

## ROLE OF 3D MULTISECTOR GASTRIC CT IN IMAGING POST BARIATRIC SURGERY PATIENTS

*Sarah H. Helal\**, *Osama M. Hetta\*\** and *Mohamed G. Mansour\*\**

Qalyoub specialized hospital\* -  
Qalyubia\* and Department of  
Radiology - Faculty of  
Medicine - Ain Shams  
University\*\* Cairo, Egypt.  
**Corresponding author**  
Sarah Hosny Othman Helal  
**Mobile: +2 01000465053**  
**E.mail:**  
[drsarahosny251@gmail.com](mailto:drsarahosny251@gmail.com)

Received: 5/4/2022  
Accepted: 12/5/2022

**Online ISSN: 2735-3540**

### ABSTRACT:

**Background:** Bariatric surgery has been shown to be an effective and safe treatment for obesity and metabolic disorders, but a variety of complaints may arise. Identification of the causes of such symptoms is often challenging due to the postoperatively modified anatomy. Quantitative three (3d) computed tomography (3D-CT) of the upper gastrointestinal tract offers a novel, adjunctive examination, revealing the detailed anatomy.

**Aim the Work:** to analyze the clinical value of 3D-CT in post-bariatric patients.

**Patients and Methods:** This study included 62 patients who underwent bariatric surgery from day one up to one year at Ain Shams University Hospitals.

**Results:** In our study we explain the complaints among 62 patients who underwent bariatric surgeries e.g LSG, RYGB, GBS and MGB. Regarding LSG in which they are 25 patients, about 13 patients are without complication and the other 12 patients are having complications e.g port infection is about (8%), leakage is about (24%), fistulous tract formation is about (8%) and gastric dilation is about (8%). Regarding RYGB in which they are 19 patients, 7 patients without complications and 12 patients are having complications e.g pouch dilation is about (31.6%), leakage is about (15.8%), port infection is about (15.8%). Regarding GBS in which they are about 11 patients, 6 patients are without and 5 patients are having complications e.g staple line disruption is about (27.3%) and pouch dilation is about (18.2%).

Regarding MGB in which they are 7 patients, 2 patients are without complications and 5 patients are having complications e.g pouch dilation is about (57.1%) and leakage is about (14.3%).

**Conclusion:** Multislice computed tomography allows crucial anatomical measurements and provides helpful information about gastric volume reduction in all patients referred for failure or complications after bariatric surgeries.

**Keywords:** Laparoscopic sleeve gastrectomy, Roux-en-Y gastric bypass, Gastric band surgery, Mini gastric bypass.

### INTRODUCTION:

Obesity is a serious, multifactorial, chronic illness affecting patients of all ages that continues to increase in prevalence at an alarming rate. The most practical means of

classifying obesity is the body mass index (BMI). Obesity is defined as a BMI of 30 or greater<sup>(1)</sup>.

The U.S. National Institutes of Health recommends bariatric surgery for obese

people with a BMI of at least 40, and for people with BMI of at least 35 and having serious co-existing medical conditions<sup>(2)</sup>.

Bariatric surgery is generally categorized into two main categories, restrictive and mal-absorptive<sup>(1)</sup>. Procedures that are restrictive shrink the size of the stomach or take up space inside the stomach, making people feel more full when they eat less<sup>(3)</sup>.

In mal-absorptive procedures, the gastrointestinal tract is surgically altered to induce malabsorption and hence decrease caloric intake. In addition procedures may combine techniques<sup>(1)</sup>. The most common bariatric procedures performed include laparoscopic sleeve gastrectomy, laparoscopic Roux-en-Y gastric bypass and laparoscopic adjustable gastric banding. Fluoroscopic upper gastrointestinal examinations and abdominal computed tomography (CT) are the major imaging tests used to evaluate patients surgeries<sup>(4)</sup>. Weight loss surgery in adults is associated with relatively large risks and complications, compared to other treatments for obesity<sup>(5)</sup>.

As for sleeve gastrectomy complications include postoperative leaks, strictures, gastric dilation and gastro esophageal reflux<sup>(2)</sup>. And complications after Roux-en-Y gastric bypass include anastomotic leaks and strictures, marginal ulcers, jejunal ischemia, small bowel obstruction, intestinal hernias, intussusception, and recurrent weight gain<sup>(4)</sup>.

Finally, complications after laparoscopic adjustable gastric banding include stomal stenosis, malpositioned bands, pouch dilation, band slippage, perforation, gastric-volvulus, intra-luminal band erosion and port-band related problems<sup>(4)</sup>.

---

#### **AIM OF THE WORK:**

The aim of this study is to present the role of 3D MSCT imaging in illustration of the normal post operative anatomy and complications after bariatric surgeries.

---

#### **PATIENTS AND METHODS:**

This cross sectional retrospective study was conducted at Ain Shams University Hospitals for a period of 12 months on 62 patients who underwent bariatric surgery from day one up to two years. No sex predilection. While patients whom body weight exceeded the CT machine's table limits were excluded from the study.

#### **Ethical Considerations:**

Informed written consent explaining the procedure details was obtained from patients. The study was conducted according to the stipulations of the ASU ethical and scientific committee.

#### **Study procedures:**

All the patients were subjected to detailed history taking prior to scanning. All patients were told to be fasting for about 4 to 6 hours prior to the examination. we use water soluble contrast media (Gastrographin) ranging from 20mLs up to 40mLs and diluted with water by about 1:1 ratio. The patient ingests it in a time window of about 5 min prior to start of scanning, then the patient lied supine on the CT table and CT Abdomen was performed with a scanning time of about 10 seconds. Post processing of the volume axial CT images is then performed on the work station without need for further patient stay in the CT machine. Examination post processing entangles 3D reconstruction.

#### **Equipment:**

MSCT scan was performed by using 16 channels MSCT helical using low dose MSCT scan with 1.5mm slice thickness and 1.5mm slice gap. Post processing was performed by using Vitrea and Synapse 3D workstations.

#### **Statistical Analysis:**

Data were collected, revised, coded and entered to the Statistical Package for Social

## *Role Of 3d Multisector Gastric CT In Imaging Post Bariatric Surgery Patients*

Science (IBM SPSS) version 20. The qualitative data were presented as number and percentages while quantitative data were presented as mean, standard deviations and ranges when their distribution found

parametric. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:  $P < 0.05 = \text{significant(S)}$ .

### **RESULTS:**

Table (1): Distribution of the studied cases according to Age and Sex

		<b>No.= 62</b>
Age	Mean $\pm$ SD	37.73 $\pm$ 5.30
	Range	27 – 47
Sex	Female	45 (72.6%)
	Male	17 (27.4%)

Table (2): Distribution of the studied cases according to Main Complaint.

Main Complaint	No.	%
Dysphagia	20	32.3%
Vomiting	15	24.2%
Diffuse abdominal pain	13	21.0%
Tachypnea	7	11.3%
Recurrent weight gain	3	4.8%
Pain at port site	2	3.2%
Anterior abdominal wall discharge	2	3.2%

Table (3): Distribution of the studied cases according to Type of bariatric surgery.

Type of bariatric surgery	No.	%
Laparoscopic sleeve gastrectomy	25	40.3%
RYGB	19	30.6%
Gastric band	11	17.7%
Mini gastric by pass	7	11.3%

Table (4): 3D MSCT Findings in the studied group.

3D MSCT Findings	No.	%
Normal	28	45.2%
Complicated	34	54.8%
Staples line disruption	3	4.8%
Fistulous tract formation	2	3.2%
Gastric dilatation	2	3.2%
Pouch dilatation	12	19.4%
Leakage	10	16.1%
Port infection	5	8.1%

Table (5): 3D CT Findings in the Laparoscopic sleeve gastrectomy surgery in the Studied group (n=25).

Laparoscopic sleeve gastrectomy	No.	%
Normal	13	52%
Complicated	12	48%
Port infection	2	8%
Fistulous tract formation	2	8%
Leakage	6	24%
Gastric dilatation	2	8%

Table (6):3D CT Findings in the RYGB surgery in the Studied group (n=19).

RYGB	No.	%
Normal	7	52%
Complicated	12	48%
Port infection	3	8%
Leakage	3	24%
Pouch dilatation	6	8%

Table (7):3D CT Findings in the Gastric band surgery in the Studied group(n=11).

Gastric band surgery	No.	%
Normal	6	54.5%
Complicated	5	45.5%
Staples line disruption	3	27.3%
Pouch dilatation	2	18.2%

Table (8):3D CT Findings in the Mini-gastric bypass surgery in the Studied group(n=7).

Mini-gastric bypass surgery	No.	%
Normal	2	28.6%
Complicated	5	71.4%
Pouch dilatation	4	57.1%
Leakage	1	14.3%

**Case 1**

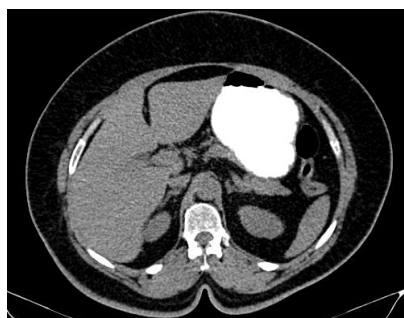
A 25 year old male with history of lap. seleeve gastrectomy 6 month ago, as his preoperative weight was about 133 kg (BMI= 41.7) and her gastric volume was

about 1.07 L .Now he is about 123 kg with postoperative gastric volume 139.9 ml. (Weight reduction percentage about7.5 % and Gastric volume reduction percentage about 87%).

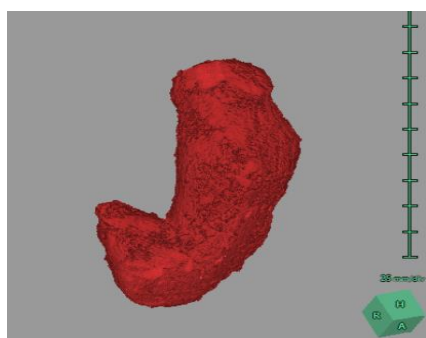
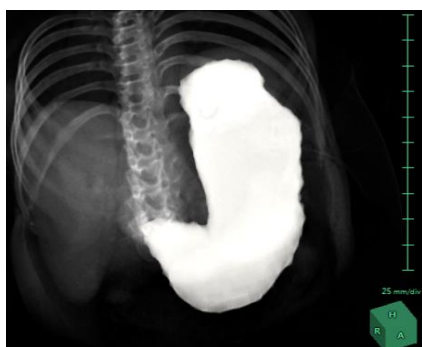
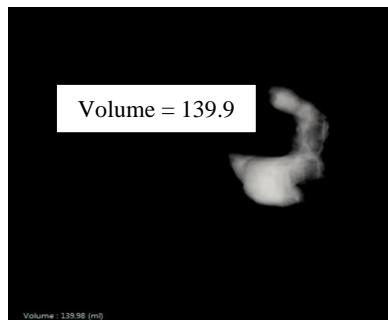
**Findings:**

*Preoperative*

*Postoperative*



*Role Of 3d Multisector Gastric CT In Imaging Post Bariatric Surgery Patients*



Axial volume and 3D reconstruction images of the stomach showing gastric volume =1.07 L

Axial volume and 3D reconstruction images of the stomach showing gastric volume = 139.9 ml (*Vol. reduction = 87 %*)

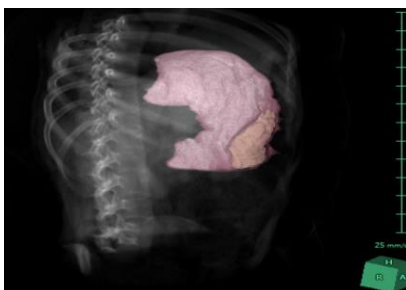
Case 2

A 37 year old female with history of lap. seleeve gastrectomy 3 month ago, as her Preoperative weight was about 134 kg (BMI= 42) and her gastric volume was about

736.3 ml. Now she is about 120 kg with Postoperative gastric volume about 81.9 ml (Weight reduction percentage about 10.4 % and Gastric volume reduction percentage about 90%).

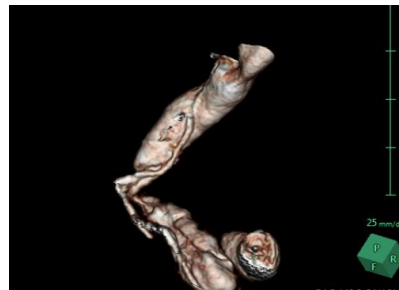
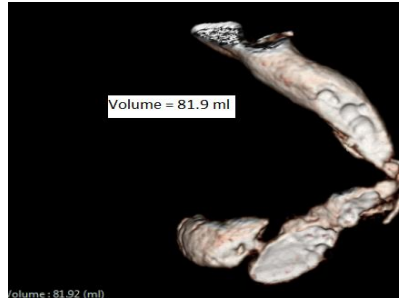
Findings:

*Preoperative*



Axial volume and 3D reconstruction images of the stomach showing gastric volume = 736.3 ml

*Postoperative*



Axial volume and 3D reconstruction images of the stomach showing gastric volume = 81.9 ml (Vol. reduction = 90 %)



## *Role Of 3d Multisector Gastric CT In Imaging Post Bariatric Surgery Patients*

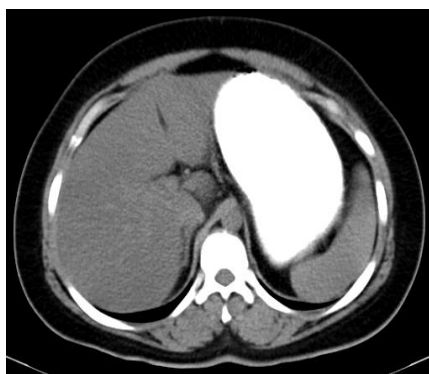
### **Case 3**

A 31 year old obese male with history of lap. sleeve gastrectomy 1 year ago as his preoperative weight was about 131 kg (BMI= 36.5) and his gastric volume was about 761.2 ml. And after 3 month he is about 121 kg with Postoperative gastric volume about 50.2 ml (Weight reduction percentage about 7.6 % and Gastric volume reduction percentage about 93.4%).

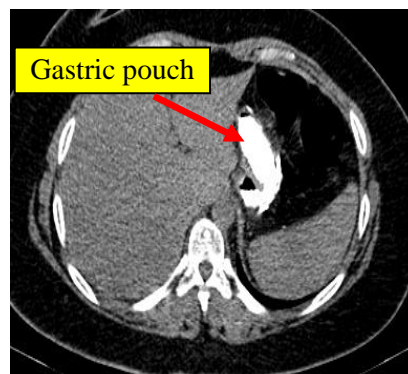
Now he is presented by abdominal pain and vomiting and MSCT with contrast was done.

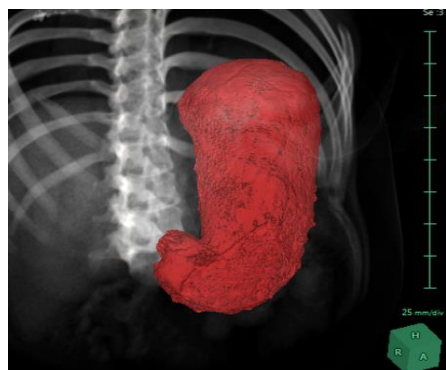
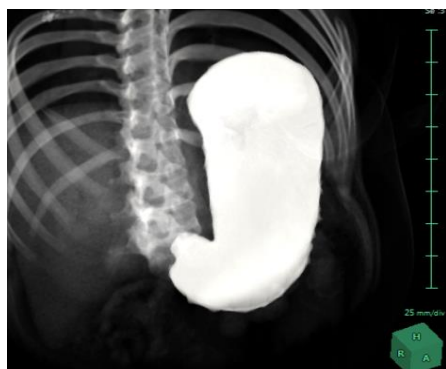
Findings:

*Preoperative*

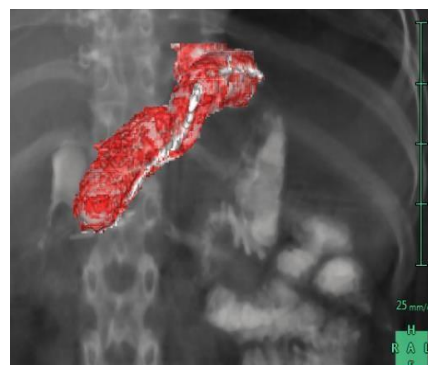
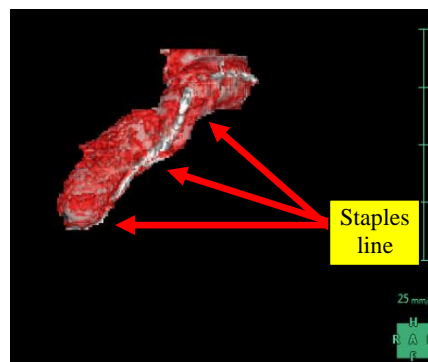


*Postoperative*



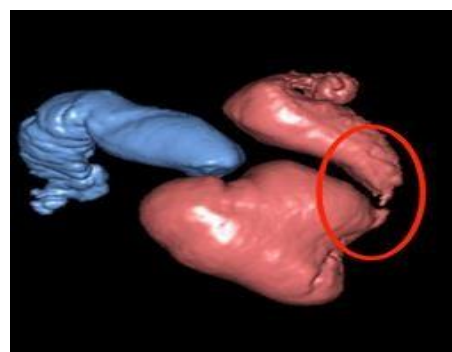


**Axial volume and 3D reconstruction images of the stomach showing gastric volume = 761.2 ml**



**Axial volume and 3D reconstruction images of the stomach showing gastric volume = 50.2 ml (Vol. reduction= 93.4 %)**

**Findings now:**



MSCT axial with contrast and 3D reconstruction view showing subtotal stenosis at the angulus fold

**Case 4**

A 22 year old female with history of lap. sleeve gastrectomy 1 year ago as her preoperative weight was about 131 kg (BMI= 45.5) and his gastric volume was about 583.9 ml. And after 3 month she is about 99 kg with Postoperative gastric volume about 62.6 ml (Weight reduction percentage about 24.4% and Gastric volume reduction percentage about 95.4%).

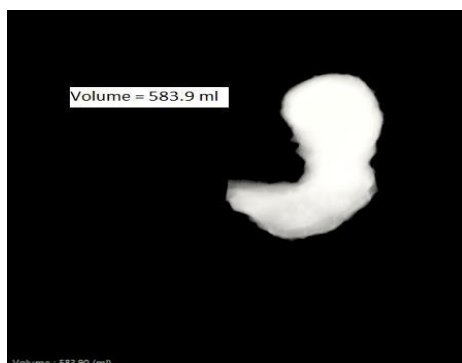
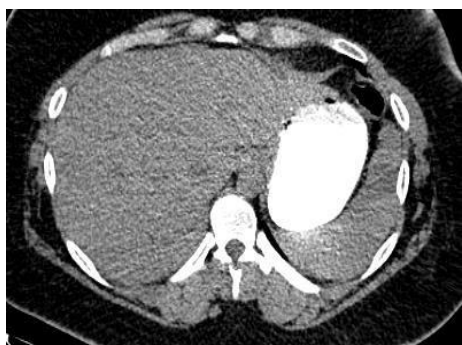
Now she is presented by weight gain and heart burn and MSCT with contrast was done.



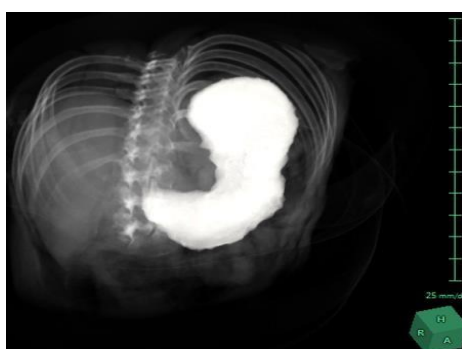
*Role Of 3d Multisector Gastric CT In Imaging Post Bariatric Surgery Patients*

**Findings:**

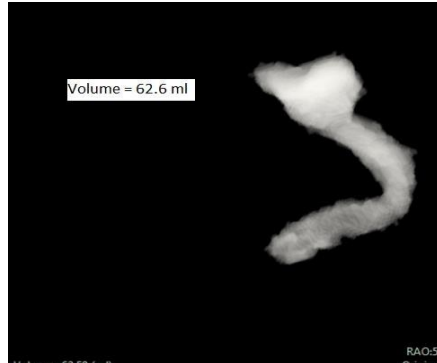
*preoperative*



*preoperative*



*postoperative*



*postoperative*





**Axial volume and 3D reconstruction images of the stomach showing gastric volume= 583.9 ml**



**Axial volume and 3D reconstruction images of the stomach showing gastric volume = 62.6 ml (Vol. reduction = 95.4 %)**

**Findings now:**



**MSCT axial with contrast and 3D reconstruction images showing the increased size of the sleeved stomach.**

---

**DISCUSSION:**

The prevalence of overweight/obesity is increasing in developed and developing countries over the past 30 years. Obesity has been identified as one of World Health Organization's top 10 risks to health<sup>(6)</sup>. Many contributing factors for obesity are existing, genetic and physiologic factors, there has been an increasing focus on contextual elements that impact weight-related behaviors and ultimately weight status. Those factors include, but are not limited to geography, food preferences, physical and social environment, gender, age, cultural identity, and family

composition<sup>(6)</sup>.

Obesity is associated with cardiovascular disease, hypertension, type2 diabetes mellitus, hyperlipidemia, stroke, sleep apnea, liver and gall bladder disease, osteoarthritis, and gynecological problems, periodontal disease, poor school performance, altered pre-pubertal hormones, and attention-deficit hyperactivity disorder in children. The complications of obesity are profound and potentiate decreased physical activity (PA) and sedentary behaviors contributing to a nerve-ending spiral of obesity → health consequences → health-limiting behaviors → increasing or maintained obesity<sup>(6)</sup>.

The American Medical Association designation of overweight/obesity as a disease necessitating appropriate medical treatment contributed to a major shift in approaches to intervention. Increasingly, medications and bariatric surgery are considered to help combat this epidemic. A recent systemic review highlights that drugs have extensive side effects<sup>(7)</sup>.

The safety and effectiveness of bariatric surgery have improved. Bariatric surgery is often an option for individuals with a BMI over 40 or those with BMI's at 35 or above with medical co-morbidities. However, surgery is often not recommended for adults with a BMI over 70 or for children. Identified benefits include improvement in mental health and physical, sexual functioning, reduction in mortality 5 to 10 years following surgery, weight loss<sup>(7)</sup>.

Patel<sup>(8)</sup> stated that radiology is an important element that must be accessible to individuals undergoing a bariatric operation, and radiology plays a great

In the present study, the results show that sleeve gastrectomy is the commonest procedure of 40.3% (25 patients) and then Roux-en-Y gastric bypass 30.6% (19 patients), stomach band 17.7% (11 patients), and mini-gastric bypass 11.3% (7 patients).

According to Bairdain and Samnaliev<sup>(10)</sup>, the prevalence of bariatric surgery among the obese students and adolescents was more common in females near 90% and in males are only 10% which supports our results.

In our study, 62 patients underwent bariatric surgery; 45 of them were female students (72.6%), while male patients were 17 (27.4%).

Concors et al.<sup>(6)</sup> stated that stenosis/stricture regularly presents as dysphagia, vomiting, nausea, and/or abdominal cramps. Stenosis can happen following 4 to 7.5% of RYGB and 3.5% of SG. Stenosis can happen either intensely after

part in the management of these patients in both late and early post-operative periods. The radiologist should have satisfactory information on the surgical procedure performed and expected anatomical presentations and post-operative complications. Computed tomography is considered the keystone imaging modalities.

The aim of this study was to present the role of 3D MSCT imaging in illustration of the normal post-operative anatomy and complications after bariatric surgeries in 62 obese patients who underwent bariatric surgery.

There are two primary categories of surgical strategy: restrictive strategy induces weight loss by considerably decreasing gastric capacity and developing early satiety, examples include laparoscopic adjustable gastric banding and sleeve gastrectomy and combined restrictive and mal-absorptive strategy incorporate the Roux-en-Y gastric bypass<sup>(9)</sup>.

surgery or as a late way.

Kehagias et al.,<sup>(11)</sup> reported that gastric leak (spill) is a dangerous complication with a frequency rate of 3.7% and this result was reported after doing MSCT.

In the current study, the incidence of leaks was 16.1% in early 30 days after the operation.

Finally our results are consistent with many studies such as Kehagias et al.,<sup>(11)</sup> Xu et al.,<sup>(12)</sup> and Lager et al.,<sup>(13)</sup> and they concluded that CT is more sensitive in diagnosis of leaking and CT scans should only be performed when the clinical suspicion is high and not for screening.

Boerlage et al.,<sup>(14)</sup> said that staple line leakage is a severe adverse event of both RYGB and SG that seen by MSCT postoperatively.

Al Hajj & Chemaly<sup>(15)</sup> stated that

diagnosis of leak/fistula was radiologically confirmed in 100% of cases after water-soluble UGI series and double-contrast abdominal-pelvic CTscan.

As regards band slippage, *Mazzariol and Wolf*<sup>(16)</sup> stated that gastric band slippage was observed in 4 to 13% of patients and resulted in an eccentrically dilated pouch seen by MSCT.

*Yazgan et al.*,<sup>(17)</sup> reported that stricture or stenosis at the gastro-jejunostomy site is a relatively common complication of mini-gastric bypass. Post-operative edema obstructs the passage which is transient, and recovery is expected within 2 weeks. Anastomotic leaks are uncommon but very essential complications and occur in only 0.5–1.9% of patients. Ulcers at the gastro-jejunal anastomosis are important complications which occur 0.6–8%. Detecting marginal ulcers on a UGI study or CT scan is less reliable than endoscopy. However, findings of scar or fibrosis might be identified on CT images. This study included only 7 cases that underwent mini-gastric bypass. One case showed leak (14.3%) 2 days post-operative.

### Conclusion:

MSCT volumetric study of the stomach is the gold standard imaging technique for evaluation of the gastric size in the preoperative and postoperative states in the context of bariatric gastric surgery.

---

### REFERENCES:

1. Chandler, R. C., Srinivas, G., Chintapalli, K. N., Schwesinger, W. H., & Prasad, S. R. (2008) Imaging in bariatric surgery: a guide to postsurgical anatomy and common complications. *American Journal of Roentgenology*, 190(1), 122-135.
2. Robinson, M.K (2009).: Surgical treatment of obesity—weighing the facts.
3. Stanczyk, M., Martindale, R. G., & Deveney, C. (2007).53 *Bariatric Surgery Overview. Hypertension*, 30, 69.
4. Levine, M.S., & Carucci, L.R. (2014). Imaging of bariatric surgery: normal anatomy and postoperative complications. *Radiology*, 270(2),327-341.
5. Cottam D, Qureshi FG, Mattar SG et al. (2006): laparoscopic sleeve gastrectomy as an initial weight loss procedure for high risk patients with morbid obesity. *Surg Endosc*; 20:859-63.
6. Concors, S.J., Ecker, B.L., Maduka, R., Furukawa, A., Raper, S.E., Dempsey, D.D.,... & Dumon, K.R. (2016). Complications and surveillance after bariatric surgery. *Current treatment options in neurology*, 18(1), 5.
7. Karlsson J, Taft C, Ryden A(2016).Ten-year trends in health related quality of life after surgical and conventional treatment for severe obesity: the SOS intervention study. *IntJObes (Lond)*. 2007; 31(8):1248–61
8. Patel, K. (2016). Radiological imaging in bariatric surgery. In *Obesity, Bariatric and Metabolic Surgery* (pp. 689-705).
9. Latif, M.A., Fouda, N., Omran, E., & Refaey, M.S. (2020). Role of imaging in assessment and detection of complications after bariatric surgery. *Egyptian Journal of Radiology and Nuclear Medicine*, 51(1), 1-9.
10. Bairdain S, Samnaliev M (2015) Cost-effectiveness of adolescent bariatric surgery. *Cureus*7(2).
11. Kehagias, I., Zygomalas, A., Karavias, D., & Karamanakos, S. (2016). Sleeve gastrectomy: have we finally found the holy grail of bariatric surgery? A review of the literature. *Eur Rev Med Pharmacol Sci*, 20(23),4930-4942.
12. Xu T, Rosculet N, Steele K, Auster M (2016) Comparison of upper gastro-intestinal fluoroscopy versus computed tomography for evaluation of postoperative leak in a bariatric surgery patient. *BJR| Case Reports* 3:20160076
13. Lager, C. J., Esfandiari, N. H., Subauste, A. R., Kraftson, A. T., Brown, M. B., Cassidy, R. B., & Oral, E. A. (2017).Roux-En-Y gastric bypass vs. sleeve gastrectomy: balancing the risks of surgery with the benefits of weight loss. *Obesity Surgery*,

- 27(1), 154-161.
14. Boerlage TCC, Houben GPM, Groenen MJM, Van Der Linde K, Van De Laar A, et al. (2018): A novel fully covered double-bump stent for staple line leaks after bariatric surgery: a retrospective analysis. *Surg Endosc*; 32:3174–3180.
  15. Al Hajj G, Chemaly R (2018) Fistula following laparoscopic sleeve gastrectomy: a proposed classification and algorithm for optimal management. *Obesity Surg*28:656–664
  16. Mazzariol, F. S., & Wolf, E. L. (2016). Bariatric /Metabolic surgery for the radiologist: Clinical insight, normal post-operative imaging and imaging of complications: Part 1: Gastric restrictive surgery. *Applied Radiology*, 45(11),10.
  17. Yazgan C, Balci S, Sahin T, Ozmen M (2016) Imaging following mini-gastric bypass and sleeve gastrectomy: what every radiologists need to know. *EurSocRadiol*13:1–18.

## دور الأشعة المقطعية ثلاثية الأبعاد في تصوير المعدة في مرحلة ما بعد جراحات السمنة

ساره حسني عثمان\* , اسامه محمد حته\*\* , محمد جمال منصور\*\*

مستشفى قلوب التخصصي\* , القليوبية\*

قسم الأشعة التشخيصية\*\* , كلية طب\*\* , جامعة عين شمس\*\*

**المقدمة:** ثبت أن جراحة علاج البدانة علاج فعال وآمن للسمنة واضطرابات التمثيل الغذائي ، ولكن قد تظهر مجموعة متنوعة من الشكاوى ، وغالبًا ما يكون تحديد أسباب هذه الأعراض صعبًا بسبب التشريح المعدل بعد الجراحة. يقدم التصوير المقطعي الكمي ثلاثي الأبعاد (3D-CT) للجهاز الهضمي العلوي فحصًا جديدًا مساعدًا ، ويكشف عن التشريح المفصل.

**الهدف من هذه الدراسة:** هو تحليل القيمة السريرية لـ 3D-CT في مرضى ما بعد السمنة.

**المرضى وطرق البحث:** لتحقيق هذا الهدف، قمنا بتضمين 62 مريضًا خضعوا لجراحة السمنة من اليوم الأول حتى عامين.

**النتائج:** كان متوسط إنقاص الوزن لدى المرضى في الدراسة الحالية  $15,48 \pm 5,59\%$  تراوحت بين 7 - 24%. بينما كان متوسط إنقاص الوزن  $86,68 \pm 7,65\%$  تراوح بين 76 - 98%. توجد فروق ذات دلالة إحصائية عالية بين بيانات ما قبل الجراحة وبعدها فيما يتعلق بوزن الجسم وحجم المعدة الجراحي.

**الخلاصة:** أن التصوير المقطعي المحوسب متعدد الشرائح يسمح بالقياسات التشريحية الحاسمة ويوفر معلومات مفيدة حول تقليل حجم المعدة في مرضى السمنة المرشحين لعملية تكميم المعدة.