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ORIGINAL CONTRIBUTIONS

Outcomes of bariatric surgery in geriatric patients ≥ 65 years: single institution study

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Abstract

Background Obesity is an epidemic with an increasing incidence in geriatric individuals also. The aim of the present study is to determine the outcomes in geriatric patients ≥ 65 years, who underwent Bariatric Surgery.

Material and Methods A retrospective review was performed of prospectively collected data on geriatric patients (age 65 to 80 years) who had undergone bariatric surgery at a single institution from Jan. 2010 to Dec. 2013. A cohort of adult patients (age 17 to 64 years) were matched for comparative evaluation who also underwent bariatric surgery in the same period. The data analyzed included gender, co-morbidities, weight (loss), complications, and resolution of co-morbidities.

Results 184 (7.3%) patients 65 years and older were identified out of 2508 patients who had bariatric surgery between January 2010 and December 2013. These were compared with 184 patients matched for types of surgery. Out of 184 patients in each group, 53 (28.8%) had undergone Roux-en-Y gastric bypass, 39 (21.2%) one anastomosis gastric bypass, and 92 (50%) sleeve gastrectomy. The average age was 68.7 years and 49.85 years in the geriatric and adult groups respectively. Average preoperative weight and BMI were 106.71 kg and117.69 kg and 42.59 kg/m^2 and 43.08 kg/m^2 in the geriatric and adult groups respectively. The co-morbid conditions were significantly more in the geriatric group. The weight (loss), nutrient deficiencies, and resolution of co-morbid conditions were similar in both groups. There were three major complications in the adult group and two in the geriatric group. One mortality was documented in the adult group from pulmonary embolus.

Conclusion The outcomes of bariatric surgery in geriatric patients in this study were similar to that in adults. Our study confirms the findings of previous published studies that bariatric surgery could be a safe and effective treatment option in a selected geriatric population.

Keywords Bariatric metabolic surgery · Obesity · Weight loss · Co-morbidities · Geriatric patients

Introduction

The global prevalence of obesity in the geriatric population is rising both in developed and developing countries of the world [1, 2]. The study of geriatric obesity and its management is a relatively new area of research, especially pertaining to those with elevated health risks. In community-dwelling geriatric population, opportunities to improve both body weight and nutritional status are hampered by inadequate programs to identify and treat obesity, but where support programs exist, there are proven benefits [3, 4]. Nutritional status of the hospitalized older adult should be optimized to overcome the stressors of chronic disease, acute illness, and/or surgery [4, 5]. Complications of care due to obesity in the nursing home setting, especially in those with advanced physical and mental disabilities, are becoming more ubiquitous; in almost all of these situations; weight stability is advocated, as some evidence links weight (loss) with increased mortality [6]. High-quality interdisciplinary studies in a variety of settings are needed to identify standards of care and effective treatments for the most vulnerable obese geriatric population. Whereas several papers have been published regarding the assessment of bariatric surgery in geriatric patients [7, 8], there remain concerns regarding the operative morbidity and mortality and the adequacy of weight (loss) due to the relative

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Table 1 Clinical profile

	Geriatric Pts. $n = 184$	Adult Pts. $n = 184$	p value
Patients profile			
Age (year)	68.7 ± 3.7	49.85 ± 8.98	0.001
Male:female	66 (35.9%):118 (64.1%)	79 (44.9%):105 (56%)	0.001
Body weight (kg)	106.71 ± 19.42	117.69 ± 23.51	0.001
Height (cm)	1.58 ± 0.10	1.64 ± 0.10	0.009
BMI (kg/m^2)	42.59 ± 7.01	43.08 ± 7.76	0.003
RYGB	42.73 ± 5.90	42.32 ± 7.83	0.764
OAGB/MGB	42.32 ± 6.53	45.38 ± 8.39	0.069
SG	42.61 ± 7.82	42.34 ± 7.49	0.813
Co-morbid conditions			
DM	87 (47.3%)	37 (20.1%)	0.004
HTN	155 (84.2%)	43 (23.4%)	0.001
H/o heart disease	33 (17.9%)	7 (3.8%)	0.005
Joint pain	70 (38.0%)	26 (14.1%)	0.002
Back pain	25 (13.6%)	13 (7.1%)	0.293

immobility of geriatric patients [9, 10]. The goals of obesity treatment in this population are aimed at increasing survival without disability, reduction of musculoskeletal co-morbidities and improvement in quality of life [11].

In this study, we reviewed and compared outcomes of bariatric surgery in geriatric patients to adult patients who had surgery at tertiary care center.

Methods

Patient and Procedure Selection

All the patients in this study were selected using the 1991 NIH criteria (patients with BMI > 40, or patients with BMI > 35 with two morbid conditions) with modifications of the BMI for Asia-Pacific patients (Asia-Pacific patients with BMI > 37.5 and patients with BMI > 32.5 with two co-morbid conditions). All patients in this study were evaluated by a multidisciplinary team (MDT) that included a bariatric surgeon, a bariatric anesthesiologist, a bariatric physician, a physiotherapist, and a nutritionist. There are other consulting specialists who consulted on some of the patients as determined by any member of the MDT. The available consultants included pulmonologist, cardiologist, nephrologist, psychiatrist, gynecologist, gastroenterologist, dermatologist, hematologist, endocrinologist, and a plastic surgeon. Our evaluation before any bariatric operation consisted of a complete history and physical examination by the bariatric physician. An arterial blood gas on room air, complete blood count and biochemical/viral investigations including electrolytes, renal and liver function, vitamin levels, HbA1C, c-peptide, hepatitis, and HIV testing were performed to all patients. Moreover, pulmonary function tests, CXR, electrocardiogram, echocardiogram, and abdominal ultrasound were also routinely performed. All patients with a BMI above 45 are also evaluated with an abdominal CT scan. Data on gender, weight, height, and co-morbid conditions were collected. All data from the preoperative evaluation were entered into a prospectively maintained database.

All patients were deemed to be safe candidates for surgery as determined by the MDT and the bariatric anesthesiologist. As needed, the patient's condition was optimized before surgery.

In 2010, when bariatric metabolic surgery was initiated at our Center, only sleeve gastrectomy was offered. In 2011, Roux Y gastric bypass, OAGB/MGB, and banded sleeve gastrectomy were offered. In 2012, banded gastric bypass was also offered. Most geriatric patients were offered the sleeve in 2010 through 2012 but by 2013, the operations were standardized and we had an algorithm for selecting the operation based on the age, co-morbidities, BMI, and risks factors. In

Table 2 Operative time and duration of stay

	Geriatric Pts. $n = 184$	Adult Pts. $n = 184$	p value
OP time and hospital stay			
Operative time (min)	41.19 ± 18.85	39.71 ± 17.01	0.430
Duration of stay (days)	3.59 ± 1.21	3.75 ± 1.24	0.314

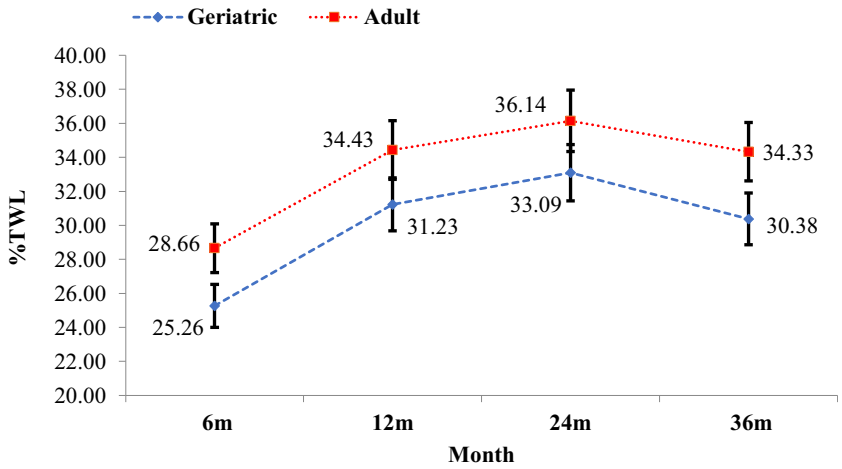

Fig. 1 %TWL in in geriatric and adult

our experience, the OAGB/MGB was a less invasive operation and took least amount of time as compared to the sleeve or gastric bypass, so geriatric patients were more likely to be offered the OAGB/MGB. Patients with diabetes were more likely to have the OAGB/MGB or gastric bypass.

Data Collection

A total of 184 patients of age greater than 64 years who underwent laparoscopic bariatric surgery from Jan. 2010 to Dec. 2013 were identified from a prospectively maintained database of bariatric metabolic procedures. An equal number of adult patients (age 17 to 64 years) matched for surgery type, who also underwent bariatric surgery in the same period at the same institution were also randomly selected for comparative outcome analysis. European guidelines for bariatric metabolic surgery (BMS) were used to select patients for surgery. All operations were performed by the same surgeon at the same institute. This minimized variability due to differences in surgical technique. The selection of operative procedure was based on an evaluation of each patient's medical, psychological, and social issues, as well as a thorough discussion of the risks and benefits of surgery with the patient and his/her family. Data was collected on weight, complications, diabetes, hypertension, and serum levels of lipid, albumin, protein, calcium, and vitamins D and B_{12} initially and at 6 months, 12 months, 24 months, and 36 months postoperatively.

Evaluation of Weight Changes

Data on body weight were collected preoperatively and then at 6 months, 1 year, and thereafter at yearly intervals. Postoperatively, patients were observed for 2–4 days then discharged home if clinically stable without signs of complications. Afterwards, patients were seen in clinics at 6 months and 1, 2, and 3 years following surgery. Postoperative weight (loss) was recorded in kilograms. The percent total weight (loss) (%TWL) and percent excess body weight (loss) (%EBWL) were calculated. The ideal weight was that corresponding to a BMI of 25 kg/m^2.

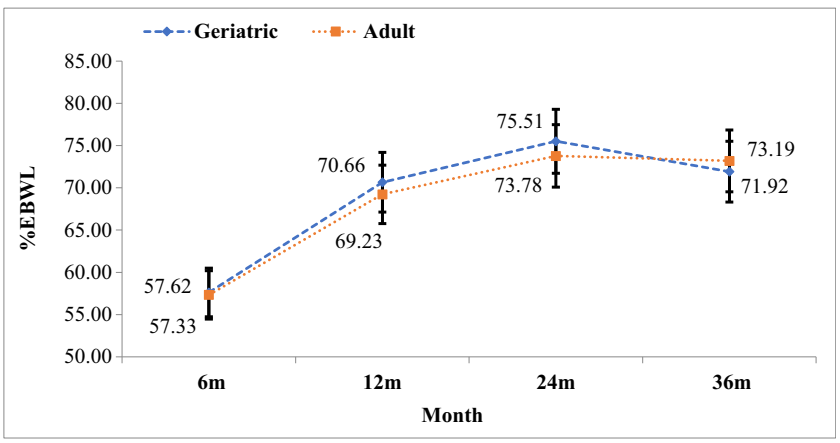

Fig. 2 %EBWL in geriatric and adult

Table 3 Three-year follow-up

	6 m	12 m	24 m	36 m
Geriatric (184)	163 (88.6%)	137 (74.5%)	106 (57.6%)	68 (37%)
Adult (184)	154 (83.7%)	133 (72.3%)	104 (56.5%)	79 (43%)

Dietary Protocol and Evaluation of Nutritional Deficiencies

Nutritional education was provided to all patients pre- and postoperatively. For the first 2 days, only sips of water were allowed. If tolerated, a diet of clear low-fat, low-carbohydrate fluids (1.5–2 L/day) with protein supplements was initiated for the following 14 days. In addition, an exercise regimen of walking was advised. For the period from 14 days to the end of the first month, puréed food consisting of low-fat, high-protein contents was given, and water intake was encouraged at 2 L/day. Finally, after the first postoperative month, a normal diet of small, frequent meals was advised, focusing on high protein intake, with as much physical activity as tolerated. Multivitamin supplements were prescribed throughout this time, along with calcium and vitamin D supplements. Nutritional metrics including circulating levels of iron, protein, albumin, vitamin B_{12}, calcium, and vitamin D_3, were recorded and compared with baseline values.

Evaluating Resolution of Obesity-Related Co-Morbidities

Resolution of obesity-related co-morbidities was determined at each follow-up visit. Remission of T2DM was defined as attaining a fasting plasma glucose level below 126 mg/dl and HbA1c below 6.5%, with cessation of all diabetes medications. For dyslipidemia, a level of < 130 mg/dL for low-density lipoprotein (LDL), > 35 mg/dL for high-density lipoprotein (HDL), and < 150 mg/dL for triglycerides-off all lipid-lowering medications was thus considered as remission. Hypertension resolution was defined as normal blood pressure (systolic < 140 mmHg and diastolic < 80 mmHg), without the use of antihypertensive medications.

Table 4 Postoperative complications adult and geriatric group

	Adults	Geriatric
Episodes of hypotension	0	2
Bleed	0	2
Re-exploration	2 (leaks)	2 (bleeding)
Leak	2	0
Early mortality	1 (PE)	0
Port site	1	1
Minor wound infection	1	0

Statistical Analysis

Data is presented as number and percentages for discrete variables and as a mean ±standard deviation for the continuous variables. Baseline and Intra and postoperative complications were compared in adults and geriatric groups using chi-square test for discrete variables and independent sample student's *t* test for continuous variables. General linear modeling for repeat measure analysis was done to see the difference in changing pattern of continuous variables in two groups. p value < 0.05 was considered significant.

Results

Equal numbers of three types of surgical procedures, 53 (28.8%) Roux-en-Y gastric bypass, 39 (21.2%) one anastomosis gastric bypass, and 92(50%) sleeve gastrectomy were performed in each group of patients. The average age of the geriatric and adult groups was 68.7 ± 3.7 year and 49.85 respectively. Sixty-six (35.9%) of the patients in the geriatric group and 79 (44.9%) in the adult group were male. BMI were similar between patients who had undergone the same procedure (RYGB, SG, and OAGB/MGB) in the geriatric ad adult population. The average preoperative weight was 106.71 kg and 117.69 kg and the average BMI 42.59 kg/$m^2$and 43.08 kg/m^2 in the geriatric and adult groups respectively. (Table 1) The average operating time and hospital stay was 39.7 and 41.1 min and 3.75 and 3.59 days in the geriatric and adult groups respectively (Table 2).

High percentage of geriatric patients had preoperative co-morbidities, diabetes (47.3% vs. 20.1%), hypertension (84.2% vs. 23.4%), joint pain (38.0% vs. 14.1%), back pain (13.6% vs. 7.1%), and history of coronary heart disease (17.9% vs. 3.8%; Table 1). The average %TWL and %EBWL after 3 years were 30.38% and 34.33% and 71.9% and 73.1% in the geriatric and adult groups respectively (Figs. 1 and 2). The percentage follow-up ranged from 88.6% at 6 months to 37% at 3 years (Table 3). There were three major complications in the adult group, one mortality from a pulmonary embolism and two leaks that required reoperations. Two postoperative intraabdominal bleeding in the geriatric group were treated by re operations (Table 4). Nutritional deficiencies (ND) were seen in some patients before the operations and the incidence was increased at 1 year after the operations in both groups (Table 5). These were treated with additional nutrient supplements on further follow-up and improvement was noted by the third year. Remission of obesity-related co-morbidities occurred similarly in both groups (Table 6).

Table 5 Nutrient deficiency (ND) status of adult and geriatric group

	0 m		6 m		12 m		24 m		36 m	
	Adult	Geriatric	Adult	Geriatric	Adult	Geriatric	Adult	Geriatric	Adult	Geriatric
Hb	12.89 ± 104	12.41 ± 1.5	11.96 ± 1.5	11.4 ± 1.5	12.3 ± 1.5	11.8 ± 1.5	12.24 ± 1.5	11.8 ± 1.6	12.7 ± 1.4	12.3 ± 1.6
p value	0.003		0.004		0.008		0.117		0.118	
%ND Hb < 11	25/184 (13.6%)	44/184 (23.9%)	41/154 (26.6%)	70/163 (42.9%)	22/133 (16.5%)	44/137 (32.1. %)	18/104 (17.3%)	31/106 (29.2%)	8/79 (10%)	20/68 (29.4%)
Alb	3.9 ± 0.45	3.9 ± 0.5	3.5 ± 0.4	3.4 ± 0.4	3.6 ± 0.5	3.5 ± 0.5	3.7 ± 0.5	3.6 ± 0.5	3.7 ± 0.5	3.6 ± 0.46
p value	0.523		0.135		0.126		0.225		0.660	
%ND < 3Alb	1/184 (0.5%)	4/184 (2.2%)	14/154 (9.0%)	30/163 (18.4%)	19/133 (14.3%)	27/137 (19.7%)	5/104 (4.8%)	17/106 (16.03%)	4/79 (5.06%)	6/68 (8.8%)
Protein	6.7 ± 0.5	6.7 ± 0.5	5.9 ± 0.6	5.9 ± 0.6	5.9 ± 0.8	5.7 ± 0.65	6.32 ± 0.7	6.36 ± 0.74	6.11 ± 0.7	6.12 ± 0.6
p value	0.770		0.907		0.276		0.703		0.926	
%ND < 6 protein	24/184 (13.0%)	25/184 (13.6%)	38/154 (24.7%)	83/16 3(50.9%)	82/133 (61.6%)	89/137 (64.9%)	31/104 (29.8%)	36/106 (33.9%)	23/79 (29.1%)	26/68 (38.2%)
Vit. B_{12}	223.87 ± 73.3	230.79 ± 101.5	235.5 ± 74.4	245.9 ± 106.4	269.1 ± 79.5	284.7 ± 113.6	270.9 ± 83.08	280.3 ± 119.01	280.8 ± 61.5	284.1 ± 90.2
p value	0.455		0.317		0.193		0.524		0.822	
%ND < 200 Vit. B_{12}	82/184 (44.6%)	76/184 (41.3%)	43/154 (27.9%)	43/163 (26.4%)	24/133 (18.0%)	19/137 (13.8%)	9/104 (8.6%)	10/106 (9.4%)	1/79 (1.2%)	2/6 8(2.9%)
Vit. D_3	29.00 ± 5.3	28.8 ± 5.4	37.0 ± 7.8	38.13 ± 7.6	41.21 ± 8.7	43.0 ± 7.8	41.8 ± 8.7	44.1 ± 8.8	39.33 ± 9.5	40.64 ± 8.16
p value	0.830		0.206		0.073		0.063		0.425	
%ND < 20 Vit.D_3	7/184 (3.8%)	7/184 (3.8%)	2/154 (1.3%)	2/163 (1.2%)	0/133 (0.0%)	0/137 (0.0%)	0/104 (0.0%)	0/106 (0.0%)	0/79 (0.0%)	0/68 (0.0%)

*%ND, percentage of nutrient deficiency

Table 6 Resolution of co-morbid conditions (at 24 month)

	Geriatric	Adult	*p* value
DM	26/34 (76.4%)	14/17 (82.35%)	0.431
HTN	46/70 (65.7%)	39/43 (67.4%)	0.735

Discussion

In the 1970s, bariatric bypass surgery was unsuitable for the treatment of morbid obesity in patients over 50 years of age [9]. In 1991, the NIH set the upper age limit for bariatric surgery at 55 years [12]. However, with significant advances in laparoscopic bariatric surgery, the number of patients aged 65 and older seeking bariatric surgery increased to above 10.1% in 2014 [13]. In our study, the percentage of patients 65 and older was 7%.

Our study was performed to see if it is safe and effective to do bariatric metabolic surgeries in geriatric patients 65 years and older in the Indian population since there are concerns of increased complications in geriatric patients due to age-related co-morbidities such as cardiac illness and less pulmonary reserve. Esteban [14] in a report on bariatric surgery on the elderly in a university health system reported that compared to the nonelderly patients, elderly patients that underwent bariatric surgery had more co-morbidities, longer length of stay, more overall complications, and higher in hospital mortality rate. We did find an increased number of co-morbidities in this study just as reported by Esteban et al. but not an increase in hospital stay, complications, and mortality. The incidence of minor complications was insignificant in both groups in this study probably due to the expertise of the surgeon and surgical team in our high-volume center where an average of > 80 cases are performed monthly. Apart from bleeding, all other perioperative complications were prevalent in the adult group though not statistically significant.

The weight (loss) in this study was not significantly different between the < 65 years old and > 65 years old groups. This is the same as reported by Sugarman [15] after gastric bypass and Karen [16] after the sleeve gastrectomy. The resolution of co-morbid conditions was not (statistically) different between the adult and geriatric group. Similar outcomes were reported by others [14–19] (Fig. 3).

Abbas et al. [20] in their study performed for considering outcomes of patients aged more than 60 found that the percentage excess weight (loss) was not significantly different from the adult groups. The difference in the complications rate in geriatric group was also not statistically significant as compared to the adult group. Our study in summary confirms what others have found and reported in other studies [21–23].

Although this study contributes to our understanding of bariatric surgery, it was limited by the retrospective design. The second limitation is that the groups were matched only for the types of procedures and not for gender and BMI which might have influenced the outcome. The third limitation is the loss to follow up with only 37% of the geriatric group and 43% in the adult group with data at 36 months. This low number does not allow for evaluating the differences in the operations or the effect of the severity of the obesity at the onset. We have now instituted a structured follow-up program to enhance the follow-up rate.

Conclusions

Bariatric surgery could be safe and feasible in selected geriatric Indian patients over 65 years old. It does not result in more

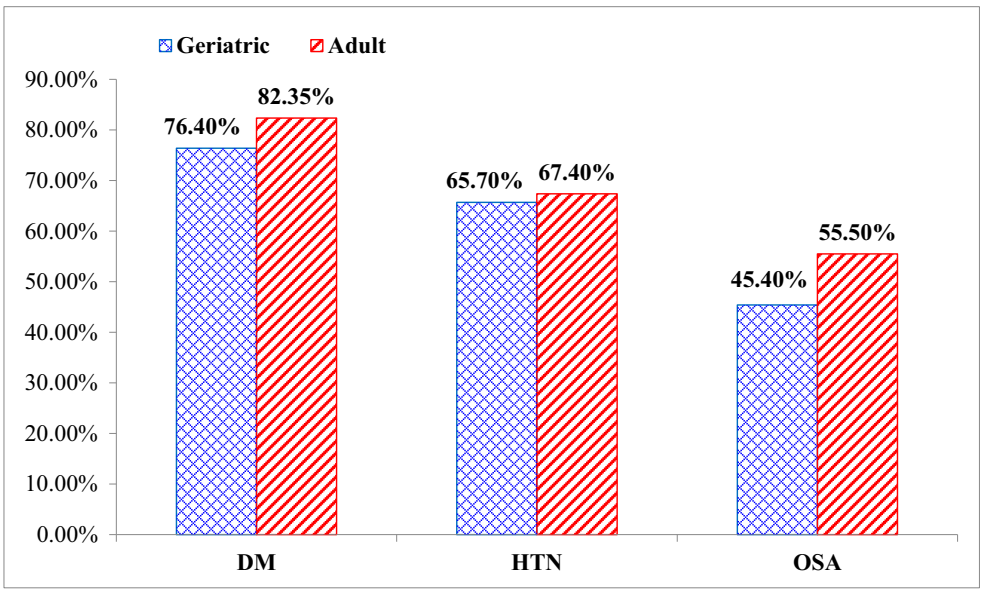

Fig. 3 Resolution of co-morbid conditions in geriatric and adult

perioperative or short-term complications as compared to the adult group. The length of hospital stay is similar to that in adult patients. Long-term and prospective studies are needed to confirm these findings.

Compliance with Ethical Standards

Conflict of Interest All the authors included in the study have no related conflict of interest. Dr. Mohit Bhandari is a consultant with Johnson and Johnson, Medtronic, Intutive Surgical, Stryker, Karl Storz, Bariatric Solution and Apollo Endo-surgery, none of which had any relationship to this study. Dr. Mathias Fobi is the founding President of Bariatec Corporation and owns shares in the company. This had no relationship with the study. Dr Winni Mathur has no conflict of interest. Dr Susmit Kosta has no conflict of interest. The data collection was done independently by the authors.

Statement of Informed Consent For this type of study, formal consent was not required of the patient however preoperatively, all patients provided written informed consent for their operation and to have de-identified data analyzed. The institutional review board approved this study.

Statement of Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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