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Is laparoscopic sleeve gastrectomy safer than laparoscopic gastric bypass?

A comparison of 30-day complications using the MBSAQIP data registry

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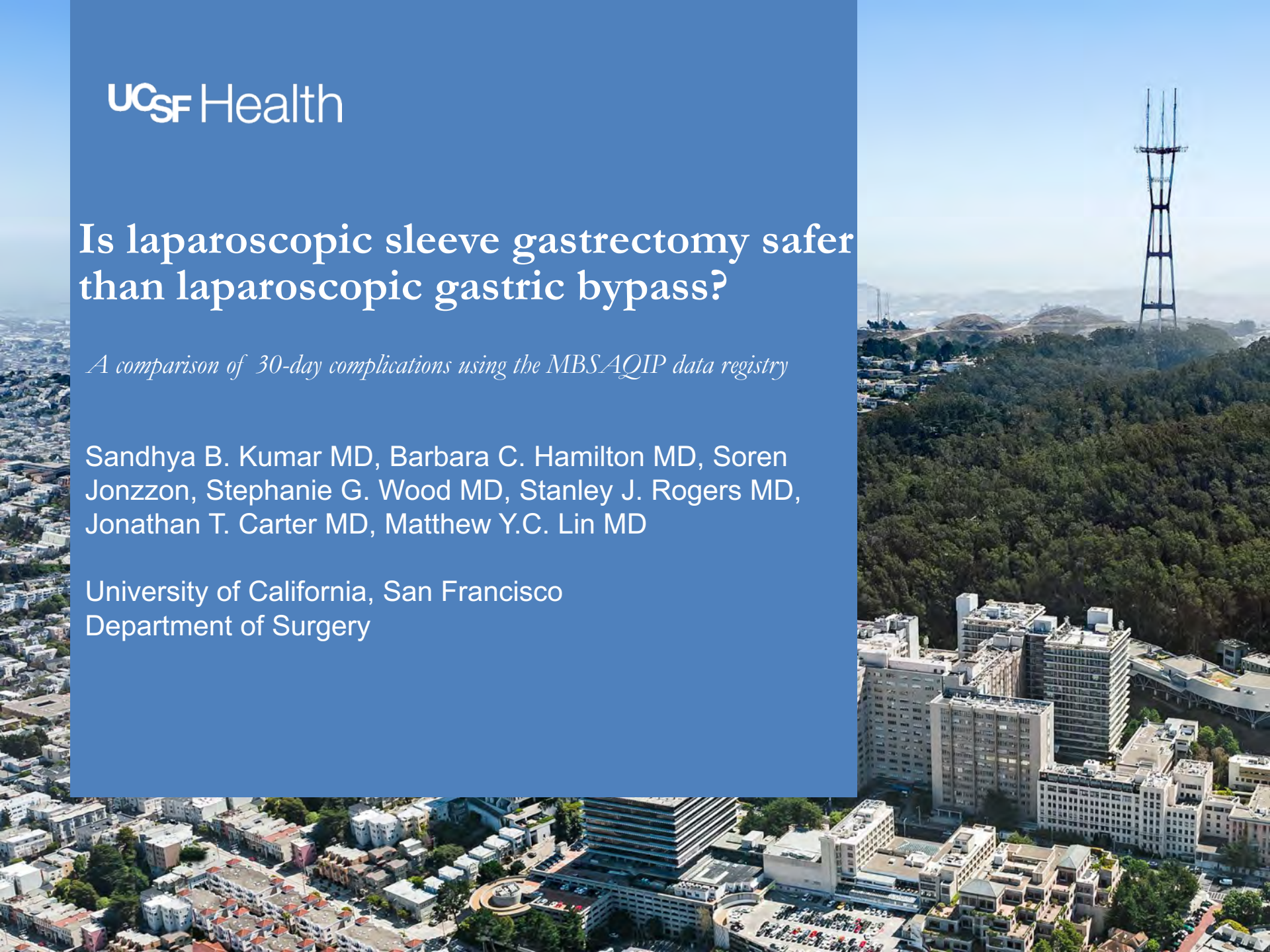

Disclosures

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Introduction

- Laparoscopic sleeve gastrectomy (LSG) is now the most popular bariatric procedure in the United States

- Some studies have shown LSG to have fewer overall complications than laparoscopic gastric bypass (LRYGB), but there is lingering concern about a higher leak rate

- The Metabolic and Bariatric Surgery Accreditation and Quality Improvement (MBSAQIP) registry is the largest bariatric-specific dataset available and therefore the best data set to compare LSG and LRYGB in a real-world setting.

1. Peterli R, Borbély Y, Kern B, et al. Early results of the Swiss Multicentre Bypass or Sleeve Study (SM-BOSS): a prospective randomized trial comparing laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass. *Annals of Surgery*. 2013;258(5):690–4.
2. Helmiö M, Victorzon M, Ovaska J, et al. SLEEVEPASS: a randomized prospective multicenter study comparing laparoscopic sleeve gastrectomy and gastric bypass in the treatment of morbid obesity: preliminary results. *Surgical Endoscopy*. 2012;26(9):2521-2526.
3. Young MT, Gebhart A, Phelan MJ, Nguyen NT. Use and Outcomes of Laparoscopic Sleeve Gastrectomy vs Laparoscopic Gastric Bypass: Analysis of the American College of Surgeons NSQIP. *Journal of the American College of Surgeons*. 2015;220(5):880-885.

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Objective

- To compare LSG and LRYGB with respect to mortality, serious morbidity, and leak, adjusting for patient characteristics.

Methods

- **Patients:** all patients undergoing bariatric surgery captured by the 2015 MBSAQIP database
- **Inclusion criteria:** all cases of primary LSG or LRYGB identified using CPT codes
- **Exclusion criteria:** revisional operations, open operations
- **Predictors:** Patient demographics and comorbidities

Methods- Outcome variables

Death

Leak = any of

- Leak outcome
- Drain at 30-days
- Organ space infection
- Leak-related readmission
- Leak-related reoperation
- Leak-related intervention

Morbidity = any of

- Deep or organ space infection
- Wound disruption
- Leak
- ICU admission
- Sepsis
- Renal failure
- Transfusion
- Cardiac arrest, myocardial infarction
- Cerebrovascular accident, coma
- Pneumonia, >48h vent, reintubation
- Pulmonary embolism, DVT
- Intervention, reoperation, readmission within 30-days

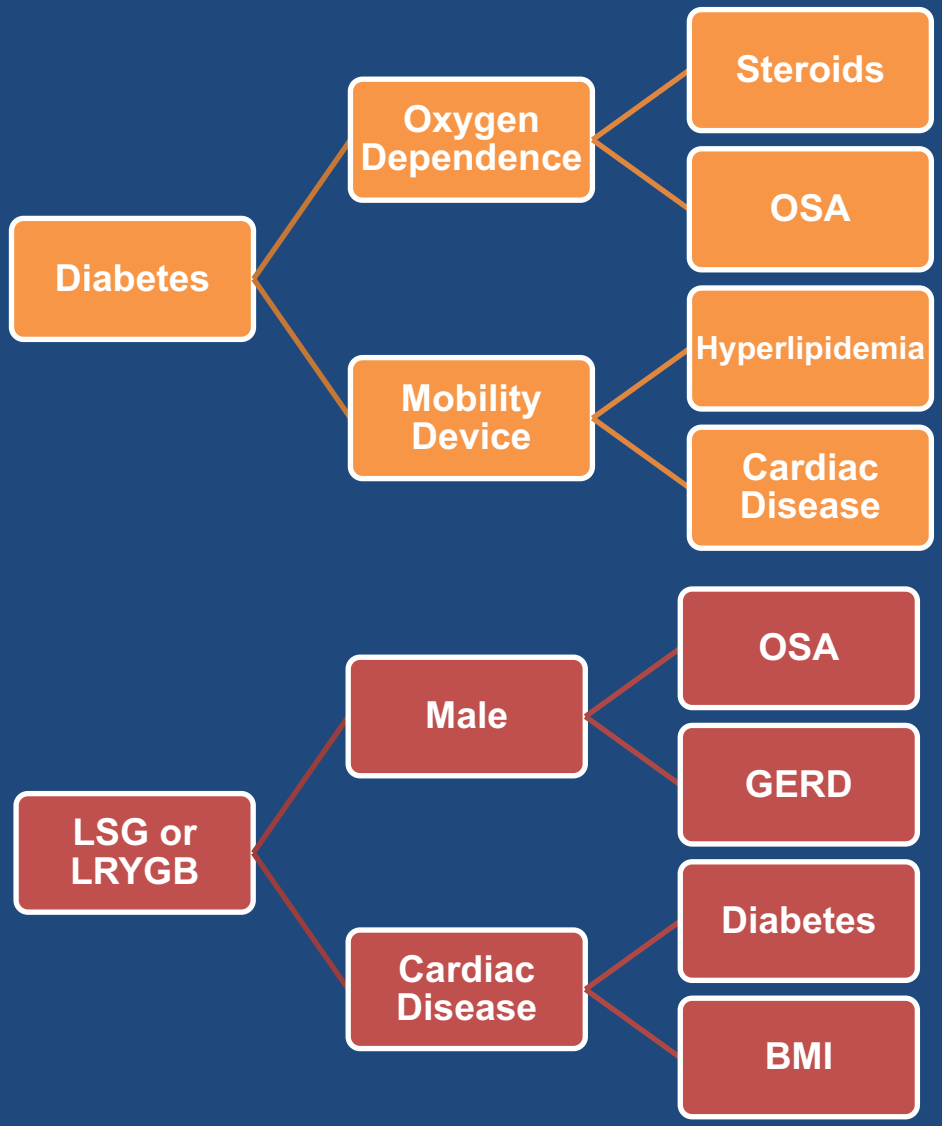
Statistical Methods

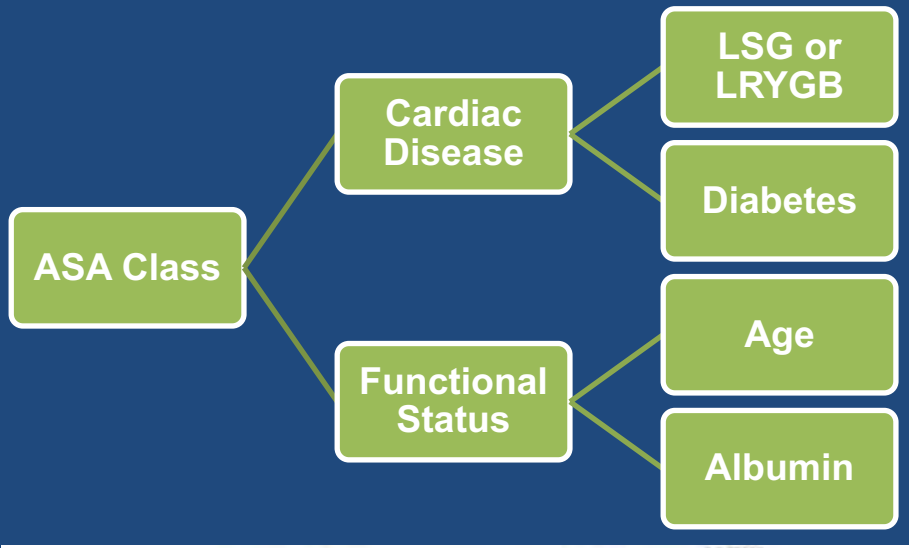
- Missing value imputation
- Partition in to Training (70%) and Testing (30%) sets
- Variable importance using Random Forest Algorithms
- Multivariate Regression Model using forward and backwards stepwise selection, minimizing Aikake Information Criterion (AIC)
- Model Diagnostics – Receiver Operating Characteristic Curves

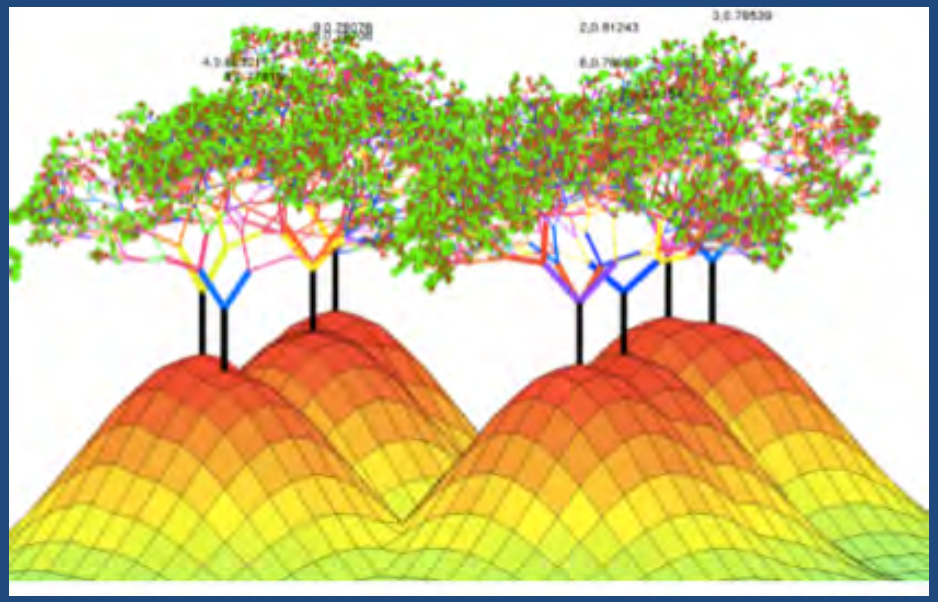
Patient Characteristic	LSG (n=93,062)	LRGYB (n=41,080)	P-value
Age (years)	44 (35 – 53)	45 (36 – 54)	< 0.001
BMI (kg/m^2)	44 (40 – 49)	45 (41 – 51)	< 0.001
Albumin (mg/dL)	4.1 (3.9 – 4.3)	4.0 (3.8 – 4.2)	< 0.001
Female	79%	79%	0.001
Diabetes			< 0.001
None	77%	65%	
None-insulin dependent	16%	21%	
Insulin dependent	7%	15%	
Hyperlipidemia	23%	30%	< 0.001
Gastroesophageal Reflux	29%	37%	< 0.001
Obstructive Sleep Apnea	35%	43%	< 0.001
COPD	1.7%	2.2%	< 0.001
Oxygen Dependence	0.7%	1.0%	< 0.001
Hypertension	48%	54%	< 0.001
History of MI	1.2%	1.6%	< 0.001
Prior PCI	2.0%	2.5%	< 0.001
Prior Cardiac Surgery	1.2%	1.2%	0.816
Renal Insufficiency	0.7%	0.7%	0.648
Dialysis Dependence	0.3%	0.2%	< 0.001
History of DVT	1.6%	1.8%	< 0.001
History of PE	1.1%	1.2%	0.04
Prior IVC Filter	1.0%	1.2%	< 0.001
Venous Stasis	0.9%	1.4%	< 0.001
Therapeutic Anticoagulation	2.2%	2.4%	0.172
Chronic Steroid Use	1.6%	1.4%	< 0.001
Smoking History	9%	9%	0.246
Prior Surgery	1.9%	1.7%	0.006
Need for Mobility Device	1.8%	2.4%	< 0.001

Patient Characteristic	LSG (n=93,062)	LRGYB (n=41,080)	P-value
Functional Status			< 0.001
Independent	99%	99%	
Partially dependent	0.6%	0.8%	
Totally dependent	0.4%	0.2%	
Level of Training of assistant			< 0.001
None	16%	12%	
PA/NP/RN	37%	39%	
Resident	17%	17%	
MIS Fellow	8%	12%	
Attending – Weight Loss Surgeon	16%	14%	
Attending - Other	6%	6%	
ASA Class			< 0.001
I	0.5%	0.2%	
II	26%	17%	
III	70%	78%	
IV	3.5%	4.6%	
V	0.01%	< 0.01%	

Random Forest Algorithm

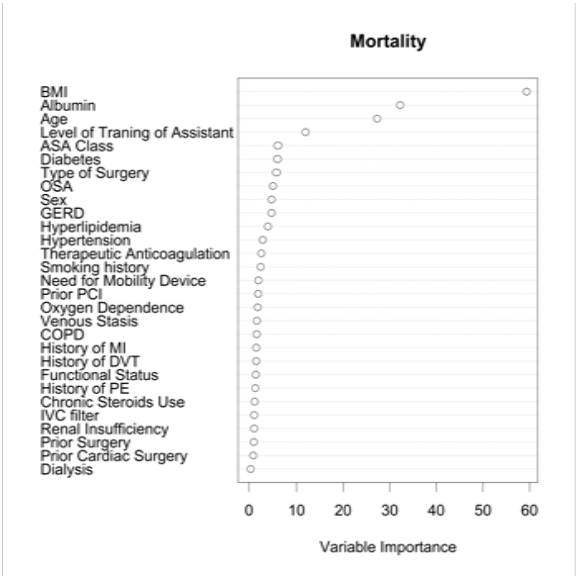







Leak
BMI
Albumin
Age
Level of Traning of Assistant
ASA Class
Diabetes
OSA
GERD
Sex
Type of Surgery
Hyperlipidemia
Hypertension
Smoking history
Functional Status
Therapeutic Anticoagulation
Prior Surgery
Need for Mobility Device
Prior PCI
COPD
Chronic Steroids Use
History of DVT
IVC filter
Oxygen Dependence
History of MI
History of PE
Venous Stasis
Renal Insufficiency
Prior Cardiac Surgery
Dialysis
0 50 100 150 200 250 300 350
Variable Importance


Morbidity
BMI
Albumin
Age
Level of Traning of Assistant
Diabetes
ASA Class
Type of Surgery
Sex
OSA
GERD
Hyperlipidemia
Hypertension
Smoking history
Therapeutic Anticoagulation
Oxygen Dependence
Need for Mobility Device
COPD
Prior PCI
History of MI
History of DVT
Venous Stasis
Functional Status
History of PE
Chronic Steroids Use
Prior Surgery
Renal Insufficiency
IVC filter
Prior Cardiac Surgery
Dialysis
0 10 20 30 40 50 60
Variable Importance


Mortality
BMI
Albumin
Age
Level of Traning of Assistant
ASA Class
Diabetes
Type of Surgery
OSA
Sex
GERD
Hyperlipidemia
Hypertension
Therapeutic Anticoagulation
Smoking history
Need for Mobility Device
Prior PCI
Oxygen Dependence
Venous Stasis
COPD
History of MI
History of DVT
Functional Status
History of PE
Chronic Steroids Use
IVC filter
Renal Insufficiency
Prior Surgery
Prior Cardiac Surgery
Dialysis
0 10 20 30 40 50 60
Variable Importance

Unadjusted 30-day outcome	LSG	LRGYB	P-value
Leak	0.8%	1.6%	< 0.001
Morbidity	5.8%	11.7%	< 0.001
Mortality	0.1%	0.2%	< 0.001

Unadjusted 30-Day Outcomes

Complication	LSG (n=93,062)	LRGYB (n=41,080)	P-value
Urinary tract infection	0.31%	0.47%	< 0.001
Deep SSI	0.03%	0.20%	< 0.001
Organ space infection	0.29%	0.60%	< 0.001
Wound disruption	0.03%	0.1%	< 0.001
Sepsis	0.22%	0.61%	< 0.001
Renal failure	0.19%	0.38%	< 0.001
Bleeding requiring transfusion	0.57%	1.19%	< 0.001
Pneumonia	0.19%	0.51%	< 0.001
Venous thromboembolism	0.23%	0.23%	0.994
Pulmonary embolism	0.11%	0.15%	0.052
Myocardial infarction	0.03%	0.08%	0.001
Cardiac arrest	0.05%	0.09%	0.003
Cerebrovascular accident	0.01%	0.01%	0.526
Coma	0.01%	< 0.01%	0.137
Unplanned intubation	0.16%	0.40%	< 0.001
ICU admission	0.71%	1.65%	< 0.001
Ventilator greater than 48 hours	0.11%	0.39%	< 0.001
Intervention within 30 days	1.51%	3.33%	< 0.001
Reoperation within 30 days	1.22%	3.19%	< 0.001
Readmission within 30 days	4.05%	7.32%	< 0.001

Multivariate Model - Leak

Variable	OR	95% CI	P-value
LRYGB (compared to LSG)	**2.10**	**1.88 – 2.34**	**< 0.001**
Age (per year)	**1.01**	**1.00 – 1.01**	**0.012**
BMI (per kg/m^2)	**1.01**	**1.00 – 1.02**	**0.001**
Hyperlipidemia	0.82	0.71 – 0.94	0.004
Obstructive Sleep Apnea	1.22	1.09 – 1.37	0.001
Hypertension	1.20	1.06 – 1.36	0.004
Therapeutic Anticoagulation	**1.82**	**1.39 – 2.39**	**< 0.001**
Chronic Steroid Use	**1.51**	**1.06 – 2.16**	**0.023**
Need for Mobility Device	0.81	0.56 – 1.19	0.289
Functional Status (Compared to Independent)			
Partially dependent	**2.52**	**1.62 – 3.91**	**< 0.001**
Totally dependent	**2.32**	**1.22 – 4.41**	**0.01**
Level of training of assistant (compared to none)			
PA/NP/RN	1.16	0.97 – 1.40	0.101
Resident	1.06	0.86 – 1.35	0.573
MIS Fellow	**0.80**	**0.62 – 1.04**	**0.100**
Attending – Weight Loss Surgeon	**0.81**	**0.65 – 1.02**	**0.075**
Attending – Other	**3.90**	**3.19 – 4.77**	**< 0.001**
ASA Class (Compared to Class I)			
II	0.54	0.31 – 0.96	0.034
III	0.42	0.24 – 0.74	0.003
IV	0.37	0.20 – 0.69	0.002

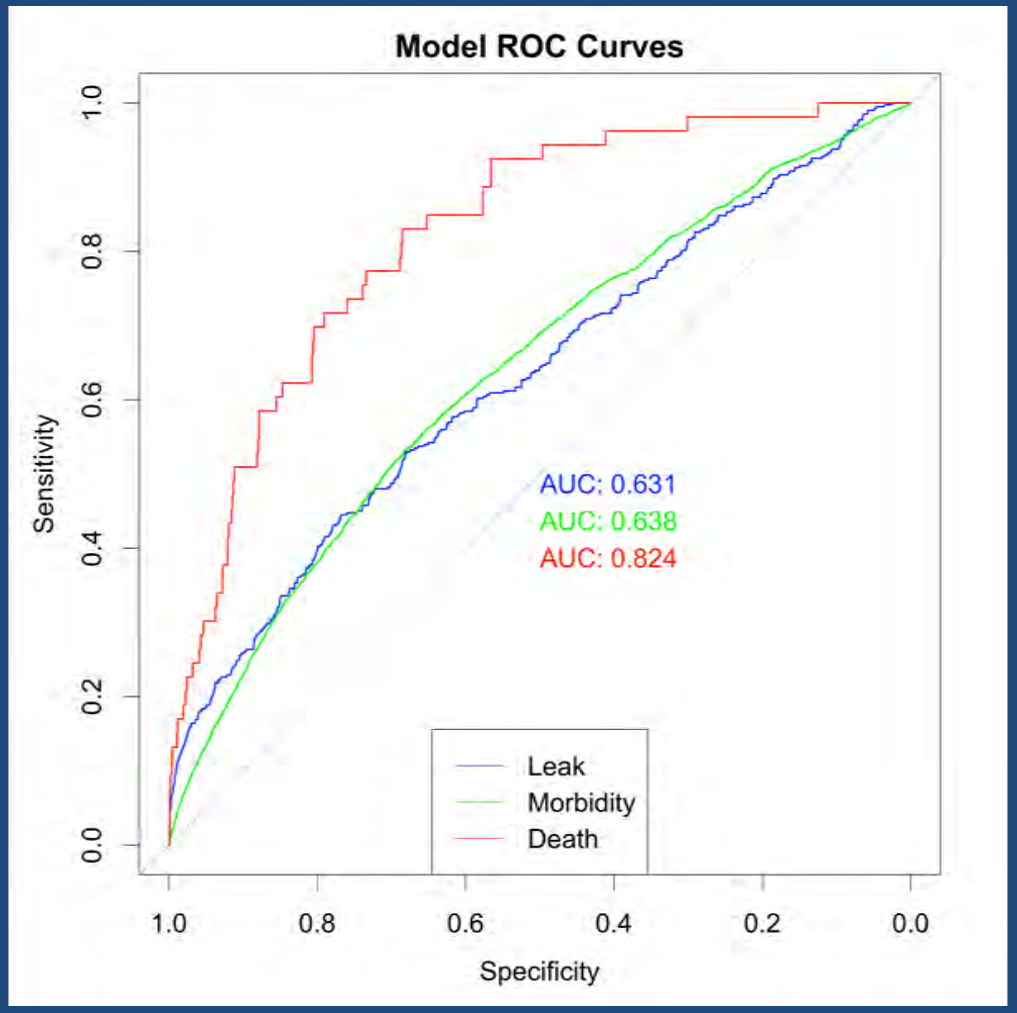
Multivariate Model - Morbidity

Variable	OR	95% CI	P-value
LRGYB (compared LSG)	**2.02**	**1.94 – 2.11**	**< 0.001**
BMI (per kg/m^2)	**1.01**	**1.01 – 1.01**	**< 0.001**
Albumin (per mg/dL)	**0.80**	**0.75 – 0.84**	**< 0.001**
Male (compared to Female)	**0.91**	**0.86 – 0.96**	**< 0.001**
Diabetes (compared to none)			
Non-insulin dependent	1.04	0.98 – 1.10	0.203
Insulin dependent	1.25	1.17 – 1.34	< 0.001
Hyperlipidemia	0.93	0.88 – 0.98	0.006
GERD	1.22	1.16 – 1.27	< 0.001
OSA	1.05	1.00 – 1.10	0.030
COPD	1.38	1.21 – 1.56	< 0.001
Oxygen dependence	1.47	1.23 – 1.76	< 0.001
Hypertension	1.17	1.12 – 1.22	< 0.001
History of MI	1.14	0.97 – 1.32	0.103
Prior Cardiac Surgery	1.54	1.32 – 1.79	< 0.001
Renal Insufficiency	**1.67**	**1.38 – 2.02**	**< 0.001**
Dialysis Dependence	**1.69**	**1.26 – 2.27**	**0.001**
History of PE	1.36	1.17 – 1.60	< 0.001
History of DVT	1.34	1.17 – 1.53	< 0.001
Prior IVC filter	**1.76**	**1.51 – 2.05**	**< 0.001**
Therapeutic Anticoagulation	**1.64**	**1.46 – 1.84**	**< 0.001**
Chronic Steroid Use	1.29	1.21 – 1.49	< 0.001
Smoking history	1.10	1.02 – 1.18	0.009
Prior Surgery	1.28	1.12 – 1.47	< 0.001
Need for Mobility Device	1.26	1.11 – 1.42	< 0.001
Functional Status (compared to Independent)			
Partially dependent	1.07	0.87 – 1.32	0.505
Totally dependent	1.50	1.13 – 2.00	0.005
Level of training of assistant (compared to none)			
PA/NP/RN	1.06	1.00 – 1.13	0.076
Resident	1.23	1.14 – 1.32	< 0.001
MIS Fellow	1.16	1.07 = 1.27	0.001
Attending – Weight Loss Surgeon	1.11	1.03 – 1.20	0.006
Attending - Other	1.38	1.26 – 1.52	< 0.001

Multivariate Model - Mortality

Variable	OR	95% CI	P-value
LRYGB (compared to LSG)	**1.64**	**1.22 – 2.22**	**0.001**
Age (per year)	**1.04**	**1.03 – 1.06**	**< 0.001**
BMI (per kg/m^2)	**1.06**	**1.05 – 1.07**	**< 0.001**
Male (compared to female)	**2.22**	**1.63 – 3.01**	**< 0.001**
Diabetes (compared to none)			
Non-insulin dependent	1.38	0.94 – 2.01	0.096
Insulin dependent	1.84	1.23 – 2.76	0.003
Hyperlipidemia	1.32	0.93 – 1.85	0.12
Oxygen dependence	**2.65**	**1.43 – 4.91**	**0.002**
Therapeutic Anticoagulation	**3.13**	**2.04 – 4.82**	**< 0.001**
Need for Mobility Device	1.69	1.00 – 2.88	0.051

Model Performance



Conclusions

- In the first 30 days, LSG was safer than LRYGB:
  - LSG had half the risk-adjusted odds of leak
  - LSG had half the risk-adjusted odds of morbidity
  - LSG had nearly half the risk-adjusted odds of death

- The reduced risk with LSG must be weighed against the benefits. Long term weight outcomes, metabolic disease resolution, and risk of GERD progression with LSG are still under study

- LSG is a better choice for high risk candidates.

Limitations

- Our study used a composite outcome of leak and morbidity.
- The discriminative ability of the models was poor for leak or morbidity.
- Outcomes after 30-days were not studied – delayed leak, stricture, ulcers, etc. are not included
- To really decide which procedure to recommend for a patient, better characterization of long-term results are needed: weight-loss maintenance, need for conversion, GERD, and diabetes resolution

Questions?