



TO STUDY THE EFFECT OF LAPAROSCOPIC SLEEVE GASTRECTOMY ON BMI AND METABOLIC PARAMETERS IN MORBIDLY OBESE PATIENTS.

General Surgery

Dr Dhaval Desai	Junior Resident, Department Of General Surgery, Mahatma Gandhi Medical College & Hospital.
Dr Sanjay Singhal*	Professor, Department Of General Surgery, Mahatma Gandhi Medical College & Hospital. *Corresponding Author
Dr Saroj Chhabra Kapoor	Associate Professor, Department Of General Surgery, Mahatma Gandhi Medical College & Hospital.
Dr Aayushi Kedawat	Senior Resident, Department Of General Surgery, Mahatma Gandhi Medical College & Hospital.

ABSTRACT

INTRODUCTION- Various behavioral therapies like nutritional therapy, physical activity and cognitive behavioral therapy that basically target lifestyle for treating obesity or overweight have always been used but the results vary depending on the person's determination, willingness and most of the times end up with unsatisfactory results. The short term as well as long-term outcomes of bariatric surgery lead to improvement in glucose metabolism, insulin resistance and quality of life.

OBJECTIVES- To study the effect of laparoscopic sleeve gastrectomy on BMI and metabolic syndrome (type II diabetes mellitus, hypertension, hyperlipidemia).

METHODS- This is a prospective study, undertaken in Mahatma Gandhi Medical College and Hospital, Jaipur from July 2017 to September 2019 after taking clearance from institution ethics committee. Total 30 morbidly obese patients with metabolic syndrome were included in the study after taking informed consent.

CONCLUSION- Laparoscopic sleeve gastrectomy has emerged as a low morbidity bariatric surgical procedure that leads to effective weight loss and control of co-morbid diseases. Most patients with DM, hypertension and dyslipidemia showed resolution or improvement after LSG. Therefore, for morbidly obese patient in the short term, LSG is very safe and effective procedure without any significant morbidity or mortality.

KEYWORDS

Obesity, Laparoscopic Sleeve Gastrectomy, Bariatric Surgery, Diabetes Mellitus, Hypertension.

INTRODUCTION-

Various behavioral therapies like nutritional therapy, physical activity and cognitive behavioral therapy that basically target lifestyle for treating obesity or overweight have always been used but the results vary depending on the person's determination, willingness and most of the times end up with unsatisfactory results. Adjunct to lifestyle modifications, pharmacotherapy can also be used for weight loss. These approaches result in 5-10% weight loss that tends to wane off over time. On the contrary, bariatric surgery leads to 50-75% of excess body weight loss, which is durable as well as significant. Hence, as per the recent international guidelines, bariatric surgery has been declared the most effective treatment for morbid obesity. (1) Various studies suggest that bariatric surgery results in a high rate of remission of type 2 diabetes mellitus and other obesity-related comorbidities like dyslipidemia, hypertension and obstructive sleep apnoea syndrome (OSA). The short term as well as long-term outcomes of bariatric surgery lead to improvement in glucose metabolism, insulin resistance and quality of life. Till date, various bariatric procedures are in practice worldwide. Laparoscopic sleeve gastrectomy (LSG), Roux-en-Y gastric bypass (RYGB), mini gastric bypass (MGB) and laparoscopic adjustable gastric banding (LAGB) are various common procedures for morbid obesity. LSG and MGB are popular procedures done in morbidly obese patients with T2DM. Both procedures have their own advantages and disadvantages. In this study, we aim to compare the clinical efficacy of LSG in remission of metabolic syndrome in morbidly obese patients.

AIMS&OBJECTIVES- To study the effect of laparoscopic sleeve gastrectomy on BMI and metabolic syndrome (type II diabetes mellitus, hypertension, hyperlipidemia).

MATERIALS&METHODS- This is a prospective study, undertaken in Mahatma Gandhi Medical College and Hospital, Jaipur from July 2017 to September 2019 after taking clearance from institution ethics committee. Total 30 morbidly obese patients with metabolic syndrome were included in the study after taking informed consent.

RESULTS-

Weight and BMI characteristics

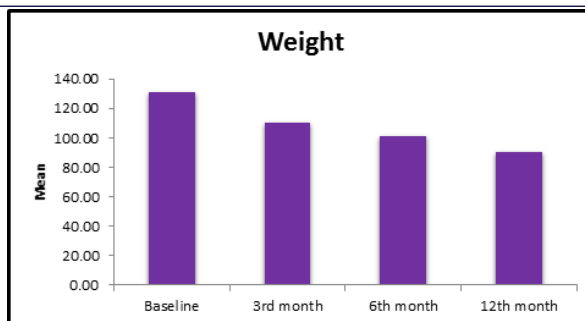


Figure 3.

Weight	Mean	S.D	F-value	P-value
Baseline	130.67	15.9034	490.453	0.0005 **
3rd month	110.43	13.5918		
6th month	101.10	11.6748		
12th month	90.13	9.3245		

** Highly Significant at $P < 0.01$ level

Table 3.

In the current study, the mean baseline weight of patients prior to surgery was 130.67 kg with a standard deviation of 15.9034. Mean BMI of patients was recorded as 43.23 kg/m² with a standard deviation of 3.3 pre-operatively as described in the tables and graphs below. Similar results were shown with a mean BMI of 49.7 kg/m² by Lester et al. (5) This is also similar to study by Capoccia et al. (2) which found average pre-op weight of 122.7 ± 32.1 kg and a mean BMI of 44.3 ± 8.2 kg/m².

The mean weight loss during the first three months was substantially more in comparison to the following months with mean weight reduced from 130 kgs to 110 kgs by the end of 3rd month. Following this period, by the end of 12 months mean weight loss of 40 ± 9.3 kgs was seen with a reduction in baseline BMI from 43.23 to 29.75. The study concluded that the weight loss and reduction of BMI at the end of 12th month was statistically significant with P value < 0.0005.

BMI

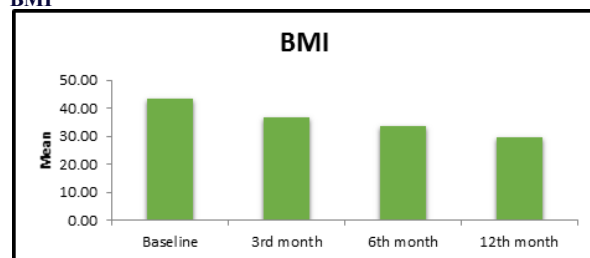


Figure 4.

Table 4.

BMI				
	Mean	S.D	F-value	P-value
Baseline	43.23	3.34057	715.083	0.0005 **
3rd month	36.60	2.80488		
6th month	33.58	2.70327		
12th month	29.75	2.11669		

Remission of diabetes mellitus

Table 5.

FBS				
	Mean	S.D	F-value	P-value
Baseline	172.40	19.7058	149.752	0.0005 **
3rd month	139.80	17.2695		
6th month	121.60	8.7871		
12th month	116.47	5.8941		

** Highly Significant at P < 0.01 level

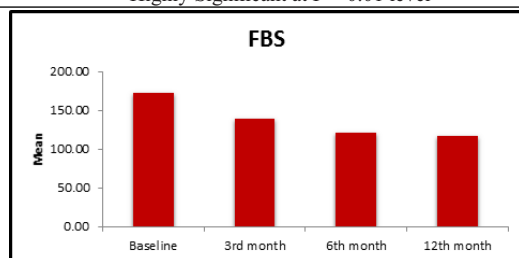


Figure 6.

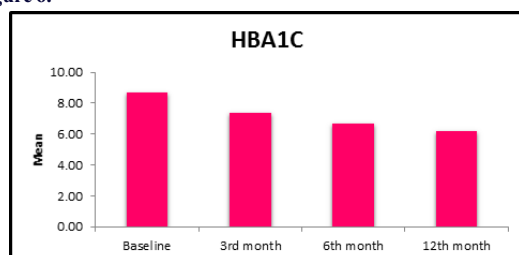


Figure 7.

Table 6.

HBA1C				
	Mean	S.D	F-value	P-value
Baseline	8.67	1.1985	145.253	0.0005 **
3rd month	7.38	.9791		
6th month	6.71	.7246		
12th month	6.18	.4191		

** Highly Significant at P < 0.01 level

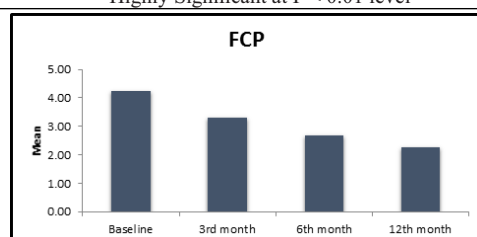


Figure 8.

Table 7.

Fasting C peptide				
	Mean	S.D	F-value	P-value
Baseline	4.25	.8299	178.147	0.0005 **
3rd month	3.31	.8610		
6th month	2.67	.7063		
12th month	2.27	.5584		

** Highly Significant at P < 0.01 level

In our study, all patients selected had diabetes mellitus with poor glycaemic control. All these patients were either on oral hypoglycemic drugs or insulin. Mean baseline fasting blood sugar was 172 ± 19.7 mg/dl that decreased to 139 ± 17.2 mg/dl at the end of 3 months and dropped to 116.4 ± 5 mg/dl by 12 months. Simultaneously, fall in HbA1c values was seen from mean of 8.67 ± 1.1 to 6.18 ± 0.4 at the end of 1 year. C peptide values were seen to drop from a mean of 4.25 to 2.27 at the end of 12 months. Similar result were quoted by Capoccia D. et al[2] in their study where mean fasting blood glucose was reduced from 151.8 ± 37.4 to 83.5 ± 10.7 mg/dl. Similar results were observed by Lee et al where fasting blood glucose levels decreased from 122.4 to 102.6 mg%. Capoccia D. et al noticed a change in HbA1c levels from 7.4 ± 1.3 to 5.7 ± 0.6 %.(2)

Mean HbA1c decreased from 7.4% preoperatively to 6.1% after 12 months postoperatively in study conducted by Bethany et al.

Majority of patients were taken off oral hypoglycemic drugs, remission or improvement in diabetes mellitus was seen in maximum cases.

REMISSION OF HYPERTENSION

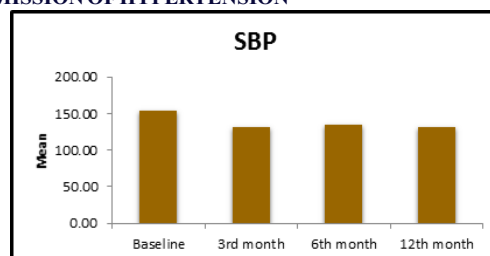


Table 8.

In our study, all patients selected were hypertensive. Out of 30, nine patients had their hypertension diagnosed pre-operatively after admission. And seven patients were under the category of uncontrolled hypertension and the remaining were on anti hypertensives. Mean baseline systolic BP was 154 ± 21 mm of Hg and mean baseline diastolic BP was 88 ± 11 mm of Hg. Significant improvement in hypertension was seen by the end of 3rd month with mean systolic coming down to 131 ± 14 mm of Hg and diastolic to 77 ± 11 mm of Hg. All patients showed improvement or resolution by the end of one year after laparoscopic sleeve gastrectomy. Our results were similar to the study done by D'Hondt et al who reported a 95% resolution/improvement in hypertension status 1-year after Sleeve gastrectomy. Chowbey et al reported improvement in hypertension in 93.75% at 1-year.(3)

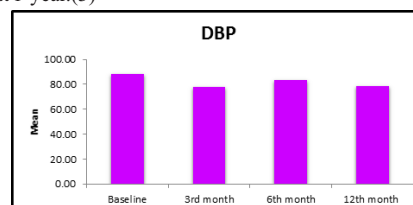
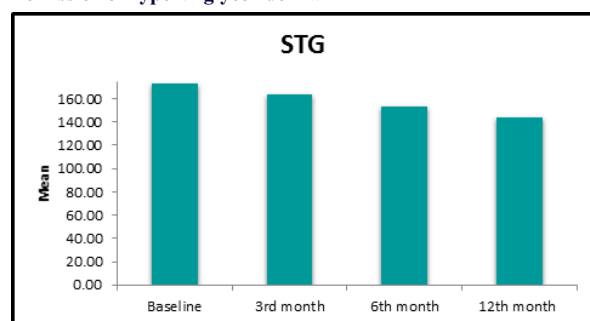


Figure 10.

Table 9.

DBP				
	Mean	S.D	F-value	P-value
Baseline	88.33	11.4390	5.544	0.002 **
3rd month	77.67	11.2291		
6th month	83.63	10.9087		
12th month	78.90	11.3634		

** Highly Significant at P < 0.01 level

Remission of hypertriglyceridemia**Figure11.****Table 10.**

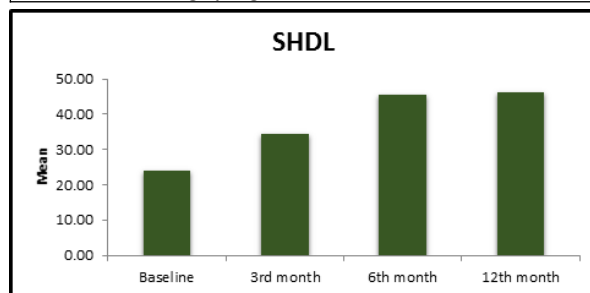
STG				
	Mean	S.D	F-value	P-value
Baseline	172.53	11.5780	323.858	0.0005 **
3rd month	163.83	9.5234		
6th month	153.20	7.5767		
12th month	144.00	6.6540		

** Highly Significant at P < 0.01 level

Table 11.

SHDL				
	Mean	S.D	F-value	P-value
Baseline	24.00	5.2066	47.608	0.0005 **
3rd month	34.55	3.7147		
6th month	45.60	3.2863		
12th month	46.33	2.9046		

** Highly Significant at P < 0.01 level

**Figure12.****Impact on serum lipid profile**

Lipid parameters	Baseline	3 months	6 months	12 months
Total Cholesterol	268.44±66.60	215.36±45.16	175.76±24.74	156.33±21
S. HDL	42.17±5.2	44.17±33.7	45.60±3.27	46.87±29
S. LDL	106.64±38.76	91.20±34.04	82.36±34.17	77.33±67.98

In our study, out of 30 patients, 21 were diagnosed with dyslipidemia. Improvement in lipid parameters were seen in 100 % of them. None of the patients required any medication after 12 months of surgery. Serum cholesterol was seen to decrease in all patients and reached within normal limits after 12 months. Improvements in S. triglycerides was seen from a baseline of 172.53 ± 11.5 to 144 ± 6.6 mg/dl. Total cholesterol was seen to reduce from a baseline 268.44 ± 66.60 to 156.33 ± 21 by the end of 1 year. Increment in Serum HDL levels was seen in all the patients from baseline of 42.17 ± 5.2 to 46.87 ± 29 mg/dl. Drop in the Serum LDL levels was seen after 12 months from a baseline level of 106.64 ± 38.76 mg/dl to 77.33 ± 98 mg/dl. Similar to our results, Chowbey et al. reported an 80% resolution of dyslipidemia at 6 months after LSG in Indian setting. Boza et al. reported an 85% resolution in dyslipidemia at 1-year after LSG.(104).

DISCUSSION

Laparoscopic sleeve gastrectomy⁽⁶⁾ was first described as a modification to the biliopancreatic diversion and combined with a duodenal switch in 1998, and was first performed laparoscopically in 1999. Patients experience excellent weight loss after LSG alone, and

multiple recent reports have documented LSG as single therapy in the treatment of morbid obesity. Weight loss is the most important parameter of bariatric surgery operations, and it is the parameter by which success or failure of weight reducing techniques is measured. In our study, 100% of patients lost > 50% of their excess weight 6 months after surgery. The mean weight loss at 3 and 6 months was 18.92 kg and 42.20 kg, the mean %EWL at 3 and 6 months was 32.21% and 65.05% respectively. LSG may induce weight loss by reducing food intake, but in accelerated gastric emptying, delivery of nutrients to the small intestine early in the eating cycle could activate small intestine satiety inducing chemoreceptors that could modify food ingestion periodicity. Increases in the response of gastrointestinal hormones, such as glucagon-like peptide-1, a meal-related satiation factor, have been reported after LSG. This type of response may be caused by the food quickly reaching the level of the small intestine due to accelerated gastric emptying.

D'Hondt *et al.*⁽¹¹⁾ retrospective reviewed 102 patients who underwent LSG as a sole bariatric operation. Their mean initial BMI was 39.3 kg/m^2 . No major complications occurred.

For the 23 patients who reached the 6-year follow-up point, the mean %EWL was $55.9\% \pm 25.55\%$. They concluded that LSG is a safe and effective bariatric procedure, although the tendency for weight regain is noted after 5 years of follow-up evaluation.

Menenakos *et al.*⁽¹²⁾ conducted a prospective single-center study of 261 patients with a median follow-up of 1-year. The median %EWL for the 1st year of follow-up was 65.7. The median BMI for the patients that had completed at least 1-year of follow-up was 29.75 kg/m^2 . The overall success rate after the 1st year was 74.3% when accounted for %EWL > 50 and 81.7% for BMI < 35 kg/m^2 . They concluded that LSG is a safe and effective option as a bariatric surgery.

Chowbey *et al.*⁽⁹⁾ reported the Indian experience with 75 patients analyzed retrospectively with LSG they reported %EWL from 31.2% at 3 months to 52.3% at 6 months, 59.13% at 1-year, and 65% at 2 years.

In one of the biggest series, Lee *et al.*⁽¹³⁾ reported an EWL of $59 \pm 17\%$ at 1-year in 216 patients who underwent LSG with a preoperative BMI of $49.2 \pm 11 \text{ kg/m}^2$. In 93 patients with a BMI of $46.9 \pm 6.5 \text{ kg/m}^2$, Skrekas *et al.*⁽¹⁴⁾ reported an EWL of $67.2 \pm 12.6\%$ and $72.3 \pm 10.3\%$ at 1 and 2 years, respectively. Nocca *et al.*⁽⁶⁾ reported an EWL of 61.5% at 2 years in 163 patients (LSG) with a preoperative BMI of 45.9 kg/m^2 . During the second LSG Summit,⁽¹³⁾ the EWL after 1, 2, and 3 years was reported to be 60.7%, 64.7%, and 61.7%, respectively.

Boza *et al.*⁽⁶⁾ presented data of 1000 patients who underwent LSG as a primary procedure for morbid obesity. Excess weight loss (EWL) was as follows: 1-year 86.6%, 2 years 84.1%, and 3 years 84.5%. Early and late complications occurred in 34 (3.4%) and 20 (2.0%) patients, respectively. There was no mortality during follow-up. They concluded that the LSG is a safe and effective surgical technique for morbid obesity as a stand-alone procedure.

Bariatric Surgery And Impact On Glucose Homeostasis

Nocca *et al.*⁽⁶⁾ studied the impact of LSG on HbA1c blood level and pharmacological treatment of T2DM in morbidly obese patients. At 1-year after surgery, T2DM had resolved in 75.8% of the LSG group. Reduced use of pharmacological therapy was noted in 15.15% of the LSG patients. Percentage EWL and BMI lost were 60.11% and 29.80% in the LSG group, respectively. Chowbey *et al.*⁽⁹⁾ reported type 2 diabetes was resolved in 81.2%, hypertension in 93.75%, and dyslipidemia in 85% at 1-year. Bariatric surgery has been shown to reduce co morbidities and mortality in patients with morbid obesity and most significantly to ameliorate or resolve T2DM. Much of the improvement has been related to the EWL after surgery. However, some effects appear to be independent from weight loss.

Rizzello *et al.*⁽¹³⁾ emphasized the resolution of T2DM after LSG. They also presented the effect of LSG on T2DM in patients with a BMI < 35 kg/m^2 . They studied 9 patients with T2DM and a BMI of 30–35 kg/m^2 , who also had hypertension, dyslipidemia, and obstructive sleep apnea. A normal BMI and normal glycemia were achieved within 6 months, with a mean HbA1c of 6.0%. T2DM resolved in all but 1 of these patients (88% cured). The patient in whom T2DM did not resolve had been diabetic for > 20 years, but postoperatively had a decrease in the

insulin requirement.

Eight of the 16 diabetic patients had resolution of diabetes at 3 months, and 13 patients had resolution after 6 months and improvement was seen in all the 16 patients. There was a reduction in the requirement of drugs in the remaining three patients. In the presence study out of 16 patients 14 had remission of diabetes; of the remaining two patients one was on metformin only and the other patient on half the dose of insulin.

Lipid Profile

Zhang *et al.*^[14] retrospectively studied changes in lipid profiles in obese patients who underwent LSG from June 2004 to June 2008. One year after surgery mean BMI decreased from 57.5 to 39.9. They concluded that 1-year after LSG, significant weight loss and improvements in HDL and triglyceride (TG) levels, total cholesterol/HDL and TG/HDL ratios were observed.

Rubin *et al.*^[15] conducted a prospective study assessment was made of 120 consecutive morbidly obese patients with body mass index (BMI) of 43, who underwent LSG. There were no postoperative complications or mortality. During a median follow-up of 11.7 months, percent of excess BMI lost reached $53\% \pm 24\%$ and the BMI decreased from 43 ± 5 to 34 ± 5 kg/m². Dyslipidemia is a recognized cardiovascular risk factor that could explain the excessive mortality rate in severely obese patients. It has been shown that bariatric procedures can improve the dyslipidemia associated with obesity; however, the impact on the lipid profile varies with various series reporting different results.

In our study, the outcomes of LSG regarding resolution of dyslipidemia. At the end of 6 months, Total cholesterol levels were decreased from 268.44 to 175.76 after 6 months of surgery. LDL cholesterol levels were decreased from 106.64 to 82.36 after 6 months of surgery. HDL levels were increased from 24.4 to 40.40 at 6 months after LSG. We conclude that the impact on lipid profile is significant after bariatric surgery, and the effects are similar after both surgeries and are related to weight loss.

Effect On Hypertension

All patients (100%) with preoperatively diagnosed hypertension (16 out of 30) showed improvement or resolution. At 6 months, 62.5% of LSG patients had resolution of hypertension. Similar results are found in the literature. Srinevasa^[7] *et al.* reported a 29% resolution and 48% improvement in hypertension 1-year after LSG. Similarly D'Hondt *et al.*^[11] reported a 95% resolution/improvement in hypertension status 1-year after Sleeve gastrectomy. Prasad *et al.*^[8] reported a 75% resolution/improvement in hypertension 1-year after sleeve gastrectomy.

Effect On Other Metabolic Parameters

All the patients in the study population had normal values of RFT's including serum electrolytes, Ca + Mg⁺, serum uric acid both pre and postoperatively at 3 and 6 months. In view of that, those parameters were not calculated statistically. And no further data were analyzed.

CONCLUSION

Laparoscopic sleeve gastrectomy has emerged as a low morbidity bariatric surgical procedure that leads to effective weight loss and control of co-morbid diseases. Most patients with dm, hypertension and dyslipidemia showed resolution or improvement after LSG.

Therefore, for morbidly obese patient in the short term, LSG is very safe and effective procedure without any significant morbidity or mortality.

REFERENCES

1. Skrekas G, Lapatsanis D, Stafyla V, Papalambros A. One year after laparoscopic "tight" sleeve gastrectomy: Technique and outcome. *Obes Surg* 2008;18:810-3.
2. D. Capoccia, F. Coccia, A. Guida *et al* Is Type 2 Diabetes Really Resolved after Laparoscopic Sleeve Gastrectomy? Glucose Variability Studied by Continuous Glucose Monitoring; *Journal of Diabetes Research*:2015, Article ID 674268.
3. Akkary E, Duffy A, Bell R. Deciphering the Sleeve: Technique, indications, efficacy, and Safety of Sleeve Gastrectomy. *Obes Surg* 2008; 18: 1323–1329
4. Bethany JS, Bellatorre N, Eisenberg D: Early Postoperative Outcomes and Medication Cost Savings after Laparoscopic Sleeve Gastrectomy in Morbidly Obese Patients with Type 2 Diabetes. *Journal of Obesity* 2011; Article ID 350523
5. Kendra Kristina Lester. Improvement and remission of prediabetes and type 2 diabetes mellitus following laparoscopic sleeve gastrectomy. Memorial University of Newfoundland; 2014
6. Nocca D, Krawczykowsky D, Bomans B, Noël P, Picot MC, Blanc PM, *et al.* A prospective multicenter study of 163 sleeve gastrectomies: Results at 1 and 2 years.

Obes Surg 2008;18:560-5.

7. Srinivasa S, Hill LS, Sammour T, Hill AG, Babor R, Rahman H. Early and mid term outcomes of single stage laparoscopic sleeve gastrectomy. *Obes Surg* 2010;20:1484-90.
8. Prasad P, Tania O, Patle N, Khanna S, Sen B. An analysis of 1.3 year follow up results of laparoscopic sleeve gastrectomy: An Indian perspective. *Obes Surg* 2012;22:507-14.
9. Aggarwal S, Kini SU, Herron DM. Laparoscopic sleeve gastrectomy for morbid obesity: A review. *Surg Obes Relat Dis* 2007;3:189-94.
10. Shi X, Karmali S, Sharma AM, Birch DW. A review of laparoscopic sleeve gastrectomy for morbid obesity. *Obes Surg* 2010;20:1171-7.
11. D'Hondt M, Vanneste S, Pottel H, Devriendt D, Van Rooy F, Vansteenkiste F. Laparoscopic sleeve gastrectomy as a single stage procedure for the treatment of morbid obesity and the resulting quality of life, resolution of comorbidities, food tolerance, and 6 year weight loss. *Surg Endosc* 2011;25:2498-504.
12. Menenakos E, Stamou KM, Albanopoulos K, Papailiou J, Theodorou D, Leandros E. Laparoscopic sleeve gastrectomy performed with intent to treat morbid obesity: A prospective single center study of 261 patients with a median follow up of 1 year. *Obes Surg* 2010;20:276-82.
13. Lee CM, Cirangle PT, Jossart GH. Vertical gastrectomy for morbid obesity in 216 patients: Report of two year results. *Surg Endosc* 2007;21:1810-6.
14. Skrekas G, Lapatsanis D, Stafyla V, Papalambros A. One year after laparoscopic "tight" sleeve gastrectomy: Technique and outcome. *Obes Surg* 2008;18:810-3.
15. Gagner M, Deitel M, Kalberer TL, Erickson AL, Crosby RD. The second international consensus summit for sleeve gastrectomy, March 19-21, 2009. *Surg Obes Relat Dis* 2009;5:476-85.
16. Arias E, Martinez PR, Ka Ming Li V, Szomstein S, Rosenthal RJ. Mid term follow up after sleeve gastrectomy as a final approach for morbid obesity. *Obes Surg* 2009;19:544-8