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3D CT Volumetry of Varient Gastric Reservoir after Sleeve Gastrectomy and Its Relation to Clinical Outcome

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: The role of radiology in gastric bariatric surgery is no longer limited for detection of postoperative complications, but also it extends to evaluate the role of surgical reduction of gastric size in body weight changes after surgery. The aim of this work was to assess the ability of 3D CT volumetry of variant gastric reservoir after sleeve gastrectomy and its relation to clinical outcome.
Methods: This prospective study that was carried out on 30 obese patients who was candidates for gastric sleeve surgery for the first time. All patients were subjected to clinical examinations [blood pressure, pulse rate and respiratory rate], pre-operative preparation: Blood testing, liver function, electrolytes and hormonal tests, an upper gastrointestinal (GI) endoscopy, abdominal ultrasound (US), echocardiography and CT volumetry
Results: There was no statistically significant correlation between body weight and gastric volume preoperative but a significant relation postoperative. Body weight, Body mass index (BMI) and gastric volume were significantly lower post-operative compared to pre-operative (P<0.001).
Conclusions: Computed tomography scan plays a significant role being a comprehensive imaging tool sensitive for accurate diagnosis of any suspected complication. Also, 3D CT volumetry adds more value in the evaluation of the new gastric pouch volume. In the setting of bariatric sleeve gastric surgery, MSCT volumetric assessment of the stomach is the gold standard imaging tool for evaluating gastric size in the postoperative phases.

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Keywords: 3D CT volumetry; gastric reservoir; sleeve gastrectomy.

1. INTRODUCTION

Obesity is considered as twenty-first century global epidemic; its prevalence is exponentially escalating and it becomes a serious health problem in the world [1].

Obesity has a slew of comorbidities, all of which are linked to a higher death rate. Type 2 diabetes mellitus (T2DM), high blood pressure, dyslipidemia, cardiovascular diseases (CVD), respiratory disorders, joint diseases, psychological disorders, and even various types of cancer (including esophageal, colon, pancreatic, prostate, and breast) are all linked to obesity [2]. Excess body weight is the sixth most important risk factor that contributes to the global burden of disease. Overweight or obese people currently account for 1.1 billion adults and 10% of children [3]. In 2016, the World Health Organization (WHO) reported that 39 percent of persons aged 18 and over were overweight, with 13 percent being obese [2,4]. Obesity affects around 36% of Egypt's adult population [5]. Currently, surgery is the only treatment capable of achieving a marked reduction in BMI, and is associated with improvement in quality of life and overall long-term mortality [6].

In morbidly obese individuals, bariatric surgery, particularly sleeve gastrectomy (SG), is the only therapeutic option that can provide dependable, short- and long-term weight loss while also significantly improving associated comorbidities [7].

Even after a narrow gastric tubulisation, stomach capacity might increase late after a sleeve gastrectomy. It is critical to evaluate objectively residual stomach volume following sleeve gastrectomy, as well as its increase, in order to determine late clinical outcomes and to suggest a retreatment plan [8]. In recent years, simulation and anatomical reconstruction CT 3D techniques have been developed. These techniques could allow measuring the exact dimensions of the reservoirs and studying their correlation with clinical outcomes [6].

The role of radiology in gastric bariatric surgery is no longer limited for detection of postoperative complications, but also it extends to evaluate the role of surgical reduction of gastric size in body weight changes (excess or loss of weight) after surgery. Multislice CT (MSCT) gastric volumetric study is the only method for accurate assessment of volumes of stomach and gastric sleeve after surgery. It ensures exact data concerning gastric volumes and diameters of anastomoses [9]. The aim of this work was to assess the ability of 3D CT volumetry of variant gastric reservoir after sleeve gastrectomy and its relation to clinical outcome.

1.1 Patients and Methods

This prospective study was carried out on 30 obese patients who was candidates for gastric sleeve surgery for the first time complaining from weight changes either excess weight gain or excess weight loss, aged between 18 - 60 years old and psychologically stable.

Pregnant female patients, patients who was candidates for gastric reduction surgery other than sleeve gastrectomy and endocrinal causes of obesity were excluded from the study.

All patients were subjected to; complete history taking, clinical examinations [blood pressure, pulse rate and respiratory rate], pre-operative preparation: Blood testing (including coagulation parameters), liver function, electrolytes and hormonal (thyroid and adrenal glands) tests as well as an upper gastrointestinal (GI) endoscopy, abdominal ultrasound (US) and echocardiography was performed. CT volumetry was performed after surgery using Toshipa 320 (Aquilion 1) MSCT helical device.

1.2 Patient Preparation

All patients received 10 mg of butylscopolamine (Buscopan) intravenously and told to be fasting for about four to six hours prior to the examination. All patients received an oral administration of 6 g of effervescent granules with 10 mL of water. It is required that this parameter be kept as low as possible. It's critical to strike the right balance between image quality and the lowest effective dose. During the liquid intake, the patients were seated, and the distention obtained was standardised by utilising the same preparations and method in each case. Patients were then placed on the CT table, and scout films were taken as soon as possible. All instructions were given to the patients about table movement, voice messages, timing and manner of breath holding.

The CT parameters were as follows: Detector collimation, 0.6 mm; table speed, 76.8 mm/sec; gantry roration, 0.5 s; 120 kVp, 200 reference mAs, 512 X 512 matrix; and 1-mm reconstruction.

1.3 CT Volumetry Imaging Technique and Image Analysis

Patient first was do CT on abdomen with oral contrast. Post processing of the volume axial CT images is then performed on the workstation without need for further patient stay in the CT machine. The 2D axial and coronal reformatted images were reconstructed at a 5 mm slice thickness at a CT console. The 3D volume-rendering images and surface-shaded display images were reconstructed using. Total stomach volume was measured on the axial cuts, we calculate the whole stomach volume, then after that we apply all the manually traced cuts to volume calculation software on the workstation to calculate the volume in cubic centimeters. Examination post processing entangles multi-planar reconstruction. The gastric volume from the cardia to the pylorus was estimated after multiplanar reconstruction and 3D volume rendering. The patient's body weight was correlated with the patient's gastric volume.

1.4 Statistical Analysis

The following statistics were applied to the data obtained, tabulated, and statistically analysed using an IBM personal computer and the Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc, Chicago, Illinois, USA). Descriptive statistics: quantitative data is provided as mean (X), standard deviation (SD), and range, while qualitative data is presented as numbers and percentages. Analytical statistics are used to determine whether there is a link between the parameters being researched and the disease being studied. The following tests of significance were used: To investigate the relationship between two qualitative variables, the Chi-square test (χ^2) was performed. Student t-test is a test of significance used for comparison between two groups having quantitative variables. P value of <0.05 was considered statistically significant

2. RESULTS

Error! Not a valid bookmark self-reference. shows Distribution of the studied cases according to age and height.

Table 2 shows descriptive analysis of the studied cases according to vital signs.

Body weight, BMI and gastric volume were significantly lower post-operative compared to pre-operative (P<0.001). Table 3.

Table 4 shows distribution of the studied cases according to post-operative complications.

There was no statistically significant correlation in between body weight and gastric volume preoperative but a significant relation postoperative Fig.1.

Table 1. Distribution of the studied cases according to age, height and gender (n = 30)

		Patients (n = 30)
Age (years)		
20 – 30		11(36.6)
31 – 40		10(33.3)
41 – 50		9(30.0)
Mean ± SD		31.43 ± 12.19
Height (Cm)		159.23 ± 8.81
Gender	Male	23(76.7)
	Female	7(23.3)

Data are presented as mean ± SD or frequency (%)

Table 2. Descriptive analysis of the studied cases according to vital signs (n = 30)

	Patients (n=30)
RR/ min	48.3 ± 10.7
Temperature	38.0 – 40.0

Data are presented as mean ± SD, RR: respiratory rate

Table 3. Comparison between pre-operative and post-operative according to body weight, Stonal vol and BMI (n = 30)

	Pre-operative	Post-operative	t	p
Body weight (kg)	113.4 ± 9.56	100.0 ± 9.69	24.698	<0.001*
BMI	40.32 ± 5.06	35.74 ± 4.42	12.492	<0.001*
Gastric volume (ML)	305.2 ± 65.22	173.92 ± 49.37	12.074	<0.001*

*Data are presented as mean ± SD, BMI: body mass index, *: significant P value*

Table 4. Distribution of the studied cases according to post-operative complications (n = 30)

Post-operative complications	Patients (n=30)
Complications	6(20.0)
Stomach dilatation	4(13.3)
Hernia	2(6.7)
No complications	24(80.0)

Data are presented as frequency (%)

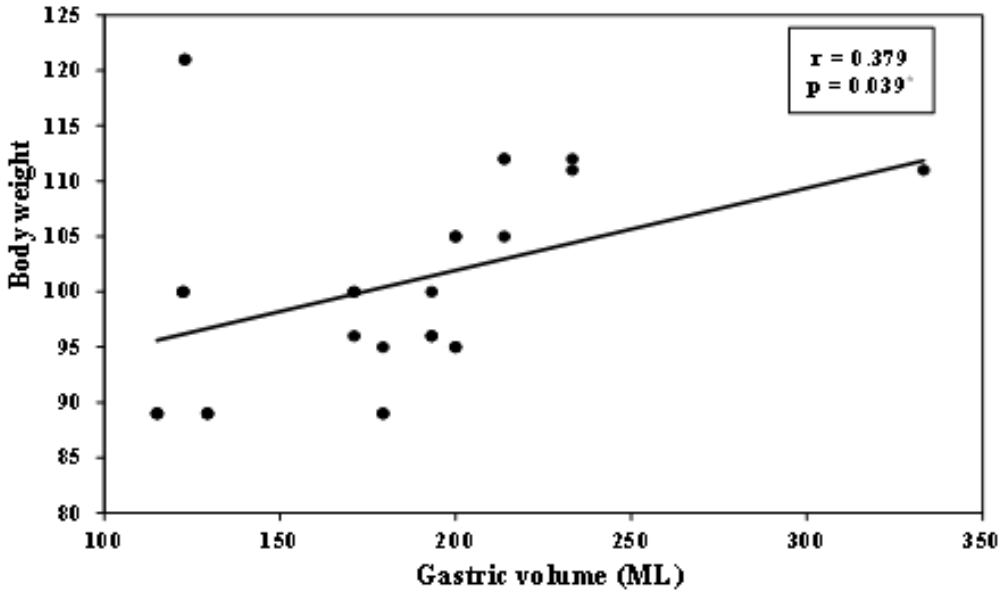

Fig. 1. Correlation between body weight and gastric volume (ML) in Post-operative

3. DISCUSSION

The benefits of bariatric surgery have radically changed the treatment of severe obesity over the last ten years, not only in terms of significant and long-term weight loss, but also in terms of lowering mortality, correcting metabolic disorders, lowering cardiovascular risk, and improving quality of life [10]. As regard to preoperative gastric volume and body weight, there was no significant correlation in between which agree with Mohamed et al. [9] who found insignificant correlation between the body weight and gastric volume measured preoperative.

Regarding to post-operative body weight and post-operative gastric volume, there was a significant correlation in between which disagree with Mohamed et al. [9] who found insignificant correlation between the body weight and gastric volume measured postoperative.

In the study of Ferrer-Márquez et al. [11] that was done on a longer time scale than our study, the volume of the gastric remnant increased significantly during the first year after LSG. However, this increment seems not to affect weight loss.

In the present study, there was a high statistically significant difference in between preoperative and post-operative body weights with P=0.001 which coincide with the study done by Himpens

et al. [12] who found a high statistically significant difference in between preoperative and post-operative body weight after sleeve gastrectomy.

Comparable variations were reported by Shen et al. [13] where the mean percentage of excess weight loss increased from 22.9% ± 6.9% at 1 month to 61.1% ± 15.9% at 12 months postoperatively with a high significant difference between preoperative and post-operative mean weight.

In the 2011, Skrekas et al. [14] research, 135 patients were included and the excess weight loss percentage was reported to be 51.7% at 6 months, 67.1% after 12 months and finally 65.2% at 24 months follow-up with a high significant statistically difference between preoperative and post-operative mean weight.

Diamantis et al. [15] reported on the 5-year results of nine studies enrolling 258 patients overall, with a mean % Excess weight loss (%EWL) of 62.3%.

Consistently, Sieber et al. [16] showed a percentage of excess body mass index loss % Excess body mass index loss (% EBMIL) of 57. 4% in their series of 54 patients 5 years after LSG.

In the present study, gastric dilatation was seen in 4 cases about 13.3% which agree with Baltasar et al. [17] who stated that the incidence of gastric dilatation appears to be low. Due to missed posterior gastric folds, an overly large pouch may be produced during the initial portion of the procedure, resulting in gastric dilatation. The patient came with weight return following effective weight loss, and an upper GI series revealed a dilated gastric sleeve with no stricture or obstruction to explain the dilatation [18]. The study of Weiner et al. [19] stated that large sleeves show short-term weight loss only and the diameter of the gastric sleeve is important for later dilation. A sleeve with a wide diameter will dilate earlier than a tighter one. This emphasizes that the gastric pouch volume does not have a direct impact on body weight.

Limitations in our study included that some overweight individuals exceeded (140 kg) which was incompatible with the used CT machine's table, those were unsuitable for the study. In some postoperative examinations, rapid gastric emptying into the small bowel loops made the gastric pouch partially devoid of contrast during scanning in spite of proper oral contrast administration.

4. CONCLUSIONS

Computed tomography scan plays a significant role being a comprehensive imaging tool sensitive for accurate diagnosis of any suspected complication. Also, 3D CT volumetry adds more value in the evaluation of the new gastric pouch volume. In the context of bariatric sleeve gastric surgery, MSCT volumetric assessment of the stomach is the gold standard imaging tool for evaluating gastric size in the postoperative phases.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT AND ETHICAL APPROVAL

An informed written consent was obtained from all patients.

The study was done after approval from the Ethical Committee Tanta University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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