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Research Article

Role of 3D Volumetric Computed Tomography in Evaluation of Postoperative Response of the Treated Stomach by Sleeve Gastrectomy.

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Abstract

Background: Obesity is a condition of gaining excessive body weight . Bariatric surgery procedures are specifically designed for individuals with severe obesity. The function of radiography in gastric bariatric surgery is detecting postoperative problems and assessing the effectiveness of surgical decrease in gastric size following the procedure. **Amis:** This study aims to examine the correlation between the decrease in stomach volume after bariatric surgery, and the relevance of MSCT based volumetric assessment of gastric sleeves post-operative. **Patient and methods:** This is a prospective study conducted on 20 obese patients from department of the general surgery to Radiology department , Faculty of Medicine, Minya University from November 2022 to November 2023. **Results:** Weight, BMI and gastric volume measurements were significantly lower 1month and 6months post-operative compared to pre-operative (P value <0.001). **Conclusion:** Loss of weight and the size of the gastric volume pouch are significantly correlated. However, there was no correlation between the volume of the gastric pouch and the percentage reduction in extra body weight.

Keywords: Volumetric, sleeve, Gastrectomy.

Introduction

Being overweight is defined as a high body mass index (BMI) in relation to one's height. The body mass index (BMI) is a common way to categorise it. It's determined by dividing the square of the height (in metres) by the weight (in kilogrammes). Underweight or wasting is defined as a body mass index (BMI) of 18.5 or lower, while extreme obesity is defined as a BMI of 40 or above. People who are overweight face several types of discrimination and inequality because of their weight. Obesity raises the risk of many chronic diseases and conditions, including depression, incapacity, heart disease, diabetes type 2, some cancers, and mortality[1,2,3].

Patients suffering from medically significant obesity are the intended recipients of bariatric surgical techniques. At the moment, those techniques are the most reliable way to combat obesity. No longer seen as experimental, laparoscopic sleeve gastrectomy (LSG) has become a mainstay in bariatric surgery[4, 5].

The use of radiography in gastric bariatric surgery has expanded beyond the detection of postoperative problems. It now also includes the evaluation of the effectiveness of surgical reduction of stomach size after the surgery. Multi-slice computer tomography (MSCT) is the exclusive approach for precise evaluation of stomach and gastric sleeve volumes following surgery. It guarantees precise information regarding the volumes of the stomach and the sizes of the surgical connections. Visualising bariatric surgery poses a difficult task.

Computed tomography (CT) is crucial in assessing patients after surgery. CT also plays a significant role in assessing the size of the newly operated stomach/pouch using 3D tissue volumetry. This method guarantees precise measurements of stomach volumes and diameters of anastomoses[6].

Patients & Methods

This is a prospective cohort study conducted on 20 obese patients were referred from department of the general surgery at Minia University Hospital to the department of diagnostic Radiology, Faculty of Medicine, Minya University starting from November 2022 to November 2023 and after ethical approval by department committee. Written and informed consent was obtained from all patients with risk explanation prior to the CT scanning.

Inclusion criteria:

- No age limits were considered.
- All patients either male or female who were candidates for gastric sleeve surgery for the first time.
- Pathological obesity cases, (BMI equal or more than 30).
- Patients with recurrent weight gain after previous gastric reduction procedure redo surgery.
- Failed non-operative management of obesity

Exclusion criteria:

- Patients who were eligible for stomach reduction procedures other than sleeve gastrectomy during their medical history.
- Pregnant females.

Methods:

All patients were subjected to the followings:

1. History Taking and demographic data collection as:
   - Age.
   - Sex.
   - Body Mass Index (BMI).
   - Type of bariatric surgery.
2. General examination
3. Laboratory investigations:
   - A full blood count (CBC).
   - Test for renal and liver function.
4. Radiological investigations:
   - 3D Multi-slice computer tomography (MSCT)
5. BMI was measured pre and post operative at 1, 3, and 6 months in the follow up period.

Statistical analysis:

The statistical analysis was conducted using SPSS v26 software (IBM Inc., Chicago, IL, USA). The normality of the data distribution was assessed using the Shapiro-Wilks test and histograms. The quantitative parametric data were reported as the mean and standard deviation (SD). The data was presented using the median and interquartile range (IQR) as measures for quantitative non-parametric variables. Qualitative variables were displayed in terms of frequency and percentage (%). The correlation between BMI and the estimated stomach capacity was assessed. Significance was observed for P values less than 0.05.

Results

Table 1: Demographic data of the studied patients

		N=20
Age (years)	**Mean ± SD**	36.8 ± 6.64
	Range	28 - 47
Sex	**Male**	6 (30%)
	Female	14 (70%)
Weight (Kg)	**Mean ± SD**	140.8 ± 23.32
	Range	101.7 - 176.6
Height (cm)	**Mean ± SD**	169.4 ± 9.16
	Range	153 - 186
BMI (Kg/m^2)	**Mean ± SD**	49.5 ± 10.75
	Range	37.75 - 73.62
DM		3 (15%)

The age ranged from 28 to 47 years with a mean value (± SD) of 36.8 (±6.64) years. There were 6 (30%) males and 14 (70%) females. The weight ranged from 101.7 to 176.6 Kg with a mean value (± SD) of 140.78 (±23.32) Kg. The height ranged from 153 to 186 cm with a mean value (± SD) of 169.4 (±9.16) cm. The BMI ranged from 37.75 to 73.62 Kg/m2 with a mean value (± SD) of 49.54 (±10.75) Kg/m^2. 3 (15%) patients were diabetic.

Table 2: 3D CT findings of the studied patients after sleeve gastrectomy surgery

	N=20
Normal	15 (75%)
Complicated	5 (25%)
• **Fistulous tract formation** • **Leakage** • **Gastric dilatation**	• 1 (20%) • 2 (40%) • 2 (40%)

3D CT findings of the studied patients after sleeve gastrectomy surgery were normal in 15 (75%) patients and complicated in 5 (25%) patients.
Complicated findings were fistulous tract formation in 1(20%) patient, leakage in 2(40%) patients and gastric dilatation in 2(40%) patients.

Table 3: Body weight, BMI and gastric volume measurements in the studied patients

		Preoperative	After 1m	After 6m
Weight (Kg)	**Mean ± SD**	140.8 ± 23.32	134.8 ± 23.2	112.6 ± 25.58
	Range	101.7 - 176.6	94.7 - 170.6	79 - 156.6
P value compared to preoperative			**<0.001***	**<0.001***
Weight loss (Kg)		**Mean ± SD**	6 ± 0.83	28.2 ± 9.63
		Range	5 - 7	6 - 43
P value			**<0.001***	
BMI (Kg/m^2)	**Mean ± SD**	49.5 ± 10.75	47.4 ± 10.55	39.7 ± 10.94
	Range	37.75 - 73.62	36.11 - 71.09	27.26 - 64.51
P value compared to preoperative			**<0.001***	**<0.001***
Gastric volume (ml)	**Mean ± SD**	752.5 ± 231.19	135.4 ± 14.01	118.2 ± 5.74
	Range	479.5 - 1168.6	108.7 - 152.6	109.5 - 129.3
P value compared to preoperative			**<0.001***	**<0.001***
Volume loss (ml)		**Mean ± SD**	617.1 ± 232.11	647.5 ± 226.06
		Range	339.4 - 1034	359.9 - 1049.3
P value			0.716	

*: significantly P value ≤ 0.05.

Weight, BMI and gastric volume measurements were significantly lower 1month and 6months post-operative compared to pre-operative (P value <0.001). Weight loss measurements were significantly higher at 6 months than 1month post-operative (P value <0.001). Volume loss measurements were insignificantly different between 1 month and 6months.

Discussion

If a person's weight is excessive in relation to their height, they are considered obese. This is based on the body mass index (BMI) scale. From a very low weight (18.5 kg/m2) to extremely high weight (40 kg/m2), this scale covers a wide spectrum of conditions.

Imaging for bariatric surgery poses challenges. CT is widely utilised for the postoperative assessment of patients. Furthermore, 3D tissue volumetry reveals that CT scans have a noteworthy and novel function in assessing the dimensions of the recently operated stomach/pouch. It ensures precise data on stomach volumes and anastomosis diameters.

The aim of our research was to investigate the role of MSCT-based volumetric evaluation of gastric sleeves in patients who have undergone bariatric surgery, and to examine the relation-ship between the reduction in stomach volume after surgery and the reduction in body weight.

This study was performed on a cohort of 20 obese individuals who experienced repeated weight gain following a previous gastric reduction procedure, necessitating redo surgery. The study will recruit patients who have been referred from the Department of General Surgery at Minya University Hospital.

In line with our results, Bendari et al., 2022[7] investigated the extra uses of multislice CT for the detection of late problems after frequently performed bariatric surgery and for the purpose of acclimating radiologists to the anatomical alterations seen in these patients. Twenty patients were enrolled in the study, with ages ranging from 26 to 45 years and an average age of 38.3 ± 5.3 SD. There were seven men and thirteen females in the group.

In a study carried out by Agrawal et al., 2015 [8], the objective was to thoroughly investigate bariatric and metabolic surgery, covering all

aspects such as preoperative care, surgical methods, risks, and results. Our results are in line with theirs. They found that 5% of patients had problems after sleeve gastrectomy.

Moreover, Latif et al., 2020[9], conducted a study with the objective of ascertaining the significance of imaging in evaluating and identifying problems following bariatric surgery. Furthermore, this study corroborated our findings, revealing that 61% of patients who underwent sleeve gastrectomy achieved clinical and radiological freedom as evidenced by 3D CT scans.

In addition, Woźniewska et al., 2021[10], provided a comprehensive overview of the prevalent issues that can arise after LSG, including their symptoms, diagnostic methods, and treatment approaches. The study found that a mere 10% of participants experienced problems following sleeve gastrectomy.

In contrast to our findings, Ezzy et al., 2021[11] sought to examine the significance of Post sleeve gastrectomy fistula as a severe consequence and its appropriate treatment. The study yielded contrasting findings, indicating that the incidence rate of fistula tract following sleeve gastrectomy ranges from 0.9% to 2.6%. The discrepancy between the outcomes of several studies and our own findings can be attributed to the limited size of our sample.

Furthermore, Da Silva et al., 2023[12], conducted a study with the aim of establishing the frequency of gastric tube anomalies following SG and its correlation with the advancement of esophagitis. The study reached a conflicting conclusion, stating that patients who underwent sleeve gastrectomy were prone to experiencing stomach dilatation, with an incidence rate of approximately 16.1%. The discrepancy between the outcomes of several studies and our own findings can be attributed to the limited size of our sample.

Additionally, Bashah et al., 2020 [13] recorded a short-to-medium term (1-year minimum) study contrasting OAGB-MGB and SADI-S as revisional treatments following weight recidivism following LSG, with a primary focus on the surgical care and postoperative results. That study contradicted our findings, pointing out that 1.5–3% of patients experience the catastrophic consequence of gastric leak following sleeve gastrectomy. Our tiny sample size is the reason why study results differ from ours.

Consistent with our findings, Aliakbarian et al., 2020 [14] also observed a substantial decrease in weight, followed by BMI and stomach volume measurements, at 1 month and 6 months after sleeve gastrectomy surgery compared to the pre-operative measurements.

Furthermore, Magouliotis et al., 2017 [15] conducted a study with the objective of summarising the available evidence about the surgical outcomes of laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG) in cases where laparoscopic adjustable gastric banding (LAGB) had previously failed.

However, Toro et al., 2015 [16] and Bakr et al., 2019 [17] had a different perspective from our findings. They reported that there were varying changes in stomach volume between 1 month and 6 months following sleeve gastrectomy.

Nevertheless, Tartaglia et al., 2022[18] reported contrasting findings. They found a correlation between the mean Excess Weight Loss % and the residual stomach area (RSA) at 1 month ($r = -0.242$, $p = 0.072$), 6 months ($r = -0.249$, $p = 0.064$), and 12 months ($r = -0.451$, $p = 0.0005$).

The results are in agreement with those of Elbanna et al., 2019[19], who used CT volumetry to measure stomach capacity before and after LSG (within a week). To further understand the role of preoperative stomach volume, residual gastric pouch volume within 1 week post-LSG, and resected stomach volume in weight loss following LSG, they also looked at the correlation between gastric volumes and body mass index (BMI) both before and 6 months following the procedure.

Researchers Moursi et al., (2022)[20] looked at the effects of magnetic resonance spectroscopy (MSCT)-based volumetric assessment of gastric sleeves in bariatric surgery patients. The purpose of the research was to establish a

connection between the decrease in body weight and the shrinkage of the stomach following bariatric surgery.

The rationale behind weight decrease following sleeve gastrectomy is that the reduced stomach size significantly limits its capacity to accommodate food intake. Consequently, patients experience a reduced capacity to consume meals compared to their previous intake. The second factor is a reduced physiological desire to eat. Resection of a significant portion of the stomach induces biochemical alterations in the body, leading to a reduction in appetite.

Conclusion

- When assessing the stomach pouch volume after sleeve gastrectomy, the gold standard imaging method is multislice scintigraphy gastric volumetry.
- Weight loss, BMI reduction, and weight at 1 year are all positively correlated with gastric pouch volume. Nonetheless, the amount of gastric pouch volume did not correlate with the proportion of excess body weight that was reduced.

Conflict of interest

The authors declare that they have no competing interest.

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