Original Article

Complications after bariatric surgery: A multicentric study of 11,568 patients from Indian bariatric surgery outcomes reporting group

Ramen Goel[1], Amrit Manik Nasta[1], Madhu Goel[1], Arun Prasad[2], Gurvinder Jammu[3], Mathias Fobi[4,5], Mohamed Ismail[6,7], Praveen Raj[8], Raj Palaniappan[9], Sandeep Aggarwal[10], Vivek Bindal[11], Abhishek Katakwar[12], Amar Vennapusa[13], Aparna Govil Bhasker[14,15], Atul Peters[16], Deep Goel[17], Digvijay Bedi[18], Jaydeep Palep[19], Lakshmi Kona[20], Magan Mehrotra[21], Manish Baijal[22], Mohit Bhandari[4,5], Nandakishore Dukkipati[23], Randeep Wadhawan[24], Sarfaraz Baig[25], Satish Pattanshetti[26], Surendra Ugale[27]

[1]Centre For Metabolic Surgery, Wockhardt Hospitals, Mumbai, Maharashtra, India, [2]Department of Surgery, Manipal Hospital, New Delhi, India, [3]Director and Chief Surgeon, Bariatric Surgery, Jammu Hospital, Jalandhar, Punjab, India, [4]Director of Clinical Affairs and Research, Mohak Bariatrics and Robotics, Indore, Madhya Pradesh, India, [5]Clinical Professor of Surgery, Sri Aurobindo Medical College and Post Graduate Institute, Indore, Madhya Pradesh, India, [6]Bariatric Surgeon, Moulana Hospital, Perintalmanna, Kerala, India, [7]Bariatric Surgeon, RIMS Hospital, Kottayam, Kerala, India, [8]Bariatric Surgeon, Gem Hospital and Research Institute, Coimbatore, Tamil Nadu, India, [9]Lead Consultant, Bariatric, Metabolic and Robotic Surgery, Institute of Bariatrics, Apollo Hospitals, Chennai, Tamil Nadu, India, [10]Bariatric Surgeon, AIIMS, New Delhi, India, [11]Vice-Chairman, Institute of Minimal Access, Metabolic and Bariatric Surgery, Sir Ganga Ram Hospital, New Delhi, India, [12]Associate Director, Laparoscopic/Robotic Bariatric and Metabolic Surgery, AIG Hospitals, Hyderabad, Telangana, India, [13]Chief Consultant Metabolic and Bariatric Surgeon, Dr. Amar Bariatric and Metabolic Center, Hyderabad, Telangana, India, [14]Bariatric and Laparoscopic GI Surgeon, Gleneagles Global Hospital, Parel, Mumbai, Maharashtra, India, [15]Bariatric and Laparoscopic GI Surgeon, Apollo Hospital, Navi Mumbai, Maharashtra, India, [16]HOD and Senior Consultant, Apollo Institute of Bariatric and Metabolic Surgery, Indraprastha Apollo Hospitals, New Delhi, India, [17]Department of Surgical Gastroenterology, Bariatric and Metabolic Surgery, BLK Super Specialty Hospital, New Delhi, India, [18]Hope Obesity Center, Bhopal, Madhya Pradesh, India, [19]Department of Bariatric and Minimal Access Surgery, Nanavati Super Speciality Hospital, Mumbai, Maharashtra, India, [20]Senior Consultant, Gleneagles Global Hospital, Hyderabad, Telangana, India, [21]Director, Bariatric Surgery, Apex Hospital, Moradabad, Uttar Pradesh, India, [22]Director, Institute of Minimal Access, Metabolic and Bariatric Surgery, Max Hospital, New Delhi, India, [23]Bariatric Surgeon, Livlife Hospitals, Hyderabad, Telangana, India, [24]Department of Minimal Access, Bariatric and Gastrointestinal Surgery, Fortis Hospital, New Delhi, India, [25]Department of Minimal Access Surgery, Belle Vue Clinic, Kolkata, West Bengal, India, [26]Ruby Hall Clinic, MJM Hospital, Pune, Maharashtra, India, [27]Director, Bariatric and Metabolic Surgery, Kirloskar and Virinchi Hospitals, Hyderabad, Telangana, India

Abstract

Background: Complications after bariatric surgery are not uncommon occurrences that influence the choice of operations both by patients and by surgeons. Complications may be classified as intra-operative, early (<30 days post-operatively) or late (beyond 30 days). The prevalence of complications is influenced by the sample size, surgeon's experience and length and percentage of follow-up. There are no multicentric reports of post-bariatric complications from India.

Objectives: To examine the various complications after different bariatric operations that currently performed in India.

Address for correspondence: Dr. Amrit Manik Nasta, Centre for Metabolic Surgery, Wockhardt Hospitals, 1877, Doctor Anandrao Nair Marg, Near Agripada Police Station, Mumbai Central, Mumbai - 400 011, Maharashtra, India.
E-mail: amritnasta@hotmail.com
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Materials and Methods: A scientific committee designed a questionnaire to examine the post-bariatric surgery complications during a fixed time period in India. Data requested included demographic data, co-morbidities, type of procedure, complications, investigations and management of complications. This questionnaire was sent to all centres where bariatric surgery is performed in India. Data collected were reviewed, were analysed and are presented.

Results: Twenty-four centres responded with a report on 11,568 bariatric procedures. These included 4776 (41.3%) sleeve gastrectomy (SG), 3187 (27.5%) one anastomosis gastric bypass (OAGB), 2993 (25.9%) Roux-en-Y gastric bypass (RYGB) and 612 (5.3%) other procedures. Total reported complications were 363 (3.13%). Post-operative bleeding (0.75%) and nutritional deficiency (0.75%) were the two most common complications. Leaks ($P = 0.009$) and gastro-oesophageal reflux disease ($P = 0.019$) were significantly higher in SG, marginal ulcers in OAGB ($P = 0.000$), intestinal obstruction in RYGB ($P = 0.001$) and nutritional complications in other procedures ($P = 0.000$). Overall, the percentage of complications was higher in 'other' procedures (6.05%, $P = 0.000$). There were 18 (0.16%) reported mortalities.

Conclusions: The post-bariatric composite complication rate from the 24 participating centres in this study from India is at par with the published data. Aggressive post-bariatric follow-up is required to improve nutritional outcomes.

Keywords: Bariatric surgery, complications, multicentric study, one anastomosis gastric bypass, Roux-en-Y gastric bypass, sleeve gastrectomy

INTRODUCTION

Bariatric surgery remains the single most effective long-term treatment option for obesity and its co-morbidities. The apprehension of possible complications deters even suitable candidates from undergoing a life-saving procedure, though it is widely accepted that experienced bariatric surgeons and centres of excellence have low complication rates. Further, the reporting format of complications varies across different centres and procedures. National trend analysis of bariatric-related complication rates and associated morbidity is essential to provide appropriate scientific information to physicians and the general population.

The 2016 International Federation for Surgery in Obesity and Metabolic Disorders (IFSO) report[1] included a total of 14,021 bariatric procedures from India, of which 13,765 (98.17%) were primary. Sleeve gastrectomy (SG) ($n = 8627$, 62.7%) was the most commonly performed procedure followed by one anastomosis gastric bypass (OAGB) ($n = 2834$, 20.6%), and Roux-en-Y gastric bypass (RYGB) ($n = 2108$, 15.3%). Despite such high volumes, the reporting of surgical outcomes and multicentric post-bariatric complication data is lacking. A recent multicentre study by Baig *et al*.[2] on weight regain showed a high incidence of anaemia (13.9%) and hypo-albuminaemia (5.9%) after OAGB. On the other hand, Nasta *et al*.[3] showed no leaks, bleeds or surgical mortality after SG or RYGB. Jammu and Sharma[4] showed a leak rate of 1.5% in SG, 0.3% in RYGB and 0% in OAGB. They reported hypo-albuminaemia of 13% after OAGB in patients with biliopancreatic limb >250 cm.

Worldwide, bariatric complications and their related morbidity and mortality have reduced over the decades.[5] Although many believe that the real incidence of post-bariatric complications is high but under-reported, it is also possible that they are low, as reported in individual series.

We aimed to study the trend of post-bariatric complications amongst various procedures and correlate them with demographics and co-morbidities as well as their management, from various bariatric centres in India.

MATERIALS AND METHODS

This retrospective study was a part of a data collection exercise conducted by our centre in collaboration with the Obesity Surgery Society of India. A record of prospectively maintained data of all bariatric procedures performed for the period of January 2015–December 2017 (3 years) was collected from the primary bariatric surgeon of each centre. The requested data included demographics, co-morbidities, type of bariatric surgery, concomitant procedures and complications. In patients with complications, further details including time of diagnosis, diagnostic modality (computed tomography [CT] scan, endoscopy, biochemistry, etc.), hospitalisation period, management (conservative, endoscopic or surgical) and outcomes were recorded. In addition, each complication was defined (e.g., bleed as haemoglobin drop >2 g%) to standardise the reporting.

Exclusions

Data provided for patients apart from the mentioned period (2015–2017) were excluded. Patients with missing data were

included for the descriptive statistics and comparison of means but were excluded from the correlation/regression analysis. Centres failing to provide data of all operated patients for the given period were excluded from the analysis.

Statistical methods

All the continuous variables were assessed for the normality using Shapiro–Wilk test. All the categorical variables were expressed either as percentage or proportion. The comparison of all the normally distributed continuous variables was done by the independent sample *t*-test or Welch's test depending on variance. Comparisons of all the non-normally distributed continuous variables were done by Mann–Whitney U-test, based on the number of groups. Comparisons of categorical variables were analysed by either Chi-square test or Fisher's exact, test based on the number of observations. A $P < 0.05$ was considered statistically significant.

RESULTS

Twenty-six bariatric centres contributed to this study, but the entries of two centres were excluded due to incomplete data. The remaining 24 centres reported 11,568 procedures for the period January 2015–December 2017, of which 156 (1.35%) were revisions. Thirteen centres performed over 100 surgeries annually, six centres 50–100 surgeries annually and five centres less than 50 surgeries annually. The procedure distribution is listed in Tables 1 and 2. SG was the most common procedure (4776, 41.3%) followed by OAGB (3187, 27.5%) and RYGB (2993, 25.9%). Other procedures constituted 612 (5.3%).

Demography and co-morbidity

Overall, the mean age was 42.12 years (±12.23). The majority of the participants (54.04%) were in the age group of 31–50 years followed by 19.61% in 51–60 years. Females comprised 57.36% of all the patients [Table 3].

Overall, the mean body mass index (BMI) was 43.74 (±7.89) kg/m^2 [Table 4]. Majority of patients belonged to BMI 40–49.9 (46.57%) followed by 30–39.9 kg/m^2 (32.33%). Although OAGBs were preferred in BMI >50 (24.17%) as compared to the other three procedures, the difference was not significant ($P > 0.05$).

62.8% ($n = 7264$) of patients suffered from at least one documented co-morbidity before surgery. Amongst them, majority had obstructive sleep apnoea (OSA) (36.10%) followed by hypertension (33.70%), type 2 diabetes (T2D, 30.00%) and others [Table 4].

Table 1: Distribution of different bariatric procedures

Procedure	Total (%)	Primary (%)	Revision (%)
SG	4776 (41.3)	4750 (99.4)	26 (0.6)
OAGB	3187 (27.5)	3143 (98.6)	44 (1.38)
RYGB	2993 (25.9)	2941 (98.3)	52 (1.73)
Others	612 (5.3)	578 (94.44)	34 (5.55)
Total	11,568 (100)	11,412 (98.65)	156 (1.35)

SG: Sleeve gastrectomy, OAGB: One anastomosis gastric bypass, RYGB: Roux-en-Y gastric bypass

Table 2: Distribution of other procedures (*n*=612)

Procedure	*n*
Adjustable band	5
SGIT	113
S-DJB	232
SADI-S	53
Sleeve with loop bi-partition	138
Intra-gastric balloon	52
Miscellaneous (band removal, bypass reversal, diagnostic laparoscopy, gastric imbrication etc.)	19
Total	612

SGIT: Sleeve gastrectomy with ileal transposition, S-DJB: Sleeve with duodenojejunal bypass, SADI-S: Single anastomosis duodenoileal bypass with sleeve

Complications analysis

A total of 363 (3.13%) complications were reported. Leaks and gastro-oesophageal reflux disease (GERD) were significantly higher in SG – 28 (0.59%, $P = 0.009$ for leaks); 13 (0.27%, $P = 0.019$ for GERD), marginal ulcer in OAGB – 18 (0.56%, $P = 0.000$), intestinal obstruction in RYGB – 11 (0.37%, $P = 0.001$) and nutritional complications in 'other procedures' – 15 (2.45%, $P = 0.000$). Overall, the incidence of complications was higher in 'other procedures' – 37 (6.05%, $P = 0.000$) [Table 5].

Demography and complications

All complications were equally distributed across both genders ($P > 0.05$). The incidence of bleeding was significantly higher in the age group >70 years (4.69%, $P < 0.05$) [Table 6]. The incidence of leak was significantly higher (2.45%, $P < 0.05$) in the 25.0–29.9 BMI group [Table 6].

Co-morbidities and complications

Of 363 patients with complications, 202 did not have any pre-existing co-morbidity. No significant association was seen between overall complications and T2D ($P = 0.08$), hypertension ($P = 0.11$), OSA ($P = 0.14$) and pre-operative GERD ($P = 0.07$). On sub-group analysis, pre-operative GERD was significantly associated with leaks after RYGB and SG ($P < 0.05$) [Table 7].

Multivariate analysis of complications

On performing multivariate analysis, the factors significantly associated with post-operative leakage were RYGB ($P = 0.03$) and presence of pre-operative GERD ($P = 0.08$), while post-

Table 3: Gender and age distribution across different procedures

Pre-operative patient characteristics	Group 1 - RYGB	Group 2 - SG	Group 3 - OAGB	Group 4 - Others	Total
Gender, *n* (%)					
Male	1214 (40.66)	1899 (39.85)	1473 (46.25)	333 (55.59)	4919 (42.64)
Female	1772 (59.34)	2866 (60.15)	1712 (53.75)	266 (44.41)	6616 (57.36)
Age, mean±SD	43.23±12.12	40.44±12.29	43.29±12.16	43.67±11.02	42.12±12.23
Age group (years), *n* (%)					
<18	18 (0.61)	60 (1.27)	22 (0.70)	4 (0.67)	104 (0.91)
18-30	484 (16.32)	1061 (22.47)	491 (15.59)	71 (11.93)	2107 (18.43)
31-40	749 (25.26)	1374 (29.10)	805 (25.56)	173 (29.08)	3101 (27.13)
41-50	835 (28.16)	1150 (24.35)	916 (29.08)	176 (29.58)	3077 (26.92)
51-60	661 (22.29)	789 (16.71)	657 (20.86)	135 (22.69)	2242 (19.61)
61-70	204 (6.88)	263 (5.57)	235 (7.46)	35 (5.88)	737 (6.45)
>70+	14 (0.47)	25 (0.53)	24 (0.76)	1 (0.17)	64 (0.56)
Total	2965 (100.00)	4722 (100.00)	3150 (100.00)	595 (100.00)	11,432 (100.00)

RYGB: Roux en Y gastric bypass, SG: Sleeve gastrectomy, OAGB: One anastomosis gastric bypass, SD: Standard deviation

Table 4: Pre-operative body mass index and co-morbidity distribution across different surgical groups

	Group 1 - RYGB	Group 2 - SG	Group 3 - OAGB	Group 4 - Others	Total
BMI, mean±SD	43.97±7.74	43.32±7.65	44.85±7.87	40.03±9.14	43.74±7.89
Co-morbidity, *n* (%)					
Diabetes mellitus	1124 (37.55)	1307 (27.37)	785 (24.63)	259 (42.32)	3475 (30.00)
Hypertension	1239 (41.4)	1310 (27.43)	1039 (32.6)	316 (51.63)	3904 (33.70)
Obstructive sleep apnoea	1114 (37.22)	1352 (28.31)	1299 (40.76)	413 (67.48)	4178 (36.10)
GERD	101 (3.37)	89 (1.86)	13 (0.41)	205 (33.5)	408 (3.53)

RYGB: Roux-en-Y gastric bypass, SG: Sleeve gastrectomy, OAGB: One anastomosis gastric bypass, SD: Standard deviation, GERD: Gastro-oesophageal reflux disease, BMI: Body mass index

Table 5: Distribution of complications across different surgical groups

Complications	Group 1 - RYGB, *n* (%)	Group 2 - SG, *n* (%)	Group 3 - OAGB, *n* (%)	Group 4 - Others, *n* (%)	Total, *n* (%)	*P*
Bleed	18 (0.6)	41 (0.86)	26 (0.82)	2 (0.33)	87 (0.75)	0.341
Leak	9 (0.3)	28 (0.59)	7 (0.22)	6 (0.98)	50 (0.43)	0.009
Deep vein thrombosis	1 (0.03)	1 (0.02)	1 (0.03)	0	3 (0.03)	0.959
Pulmonary embolism	1 (0.03)	3 (0.06)	3 (0.09)	0	7 (0.06)	>0.05
Atelectasis	0	1 (0.02)	0	1 (0.16)	2 (0.02)	>0.05
Intestinal obstruction	11 (0.37)	4 (0.08)	1 (0.03)	3 (0.49)	19 (0.16)	0.001
GERD	0	13 (0.27)	6 (0.18)	0	19 (0.16)	0.019
Biliary reflux	0	0	3 (0.09)	0	3 (0.03)	>0.05
Marginal ulcer	14 (0.47)	0	18 (0.56)	0	32 (0.28)	0.000
Nutritional	8 (0.27)	31 (0.65)	30 (0.94)	18 (2.94)	87 (0.75)	<0.05
Band erosion	1 (0.03)	0	0	1 (0.16)	2 (0.02)	>0.05
Any other	17 (0.57)	19 (0.4)	7 (0.22)	9 (1.47)	52 (0.45)	0.001
Total	81 (2.71)	138 (2.89)	107 (3.36)	37 (6.05)	363 (3.14)	0.000

RYGB: Roux-en-Y gastric bypass, SG: Sleeve gastrectomy, OAGB: One anastomosis gastric bypass, GERD: Gastro-oesophageal reflux disease

operative bleeding was significantly associated with OAGB ($P = 0.02$). Other factors such as age, with these complications.

Primary versus revision procedures

Overall, the complications were significantly higher in revision surgery (12.18% vs. 3%, $P = 0.007$). Intestinal obstructions, GERD and bile reflux and nutritional deficiencies were significantly ($P < 0.05$) higher in patients who underwent revision surgery. However, no significant difference was seen in the incidence of bleed, leak, deep vein thrombosis (DVT) and marginal ulcers between primary and revision surgery.

Correlation between surgical volume and complications rate

The overall complication rate was higher at centres performing <50 surgeries annually ($P = 0.000$). On individual analysis, each complication except nutritional deficiencies and DVT was significantly higher in centres performing <50 surgeries annually [Table 8].

Diagnosis and management of complications

Post-operative bleeding

Eighty (92%) patients with post-operative bleeding were diagnosed within 48 h of surgery. Imaging (CT scan/ultrasound abdomen) was performed in 44 (50.6%) patients. Forty-eight (55.2%) were managed non-surgically, 31 (35.7%) underwent re-laparoscopy, 4 (4.6%) required laparotomy and 4 (4.6%) were managed endoscopically. No mortality was reported due to bleeding in the post-operative period.

Post-operative leaks

In patients with post-operative leak, 16 (32%) were

Table 6: Association of post-operative bleeding with age groups; association of post-operative leaks with BMI groups

Age groups (years)	<18	18-30	31-40	41-50	51-60	61-70	>70+	*P*
Number of bleeds, *n* (%)	2 (1.92)	8 (0.38)	19 (0.61)	28 (0.91)	19 (0.85)	6 (0.81)	3 (4.69)	<0.05
BMI groups (kg/m²)	**25-29.9**	**30-39.9**	**40-49.9**	**≥50**			***P***	
Leak, *n* (%)	4 (2.45)	12 (0.32)	29 (0.54)	5 (0.22)			<0.05	

BMI: Body mass index

Table 7: Association of leak and pre-operative gastro-oesophageal reflux disease after sleeve gastrectomy and Roux-en-Y gastric bypass

Leak after	No GERD, *n* (%)	GERD, *n* (%)	*P*
RYGB	7 (0.24)	2 (1.98)	<0.05
SG	26 (0.55)	2 (2.25)	<0.05

GERD: Gastro-oesophageal reflux disease, RYGB: Roux-en-Y gastric bypass, SG: Sleeve gastrectomy

diagnosed after 7 days. The time of diagnosis was not mentioned in six patients. Imaging (CT/oral contrast/ultrasound abdomen) was performed in 41 (82%) patients, while no imaging was reported in 9 (18%). Twenty-nine (58%) underwent re-laparoscopy, 5 (10%) underwent laparotomy, 9 (18%) underwent endoscopic management, 1 (2%) underwent image-guided pigtail drainage, 2 (4%) were managed expectantly and 2 (4%) underwent combined endoscopic with laparoscopic management. Three (6%) mortalities were reported after leaks.

Post-operative nutritional deficiencies

Post-operative nutritional deficiencies were reported in 87 patients. Of these, 29 had anaemia, 35 had hypo-proteinaemia and 41 had multi-vitamin deficiencies. A few patients had both multi-vitamin and macro-nutrient deficiencies.

Thirty (34.5%) patients were diagnosed within the first 3 months, 18 (20.7%) during the 4 months to 1-year and 31 (35.6%) after the 1-year period. Seventy-five (86.2%) patients were managed with nutritional supplementation only. 12 (13.8%) patients (6 OAGBs, 4 single anastomosis duodenoileal bypass with sleeve [SADI-S], one sleeve with duodenojejunal bypass and one RYGB) required revision of limb length or reversal for severe nutritional deficiency. Overall, six mortalities were reported after nutritional complications.

Mortality

Mortality was reported in 18 (0.16%) patients [Table 9]. Leak ($P = 0.01$) or nutritional ($P = 0.019$) complications were found to be significantly associated with mortality.

DISCUSSION

This study presents the findings and analysis of 363 (3.13%) post-bariatric complications out of 11,568 surgeries from 24 centres in India.

Consistent with most published reports,[1,6] SG was the most commonly performed bariatric procedure. There were more OAGBs than RYGBs performed in these centres in India. Other bariatric procedures including SADI-S, sleeve with loop bipartition and SG with ileal transposition were performed in small numbers and at a few centres. 1.5% of revisions were reported in this study, as compared to 13.6% in the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) registry report.[7]

Demography

More male patients (42.64%) are undergoing bariatric surgery in India, in contrast to other countries where only 22% of men are reported to undergo surgery.[8] Although the most common BMI group in our study was 40–50 kg/m^2 (46.6%), a good proportion (32.3%) belonged to 30–40 kg/m2. This may be because BMI cut-off for Asians is lower than international standards.[9] In our study, 30% of the patients suffered from T2D, 33.7% from hypertension and 36.1% from OSA in contrast to the global IFSO registry report,[10] with 19.5% patients with T2D, 30.2% with hypertension and 18.4% with sleep apnoea.

Complications

The overall complication rate in this study is 3.13% ($n = 363$), similar to 2.1%–3% reported by Melissas *et al*.[6] from IFSO Centres of Excellence and 3.1% by Miras *et al*.[8] Higher complication rate of revision surgeries is reported in this study, in line with the report by Chaar *et al*.[7] 'Other procedures' had higher complications rates (6.05%) as compared to common procedures (2.71%, 2.89% and 3.36% for RYGB, SG and OAGB, respectively).

In this study, centres performing <50 surgeries annually had significantly more complications than centres performing higher numbers (50–100 or >100 procedures). This is in line with the study by Varban *et al*.,[11] who reported lower complication rates in high-volume centres (>125/year) and higher rates in low-volume centres (<50/year).

The most common complications reported were post-operative bleeding (0.75%) and nutritional deficiencies (0.75%), followed by leaks (0.43%). Subgroup analysis showed significantly higher leaks and GERD after SG, intestinal obstruction after RYGB, marginal ulcer after

Table 8: Complication rates across different surgical volume centres

Types of complications	Centres performing <50 surgeries annually	Centres performing 50-100 surgeries annually	Centres performing >100 surgeries annually	Total	*P*
Bleed	7 (2.81)	10 (0.68)	70 (0.71)	87 (0.75)	0.002
Leak	7 (2.81)	8 (0.54)	35 (0.36)	50 (0.43)	0.000
DVT	0 (0)	1 (0.07)	2 (0.02)	3 (0.03)	0.557
Pulmonary embolism	0 (0)	2 (0.14)	5 (0.05)	7 (0.06)	>0.05
Intestinal obstruction	4 (1.61)	2 (0.14)	13 (0.13)	19 (0.16)	0.000
GERD and biliary reflux	2 (0.8)	7 (0.47)	13 (0.13)	22 (0.19)	0.000
Nutritional	3 (1.2)	10 (0.68)	74 (0.75)	87 (0.75)	0.133
Marginal ulcer	3 (1.2)	4 (0.27)	25 (0.25)	32 (0.28)	0.000
Others	5 (2.01)	13 (0.88)	38 (0.39)	56 (0.48)	0.000
Total complications	32 (12.85)	54 (3.65)	277 (2.82)	363 (3.14)	0.000
Total procedures	248	1481	9839	11568	

DVT: Deep vein thrombosis, GERD: Gastro-oesophageal reflux disease

Table 9: Aetiological factors for mortality in post-operative period

	Group 1 - RYGB	Group 2 - SG	Group 3 - OAGB	Group 4 - Other procedures	Total
n (%)	4 (0.13)	4 (0.08)	5 (0.16)	5 (0.82)	18 (0.16)
Aetiology	Leak at jejuno-jejunostomy	Mesenteric vascular thrombosis	Nutritional	Liver failure after SADI-S	
	Leak at jejuno-jejunostomy	Nutritional	Pulmonary embolism	Nutritional (SADI-S)	
	Pulmonary embolism	Mesenteric panniculitis	Pulmonary embolism	Nutritional (sleeve with loop bi-partition)	
	Leak (site unspecified)	Pulmonary embolism	Rhabdomyolysis	Nutritional (sleeve with loop bi-partition)	
			Nutritional	Nutritional (sleeve with loop bi-partition)	

RYGB: Roux-en-Y gastric bypass, SG: Sleeve gastrectomy, OAGB: One anastomosis gastric bypass, SADI-S: Single anastomosis duodenoileal bypass with sleeve

OAGB and nutritional deficiencies after SADI-S and sleeve with loop bipartition (other procedures). The study by Melissas *et al*.[6] showed bleeding as the most common complication although it was similar after SG (1.2%) and RYGB (1%). Miras *et al*.[8] showed post-operative vomiting and poor oral intake as the most common complication. The nutritional complications reported in this study are high, reflecting the need for improved peri-operative care and support. The study by Melissas *et al*.[6] showed protein malnutrition of 0.03%–0.05% after SG and RYGB. The study by Baig *et al*.[2] showed a hypo-albuminaemia of 2.2%–5.9% and an anaemia of 8.2%–13.9% based on different procedures.

Mortality

The mortality rate in this study was 0.16% (n = 18), while a Swedish registry study by Tao *et al*.[12] showed a 1-year cumulative mortality of 0.22%. In this study, leaks and nutritional deficiency were found to be significantly associated with mortality, whereas the MBSAQIP database study by Daigle *et al*.[13] showed venous thromboembolism, bleeding and leaks to be the major causes of mortality.

Demography and co-morbidity with complications

Complications were equally distributed across both genders in this study. The study by Stroh *et al*.[14] showed a higher incidence of leaks and overall complication rates in males undergoing RYGB. The age group >70 years had significantly more post-operative bleeds in our study. The Scandinavian Obesity Surgery Registry by Gerber *et al*.[15] showed a higher incidence of leaks and bleeds in the age group more than 50 years, while medical complications were more in the age group more than 60 years. In our study, there was no significant association of BMI with complications, except in one BMI group. In the study by Chiappetta *et al*.,[5] BMI did not differ significantly between patients with (n = 503) and without complications (n =8934). On the other hand, Sanni *et al*.[16] showed an increased risk of complication with every one-point increase in BMI.

Overall co-morbidities were not significantly associated with any complication. This is contrary to the American College of Surgeons database report by Abraham *et al*.,[17] where T2D and hypertension were significantly associated with 30-day re-admission. In our study, sub-group analysis showed that pre-existing GERD was significantly associated with leaks after SG and RYGB, whereas the study by Masoomi *et al*.[18] with 225,000 RYGB patients showed that the significant risk factors for leak were age > 50 years, male gender, congestive heart failure, renal failure and chronic pulmonary disease. Similarly, a study by Alizadeh *et al*.[19] identified an increased risk for leak in patients with oxygen dependency (adjusted odds ratio [AOR] 1.97), hypo-albuminaemia (AOR 1.66), sleep apnoea (AOR 1.52), hypertension (AOR 1.36) and T2D (AOR 1.18). We could not find any large-scale study where GERD has been linked to an increased rate of leaks.

Management

A CECT scan was performed in 50.6% with post-operative bleed, and 55.2% of the patients with bleeding were managed conservatively. In the study by Zafar *et al*.[20] on bleeding after RYGB, 25.3% of patients required re-exploration, 14.9% required endoscopic management and the rest were managed conservatively. A CT/oral contrast study was performed in 82% with leak, and a laparoscopy/laparotomy was required in 68%. According to the ASMBS position statement,[21] in the clinically stable patient with a suspected leak, CT of the abdomen and pelvis with oral and intravenous contrast may have higher sensitivity and specificity than upper gastrointestinal contrast studies, with the added utility of identifying associated intra-abdominal abscesses, hernias or other pathologic conditions after RYGB or SG. Re-exploration, open or laparoscopic, is an appropriate and acceptable treatment modality when a leak is suspected and remains the diagnostic test with the highest sensitivity and specificity after RYGB and SG.

In this study, 13.8% of patients with nutritional deficiency (overall 0.1%) required revision of the limb length or reversal of the procedure. A review by Mahawar *et al*.[22] reported that 0.37%–0.51% of the patients after OAGB required surgical correction for nutritional deficiency. Initial reports of SADI-S have shown a conversion rate of 2.3%–3.8% for severe malnutrition.[23]

The strength of this study is twofold. It is a large volume multicentric study showing an acceptable overall complication rate, comparable to reports from other national and worldwide registries. Second, both high- and low-volume centres have participated which is a good representation of bariatric practices and post-bariatric complications in India.

There are some weaknesses in our study. As data collection exercise was started in December 2018 for patients operated in 2015–2017, long-term outcome analysis was not possible. Being a retrospective analysis, the data points could not be ascertained in advance. In addition, variation in surgical techniques of different contributing centres, which may impact complications, could not be correlated.

CONCLUSIONS

SG remains the most commonly performed procedure in India, with an upward trend in OAGB numbers. The incidence and types of complications in this study are similar to studies from other countries. Despite an acceptable complication rate, higher number of nutritional complications and complications associated with newer procedures are reported. A bariatric regulatory mechanism including institutional review for new procedures and stronger nutritional surveillance is desirable.

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Conflicts of interest

There are no conflicts of interest.

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