Original Research Article

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

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

Keywords: 3D CT Volumetry, Gastric Reservoir, Sleeve Gastrectomy.

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-associated comorbidities are numerous and are also allied to higher mortality. Obesity is a risk factor for a number of other chronic illnesses related to metabolic syndrome including type 2 diabetes mellitus (T2DM), high blood pressure, dyslipidemia, cardiovascular diseases (CVD), respiratory disorders, joint diseases, psychosocial disorders, and even several types of cancer (including oesophagus, colon, pancreas, prostate, and breast) [2].

Excess body weight is the sixth most important risk factor contributing to the overall burden of diseases worldwide. 1.1 billion adults and 10% of children are now classified as overweight or obese [3]. According to the World Health Organization (WHO) in 2016, 39% of adults aged 18 years and over were overweight and about 13% were obese [2, 4]. In Egypt, around 36% of the adult population is considered obese [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].

Bariatric surgery including sleeve gastrectomy (SG) is the only therapeutic option that can achieve reliable, short- and long-term weight loss with significant improvement of associated comorbidities in morbidly obese patients [7].

Gastric capacity can increase late after sleeve gastrectomy even after performing a narrow gastric tubulisation. It is very important to measure objectively residual gastric volume after sleeve gastrectomy and its increase in order to determine the late clinical results and to indicate the eventual strategy for retreatment [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.

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. An informed written consent was obtained from all patients. The study was done after approval from the Ethical Committee Tanta University.

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.

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 mandatory to keep this parameter as low as possible. Achieving a proper balance between image quality and lowest effective dose is a must. Patients were sitting during the liquid intake, the distention obtained was standardized using the same preparation and technique in every case. Then, patients lay on the CT table and the scout films were acquired 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.

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.

Statistical analysis

Data were collected, tabulated, statistically analyzed using an IBM personal computer with Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc, Chicago, Illinois, USA)

where the following statistics were applied: Descriptive statistics: in which quantitative data were presented in the form of mean (X), standard deviation (SD), range, and qualitative data were presented in the form numbers and percentages. Analytical statistics used to find out the possible association between studied factors and the targeted disease. The used tests of significance included: Chi-square test (χ^2) was used to study association between two qualitative variables. 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

Results:

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

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

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

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

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

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 (%)

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

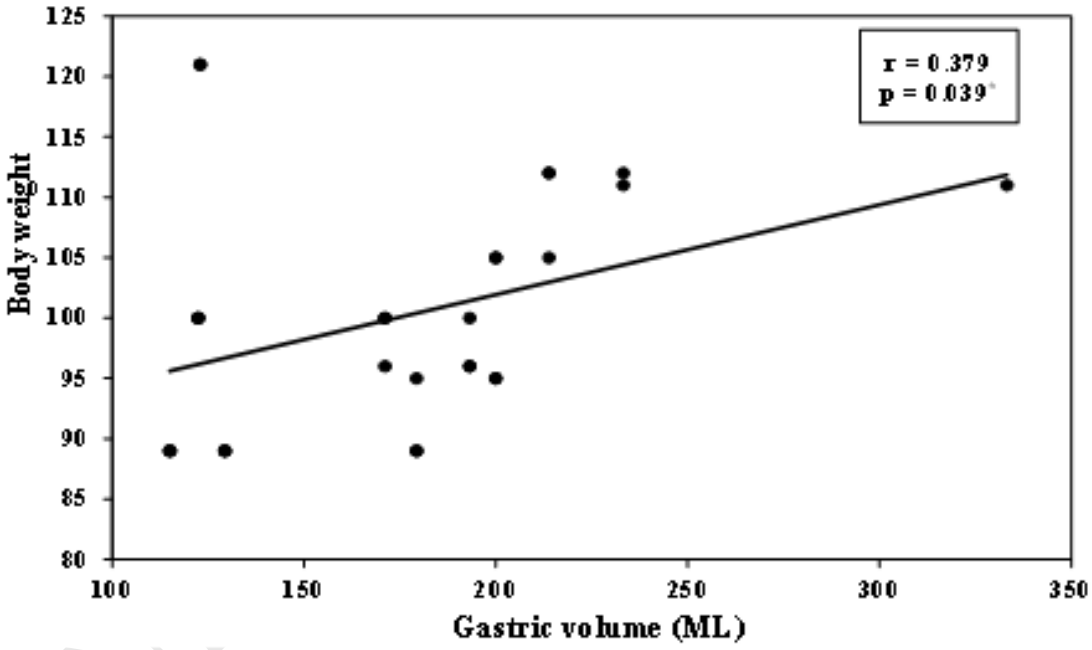

Figure 1: Correlation between body weight and gastric volume (ML) in Post-operative

Discussion

Over the past 10 years, the treatment of severe obesity has radically changed through the benefits of bariatric surgery not only on weight loss significant and lasting, but also on reducing mortality, correction of metabolic disorders, reduction of cardiovascular risk and improving the 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. Gastric dilatation may be due to an excessively large pouch created during the initial phase of the operation due to missed posterior gastric folds. In the rare, reported cases, the patient presented with weight regain after successful weight reduction and upper GI series showed a dilated gastric sleeve without any stricture or obstacle to explain this 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.

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

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. 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.

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