Bariatric surgery in obese older people: useful or not?

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Objective **The aim of this study was to determine whether older (≥65 years) obese people would benefit from bariatric surgery, considering the prevalence of multiple comorbidities and frailty in this group.**

Methods **A PubMed search was carried out for studies on the use of bariatric surgery in older obese people published in the database from 1980 to the present (August 2014).**

Results **A total of 244 citations were obtained on searching; 182 of these publications were selected for manual checking and 10 studies were identified as containing useable data on this patient cohort. Published data were available for efficacy in 641 patients. Substantial improvement was observed in diabetes (76%), hypertension (68%) and sleep apnoea (67%) following bariatric surgery. Laparoscopic adjustable gastric banding ($n = 456$) was the most frequently reported procedure. Similar findings but with greater weight loss and fewer complications were found in the small numbers of patients undergoing other procedures. Data from four large registry studies ($n = 6837$) showed mortality and complications associated with bariatric surgery to be increased in older compared with younger people especially in those undergoing gastric bypass surgery. The elderly had longer hospital stays, and patients with cardiac, pulmonary or renal comorbidities generally had a worse prognosis.**

Conclusion **Bariatric surgery in older people is effective in reducing complications of obesity, but is also associated with increased rates of complications compared with those seen in younger patients. The few reported studies in the elderly are retrospective, generally small, primarily describe findings of laparoscopic adjustable gastric banding as the surgical intervention option and lack long-term follow-up. More trials and registry data, especially for sleeve gastrectomy and gastric bypass, are required to better address the utility of bariatric surgery in the elderly and to define long-term clinical outcomes.** ***Cardiovasc Endocrinol*** **4:60–66**

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Introduction

Rates of obesity have increased worldwide over the last decade [1,2]. In the UK rates have increased from 13 to 24% in men and from 16 to 26% in women in the period 1993–2011 [3]. Inpatient admissions to hospitals in England that have a primary diagnosis of obesity have tripled in the last 5 years to 11 740 (2011–2012). Most (3 : 1) of these admissions were women. The economic burden of obesity on society was estimated to be £16 billion in 2007 (over 1% of UK gross domestic product). The incidence of obesity increases with age and is associated with increased risks of type 2 diabetes mellitus (T2DM), hypertension, obstructive sleep apnoea (OSA) and cancer [3]. Similarly, incidence of T2DM is associated with age, sex, ethnicity, BMI and family history of diabetes. It is also understood that T2DM results in a 5-year reduction in life expectancy after correcting for BMI [4].

Emerging evidence suggests that bariatric surgery results in a high chance of remission from T2DM and subsequent reduction in the incidence of other comorbidities including hyperlipidaemia and hypertension [5,6]. Large-scale registry studies of bariatric surgery such as the Swedish Obese Subjects study have shown treatment to be associated with reductions in total mortality [7] and up to 75% reduction in severity or presence of T2DM [8]. Furthermore, the outcomes obtained when bariatric surgery is combined with medical therapy for T2DM are far better than those usually achieved by medical treatments alone [9,10]. A meta-analysis of outcomes from bariatric surgery in 22 094 patients showed that T2DM resolved or improved in 86% of the patients [5]. These beneficial effects have seen eligibility thresholds for bariatric surgery in patients with T2DM being decreased to a BMI of 35 kg/m^2 in 2007 [11] and then to a BMI of 30–35 kg/m^2 in 2013 [10]. However, almost all surgical studies thus far have limited their observations to patients below 60 years of age. There remain unresolved issues over the impact of interventions in the elderly on their diabetes such as susceptibility to hypoglycaemia, functional capacity and disability, relevance of other comorbidities, cognitive status and life expectancy. Consequently, guidelines for

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Table 1 Results of studies documenting efficacy of bariatric surgery in reducing weight, improving diabetes, blood pressure and sleep apnoea and quoting safety data for the case series

References	Number	Age	BMI pre (kg/m^2)	Operation	Follow-up (years)	BMI post (kg/m^2)	T2DM change (%)	BP change (%)	OSA change (%)	Death (30 day) Complications (%)
Abu-Abeid *et al.* [14]	18	63.6	44.2 (35–65)	LAGB	1.8	30.5	71 ($n=7$)	33 ($n=6$)	100 ($n=3$)	0
Tel Aviv						?				22
Quebbemann *et al.* [15]	14	68 (66–73)	47.3	LAGB	1.5	~36	0	0	–	0
California							?	?		7
Taylor and Layani [16]	40	65.8 (60–72)	42	LAGB	2.3	33	80 ($n=15$)	69 ($n=28$)	75 ($n=12$)	0
Australia										7.5
Busetto *et al.* [17]	216	64±4 (60–80)	44±8	LAGB	5	36±8	100 ($n=45$)	67 ($n=76$)	100 ($n=34$)	<1
Italy Registry										?
Clough *et al.* [18]	113	63.6 (60–73)	42.4	LAGB	2.1	?	74 ($n=35$)	57 ($n=76$)	47 ($n=15$)	0
Australia						eBMI – 43%				7
Loy *et al.* [19]	55	72±3 (70–82)	45±6	LAGB	1	37±6	35 ($n=23$)	27 ($n=49$)	35 ($n=31$)	2
New York										?
Mizrahi *et al.* [20]	52	63±0.3 (60–70)	43±1	LSG	1.5	32±0.5	84 ($n=31$)	61 ($n=36$)	80 ($n=10$)	0
Jerusalem										21
Burchett *et al.* [21]	17	>62	45	LSG	3	31	83 ($n=6$)	69 ($n=16$)	25 ($n=8$)	0
Illinois										12
Sugerman *et al.* [22]	80	63±3 (60–75)	49±7	HBP, VBP, later GBP	5	34±8	66 ($n=39$)	35 ($n=64$)	100 ($n=7$)	0
Maryland Registry										?
Quebbemann *et al.*[15]	13	68 (66–73)	47.3	GBP	0.8	~30	100 ($n=9$)	82 ($n=22$)	–	0
California										0
Sosa *et al.* [23]	23	>60	48.5 (40–62)	GBP	1	32.5	75 ($n=4$)	91 ($n=11$)	67 ($n=3$)	4.3
Miami						?				4.3

? indicates unknown.

BP, blood pressure; GBP, gastric bypass; HBP; high-banded gastroplasty; LAGB, laparoscopic adjustable gastric banding; LSG, laparoscopic sleeve gastrectomy; OSA, obstructive sleep apnoea; T2DM, type 2 diabetes mellitus; VBP, vertical banded gastroplasty.

management of diabetes in the elderly do not yet include bariatric surgery as an option for treatment [12,13]. This study attempted to summarize available evidence for the benefits and risks of bariatric surgery in populations older than 65 years of age in whom cardiovascular mortality, either postprocedure or from T2DM, may pose a significant limitation to bariatric surgery.

Methods

A systematic review of all studies published in the scientific literature on the use of bariatric surgery in older people with T2DM was carried out. Only reports published in English were included for review. PubMed was searched from 1 January 1980 to the present (August 2014), inclusive. Search terms were: ['obesity/surgery' OR 'gastric bypass' OR 'gastroplasty' OR 'bariatric' OR 'gastric banding' OR 'anastomosis, Roux-en-Y' OR 'biliopancreatic diversion' OR 'jejunoileal bypass' OR 'gastric pacing' OR 'gastric stimulation' OR 'laparoscopic adjustable gastric banding'] AND ['diabetes' AND 'elderly' OR 'senior' OR 'geriatric' OR 'older' OR 'aged']. To supplement the electronic search, manual reference checks were performed in the identified studies. Study authors, country, year of publication, surgical procedure and study design were recorded and the findings were summarized. Characteristics of the study groups, BMI and age were also noted.

Results

Two hundred and forty-four citations were obtained on electronic searching; 182 of these publications were identified and manual reference checks were performed on these identified studies. Fourteen reports were not published in English and were excluded. No primary studies met the full criteria for inclusion in this review. Ten manuscripts reporting on bariatric surgery studies were identified in which data were reported in older patients, although the studies were not specifically designed to report on the outcomes of bariatric interventions in 641 older patients with T2DM or other comorbidities (Table 1) [16–20,24]. Four registry studies were identified in which data were reported on older patients, which yielded little efficacy data but did yield postoperative mortality and 30-day complication rates in 6837 patients. None of the studies were conducted in the UK.

Outcomes of bariatric surgery

Data for bariatric surgery in elderly patients is limited with patients with T2DM being reported in subsets within the overall groups (Table 1). The prevalence of surgical operations was 478 patients receiving laparoscopic adjustable gastric banding (LAGB) [14–19,24], 52 laparoscopic sleeve gastrectomies (LSGs) [20,21], 36 Roux-en-Y gastric bypasses [15,23] and a mixed series of open and laparoscopic gastric bypass (LGBP) operations in 80 patients [22]. No consistent definition of improvement nor resolution of T2DM, hypertension or OSA was used in these studies. Few studies reported more than 1 year of follow-up data, whereas improvement in, or resolution of, the above comorbidities was reported in most of the studies. Overall, glycaemic control improved in 76% (155/204) of patients, hypertension in 68% (260/384) and OSA/snoring in 67% (83/123). The greatest amount of data reported was following LAGB, in which glycaemia improved in 75% (86/115) of patients; hypertension in 66% (156/235) and OSA in 67% (64/95). Mortality rates associated with LAGB (within 30 days) generally appeared to be low (0–2% of patients) considering the target population, whereas complications like surgical site port infections and band removals appeared to be relatively common (8–22% of patients). Data for LSG and LGBP were similar. One study compared outcomes in patients undergoing LAGB ($n = 14$) or LGBP ($n = 13$) surgery. Both surgical approaches were associated with improved quality of life scores. However, postsurgical reductions in weight were less following LAGB, which also led to higher rates of complications and no resolution of comorbidities when compared with LGBP, which resulted in almost twice the weight loss and demonstrated a better safety profile and a 60–80% improvement in comorbidities [15].

One single centre registry in older patients (mean age 63 years) collected data on patients undergoing open and laparoscopic procedures. The period of study (1981–2003) covered a changeover in surgical practice from vertical banded gastroplasty to LGBP [22]. Laparoscopic procedures appeared to be associated with fewer complications and/or a better safety profile compared with open procedures. These procedures were associated with a 16 kg/m^2 reduction in BMI, which was also associated with improvements in glycaemic control (66% of patients), blood pressure (32% of patients) and OSA (80% of patients). Patients undergoing LSG showed less marked reductions in BMI reduction (9 kg/m^2) [20] compared with those who underwent GB (17 kg/m^2), but both surgical approaches reported similar rates of improvement in comorbidities. Rates of complications varied greatly with minimal numbers being seen with LAGB (5%), but one series showing a 21% rate with LSG [20].

Safety and tolerability of bariatric surgery in older people

Several large registries have collected safety data on bariatric surgery in older people without recording information on outcomes, weight loss or change in comorbidities. Four studies, comprising 6837 elderly patients were identified in which a small percentage of patients (3–4%) were aged over 65 years [25–28]. Most of the patients had undergone minimally invasive procedures (LABGs) and the data suggest a 'slight to moderate' increase in complications and mortality rates, but these were lower than those reported in comparator cohorts undergoing other surgical procedures in this age group. Older patients had longer lengths of stay in

hospital and their prognosis was poorer in patients with worse preoperative anaesthetic assessment scores, those who were male, those with diabetes and those with concomitant pulmonary or cardiovascular comorbidities or decreased renal function.

The American College of Surgeons National Surgical Quality Improvement Program (2005–2009) included 48 738 patients, of whom 4.1% ($n = 1994$) were over 65 years of age [25]. The registry reported the frequency of bariatric surgery in the elderly increasing from 1.9 to 4.8% during the period of the study. Fewer elderly patients underwent LGBP and more had LAGB insertions than seen in younger cohorts. Although operative mortality was numerically higher in the younger cohort (0.1%), this difference did not achieve statistical significance ($P = 0.15$). Predictors of mortality for laparoscopic surgery included BMI more than 60 kg/m^2 (vs. 45–49 kg/m^2), male sex, presence of diabetes and cardiovascular or pulmonary comorbidities, and higher American Society of Anaesthesiologists' (ASA) scores or renal impairment (creatinine > 140 μmol/l). Older patients did not have a higher risk of major complications with either open or laparoscopic procedures, although they were more likely to experience prolonged length of stay (>90th centile) following open procedures [25].

A report that reviews bariatric surgery performed in 99 US centres between 1999 and 2005 compared outcomes in patients over 60 years of age with those aged 19–60 years [26]. Despite the procedure being offered to older patients in 80% of the study centres, only 2.7% ($n = 1339$) of the study cohort were elderly. The older patients (vs. younger patients, respectively) reported more comorbidities, longer lengths of stay (4.9 vs. 3.8 days), higher rates of in-hospital mortality (0.7 vs. 0.3%) and more complications (18.9 vs. 10.9%). Although morbidity and mortality were higher in the older cohort, the overall safety of bariatric surgery was better than predicted (risk adjusted) mortality rates.

More recent data reported from the US National Surgical Quality Improvement Program (NSQIP) database for the period 2010–2011 compared patients undergoing LAGB with those undergoing LSG operations [27]. The data were used to assess 30-day morbidity and mortality associated with these procedures in the elderly (>65 years) compared with that of younger patients. The audit identified 1005 patients with BMI 44 ± 7 kg/m^2; of these, sleeve gastrectomy had been performed in 155 (15.4%) patients. The percentage of patients with preoperative ASA physical classifications of 3 or 4 was similar between the two groups (LAGB 82.6% vs. LSG 86.7%, $P = 0.17$). Diabetes occurred more frequently in the LGBP group (43 vs. 56%, $P = 0.004$). The data showed 30-day mortality [0.6 vs. 0.6%, odds ratio (OR) 1.1, 95% confidence interval (CI) 0.11–9.49], serious morbidity (5.2 vs. 5.6%, OR 0.91, 95% CI 0.42–0.96), and overall morbidity (9 vs. 9.1%, OR 1.0, 95% CI 0.55–1.81) were similar for the procedures. Both were considered to demonstrate acceptable rates of morbidity and mortality. An updated analysis of the registry data for the period 2005–2012 identified 303 of the 67 499 patients as being older than 65 years of age [28]. Overall, there was little difference between complications in patients undergoing LSG and LGBP. There was a marked difference in complications following LSG in the 50–65-year-old group compared with the over 65-year age group (4.0 vs. 7.3%, respectively, OR 1.75, $P = 0.006$); however, age did not emerge as a risk factor for complications following this operation on multiple regression analysis. In contrast, in the 2196 patients who underwent LGBP, incidence of complications appeared to be associated with age, culminating with nearly 8% of patients aged over 65 years experiencing complications of one form or another. Death rates were 0.7% for LSG and 0.5% for LGBP, and surgical complications occurred in 1.3% for LSG and 2.6% of LGBP cases.

Discussion

An extensive literature now exists on the risk and benefits of bariatric surgery in middle-aged populations, including those with T2DM. Overall, results are very positive with rates of remission for T2DM of 70–85% and with relatively low rates of postoperative complications. Bariatric surgery is now recommended as an option for the treatment of T2DM and its complications [30–32] (Table 2). The summary of data generated by the literature search we performed [29] has shown that the current evidence base for bariatric surgery in the elderly is limited. Efficacy data comprise a heterogeneous group of operative interventions from 10 studies comprising 624 patients that report a broad collection of outcome measures. In contrast, 30-day safety outcomes are reported for 6837 patients. Most of the efficacy data are based on studies using LAGB surgery that has limited efficacy in terms of weight reduction and is associated with a high rate of complications (Table 1). Despite these limitations, many studies showed significant benefits on comorbidities including T2DM (76% improved/resolved), hypertension (68%) and OSA (67%). The published datasets on LSG or LGBP procedures in the elderly are very limited. Overall, they suggest that despite greater weight reductions, rates of resolution of comorbidities are similar to LAGB but with lower rates of complications. The use of LAGB surgery appears to be declining in popularity in younger obese populations, given its moderate efficacy, high associated work-load and higher rate of complications [33].

Data on postoperative complications in elderly patients undergoing bariatric surgery are a little more robust than that for efficacy, with four registry reviews comprising data on 6837 patients aged above 65 years. Historically, operative mortality associated with bariatric surgery has been between 0.1 and 2.0%, and recent data show a mortality rate of no more than 1% [30–32]. An analysis

Table 2 Comparison of the advantages and disadvantages of frequently used bariatric procedures

Types of procedure	Advantages	Disadvantages
Laparoscopic Roux-en-Y gastric bypass (LGP)	Weight loss is swift, usually 50% of excess weight loss in the first 6 months and may continue for up to 2 years Rapid resolution of type 2 diabetes Long-term results show patients keep weight off for 10 years or longer Obesity related comorbidities often quickly improve	Malabsorptive procedure increased risk for nutrient deficiencies: thiamine, vitamin B_{12} and D, iron, copper and calcium High dose dietary supplements are required Adverse events include bone loss, diarrhoea, hernias and gallstone formation Risk of 'dumping syndrome' and reactive hypoglycaemia
Laparoscopic adjustable gastric banding (LAGB)	Considered less invasive and safer than gastric bypass Recovery is quick, hospital stays are shorter and the surgery is reversible Physically restricts the amount of food consumed	Weight loss is limited (10–20%) and weight is often regained Multiple band-related problems including vomiting and acid reflux. Bands can slip, loosen, erode the stomach or leak. Multiple follow-up visits are required to adjust band filling 50% long-term failure rate
Laparoscopic sleeve gastrectomy (LSG)	Associated with greater weight loss than LAGB but less than LGBP Reduces appetite; consuming small amounts of food generates early and lasting satiety Resolves type 2 diabetes in many cases in 1 year Does not affect food absorption, reducing the risk of nutritional deficiencies	Relatively new procedure Leakage risk post-operation in 2.5% Gastric remnant dilation and weight regain
Biliopancreatic diversion with a duodenal switch	Weight loss is swift with an average excess weight loss of 70–80% Remission rate for type 2 diabetes mellitus is very high Comorbidities such as hypertension, hyperlipidemia, sleep apnoea resolve More pronounced benefits among super-obese patients	Serious risk of nutritional deficiencies including rare trace elements e.g. selenium The requirement for dietary supplements is higher than LGBP Increased risk of dumping syndrome, gallstones and hernias More complicated, invasive surgical procedure than RYGB Higher risk procedure with Longer hospital stays following surgery

Data adapted from Marihart *et al.* [29].
LAGB, laparoscopic adjustable gastric banding; RYGB, Roux-en-Y gastric bypass.

of the UK General Practice Research Database has been carried out for mortality of 15 394 patients undergoing bariatric surgery. Patients included in the analysis were aged below 65 years with a mean ± SD age of 47 ± 12 years and BMI of 36 ± 6 kg/m^2 (63% were women) [34]. Postoperative all-cause mortality in the study population was 2.1% after a mean follow-up of 9.9 years. These data were used to derive a predictive model for 10-year mortality that included age (OR 1.09 per year, 95% CI 1.07–1.10), presence of T2DM (OR 2.25, 95% CI 1.76–2.87), current smoking (OR 1.62, 95% CI 1.28–2.06) and sex (male sex: OR 1.50, 95% CI 1.20–1.87), but not BMI (OR 1.03, 95% CI 1.01–1.05 per unit, not significant). This score had a total *C* statistic of 0.768, and could be divided into four risk bands ranging from 0.2 to 5.2%. The highest risk category in practice is defined mostly by the presence of smoking and T2DM. Registries show no significant increase in postoperative mortality nor major adverse events in the elderly [29], though lengths of stay appeared to be longer in the elderly patients, especially if they had cardiac or pulmonary comorbidities or impaired renal function [25]. These data do not *per se* define risks for a more elderly population, but does suggest that age and comorbidities should be considered rather than age alone for making decisions on whether to offer bariatric surgery to an elderly patient. The recent registry data [28] suggest that age is a risk factor for increased complications and extended hospital stays and that the effect seems most pronounced for LGBP.

Evidence from health economic studies of bariatric surgery appears to be consistent in their demonstration that bariatric surgery improves quality-adjusted life years (QALYS) by 0.9–1.2 and that surgery is a cost-effective treatment option [e.g. National Institute for Health and Clinical Excellence (NICE) < £20 000 per life year saved] [3,35,36]. These analyses do not stratify their analyses by age and few by duration of diabetes. Admissions increase over the first 6 years postbariatric surgery and so a reduction in life-long available QALYS would be expected in the elderly as opposed to younger patients [37]. The role of social care costs also remains unclear as the Swedish Obesity Study of 2901 patients over 10 years suggests a decrease in disability pensions and in disability days (609 vs. 734 days, 21%, $P = 0.01$) in men but not women aged less than 65 years [38]. There currently appear to be no data on the elderly, in whom these costs are potentially highly significant.

A study of direct costs conducted in the USA found that bariatric surgery in (young) patients with T2DM was cost-effective [39]. The retrospective time–series study of 2235 patients with T2DM aged 18–64 years showed baseline annual costs of $6376 per person. Total annual healthcare costs in the first year after surgery increased 10% ($616), but then decreased by 34% ($2179) in year 2 and 71% ($4498) in year 3. Bariatric surgery was associated with elimination of diabetes medication use in 1669 of 2235 (75%) patients at 6 months, 1489 of 1847 (81%) patients at 1 year, and 906 of 1072 (85%) patients at 2 years. Given the current cost of bariatric surgery, data suggest that the surgery should have paid for itself within 3.5 years.

The UK government published the National Service Framework (NSF) for Older People in 2001 with the aim

of improving the treatment of older people within the NHS [40]. A report on the treatment of older people within health and social care concluded that 'some age groups, especially older people, are much more likely to receive poor services' [41]. The Centre for Policy on Ageing (*http://www.cpa.org.uk/reviews*) noted in five literature reviews from 2007 to 2009 that older patients were less likely to be referred for surgical interventions for cancer, heart disease and stroke. Since the UK Equality Act 2010 came into force in 2012 it is now unlawful to discriminate on the basis of age and therefore it seems that current practice in terms of bariatric surgery requires further justification.

The NIH Consensus Conference on bariatric surgery in 1991 proposed age limitations of 18–50 years [42] but later extended this to age 60 years [31,43]. In 2014, the UK NICE reviewed the utility of bariatric surgery for patients and found it cost-effective especially for those with onset of T2DM under 10 years previously. UK NICE allows bariatric intervention in patients with BMI more than 40 or 35–40 kg/m^2 with other significant disease (e.g. T2DM or high blood pressure) [3]. However, despite its stated brief of encompassing inequalities, NICE failed to make any specific clinical practice or research recommendations on the utility of bariatric surgery in the elderly [3]. The majority of patients who undergo bariatric surgery in the UK appear to be younger than 60 years [36], as in other countries [8,25,26,28]. Similarly, other guidelines on the management of diabetes in the elderly do not consider bariatric surgery as an option for this group [12,13], but note an increased risk of cardiovascular disease [44].

The limited evidence presented here suggests that bariatric surgery is safe and clinically effective in producing weight loss and remission of comorbidities in older people. However, it appears that few elderly patients are currently considered for bariatric surgery [29]. In fact, little evidence exists to guide selection of procedures in the elderly as much of the data relate to a declining procedure of limited efficacy (LAGB), whereas LGBP is frequently used and LSG is rapidly increasing in popularity [33]. There is minimal published data on these more effective procedures in older people.

The available data suggest that following bariatric surgery, older people lose significant amounts of weight and their obesity-related comorbidities improve, medication requirements decrease and quality of life improves. However, the amount of data to support this conclusion is limited; the studies described are small, retrospective, use dated procedures of limited efficacy and lack long-term follow-up. Specific studies are needed in elderly patients to determine whether patients and healthcare services could benefit from the improvements that bariatric surgery is currently delivering through its use in younger patients.

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Conflicts of interest

There are no conflicts of interest.

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