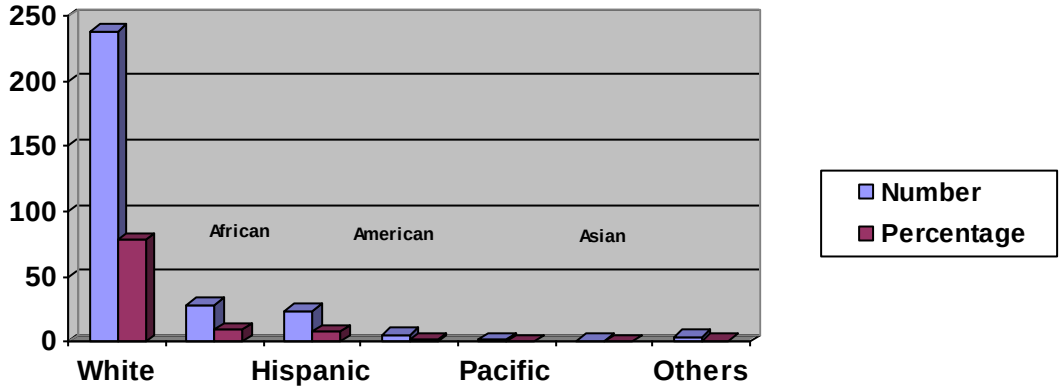
Results

During the period from 1st of June 2008 till 31 of May 2009, 304 morbidly obese patients were enrolled in this study from the University of California Davis (UCD) Medical Center in Sacramento/California, either Laparoscopic Roux En Y Gastric Bypass, Laparoscopic Sleeve Gastrectomy, Laparoscopic Adjustable Gastric Banding according to criteria for bariatric surgery and they are followed for one year postoperative .

Demographic characteristics of our patients (249 female 82% and 55 male 18%) of those (29 African American,238 White,24 Hispanic,6 American Indian,1 Asian,2 Pacific Islander, 4 others). The age range was 20-65 with a mean of 44.9 years .The weight ranged from 175-570 pounds(lb) (79.5-259 kilogram(kg)) with a mean of 293.8 lbs(133.5kg), The height ranges from138cm (54.2 inches) to 193cm (76 inches) with a mean of 165cm(65 inches).The BMI ranged from 33-90kg/m2 with a mean of 48kg/m2.

Table(3) Races of our patients:

Race	White	African American	Hispanic	American Indian	Pacific	Asian	Others
Number	238	29	24	6	2	1	4
Percentage	78.3	9.5	7.9	1.9	.6	.3	1.2



(Figure 22) ***Races of our patients***

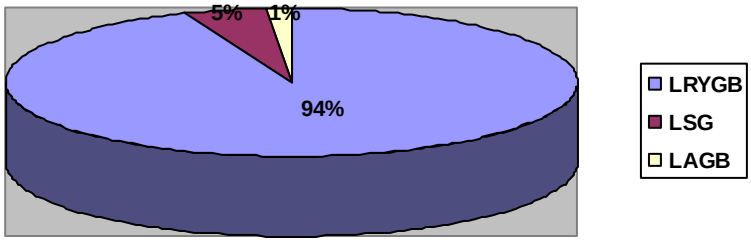
Table(4) Demographic characteristics of our patients :

Variables	LRYGB N=285	LSG N=15	LAGB N=4
Age(year) (mean ± SD)	44.7±11	47±9.4	50.7±15.9
Sex(M/F) (Number)	47/285	4/15	0/4
Preoperative Weight(LB) (Mean± SD)	291.7±56	276±47	315±74.3
Preoperative BMI(Mean± SD)	48±7.8	42.6±5.7	51±11.4

The total number we had done is 304 cases of them 285 LRYGB, 15 LSG and 4 cases of LAGB.

Table (2) Number of patients for every operation.

Procedure	LRYGB	LSG	LAGB
Number	285	15	4
Percentage	93.8	4,9	1,3



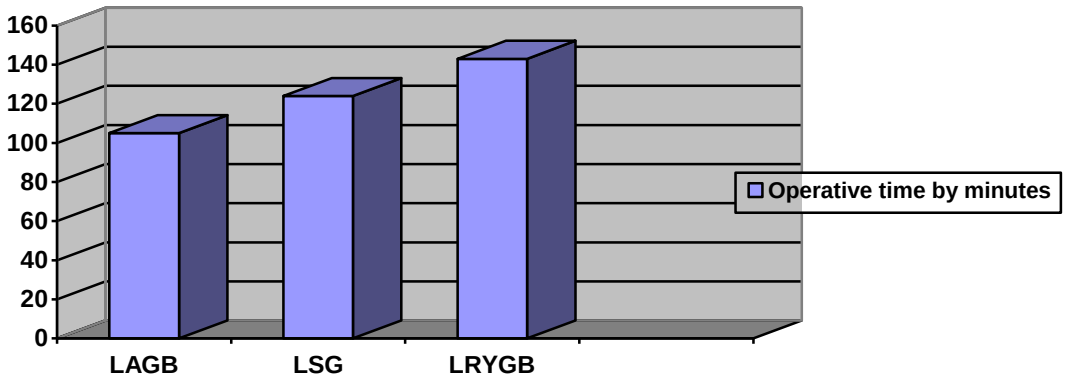
(Figure 23) Percentage to total No of operations

All cases are done and completed laparoscopically except 5 cases of REYGB which are done by robotic surgery with no conversion for any case.

The mean operative time for LAGB was 105 minutes (range from 90 - 120 min), 143 minutes for LRYGB (range from 70 -330 min), 124 minutes for LSG (range from 60 -395 min).

Table (5) Mean operative time:

Procedure	LAGB	LSG	LRYGB
Mean operative time ±SD	105 min ±14.7	124 min ±40.3	143 min ±82.6

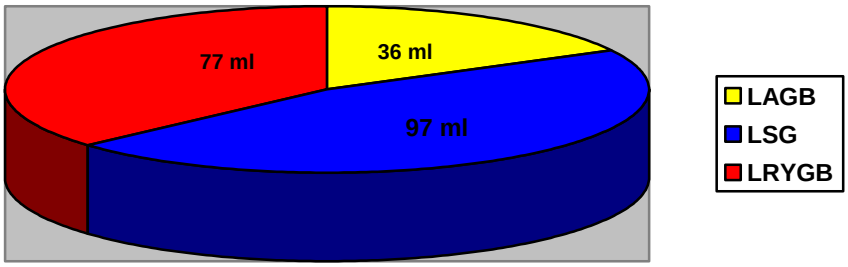


(Figure 24) Operative time by minutes

The mean intraoperative estimated blood loss is about 36 ml for LAGB and 77 ml for LRYGB and 97 ml for LSG.

Table (6) Intraoperative blood loss:

Procedure	LAGB	LSG	LRYGB
Mean operative blood loss	36 ml	97ml	77 ml



(Figure 25) Intraoperative blood loss

The mean hospital stay was 44 hours (range from 24- 216 hours).

Table (7) Mean hospital stay:

Procedure	LAGB	LSG	LRYGB
Mean hospital stay	30 Hours	44 Hours	44 Hours

We had 2 unrelated mortalities representing 4% of complications and 0.6 of cases one of them due to drug overdose 8 months after operation, the other one is due to unknown cause 20 months after operation.

Table (8) Intraoperative complications in studied patients:

Complications	Number (304)	Percent of total cases	Percent of complications
Intra abdominal bleeding	2	0.7%	3.9%
Injury of spleen	1	0.3	2%
Total	3	1%	5.9%

Table (9) Early post operative Complications in studied patients:

Complications	Number (304)	Percent of total cases	Percent of complications
Deep venous thrombosis	3	1%	5.9%
Pulmonary embolism	1	0.3%	2%
Intra abdominal abscess	1	0.3%	2%
Pleural effusion	1	0.3%	2%
Surgical wound infection	1	0.3%	2%
Wound complications	2	0.7%	3.9%
Dehydration	11	3.6%	21.6%
Nausea vomiting	8	2.6%	15.7%
Nutritional support required via TPN	4	1.3%	7.8%
Urinary infection	2	0.7%	3.9%
Total	34	11.1%	65.8%

Table (10) Late postoperative complications in studied patients :

Complications	Number (304)	Percentage of total cases	Percentage of complications
Obstruction	1	0.3%	2%
Ulcer	4	1.3%	7.8%
Incisional hernia	1	0.3%	2%
Anemia	1	0.3%	2%
Renal calculus	3	1%	5.9%
Diarrhea	1	0.3%	2%
Total	11	3.5%	21.7%

There are 6 cases required re operation representing 1.9% of all cases 3 cases of them within the same hospital admission and the other 3 cases are late required readmission again.

Table (11) Reoperation:

Complication	Op. Type	Comp.Day	Reop. Day	Ward Days	ICU Days
Bleeding	LRYGB	0	1	0	2
Bleeding	LRYGB	1	1	0	0
Injury of Spleen	LRYGB	0	0	0	0
Pleural effusion	LRYGB	37	39	9	0

Obstruction	LRYGB	82	82	16	3
Obstruction	LRYGB	716	719	0	0

Table (12)The Mean weight loss, mean body mass index, excess weight loss and excess weight loss percentage for LVSG,LAGB and LRYGB during follow up period at 2, 6, and 12 months.

LVSG	2 months(n=15)	6 months(n=9)	12 months(n=7)	P Value
Initial weight	276.4(47.1)	276.4(47.1)	276.4(47.1)	----------
Initial BMI	42.7(47.1)	42.7(47.1)	42.7(47.1)	----------
Weight	244(38.8)	217.9(47.5)	207.5(34.3)	P = 0.0052
BMI	37.7(5.7)	31.6(5.5)	31.1(3)	P < 0.0001
EWL	32.4(17.4)	54.4(19.3)	59.4(17)	P = 0.0051
EWL%	24.3(10.8)	50.7(15.2)	54.1(14.9)	----------
Maximum Wt.	301	277	250	----------
Minimum Wt.	159	144	178.5	----------

LAGB	2 months(n=4)	6 months(n=3)	12 month(n=3)	P Value
Initial weight	315(74.2)	315(74.2)	315(74.2)	----------
Initial BMI	51(11.4)	51(11.4)	51(11.4)	----------
Weight	283.7(47.9)	283(53)	278(60.8)	P = 0.7858
BMI	43.7(7.9)	45.3(10.2)	42.5(9.3)	P = 0.6814
EWL	41.6(39.5)	43.7(34.4)	47(32.5)	P = 0.9831
EWL%	20(9.6)	22.7(9.7)	25(10.6)	----------
Maximum Wt.	339	343	347	----------
Maximum Wt.	255	241	231.7	----------

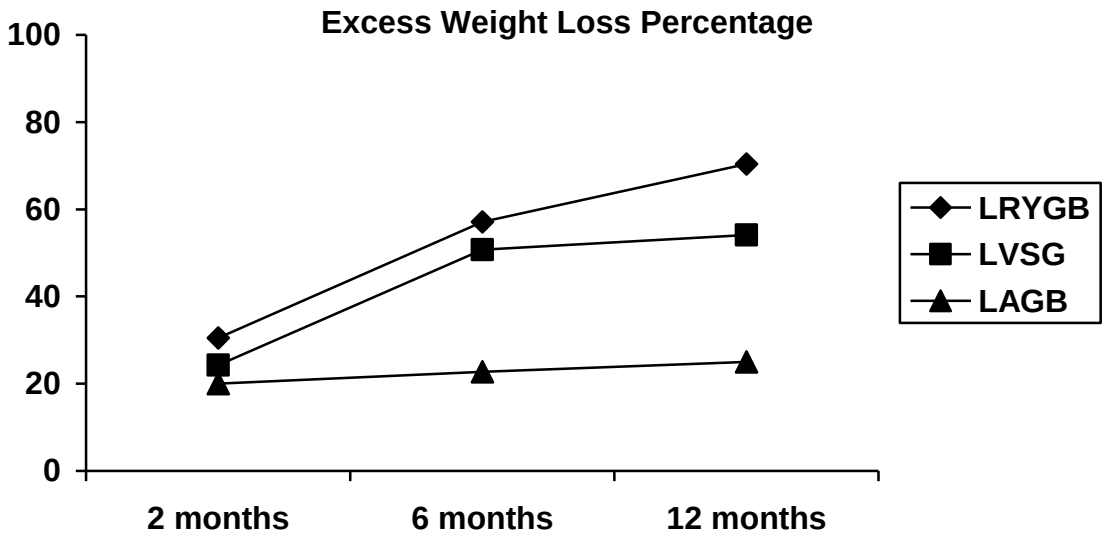
LRYGB	2 months(n=283)	6 months(n=205)	12 months(173)	P Value
Initial weight	291.8(56.1)	291.8(56.1)	291.8(56.1)	---------
Initial BMI	48(7.8)	48(7.8)	48(7.8)	---------
Postop. Wt.	245.3(49)	209.6(45)	190.1(44.2)	P < 0.0001
Postop. BMI	41.3(15.7)	34.4(6.3)	31.5(8.5)	P < 0.0001

EWL	45.8(18.9)	78.2(25.3)	79.7(33.4)	P < 0.0001
EWL%	30.5(10.4)	57.1(16.9)	70.4(23.5)	----------
Maximum Wt.	432	395	378	----------
Minimum Wt.	41.7	117	105	----------

Percent of patients lost more than 50% of their excess weight which means successful operation is (130/173) 75.1% after one year follow up in LRYGB and (5/7) 71.4 for LVSG and (0/3) 0% for LAGB .

Table(13) showing percent of excess weight loss .

EWL%	2 months	6 months	12 months
LRYGB	30.5	57.1	70.4
LVSG	24.3	50.7	54.1
LAGB	20	22.7	25



(Figure 26) Excess weight loss percentage

Regarding metabolic complications the most significant were vitamin B_{12} and iron deficiency. However there was no clinical impact and all the patients were treated conservatively with intramuscular injections of vitamin B_{12} and oral iron supplements as necessary as seen in the following table .

***Table (14) clinical assessment of patients of LRYGB during follow up*:**

Laboratory findings	Mean ± SD	% of abnormal patients
Hematocrit (%)	37.6±6.4	Low 17.8
Albumin (gm/dl)	4.6±1.3	Low 4.6
Iron (ng/dl)	83.77± 23.2	Low 13.8
Calcium (mg/dl)	9.7±0.4	Low 5
Vitamin D (pg/ml)	46.8± 12.5	Low 8
Vitamin B12 (pg/ml)	559± 121.3	Low 16.7
Folic acid (ng/ml)	15.9± 2.6	All in range

Table(15) Co morbidities associated with obesity in studied patients:

Diseases	Co morbidity SCORE					Total	%	Mean of scors
	1	2	3	4	5			
GERD	47	19	63	9	0	138	45%	2.3
Hypertension	26	9	85	78	0	179	58%	3
Diabetes Mellitus	22	48	14	16	4	104	34%	3.1
Dyslipidemia	30	20	92	5	0	147	48%	2.2
Ischemic Heart Disease	0	1	7	0	0	8	3%	1
Obstructive Sleep Apnea Syndrome	17	18	96	0	1	132	43%	2.8
Obesity Hypoventilation Syndrome	10	1	0	1	0	12	4%	1
Functional Status	1	1	1	0	0	3	1%	1
Angina Assessment	0	1	1	0	3	5	2%	1.3
Asthma	13	38	12	2	0	65	21%	1.9
Back Pain	88	66	37	9	4	204	67%	2.2
Cholelithiasis	4	5	51	0	2	62	20%	1.9
DVT/PE	3	1	0	1	2	7	2%	1.1
Fibromyalgia	0	3	1	0	0	4	1%	1
Stress Urinary Incontinence	60	26	11	4	3	104	34%	1.8
Pulmonary Hypertension	1	0	0	1	0	2	1%	2.5

Psychosocial impairment	40	133	19	2	0	194	63%	2.1
Pseudotumor Cerebri	20	9	0	1	0	30	10%	3
Mental Health Confirmation	16	7	0	0	0	23	8%	1.7
Polycystic Ovarian Syndrome	19	9	2	1	2	33	11%	1.9
Peripheral Vascular Disease	0	1	0	0	0	1	,3%	1
Musculoskeletal Disease	77	55	63	0	12	207	68%	2.1
Menstrual Irregularities (not PCOS)	20	2	0	6	0	28	9%	2.3
Liver Disease	1	1	0	0	0	2	1%	1.2
Lower Extremity edema	75	61	3	0	0	139	45%	1.5
Alcohol Use	39	34	18	0	0	91	30%	2.3
Congestive Heart Failure	2	0	0	0	0	2	1%	1
Depression	45	11	75	4	1	136	44%	2.8
Gout/ Hyperuricemia	0	2	0	0	0	2	1%	2
Substance Abuse	1	1	4	0	0	6	2%	2.3
Tobacco Use	4	3	10	0	0	17	6%	2.9
Abdominal Hernia	5	3	18	1	1	28	9%	2.4
Total	686	590	683	138	35	2115	----	----

The prevalence of comorbidities in the preoperative patients shows that musculoskeletal pains are the most prevalent followed by backpain and psychosocial impairment.

The post operative data available about comorbidities resolution in both LVSG and LAGB are minimal making any statistical analysis of no meaning so we concentrated on LRYGB.

AORC Assessment of Obesity-Related Co-morbidities Scoring system.

Hypertension:

1. No history of hypertension.
2. Borderline, no medication.
3. Diagnosis of hypertension, no medication.
4. Treatment with single medication.
5. Treatment with multiple medications.
6. Poorly controlled by medications, organ damage or dysfunction.

Lipids (Dyslipidemia or Hyperlipidemia):

1. Not present.
2. Present, no treatment required.
3. Controlled with lifestyle change, including Step 1 or Step 2 diet.
4. Controlled with single medication.
5. Controlled with multiple medications.
6. Not controlled.

Glucose Metabolism:

1. No symptoms or evidence of diabetes.
2. Elevated fasting glucose.
3. Diabetes, controlled with oral medication.
4. Diabetes, controlled with insulin.
5. Diabetes, controlled with insulin and oral medication.
6. Diabetis, with severe complications (retinopathy,neuropathy, renal failure, blindness).

According to the AORC, co-morbidities that require medical treatment or show signs of complications receive a score of ≥3. The metabolic syndrome was, thus, defined as an AORC score of ≥3 for each of the comorbidities constituting the metabolic syndrome (DM, DYS, and HTN). An AORC score of ≥3 for DM, HTN, and DYS signified that the particular co-morbidity had reached sufficient severity to require medical treatment. This system is initially started by Mohamed Ali **(Ali et. al., 2009)** a new and novel approach to categorize and more accurately define the magnitude of improvement in co-morbidities after laparoscopic Roux-en-Y gastric bypass , then modified to this new one by BOLD (Bariatric Outcomes Longitudinal Database) to accurately assess the improvement in comorbidities.

Table (16) Response of comorbidities to Roux en Y gastric bypass in all patients:

Comorbidities	Mean comorbidity score			
	Preoperative	2 months	6 months	12 months
Diabetes	0.69	0.32	0.44	0
Hypertension	1.42	0.97	0.65	0
Dyslipidemia	1.02	0.51	0.53	0.33
Back pain	1.26	0.43	0.44	0
Musculoskeletal pain	1.59	0.89	0.71	0.83
GERD disease	1.23	0.46	0.09	0.50
Pseudotumor cerebri	0.04	0	0	0
Urinary incontinence	0.73	0.17	0	0
Lower extremity edema	0.72	0.03	0.03	0

Sleep apnea syndrome	1.21	0.68	0.32	0.33
Psychosocial affection	1.84	0.54	0.12	0.33
Depression	1.32	0.94	0.65	0.67

Table (17)Statistical analysis of Response to Roux en Y gastric bypass in affected patients:

Comorbidities	Mean comorbidity score			
	Preoperative	2 months	6 months	12 months
Diabetes	3.10	1.82	1.05*	0.6*
Hypertension	2.99	1.74*	1.29*	0.45*
Dyslipidemia	2.07	1.07*	1.13	1.00
Back pain	2.01	0.82*	0.71*	0.00
Musculoskeletal pain	2.06	1.42*	0.80*	1.00
GERD disease	2.25	0.83*	0.14*	0.60
Urinary incontinence	1.83	0.42*	0.00	0.00
Lower extremity edema	1.45	0.44*	0.11*	-------
Sleep apnea syndrome	2.19	1.95	0.92	1.00
Psychosocial affection	2.04	0.69*	0.15*	0.33
Depression	2.79	2.11	1.69	2.00
0.05.<*Significant difference versus preop, p				