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Does bariatric surgery adversely impact on diabetic retinopathy in persons with morbid obesity and type 2 diabetes? A pilot study ☆

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ABSTRACT

Aims: To assess the incidence and progression of diabetic retinopathy (DR) 12 months post bariatric surgery in persons with morbid obesity and type 2 diabetes.
Methods: A retrospective pilot analysis of electronic hospital records between 1998 and 2012.
Results: 40 of 148 subjects had pre- and post-surgery DR screening. Of those without DR pre-surgery 1.5% (n = 26) progressed to minimum background DR (BDR) post surgery. Those with minimum BDR (n = 9) pre-surgery revealed no progression, with 55.6% (n = 5) showing evidence of regression. One person with moderately severe BDR and two with pre-proliferative DR (PPDR) prior to surgery experienced progression. Two persons with PPDR prior to surgery remained under the hospital eye services and were therefore not eligible to be re-assessed by the screening service.
Conclusions: There was a low incidence of new DR and progression of DR in those either without evidence of retinopathy or with minimal BDR prior to surgery with some subjects showing evidence of regression. There was however a risk of progression of DR in those with moderate BDR or worse, and should therefore be monitored closely post-surgery.

1. Introduction

Currently, bariatric surgery provides the most reliable means to achieve substantial and sustained weight loss in morbidly obese persons (Brolin, 1996; Buchwald, 2005; NIH conference, 1991), as well as inducing remission of type 2 diabetes (Buchwald, Avidor, Braunwald, et al., 2004; Buchwald, Estok, Fahrbach, et al., 2009). Improvement in glycaemic control has been widely demonstrated to reduce the risk of vascular complications in persons with both type 1 and type 2 diabetes (Duckworth, Abriaira, Moritz, et al., 2009; Patel et al., 2008; The Diabetes Control and Complications Trial Research Group, 1995; UK Prospective diabetes study group (UKPDS), 1998). However, a rapid change in glycaemic control may result in a paradoxical deterioration in microvascular complications such as diabetic retinopathy (DR), usually in those already with evidence of complications and poor glycaemic control. This has been shown in several studies in response to the intensification of diabetes treatments such as the initiation and rapid escalation of insulin therapy (Brooks & Lissett, 2009; Henricsson, Berntorp, Fernlund, & Sundkvist, 2002; Rasmussen et al., 2010; The Diabetes Control and Complications Trial Research Group, 1995; The Diabetes Control and Complications Trial Research Group (DCCT), 2000; Varadhan, Humphreys, Hariman, et al., 2011). As bariatric surgery is a situation where a rapid improvement in glycaemic control occurs (often before signs of weight loss) it is another clinical situation where the paradoxical deterioration in DR may occur (Buchwald et al., 2004).

2. Subjects, materials and methods

2.1. Bariatric surgery in Wales

In Wales, UK all NHS bariatric procedures are carried out by the Welsh Institute of Metabolic and Obesity Surgery (WIMOS) at Morriston Hospital, Swansea. The service in Wales is currently limited to persons aged >18 years, with a BMI >50 kg/m2 and the presence of a serious co-morbidity such as uncontrolled hypertension, sleep apnoea or type 2 diabetes. Four types of bariatric procedures are performed including the restrictive procedures laparoscopic gastric banding (LGB) and laparoscopic sleeve gastrectomy (LSG); and the malabsorptive procedures bilio-pancreatic diversion (BPD) and Roux

☆ Conflicts of Interest. All authors disclose that there are no conflicts of interest to declare.

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Table 1
Study population characteristics pre and post surgery.

	Pre mean (±SD)	Post mean (±SD)	P value
Weight (kg)	145.9 (25.5)	114.0 (24.7)	<0.001
BMI (kg/m^2)	50.3 (7.5)	39.41(6.9)	<0.001
HbA_{1c} (%)	7.9 (1.7)	6.4 (1.3)	<0.001
HbA_{1c} (mmol/mol)	63 (19)	47 (14)	<0.001
Fasting glucose (mmol/L)	10.5 (4.9)	7.0 (2.6)	0.003
Fasting glucose (mg/dL)	189 (88.2)	126 (46.8)	0.003
Cholesterol (mmol/L)	4.7 (1.0)	4.3 (1.2)	0.36
Cholesterol (mg/dL)	181.7 (38.7)	166.3 (46.4)	0.36

Mean (±SD).

en Y gastric bypass (RYGB). LGB procedures have a band placed around the top part of the stomach creating a small pouch that can only hold a few ounces of food, however it is not recommended in morbidly obese persons due to its low early weight loss results and does not alleviate type 2 diabetes symptoms. This procedure was carried out in the early days of bariatric surgery and the reversible nature of the procedure can be attractive to patients. The malabsorptive procedures BPD and RYGB (two variations where the lower part of the stomach is excised and small intestine connected to the pouch that remains) are the classic procedures achieving good weight loss and resolution of type 2 diabetes. However both procedures have side effects including vitamin and mineral deficiencies, and are time consuming. LSG, where staples are used to divide the stomach creating a narrow tube to carry food and a large pouch which is excised, is a relatively new procedure which obtains comparatively similar weight loss and resolution of type 2 diabetes as the malabsorptive procedures but with fewer complications and a shorter operating time making it a more cost effective procedure.

2.2. Diabetic retinopathy screening in Wales

Diabetic retinopathy screening in Wales is conducted by the Diabetic Retinopathy Screening Service for Wales (DRSSW). This is a community based screening programme for all persons with diabetes within Wales over the age of 12 years. It utilises standardised digital photography capturing two 45° fields per eye (one macular centred and one nasal retina), using a Canon Dgi digital camera following mydriasis with 1% tropicamide. Grading is performed centrally by primary and secondary retinal graders at the DRSSW, with an arbitration step in place to resolve any inconsistencies during quality control procedures. The grading structure, is a modified version of the UK Screening Committee grading protocol (Thomas et al., 2012).

2.3. Record retrieval

For this study a list of all persons undergoing a bariatric surgical procedure in Wales for obesity with concomitant type 2 diabetes was compiled from the WIMOS register up until 2012. The demographic and clinical characteristics were extracted from the electronic patient records of the hospital system. The DRSSW provided the results of screening prior to bariatric surgery as close to the date of surgery as possible and approximately 12 months post-surgery for each person.

3. Results

3.1. Population characteristics

A total of 148 obese persons with type 2 diabetes underwent bariatric surgery between 1998 and 2012 in Wales, UK. Of these 40 had data available on HbA_{1c} values both pre- and post-surgery and were therefore included in the study. The mean (SD) screening intervals pre- and post-surgery were 11.4 (11.3) and 13.5 (15.8) months, respectively. Following bariatric surgery there was a significant mean (SD) reduction in weight of 32.7 (11.6) kg, BMI 11.4 (4.3) kg/m^2, HbA_{1c} 1.8 (1.6) % (20 [17.6] mmol/mol) and fasting plasma glucose of 3.3 (5.0) mmol/L (59.4 [90] mg/dL) (all $p < 0.001$) (Table 1).

3.2. Bariatric surgery

LSG (35%) was the most common procedure within the sample followed by RYG (30%) and BPD (25%) with very few LGB (10%) performed. Pre-surgery there were no significant differences in weight, BMI, blood pressure, HbA_{1c} or fasting glucose between surgical groups (Table 2). Post-operatively there was a significant difference in weight between procedures with those undergoing LGB having the highest weight (148.5 kg), compared to BPD (126.5 kg), RYG (110.6 kg) and LSG (104.7 kg) (Table 3). However there were no other significant differences between groups post-operatively or in the changes induced as a result of the surgery.

3.3. Diabetic retinopathy

Prior to bariatric surgery 65.0% (n = 26) of the participants did not have any evidence of DR, 22.5% (n = 9) had minimum background DR (BDR), 2.5% (n = 1) moderate BDR and 10.0% (n = 4) pre-proliferative DR (PPDR) with or without maculopathy or maculopathy alone (Fig. 1). Of those without any evidence of DR prior to surgery 84.6% (n = 22) did not develop DR post operatively. The remainder 15.4% (n = 4) developed only 1 or 2 microaneurysms and were therefore classed as developing minimum BDR. Of those with minimum BDR prior to surgery, 55.6% (n = 5) with 1 or 2 pre-existing microaneurysms had no evidence of DR post-surgery whereas the remaining 44.4% (n = 4) all had only 1 microaneurysm pre- and post-surgery therefore, remaining within the minimum BDR category. The one subject with moderate BDR prior to surgery had evidence of 7 microaneurysms, a blot haemorrhage and some small hard exudates in the nasal retina. Post-surgery the number of microaneurysms increased to more than 20 with more than 8 blot haemorrhages and the appearance of cotton wool spots i.e. PPDR which required referral

Table 2
Pre-surgery characteristics by the four different types of procedures performed.

Surgical procedure	LGB	LSG	BPD	RYG	P value
	Pre	Pre	Pre	Pre	
Weight (kg)	153.7 (55.8)	134.8 (1.9)	163.1 (22.4)	146.3 (18.7)	0.06
BMI (kg/m^2)	48.9 (12.2)	48.3 (7.0)	54.1 (22.4)	51.3 (18.7)	0.23
HbA_{1c} (%)	8.8 (0.5)	8.5 (2.3)	6.9 (1.6)	7.7 (0.8)	0.31
HbA_{1c} (mmol/mol)	72 (6)	69 (25)	52 (18)	61 (9)	0.31
Fasting glucose (mmol/L)	11.7 (1.3)	13.1 (6.5)	8.0 (3.1)	9.3 (3.6)	0.14
Fasting glucose (mg/dL)	210.6 (23.4)	235.8 (117.0)	144.0 (55.8)	167.4 (64.8)	0.14
Systolic BP (mmHg)	130.5 (12.0)	148.8 (15.4)	152.2 (39.8)	149.1 (22.7)	0.82
Diastolic BP (mmHg)	65.5 (2.1)	81.3 (11.1)	94.0 (29.3)	85.3 (6.2)	0.28

Mean (±SD).