)*	n 1,032	89.2	95.1	Increase
	moderate increase (130-150)	2.4%	7.6%	
	marked increase (>150)	4.2%	5.3%	

*P<0.02 **P<0.001

not obvious, even 10 years after the original Scopinaro biliopancreatic diversion. Bone density was even increased in one-third of patients and it was difficult to correlate directly to the operation. Our monitoring for fracture rate remained inconclusive. The annual cumulative rate of all fractures after surgery was 1.4%, but this was meaningless without a comparable control group.

After DS, serum calcium decreased despite the calcium supplement. Most patients remained within normal, but in 20% serum calcium was below normal; serious deficiency was rare (1.3%). Calcium decreased independently of the level of vitamin D and was associated with an increased parathyroid hormone (PTH) and alkaline phosphatase (ALP). Altogether, this suggested an increase in bone activity (Table 5). Mild hyperparathyroidism (PTH 75-100 ng/l) was present in 32% with a more serious increase (PTH>100 ng/l) in 17%. Increasing the calcium supplement lowered the PTH level. A PTH level maintained below 100 ng/l was tolerated in the absence of evidence that a mild elevation is damaging. As a preventive measure, increases in routine calcium supplements are proposed.

The question remains whether a mild increase in PTH level is damaging for bone. To answer this question would have required following bone density over the years. Unfortunately, this was not done. Only recently has bone density be assessed and only in patients where symptoms or clinical biochemistry results warranted investigation.

Bone density was assessed on 87 patients aged 53.4±9.5 years at a mean of 6.7 years after surgery. This group was compared with a group of 49 consecutive patients waiting for surgery (aged 35.8±9 yrs). There was no significant difference between groups in spite of a 9% decrease at spine level and a 12% decrease at hip level in postoperative patients. Such a small difference was insignificant considering that the postoperative group was 17 years older. Indeed, it has been shown that normally, at this age, bone loss is expected to decrease about 1% per year.[18] We would have expected a greater difference considering that the postoperative group was selected based on potential bone damage. Taking age into consideration by using the Z-Score, there was no difference between the two groups and the percentage of osteopenic patients (SD -1 to -2.5) remained similar.

Another reassuring factor was that both curative and preventive measures were efficient in increasing bone density. In 12 patients, with data on bone density, before and after treatment taken following 25.6±1.6 months of treatment, density was increased in 9 subjects and the Z-score was significantly improved (P<0.05) for the whole group.

Based on this data, we conclude that the increased bone activity was not necessarily causing damage, bone seemed relatively resistant, and preventive and curative treatment was appropriate.

Risk of Liver Damage

As a whole, after surgery, liver enzymes were improved (Table 6). Liver enzymes increased when malnutrition was present, and normalized when nutrition was improved. No permanent damage has ever been identified and no case of postoperative cirrhosis recognized. On the other hand, there were 35 patients who were found at surgery to have unsuspected cirrhosis, proven by routine biopsy. Six of them admitted to have continued to consume alcohol more than three times a week after surgery. At current assessment after 6.9±4.1 years (range 0.8-148), none have died of liver failure. There were two deaths, one from cardiac surgery (11 years after DS) and the other from lung cancer (3 years after DS). One patient had a liver transplant 10 years after surgery and is still alive.

Table 6. Liver enzymes: before and after surgery

		Before	After	Relation/time
ALT n 918	mean (u/l) >42	32.9 ± 22.6 192	30.9 ± 14.48* 142	decrease
AST n 902	mean (u/l) >40	25.3 ± 16.2 92	27.3 ± 10.8* 90	increase
GGT n 866	mean (u/l) >36	39.8 ± 41.9 294	21.2 ± 29.0* 80	stable

*P<0.001. ALT: alanine-amino-transferase; AST: asparagine-amino-transferase; GGT: gamma-glutamyl-tranpeptidase.

Other Long-term Complications

Kidney stones: The incidence of kidney stones increased after DS. The prevalence before surgery was 6.3% and during the 15 years of follow-up the prevalence increased to 14.8%. This was not different than the 16% reported 11 years after long Roux-en-Y gastric bypass.[19-21]

Intestinal obstruction: During the 15 years of observation, laparotomy was required for intestinal obstruction in 6% of patients (83/1356), a mean of 3.2 years after DS. No published data is available for comparison.

Incisional hernia: Incisional hernia was repaired in 13% of patients (176/1356). This is within expected outcomes after major abdominal surgery.[22,23]

Discussion

In our view, morbid obesity is a metabolic disease that extends beyond uncontrolled appetite and abnormal food intake. For the past 25 years, our goal has been to change the basic physiology of these patients, allowing for excess weight loss, maintenance of weight loss and continuation of a normal life. We consider that it is important for quality of life to be able to eat normally. We felt that it was preferable not to concentrate our effort on food restriction, giving a false impression that the only problem is a lack of control of food intake, but rather to target correction of the metabolic dysfunction. In these patients, the difficulty has never been to attain weight loss, but to maintain that weight loss. Morbid obesity should be considered a chronic disease, which requires treatment for life.

The first 8 years (1982-1990), BPD as described by Scopinaro was the procedure of choice within this center. While the results were positive, a decrease in side-effects with improvement of absorption were further targets. The procedure was modified successfully. For the last 15 years (1992-2007), DS has been our primary procedure for all patients. This choice has been reinforced with additional knowledge on important involvement of intestinal hormones in the etiology of obesity. It was also reinforced by the high long-term failure rates reported for numerous other procedures.

The present study could be considered exceptional. The Canadian medical system has facilitated an efficient follow-up of a large unselected cohort. We are not aware of any comparable study, using a consistent procedure with such an extended and thorough complete follow-up.

Our review shows excellent long-term results after 15 years. Both the weight loss and its maintenance compared favorably with any other procedure. It has the best "cure rate" where cure rate is defined as the absence of morbid obesity: 83% of those with an initial BMI >50 maintained a BMI <40 and 92% of those with an initial BMI <50 maintained a postoperative BMI <35.

DS also targeted co-morbidities. It "cured" most diabetic and dyslipidemic patients. For other associated morbidities, results were related to the extent of weight loss, where DS was as efficient as any other procedure.

The reluctance for using DS has been the concern over long-term risks. The present review should be reassuring. The procedure saves lives. A 15-year survival rate of 92% is much better than that of non-operated morbidly obese subjects and perhaps even better than after RYGBP.[8] The operative mortality was found to be comparable to that of RYGBP.[13]

The long-term risk for malnutrition is real but preventable. Deficiency in albumin, iron, calcium and fat-soluble vitamins requires compliance and med-

ical attention. These deficiencies were rare, they appeared slowly, and were always reversible without permanent damage.

The procedure was relatively secure for bone maintenance. It is possible that with the medical attention provided after surgery, including increased physical activity, better alimentation and appropriate nutritional supplements, the procedure may even be beneficial for bone metabolism, rather than representing a risk.

The negative side-effects with DS were not benign. The unpleasant odor of stool and gas and the frequent abdominal bloating were the price to pay for these patients and it was a major preoccupation for many of them. However, 95% of patients declared themselves satisfied despite this handicap and no one has required reversal of the procedure for this reason.

The present evaluation has an important characteristic, in that it is comprised of a non-selected group of patients. No pre-selection was done on the basis of age, BMI, eating behavior, financial or psychological conditions, merits or expected difficulties for follow-up. With appropriate support, the procedure was found to be useful for all groups. Thus, the global applications should be appreciated.

We conclude that with a structured and devoted treatment team, DS is a very efficient bariatric operation, to the great satisfaction of both the patients and the care-providers.

Finally, one of the striking conclusions of this study is that, in spite of the inherent mortality risk of the bariatric surgery, the long-term outcomes are more positive than the mortality risk without surgery. Furthermore, in spite of the side-effects which are not minimal, the overall patient satisfaction dominates. These two points highlight the profound effect that morbid obesity has, not only on mortality, but also on quality of life.

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