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Journal

Surgery for Obesity and Related Diseases, 13(10)

ISSN

1550-7289

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Publication Date

2017-10-01

DOI

10.1016/j.soard.2017.07.021

Peer reviewed

HHS Public Access

Author manuscript

Surg Obes Relat Dis. Author manuscript; available in PMC 2018 December 05.

Published in final edited form as:

Surg Obes Relat Dis. 2017 October ; 13(10): 1723–1727. doi:10.1016/j.soard.2017.07.021.

The effect of hospital teaching status on outcomes in bariatric surgery

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Abstract

Background: Studies have shown conflicting effects of resident involvement on outcomes after laparoscopic bariatric surgery. Resident involvement may be a proxy for a teaching environment in which multiple factors affect patient outcomes. However, no study has examined outcomes of laparoscopic bariatric surgery based on hospital teaching status.

Objective: To compare outcomes after laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG) between teaching hospitals (THs) and nonteaching hospitals (NTHs).

Setting: Retrospective review of a national database in the United States.

Methods: The Nationwide Inpatient Sample database (2011–2013) was reviewed for obese patients who underwent LRYGB or LSG. Patient demographic characteristics and outcomes were analyzed according to hospital teaching status. Primary outcome measures included risk-adjusted inpatient mortality and serious morbidity.

Results: We analyzed 32,449 LRYGBs and 26,075 LSGs. There were 35,160 (60.1%) cases performed at THs and 23,364 (39.9%) cases performed at NTHs. At THs, the distribution of LRYGB versus LSG cases was 20,461 (58.2%) versus 14,699 (41.8%), respectively; at NTHs, the distribution was 11,988 (51.3%) versus 11,376 (48.7%), respectively. For LRYGB, there were no significant differences between THs versus NTHs in mortality (AOR 1.14; $P = 0.99$), but there was an increase in odds of serious morbidity at THs (AOR 1.36; $P < 0.001$). For LSG, there were no significant differences between THs versus NTHs for mortality (AOR 1.15; $P = 0.99$) or serious morbidity (AOR 1.03; $P = 0.99$).

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Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.soard.2017.07.021.

Conclusions: There is an association between THs and increased serious morbidity for LRYGB, but hospital teaching status has no effect on morbidity or mortality after LSG. Further research is warranted to elucidate the reasons for these associations.

Keywords

Laparoscopic bariatric surgery; Gastric bypass; Sleeve gastrectomy; Resident education; Teaching hospital; Academic institution; LRYGB; LSG; Surgical resident

Surgical resident education is imperative to train the next generation of surgeons, but training must be balanced with patient safety. Several studies examining the effect of resident involvement during laparoscopic bariatric surgery have demonstrated mixed results, with some studies suggesting worse outcomes with resident involvement and others suggesting there is no difference [1–6]. However, the presence of a resident in a surgical case may be only a proxy for a teaching environment in which other learners (e.g., anesthesia or medicine residents) may be participating in the patient's perioperative care [1]. It is likely that resident participation in laparoscopic bariatric surgery cases is only one of many factors in the teaching environment that may be influencing patient outcomes. Therefore, rather than focusing on just the presence of residents in surgical cases, the aim of the present study was to examine the overall teaching environment by comparing outcomes between teaching hospitals (THs) and nonteaching hospitals (NTHs) after laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG).

Methods

Data source

Data were obtained using the National (Nationwide) Inpatient Sample (NIS) database. The NIS database is a 20% sample of all discharges in the United States and contains data from over 7 million annual hospital admissions nationwide. It is the largest publically available inpatient care database in the United States. It was developed for the Healthcare Cost and Utilization Project (HCUP) and is sponsored by the Agency for Healthcare Research and Quality. The NIS database is limited to inpatient care and does not provide any postdischarge information. Details about NIS sampling methodology and data abstraction can be found on the HCUP website [7]. Approval for use of the NIS database was obtained from the HCUP. This study was exempt from approval by our institutional review board because the NIS is a publically available database with de-identified data.

Patient selection

The NIS database was reviewed for obese patients aged ≥18 years who underwent LRYGB or LSG between 2011 and 2013. Diagnoses and procedures were selected using the International Classification of Diseases 9th Edition (ICD-9) and the ICD-9 Clinical Modification (ICD-9-CM), respectively: obesity (ICD-9 278.0, 278.00, 278.01), LRYGB (ICD-9-CM 44.38), and LSG (ICD-9-CM 43.82). Emergent cases were excluded, as were cases that were transferred or that involved malignancy, inflammatory bowel disease, or noninfectious colitis.

Demographic characteristics and outcome variables

Patient demographic characteristics and outcomes were stratified according to hospital teaching status and analyzed separately based on procedure, either LRYGB or LSG, to control for the effect of procedure type. The NIS database considers a hospital to be a TH if it has an Accreditation Council for Graduate Medical Education–approved residency program, is a member of the Council of Teaching Hospitals, or has a ratio of full-time equivalent interns and residents to beds of .25 or higher [7]. Primary outcome measures included risk-adjusted rates of inpatient mortality and serious morbidity, and secondary outcome measures included risk-adjusted hospital length of stay (LOS). Serious morbidity was defined as any of the following major complications: cerebral vascular accident, myocardial infarction, pneumonia, acute respiratory failure, bowel obstruction, acute renal failure, deep vein thrombosis, pulmonary embolism, intra-abdominal abscess, wound dehiscence, bleeding, or sepsis. A list of the ICD-9 codes used to identify these complications is available in Appendix 1.

Statistical analysis

Data management was carried out using SAS version 9.4 (SAS Institute Inc., Cary, NC), and all statistical analyses were performed using the R language and environment. Logistic regression was used to model the probability of binary outcomes based on hospital teaching status, and associations were quantified as adjusted odds ratios (AOR). Linear regression was used to model the mean of continuous outcomes based on hospital teaching status, and associations were quantified as estimated adjusted mean differences (AMD). Adjustments for both AOR and AMD included age, sex, race, disease severity, and pre-operative co-morbidities including history of congestive heart failure, chronic pulmonary disease, diabetes, hyper-tension, liver disease, renal failure, pulmonary circulatory disease, peripheral vascular disease, and smoking. Missing data were excluded from regression analysis. Robust standard errors were used to guard against model misspecification [8]. Estimates were bias-adjusted for rare events [9]. All P values are 2-sided. Statistical significance was set at $P \leq .05$. Holm's method was used to adjust P values for multiple comparisons [10].

Results

A total of 58,524 cases were analyzed, including 32,449 LRYGB cases (55.4%) and 26,075 LSG cases (44.6%). There were 35,160 (60.1%) cases performed at THs and 23,364 (39.9%) cases performed at NTHs. At THs, the distribution of LRYGB versus LSG cases was 20,461(58.2%) versus 14,699 (41.8%), respectively, and at NTHs, the distribution was 11,988 (51.3%) versus 11,376 (48.7%), respectively. Patient demographic characteristics and co-morbidities are listed in Table 1.

Table 2 lists unadjusted outcome rates, and Table 3 lists the risk-adjusted multivariate regression analysis for mortality, serious morbidity, and LOS. After risk adjustment, hospital teaching status was not associated with a statistically significant difference in mortality for either LRYGB (TH versus NTH AOR 1.14; $P = 0.99$) or LSG (TH versus NTH AOR 1.15; $P = 0.99$). Compared with NTHs, THs were associated with increased odds of overall serious morbidity for LRYGB (AOR 1.36, $P < .001$), but there was no difference in serious

morbidity for LSG (AOR 1.03, $P = 0.99$). The estimated mean LOS was higher at THs versus NTHs for both groups (LRYGB: AMD .08, $P < .001$; LSG: AMD .15, $P < .001$).

Discussion

THs provide training for residents and fellows across various medical and surgical disciplines in a teaching environment that may affect patient outcomes. In this study, we examined the effect of THs on outcomes of patients who underwent laparoscopic bariatric surgery. We found that compared with NTHs, THs are associated with higher odds of serious morbidity for LRYGB but no significant difference in odds of serious morbidity or mortality for LSG.

Previous studies have reported that resident involvement in LRYGB cases is associated with increased morbidity (Table 4) [1–3]. In an American College of Surgeons National Surgical Quality Improvement Program (NSQIP) study that evaluated resident involvement in several different laparoscopic surgery cases, resident involvement in LRYGB was associated with increased morbidity compared with no resident involvement (5.2% versus 4%, respectively; $P < .01$), without any differences in mortality (.2% versus .1%, respectively) [1]. In another NSQIP study examining the effect of resident involvement in 43,477 LRYGB cases, the authors found that resident involvement was associated with increased rates of superficial surgical site infections (AOR 1.47, $P < .001$), renal failure (AOR 2.26, $P = .002$), urinary tract infections (AOR 1.26, $P = .024$), and sepsis (AOR 1.29, $P = .031$), without any differences in mortality [2]. In a study of over 17,000 patients who underwent LRYGB in the Michigan Bariatric Surgery Collaborative database, resident involvement was independently associated with increased rates of wound infections (AOR 2.06, 95% CI 1.03–2.85) and venous thromboembolism events (AOR 2.01, 95% CI .78–2.61) [3]. However, 2 studies found no difference in morbidity or mortality when residents were involved in LRYGB cases [4,5].

We also found LOS to be increased in THs compared with NTHs for both LRYGB (AMD .08, $P < .001$) and LSG (AMD .15, $P < .001$). A NSQIP study demonstrated that resident involvement in LRYGB cases was similarly associated with greater LOS (AMD .14, $P < .001$) [2]. However, the small increases in LOS are likely not clinically significant. Two other studies that evaluated LOS based on resident involvement during LRYGB cases did not find any statistical difference in LOS with resident involvement [1,5].

The inconsistent conclusions regarding the effect of resident involvement on outcomes after LRYGB may be attributable to variable degrees of resident involvement and attending oversight, both of which are poorly documented in the literature. Another explanation may be that resident involvement in surgery is merely a proxy for the teaching environment in general, in which multiple learners are involved at various points in a patient's care [1]. There may be other differences between THs and NTHs that may affect patient outcomes, such as staffing ratios, adherence to care process guidelines, and communication and coordination of care [11]. Additionally, THs are often tertiary referral centers for more complex patients with higher severity of illness [11–14]. Therefore, resident participation in surgical cases may be just one of many factors affecting patient outcomes within the

teaching environment. However, it is difficult to fully adjust for all these possible confounders.

As for LSG, the literature on the effect of resident involvement on outcomes is limited to a recently published single-institutional study from Poland that reported no difference in perioperative complications after 205 LSG cases performed by residents versus 28 LSG cases performed by experienced bariatric surgeons [6]. This study was likely underpowered to detect differences in morbidity or mortality. Our study is the first to assess the effect of the overall teaching environment on LSG, and we found no differences in morbidity or mortality between THs and NTHs.

There are several limitations to our study. As a retrospective database review, this study was subject to bias from missing data. There were also no variables to allow us to control for multiple other factors that might affect patient outcomes at THs versus NTHs, such as patient surgical complexity, surgeon skill, or hospital accreditation status. The NIS database is also limited to inpatient data, and we were unable to account for any complications that may have occurred after discharge from the hospital. Despite these limitations, our study is the first to evaluate the effect of the hospital teaching environment on outcomes after laparoscopic bariatric surgery, allowing us to examine the bigger picture rather than only the effect of resident involvement in surgical cases. Additionally, the NIS database is a 20% representative sample of all hospital discharges in the United States, allowing us to extrapolate our results nationally. This is not possible with other national databases such as NSQIP, for which data represent only those institutions that choose to participate, introducing a degree of selection bias to the analysis.

Conclusion

There is an association between THs and increased serious morbidity for LRYGB, but hospital teaching status has no significant impact on outcomes after LSG. Further research is warranted to elucidate the reasons for these associations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

[1]. Davis SS, Jr, Husain FA, Lin E, Nandipati KC, Perez S, Sweeney JF. Resident participation in index laparoscopic general surgical cases: impact of the learning environment on surgical outcomes. J Am Coll Surg 2013;216(1):96–104. [PubMed: 22999330]

[2]. Doyon L, Moreno-Koehler A, Ricciardi R, Nepomnayshy D. Resident participation in laparoscopic Roux-en-Y gastric bypass: a comparison of outcomes from the ACS-NSQIP database. Surg Endosc 2016;30(8):3216–24. [PubMed: 26541722]

[3]. Krell RW, Birkmeyer NJ, Reames BN, et al. Effects of resident involvement on complication rates after laparoscopic gastric bypass. J Am Coll Surg 2014;218(2):253–60. [PubMed: 24315885]

[4]. Tseng WH, Jin L, Canter RJ, et al. Surgical resident involvement is safe for common elective general surgery procedures. J Am Coll Surg 2011;213(1):19–26; discussion 26–8. [PubMed: 21493108]

[5]. Fanous M, Carlin A. Surgical resident participation in laparoscopic Roux-en-Y bypass: is it safe? Surgery 2012;152(1):21–5. [PubMed: 22503322]

[6]. Major P, Wysocki M, Dworak J, Pedziwiatr M, Malczak P, Budzynski A. Are bariatric operations performed by residents safe and efficient? Surg Obes Relat Dis 2017;13(4):614–21. [PubMed: 28159560]

[7]. Healthcare Cost and Utilization Project (HCUP) [database on the Internet]. Rockville (MD): Hcup-Databases, 2016 [cited 2017 Feb 7]. Available from: www.hcup-us.ahrq.gov/nisoverview.jsp.

[8]. Huber PJ. The behavior of maximum likelihood estimates under nonstandard conditions Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability, Volume 1: Statistics; 1965 June 21–July 18, and 1965 December 27–1966 January 7; Berkeley, CA. Berkeley: University of California Press; 1967.

[9]. King GZ. Logistic regression in rare events data. Political Analysis 2001;9:137–63.

[10]. Hothorn T, Westfall PH, Bretz F. Multiple comparisons using R. New York: Chapman and Hall; 2011.

[11]. Shahian DM, Nordberg P, Meyer GS, et al. Contemporary performance of U.S. teaching and nonteaching hospitals. Acad Med 2012;87 (6):701–8. [PubMed: 22534588]

[12]. Shahian DM, Liu X, Meyer GS, Normand SL. Comparing teaching versus nonteaching hospitals: the association of patient characteristics with teaching intensity for three common medical conditions. Acad Med 2014;89(1):94–106. [PubMed: 24280849]

[13]. Wyatt SM, Moy E, Levin RJ, et al. Patients transferred to academic medical centers and other hospitals: characteristics, resource use, and outcomes. Acad Med 1997;72(10):921–30. [PubMed: 9347720]

[14]. Carbonell AM, Lincourt AE, Matthews BD, Kercher KW, Sing RF, Heniford BT. National study of the effect of patient and hospital characteristics on bariatric surgery outcomes. Am Surg 2005;71 (4):308–14. [PubMed: 15943404]

Table 1

Patient characteristics for laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy at teaching and nonteaching hospitals

Patient characteristics	LRYGB		LSG	
	TH (n = 20,461)	NTH (n = 11,988)	TH(n = 14,699)	NTH (n = 11,376)
Age, median (IQR), yr	45 (36–54)	45 (36–55)	44 (35–52)	43 (36–52)
Female	79.3	78.1	78.1	78.3
Race				
White	60.2	71.6	58.1	65.1
Black	14.9	10.0	18.6	12.5
Hispanic	12.2	10.3	12.5	12.9
Other	3.2	4.5	4.7	6.7
Missing	9.5	3.6	6.1	2.8
Insurance				
Medicare	18.3	16.8	9.6	8.1
Medicaid	14.0	9.9	9.8	6.0
Private/HMO	61.6	64.7	74.8	76.0
Self-Pay	1.6	3.0	3.7	7.0
Other	4.5	4.7	1.8	1.0
Missing	.12	.75	0.18	1.9
ASA				
I	53.6	56.7	62.6	64.7
II	41.8	39.5	35.0	33.7
III	4.0	3.3	2.1	1.5
IV	.59	.46	.22	.14
BMI				
<30	.07	.08	.12	.21
30–39.9	15.9	16.5	20.5	22.5
40–40.9	51.7	51.7	51.6	50.3
50–50.9	21.2	21.2	17.6	16.1
>60	6.1	6.2	5.3	4.3
Missing	5.0	4.3	4.7	6.5
Preoperative Co-morbidities				
Congestive heart failure	2.0	1.6	1.5	1.1
Chronic pulmonary disease	21.9	18.7	18.4	15.8
Diabetes	38.3	38.8	26.2	25.1
Hypertension	59.6	61.0	53.1	52.6
Liver disease	13.0	11.6	9.4	11.7
Peripheral vascular disease	.84	.63	.65	.63
Renal failure	2.2	1.6	1.8	1.1
Smoking	17.2	16.1	16.7	14.6

LRYGB = laparoscopic Roux-en-Y gastric bypass; LSG = laparoscopic sleeve gastrectomy; TH = teaching hospital; NTH = nonteaching hospital; IQR = interquartile range; HMO health maintenance organization; ASA = American Society of Anesthesiology; BMI = body mass index.

Data are stated as percentages unless otherwise indicated. Percentages reflect the number of complete cases, not necessarily the total number in the study.

Table 2

Unadjusted outcomes for laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy at teaching and nonteaching hospitals

Outcomes	LRYGB		LSG	
	TH (n = 20,461)	NTH (n = 11,988)	TH (n = 14,699)	NTH (n = 11,376)
Mortality	.09	.05	.03	.02
Serious Morbidity	3.64	2.63	1.85	1.42
Cerebral vascular accident	.00	.01	.00	.00
Myocardial infarction	.57	.40	.44	.29
Pneumonia	.46	.33	.22	.13
Acute respiratory failure	.73	.32	.34	.15
Bowel obstruction	.25	.18	.05	.02
Acute renal failure	1.79	1.44	.80	.80
Deep venous thrombosis	.07	.07	.04	.01
Pulmonary embolism	.06	.07	.03	.04
Intra-abdominal abscess	.08	.09	.07	.03
Wound dehiscence	.35	.34	.16	.12
Bleeding	.00	.00	.00	.00
Sepsis	.25	.23	.11	.08
Mean (SD) length of stay, d	2.31 (2.01)	2.20 (1.73)	1.97 (1.79)	1.77 (1.13)

LRYGB = laparoscopicRoux-en-Ygastricbypass;LSG = laparoscopic sleevegastrectomy;TH = teaching hospital;NTH = nonteaching hospital; SD = standard deviation.

Data are listed as percentages unless otherwise stated. Percentages reflect the number of complete cases, not necessarily the total number in the study.

Table 3

Risk-adjusted odds ratios and mean differences at teaching versus nonteaching hospitals for laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy

TH versus NTH (reference)	AOR/AMD	95% CI	Adjusted *P* alue
LRYGB			
Mortality	1.14	(.40–3.29)	1
Serious morbidity	1.36	(1.16–1.59)	<.001
Length of stay (d)	.08	(.04-. 12)	<.001
LSG			
Mortality	1.15	(.14–9.07)	1
Serious morbidity	1.03	(.82–1.28)	1
Length of stay (d)	.15	(.12-. 18)	<.001

TH = teaching hospital; NTH = nonteaching hospital; AOR = adjusted odds ratio; AMD = adjusted mean difference; CI = confidence interval; LRYGB = laparoscopic Roux-en-Y gastric bypass; LSG = laparoscopic sleeve gastrectomy.

Table 4

Outcomes from selected studies comparing resident versus no resident involvement in laparoscopic Roux-en-Y Gastric bypass procedures

Study	Study type	Study size (n)	Resident involvement versus no resident involvement	
			Morbidity	**Mortality**
Davis et al. [1]	NSQIP database	12,390 *	↑ Morbidity † (5.2% versus 4%, $P < .01$)	No difference
Doyon et al. [2]	NSQIP database	43,477	↑ Superficial SSI (AOR 1.47, $P < .001$)	No difference
			↑ Renal failure (AOR 2.26, $P = .002$)	
			↑ UTI (AOR 1.26, $P = .024$)	
			↑ Sepsis (AOR 1.29, $P = .003$)	
			↓ Wound disruption (AOR .29, $P < .001$)	
Fanous et al. [5]	Institutional review	711	No difference	No difference
Krell et al. [3]	MBSC database	17,057	↑ Any complication (13% versus 8.5%, AOR 1.44, $P < .05$)	Not evaluated
			↑ Any surgical complication (10.9% versus 6.9%, AOR 1.41, $P < .05$)	
			↑ Wound Infection (4.5% versus 2.3%, AOR 2.06, $P < .05$)	
			↑ VTE (0.6% versus .2%, AOR, 2.01, $P < .05$)	
Tseng et al. [4]	NSQIP database	9372 ‡	No difference	No difference

NSQIP = National Surgery Quality Improvement Program; SSI = surgical site infection; AOR = adjusted ratio; UTI = urinary tract infection; MBSC = Michigan Surgery Collaborative; VTE = thromboembolism.

*Subgroup of total 89,720 patients undergoing 1 of 6 different procedures.

†Unadjusted rates; adjusted rates not reported.

‡Subgroup of total 37,907 patients undergoing 1 of 7 different procedures.