Duodenal switch—the initial experience in New Zealand

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Abstract

Aims The duodenal switch (DS) has now established itself as an effective, durable and safe bariatric procedure. We present our initial experience on 60 patients from May 2008 to November 2012.

Methods Retrospective case series from a prospective database. 94.8% follow-up over 4 years.

Results 45 patients have completed 1-year follow-up and 28 patients completed 2-year follow-up. The mean initial body mass index (BMI) was 52.8 kg/m² (range 40–66 kg/m²). The excess weight loss has been 69.5% at 1 year (n=45) and 73.1% at 2 years (n=28) respectively. The mean hospital stay is 5.08 days (range 3–18). The range of bowel motions at 1 year is one to two movements per day. Comorbidity resolution rates were 95% (n=18) for diabetes, 100% (n=9) for obstructive sleep apnoea, 72% (18/25) or hypertension, and 92% (33/36) or dyslipidaemia. One death from liver failure occurred 9 months following surgery resulting from poor compliance with follow-up and intake of multivitamins.

Conclusion In our short-term analysis DS appears to be very efficient in terms of cure rate for morbid obesity and its comorbidities. In terms of risk/benefit DS has appeared safe with adherence to the appropriate follow-up regimen.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BPL</td>
<td>Biliopancreatic limb</td>
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<td>DS</td>
<td>Duodenal switch</td>
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<td>LSG</td>
<td>Laparoscopic sleeve gastrectomy</td>
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<td>OGTT</td>
<td>Oral glucose tolerance test</td>
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<td>RYGB</td>
<td>Roux-en-Y gastric bypass</td>
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<tr>
<td>LAGB</td>
<td>Laparoscopic adjustable gastric banding</td>
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<td>WHO</td>
<td>World Health Organization</td>
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</table>

Duodenal switch (DS) is an improved version of the initial biliopancreatic diversion Scopinaro-type operation (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.¹⁻³ See Figure 1.

The hallmark of the DS is pylorus preservation. The distal gastrectomy component of Scoparino’s BPD had two main problems; marginal ulceration at the jejunal side of the anastomosis and dumping syndrome.¹⁻⁶ By substituting a sleeve gastrectomy for the distal gastrectomy, the pylorus is preserved and marginal ulceration and dumping syndrome are virtually eliminated.
The goal in diverting pancreatic secretions and bile was to decrease caloric and fat absorption while preserving normal nourishment. Later additional benefits were discovered including remission of diabetes. The mechanism of action is complex but by bypassing the proximal intestine and reaching the distal small bowel directly, there is an alteration in the secretion of intestinal hormones but synergistically act to induce remission of diabetes and prevent obesity.\(^4\text{–}7\)

Historically there has been resistance to anatomical routing to create a change in the physiological pathway, previous experience in the 1960s with an operation called “intestinal bypass”, which whilst initially demonstrated good results became associated with malabsorptive side effects, mainly because of the very long intestinal bypass and the creation of a long blind loop of bypassed intestine.

With a greater understanding of the physiological disturbance underpinning type 2 diabetes these changes in the physiological pathway offer a mechanism for the remission of diabetes.\(^7\text{,}8\)
Marceau et al. after 10 years’ experience with the original BPD-SC\(^8,9\) changed to DS\(^9,10\) due to fewer side effects and improved absorption of both protein and fat soluble vitamins without compromising weight loss. After 20 years of performing DS as the primary procedure for all morbidly obese patients Marceau et al have published their long-term results, which includes the follow-up of over 1423 patients\(^10,11\).

**Resolution of diabetes and other comorbidities**

Defining remission or cure of diabetes is not as straightforward as it may seem. Diabetes is defined by hyperglycaemia, which exists as a continuum and may be impacted over a short time frame by treatment or events (medications, diet, activity, intercurrent illness).

A consensus group agreed upon the following definitions, which are the same for type 1 and type 2 diabetes:

- Remission is defined as achieving glycaemia below the diabetic range in the absence of active pharmacological (anti-hyperglycaemic medications) or surgical (ongoing procedures such as repeated replacements of endoluminal devices).

- A remission can be partial or complete. Partial remission is defined as sub-diabetic hyperglycaemia (HbA\(_1c\) <6.5%) of at least 1 year’s duration in the absence of active pharmacologic therapies or ongoing procedures. Complete remission is defines as a return to normal measures of glucose metabolism (HbA\(_1c\) in the normal range) for at least 1 year’s duration\(^12\).

In 2004, Buchwald et al published a meta-analysis of various types of bariatric surgery on weight loss and resolution of type 2 diabetes and other obesity related comorbidities.

DS was shown to be superior to RNYGB, gastroplasty and laparoscopic gastric banding (LAGB) in terms of weight loss, resolution of type 2 diabetes, hyperlipidaemia treatment, hypertension treatment and obstructive sleep apnoea (OSA)\(^11,13\).

**Body composition**—Strain et al showed that DS resulted in better overall weight loss and greater fat loss and better preservation of lean body mass than RNYGB, LAGB and LSG\(^14,15\).

**Nutritional complications**—In a randomised study of vitamin status after LRYGB and DS, Aashiem et al found that patients who underwent DS may be associated with a greater risk of Vitamin A and D deficiencies in the first year after surgery. Thiamine deficiency was also more common in the DS group in the first few months after surgery\(^13,16\).

**Materials and Methods**

**Definition of cohort and baseline demographic characteristics**—All patients offered a Duodenal Switch as a primary weight loss procedure at North Shore Hospital, Auckland, New Zealand between May 2008 and November 2012 were included in this cohort.

Patients were identified using the local registry of bariatric patients, all observations were entered prospectively into a local bariatric database by a single surgeon. Baseline demographic (Age, sex, ethnicity, height, weight BMI) and clinical (prior diabetes, hypertension, liver disease) data were
collected. Details of the bariatric procedure and preoperative BMI were recorded. The last known preoperative BMI prior to surgery was recorded.

Height and weight was recorded and updated during outpatient clinic visits at 3 weeks, 6 weeks, 3 months, 6 months, 9 months, 12 months and annually thereafter.

**Operative details**—All procedures were performed open through an upper midline vertical laparotomy. The sleeve gastrectomy was fashioned over a 36 F Bougie with multiple firings of a linear stapler device beginning at 6 cm proximal to the pylorus and continuing to the angle of His. An ultrasonic dissection device was used to mobilise the greater curvature of the stomach. The first part of the duodenum was mobilised for approximately 4 cm distal to the pylorus; the duodenum was Kocherised.

The duodenum was divided with a linear stapler 4 cm distal to the pylorus. Small bowel length was measured with a 15 cm umbilical tape. The small bowel was divided at 50% of its total length from the ileocaecal valve using a linear stapler. A retrocolic end to side double layered anastomosis was performed between the proximal duodenum and the alimentary limb of the small bowel using continuous 3/0 PDS (Ethicon) suture.

The biliopancreatic limb was anastamosed side to side using a 60 mm linear stapler with a common channel at 10% of total small bowel length but not less than 100 cm from the ileocaecal valve. Mesenteric defects were closed with 3/0 PDS (Ethicon). The greater omentum was reattached to the neostomach with 3/0 PDS (Ethicon).

**Nutritional supplements/support**—All patients received the following daily supplementation postoperatively:

- Cholecalciferol 1.25 mg once weekly
- Ferrous fumarate 310 mg and folic acid 350 mcg twice daily (as Ferro-F)
- Vitamin B₁₂ 1000 mcg once monthly
- Calcium 2458 mg as calcium citrate powder 1.5 teaspoon once daily
- Centrum® Advance 50+ (Pfizer) once daily
- Vit ABDECK™ (Pharmaco) capsule twice daily
- Vitamin A 10,000 iu daily

The cost of these supplements at the time of writing is approximately NZ$2 per day.

All patients received a one-to-one 1-hour nutritional counselling session with a qualified bariatric dietician prior to surgery. Patients were seen 2-4 weeks prior to the surgery date at the surgical outpatient clinic where the technical details of the operation were discussed in addition to the expected recovery and potential complications. Patients were handed over a surgical consent form for them to take home, read and bring back to the hospital on the admission day. On both occasions written information was given regarding diet and supplements. Further dietician sessions were provided at 1, 3, 6, 9, 12, 18 and 24 month follow-up visits. Telephone numbers were provided for the dietician and bariatric nurse specialist in the event of queries arising between clinic visits.

**Excess weight loss**—Height and weight are measured routinely at all attendances for postoperative follow-up.

In the absence of a pre-existing diagnosis of diabetes mellitus, preoperative glucose and HbA₁c measurements were used to identify undiagnosed cases, using WHO criteria.

**Remission of diabetes**—All available glucose levels were analysed using WHO criteria.

Data was analysed using STATAV® v.11 for Windows® software (StataCorp, Texas). Appropriate parametric and non-parametric methods were used as necessary. Survival analysis was performed using the Cox proportional hazards model. Statistical significance was set at p=0.05.

**Results**

Baseline demographic data is summarised in Table 1 below.
Table 1. Baseline demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>22–59 (43)</td>
</tr>
<tr>
<td>Gender</td>
<td>47F 13M</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>40–66 (52)</td>
</tr>
<tr>
<td>Weight at presentation (kg)</td>
<td>113–235 (150)</td>
</tr>
</tbody>
</table>

Numbers in parentheses are median values.

94.8% follow-up of these patients over the last 4 years, including clinical biochemistry evaluation; 45/49 have completed 1-year follow-up and 28/33 have completed 2-year follow-up.

The median initial body mass index (BMI) was 52.8 kg/m² (range 40–66 kg/m²). After a mean follow-up of 2.4 years (range 2 months to 4 years), the excess weight loss has been 69.5% and 73.1% at 1 year (n=45) and 2 years (n=28), respectively. See Figure 2.

Figure 2. Weight loss post surgery

The mean hospital stay is 5.08 days (n=61), range 4–6 days. The range of bowel motions at 1 year is one to two movements per day.

Remission of diabetes was achieved (i.e. medication was discontinued) in 94.7% (18/19).
The nutritional impact has been acceptable with one case of albumin deficiency (<30 g/L), one case of vitamin A deficiency and seven cases of ferritin deficiency. See Table 2 below.

### Table 2. Nutritional impact

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin deficiency (&lt;30 g/L)</td>
<td>0</td>
<td>1 (2.0%)</td>
</tr>
<tr>
<td>Vitamin D deficiency (&lt;50 nmol/L)</td>
<td>33 (67.3%)</td>
<td>5 (10.2%)</td>
</tr>
<tr>
<td>Raised parathyroid hormone (&gt;7.3 pmol/L)</td>
<td>1 (2%)</td>
<td>5 (10.2%)</td>
</tr>
<tr>
<td>Folate (&lt;7 mmol/L)</td>
<td>3 (6.1%)</td>
<td>1 (2.0%)</td>
</tr>
<tr>
<td>Vitamin B12 deficiency (&lt;170 pmol/L)</td>
<td>2 (4.1%)</td>
<td>4 (8.2%)</td>
</tr>
<tr>
<td>Vitamin A deficiency (&lt;0.7 µmol/L)</td>
<td>0</td>
<td>3 (6.1%)</td>
</tr>
<tr>
<td>Ferritin deficiency (&lt;20 µg/L)</td>
<td>5 (10.2%)</td>
<td>11 (22.4%)</td>
</tr>
</tbody>
</table>

Four patients have suffered significant postoperative complications including pancreatic fistula, myocardial infarction, pneumonia and intraoperative splenectomy in different individuals.

See Table 3 below. No patients have required reversal of their procedure in this series. One death from liver failure occurred 9 months post surgery.

### Table 3. Early and late complications

<table>
<thead>
<tr>
<th>Early (&lt;30 days postoperatively)</th>
<th>Late (&gt;30 days postoperatively)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 pneumonia</td>
<td>5 incisional hernia</td>
</tr>
<tr>
<td>1 pancreatic fistula</td>
<td>4 wound sinus</td>
</tr>
<tr>
<td>1 myocardial infarctio</td>
<td>1 gallstones (laparoscopic cholecystectomy)</td>
</tr>
<tr>
<td>1 splenectomy</td>
<td>1 adhesional bowel obstruction</td>
</tr>
<tr>
<td>Zero 90-day mortality</td>
<td>1 death (liver failure) 9 months postoperatively</td>
</tr>
</tbody>
</table>

The use of CPAP apparatus was discontinued in 100% (9/9) with remission rates of 72% (18/25) and 91.7% (33/36) for hypertension and dyslipidaemia, respectively. See Table 4 below.

### Table 4. Resolution of comorbidities

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>Number of patients (% of total)</th>
<th>Remission (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>19 (42)</td>
<td>18 (95)</td>
</tr>
<tr>
<td>Obstructive sleep apnoea (sleep clinic diagnosis and use of CPAP* machine)</td>
<td>9 (20)</td>
<td>9 (100)</td>
</tr>
<tr>
<td>Hypertension (BP**&gt;135/85 mmHg) and requiring drug therapy</td>
<td>25 (56)</td>
<td>18 (72)</td>
</tr>
<tr>
<td>Dyslipidaemia (total cholesterol &gt;4 mmol/L and/or LDL cholesterol &gt;2 mmol/L and/or triglycerides &gt;2.2 mmol/L)</td>
<td>36 (80)</td>
<td>33 (92)</td>
</tr>
</tbody>
</table>

*Continuous positive airway pressure.

**Blood pressure.
There were several incidental intraoperative findings. These are detailed in Table 5 below.

Table 5. Incidental intraoperative findings

<table>
<thead>
<tr>
<th>Intraoperative finding</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver cirrhosis</td>
<td>2</td>
</tr>
<tr>
<td>Incomplete regression of pancreatic ring around duodenum</td>
<td>1</td>
</tr>
<tr>
<td>Large duodenal diverticulum</td>
<td>1</td>
</tr>
<tr>
<td>Duodenal lipoma</td>
<td>2</td>
</tr>
<tr>
<td>Meckel’s diverticulum</td>
<td>3</td>
</tr>
<tr>
<td>Carcinoid tumour of ileum with regional lymph node involvement*</td>
<td>1</td>
</tr>
</tbody>
</table>

*Surgery converted to sleeve gastrectomy.

Discussion

Morbid obesity is a chronic, metabolic disease that requires lifelong treatment. The DS has been shown to produce greater excess weight loss than either gastric band or gastric bypass; and higher remission rates of obesity-related comorbidities including type 2 diabetes mellitus (T2DM).14,17

Despite the advantages of DS there has been reluctance amongst bariatric surgeons to adopt the procedure. The main concern surrounds the longer malabsorptive component of the operation, which can result in relatively higher rates of metabolic complications, nutrient deficiencies and life-threatening protein-calorie malnutrition compared to RNYGB. DS is a longer and technically more demanding procedure than other bariatric surgeries and is difficult to undertake laparoscopically.16,18

This article describes the first 60 cases performed by a single surgeon in our unit. Our unit has progressed from performing open DS surgery to the point where we are now beginning to offer laparoscopic DS both as a single-stage primary bariatric surgery and as a 2 stage approach after sleeve gastrectomy in selected patients.

Initial patient selection and an intensive postoperative follow-up protocol is vital to ensure good outcomes from DS surgery.

Biertho et al17,19 showed a complication rate comparable to that of RNYGB in their series of 1000 patients. Indeed they only had 1 death in the 1000 patients (0.1%). Only 5 patients required revisional surgery (0.5%). This large series shows that acceptable safety rates can be achieved with DS surgery.

Biertho et al have also shown that long-term nutritional deficiencies are rare with close long-term follow-up and careful adjustment of nutritional supplementation. They report a series of 810 patients who have undergone DS with a mean follow-up of 103 months. In this study, they showed that the risk of protein malabsorption after DS was comparable to that after distal RNYGB. Around 4% of patients may require rehospitalisation and nutritional support for severe protein deficiency or food intolerance. Severe protein deficiency was detected in 1% of patients in this series17,18.

The obvious statistic in our results is the death from liver failure at 9 months postoperatively. The patient was a 46-year-old female with a preoperative weight of
235 kg and a BMI of 62 kg/m^2. She had pre-existing steatohepatitis and colonic dysmotility as well as a history of depression. Adherence to the recommended dietary intake and multivitamin/mineral supplementation had been difficult for this patient. She presented acutely to hospital with a 2-month history of jaundice and hepatic encephalopathy secondary to liver failure from protein-calorie malnutrition; which is a recognised complication of DS.

Baltasar et al also reported a death from hepatic failure after DS.\textsuperscript{19,20} One death in our series of 60 patients gives a mortality rate of 1.66%. This is much higher than the 0.1% seen by Biertho et al in their series of 1000 patients. They comment that a reduction in mortality from DS came with a move to laparoscopic surgery from the open procedure.\textsuperscript{17,21} We hope that our adoption of the laparoscopic technique will yield similar benefits.

Morbidly obese patients show a high prevalence of hepatic steatosis and steatohepatitis.\textsuperscript{19,20} Questions have been raised about performing the DS in patients with pre-existing liver disease.

Baltasar et al report a series of 470 DS patients in which 10 developed postoperative clinical hepatic impairment. 1 patient died from hepatic failure. Deaths from liver failure have also been reported after other types of bariatric surgery.\textsuperscript{19} Keshishian et al found in a series of 697 patients that DS improves hepatic steatosis; there is a mild worsening of liver function in the first 6 months postoperatively but then an improvement over preoperative levels after 1 year. They conclude that DS should be beneficial in reducing the rate of cirrhosis and liver failure from the progression of non-alcoholic steatohepatosis (NASH) in obese patients.\textsuperscript{21} Kral et al have also shown reversal of severe fibrosis and cirrhosis in obese patients following biliopancreatic diversion (BPD).\textsuperscript{22}

Two of our patients had Child-Pugh A liver cirrhosis found incidentally at surgery. They also had type 2 diabetes. Both have had good results achieving 100% and 70% weight loss at 2-year follow-up post DS surgery, with normalisation of their liver function tests and their diabetes remain in remission. One of them had a liver biopsy at 2 years post DS, the histology result on which confirmed resolution of steatosis but fibrosis was still present.

DS may also have an increasing role as a two stage procedure in patients who have previously undergone a sleeve gastrectomy. Such patients who have done well with excess weight loss but have not had satisfactory resolution of comorbidities may be candidates for a two-stage DS. In order to be considered for the two-stage procedure patients should have demonstrated good understanding and compliance with healthy eating and regular exercise since the sleeve gastrectomy.

We believe that DS surgery can be safely performed in a unit with facilities to provide intensive follow-up. Rates of operative mortality and nutritional sequelae similar to RNYGB can be achieved. DS does require larger doses of nutritional supplements and careful long-term follow-up to achieve these safety levels.

Potential patients need to be carefully selected for their willingness to attend all follow-up visits and their ability to understand the postoperative nutritional requirements as well as the risks that are associated with non-adherence.
Competing interests: Nil.

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References:

