Journal Title: Arch Surg

Volume: 138
Issue: 4
Month/Year: ?
Pages: 367-75

Article Author: Cottam

Article Title: Laparoscopic era ot Operation

Imprint:

OCT 0 4 2007

Call #:

LD NUMBER:

Item #:

PATRON TYPE: Other

CUSTOMER HAS REQUESTED:

Carol Brown (cbrown)
1050 East South Temple
SALT LAKE CITY, UT 84102

NOTE:
email to DR Cottam drdanielcottam@yahoo.com

SPECIAL ARTICLE

Laparoscopic Era of Operations for Morbid Obesity

Daniel R. Cottam, MD; Samer G. Mattar, MD; Philip R. Schauer, MD

The goal of this article is to review the status of the emerging field of laparoscopic bariatric surgery, to discuss developmental issues regarding technique and training, and finally, to summarize the present and future roles of laparoscopic bariatric surgery. We reviewed all published literature from 1992 to the present on MEDLINE. Articles were excluded for analyses that were case reports or articles on technical aspects of given procedures. Laparoscopic vertical banded gastroplasty (LVBG) has reduced perioperative morbidity compared with the open approach but seems to have a low overall adoption rate, at least, in the United States. Laparoscopic adjustable silicone gastric banding (LASGB) has become firmly established in Europe and Australia. It has only recently been introduced in the United States. Laparoscopic adjustable silicone gastric banding has been proven to be an effective weight loss procedure in Europeans with morbid obesity. Laparoscopic Roux-en-Y gastric bypasses (LRYGBPs) can also be safely performed laparoscopically with weight loss similar to open Roux-en-Y gastric bypass surgery. Laparoscopic biliopancreatic diversion procedures (LBPDs) have been performed safely in a few small series, but overall, experience is insufficient to draw strong conclusions. All laparoscopic bariatric procedures have significant learning curves. Laparoscopic bariatric surgery can be safely performed for all types of bariatric operations. The laparoscopic approaches to bariatric surgery significantly reduce perioperative morbidity justifying the acquisition of skills needed to perform these procedures.

Two major events characterize the current era of bariatric surgery. The first event is the accumulation of numerous outcome-based studies that provide reliable information on both short-term and long-term results of bariatric operations that have been proven to be relatively safe and effective. The second event is the development, maturation, and application of laparoscopic techniques to the field of bariatric surgery. Laparoscopy in bariatric surgery is a major advance because it reduces perioperative morbidity and speeds recovery.

Current laparoscopic approaches to bariatric operations include LVBG, LASGB, LRYGBP, and LBPDs. The transition from second-generation procedures, such as laparoscopic Nissen fundoplication, to laparoscopic bariatric operations has been arduous because of the technical complexity of the procedures.

Sufficient experience is available to review the outcomes of the following 4 bariatric procedures: LVBG, LASGB, LRYGBP, and LBPD. The goal of this article is to review the status of the emerging field of laparoscopic bariatric surgery, to discuss developmental issues regarding training, and finally, to summarize the present and future roles of laparoscopic bariatric operations.

From the Department of Surgery, University of Pittsburgh; and the Minimally Invasive Surgery Center, University of Pennsylvania Medical Center, Pittsburgh. Dr Schauer is now with the Department of Surgery, University of Pittsburgh, Magee–Women's Hospital.

Table 1. Outcomes for Open Gastric Bypass Surgery: Selected Series

Source	Total No. of Patients	Size of Patient, BMI or IBW*	Length of OR Time, min	Length of Hospital Stay, d	Early Complication Rate, %	Mortality, %	Pulmonary Embolism Rate, %	Leakage Rate, %	Hernia Rate, %	Duration of Follow-up, mo	Weight Loss, kg	EWL, %
Mason and Ito,[2] 1969	26	BMI 42	NI	NI	19.0	7.7	3.4	0	11.5	12	43	NA
Griffen et al,[3] 1981	402	BMI 134	NI	NI	4.2	0.7	0.2	5.5	3.5	6	35	NA
Linner,[4] 1982	174	BMI 126	NI	NI	10.4 (all)	0.6	0	0.6	0	24	NA	64
Sugerman et al,[5] 1989	182	IBW 213	NI	6-7	NI	1.0	0	1.6	18	12	NA	67
Hall et al,[6] 1990	99	IBW 198	120	8	20.0	0	3.0	0	2	36	NA	67 Lost >50% EBW
Brolin et al,[7] 1992	90	BMI 62	NI	NI	5.0	0	1.1	0	6.6	43	NA	64
MacLean et al,[8] 1993	106	BMI 50	NI	NI	NI	0	NI	5.6	NI	33	NA	58 Lost >50% EBW
Poires et al,[9] 1995	608	BMI 50	NI	5-6	25.5	1.5	NI	NI	23.9	168	NA	49
Capella and Capella,[10] 1996	560	BMI 52	NI	NI	1.0	0	0	0	NI	60	NA	62
Fobi et al,[11] 1998	944	BMI 46	NI	4	2.7	0.4	0.6	3.1	4.7	24	NA	80
MacLean et al,[12]	243	BMI 49	NI	NI	NI	0.4	NI	NI	16.0	66	NA	44/29†
Capella and Capella,[13] 2002	652	BMI 50	NI	NI	3.0	0.3	0.3	0	28.0	60	NA	77

Abbreviations: BMI, body mass index; EBW, excess body weight; EWL, excess weight loss; IBW, ideal body weight; NA, not applicable; NI, not indicated; OR, operating room.

*The BMI is calculated as the weight in kilograms divided by the height in meters squared; IBW is given as a percentage.

†Value given as preoperative BMI/postoperative BMI.

CURRENT BENCHMARK FOR BARIATRIC SURGERY

The RYGBP is the most commonly performed bariatric procedure in the United States.[1] Furthermore, there are numerous studies documenting both short-term and long-term outcomes.[2-12] These studies, listed in **Table 1**, collectively suggest that open RYGBP results in a hospital stay ranging from 4 to 8 days, a perioperative complication rate of 3% to 20%, a mortality rate of 0% to 1%, a pulmonary embolus rate of 0% to 3%, a leakage rate of 0% to 5%, and a hernia rate of 5% to 28%. Operative time and hospital stay were not reliably reported in most studies. Long-term weight loss at 5 to 15 years seems to be 49% to 77% of excess body weight. Most comorbidities including hypertension, sleep apnea, osteoarthritis, type 2 diabetes mellitus, and gastroesophageal reflux are improved or resolved and the quality of life is significantly improved. Late complications may include marginal ulcer, bowel obstruction, and anastomotic stricture. Late nutritional deficiencies are a consequence of the foregut bypass and include iron deficiency anemia (up to 47%), vitamin B deficiency (up to 40%), folate deficiency (up to 18%), and other micronutrient deficiencies.[14] Most of these nutrient deficiencies can be circumvented by adequate dietary supplementation. Protein malnutrition, however, is not a recognized complication of RYGBP. It is against these benchmarks that all bariatric operations, laparoscopic or open, should be judged.

RATIONALE FOR A LESS INVASIVE APPROACH TO BARIATRIC SURGERY

As experience with open bariatric procedures has progressed, complication rates have steadily decreased. However, cardiopulmonary and wound complications still remain a major problem.[15,16] By minimizing the access incision, the surgeon using a laparoscopic procedure has a strong potential to significantly reduce recovery time and morbidity associated with laparotomy. Evidence favoring the laparoscopic approach for major abdominal operations is the reduction of the stress response to surgery. Studies have shown that laparoscopic surgery offers better preserved cell-mediated immunity and decreased levels of catecholamines, cortisol, glucose, cytokines, and other acute-phase reactants compared with laparotomy.[17-19] Although not definitively proven, the reduced stress response may translate to a reduction in incidence and severity of related complications. Cardiopulmonary complications have been shown to occur less commonly after laparoscopic procedures compared with laparotomy.[20] Preserved pulmonary function is the most well-documented benefit of laparoscopic surgery, with comparatively less impairment in postoperative ventilation, total lung capacity, and oxygen saturation.[21] Reduced postoperative pulmonary compromise attributed to laparoscopy directly results in fewer pulmonary complications.[21] The gastrointestinal system also benefits from laparoscopy. Postoperative ileus is less common and of shorter duration following laparoscopic procedures.[22] Adhesion-related morbidity such as infertility, bowel obstruction, and chronic abdominal pain are reduced following laparoscopic surgery.[23] Additionally, laparoscopic access has dramatically reduced the incidence and magnitude of wound-related complications including hernias, seromas, infections, hematomas, and dehiscences.[20]

Overall operative morbidity and mortality, particularly in high-risk patients, may be reduced by the laparoscopic approach as demonstrated in comparative studies of laparoscopic vs open cholecystectomy.[20,24] Obese patients are generally at higher risk than nonobese patients for cardiovascular and pulmonary risks, along with higher rates of thromboembolic events, postoperative infections, and wound complications.[25-35] Thus, despite good or acceptable outcomes for open bariatric operations, the well-documented benefits of laparoscopic surgery in nonobese patients may be even more profound in obese patients. Supportive evidence comes from one retrospective study comparing laparoscopic cholecystectomy with open cholecystectomy in patients with morbid obesity that demonstrated that the laparoscopic approach was associated with a significant reduction in morbidity and mortality in high-risk patients who have diabetes mellitus.[36] Finally, Nguyen et al[37,38] in an elegant series of prospective randomized studies showed that laparoscopic compared with open gastric bypass surgery resulted in less blood loss, reduced pulmonary complications, shorter hospital stay, faster recovery, and reduced need for intensive care. In summary, strong evidence suggests that the benefits for the laparoscopic approach to bariatric operations more than justify the effort to develop and to perfect these techniques.

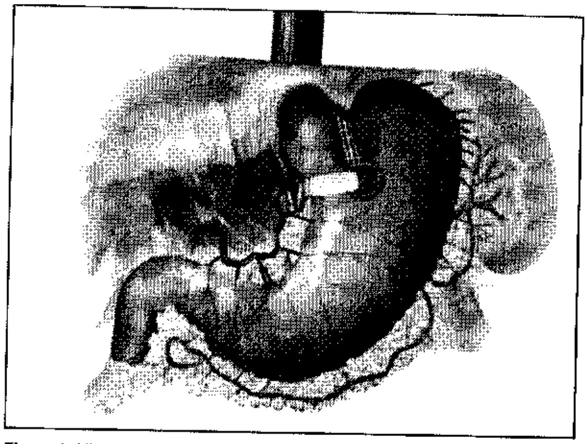

Figure 1. View of completed vertical banded gastroplasty (Reprinted from Schauer P, Hamad G, Ikramuddin S. Surgical management of gastroesophageal reflux disease in obese patients. *Semin Laparosc Surg.* 2001;8:256-264, with permission from Elsevier.)

LAPAROSCOPIC VERTICAL BANDED GASTROPLASTY

All variations of LVBGs (**Figure 1**) are derived from the Mason gastroplasty.[39] The experience with LVBG comes predominantly from Europe. Surgeons in the United States seem reluctant to consider LVBG because long-term weight loss after open VBG seems less favorable than that of RYGB.[40-42] Furthermore, complications such as gastroesophageal reflux disease (16%) and frequent vomiting (21%) are common.[40]

To date there are several studies of LVBG with short follow-up periods that have been published, mostly by European surgeons (**Table 2**).[43-51] These studies should be interpreted considering that most of the patients are European and have low body mass indexes (BMIs) (in the 40s) who, for unclear reasons, respond better to gastric restrictive procedures than do patients in the United States. Mean operative time ranges from 60 to 120 minutes with hospital stays of 1 to 4 days. Conversion rates range from 1% to 12%. The most common complications include bleeding (0%-2%), fistula (0%-1.5%), subphrenic abscess (0%-2%), gastric perforation (0%-2%), outlet stenosis (0%-2%), deep vein thrombosis–pulmonary embolism (0%-2%), and pulmonary complications (0%-3%). Wound infections were uncommon. Late complications after LVBG that may require reoperation include new onset gastroesophageal reflux (0.5%-12%), staple-line fistula (0%-3%), food intolerance (0%-2%), outlet stenosis (0%-2%), pouch enlargement (0%-2%), and port-site incisional hernia (0%-0.5%). Mortality varied from 0% to 1.7%, with pulmonary embolus being the most common

Table 2. Selected Laparoscopic Vertical Banded Gastroplasty Series

Source	Total No. of Patients	Female, %	BMI*	Length of OR Time, min	Conversion Rate, %	Complication Rate, % Early	Complication Rate, % Late	Length of Hospital Stay, d	Duration of Follow-up, mo	Type of Weight Loss
Alle et al,[43] 1998	261	85.4	43.3	102	1.1	1.9	5.7	4	28 (Mean)	75% EWL at 18 mo
Goergen et al,[45] 1999	203	79.8	43.0	120	2.8	2.9	2.0	4	NI	NI
Lonroth and Dalenback,[46] 1998	105	75.2	41.0	NI	5.7	1.9	1.9	3-5	6	25 kg (Mean) at 6 mo
Naslund et al,[47] 1999	60	83.0	44.4	115	25.0	6.7	2.2	3	23 (Mean)	BMI ↓ 10.9 at 36 mo
Salval et al,[48] 1999	87	86.0	43.4	NI	0	12.6	7.4	NI	6-18 (Range)	76% EWL at 18 mo
Toppino et al,[49] 1999	170	NI	43.9	95	0.6	4.7	4.0	NI	1-36 (Range)	61% EWL at 36 mo
Morino et al,[50] 2002	250	87.0	45.0	95	0.8	4.4	4.0	5	48	62% EWL at 48 mo

Abbreviations: BMI, body mass index; EWL, excessive weight loss; NI, not indicated; OR, operating room; ↓, decrease.
*The BMI is calculated as the weight in kilograms divided by the height in meters squared.

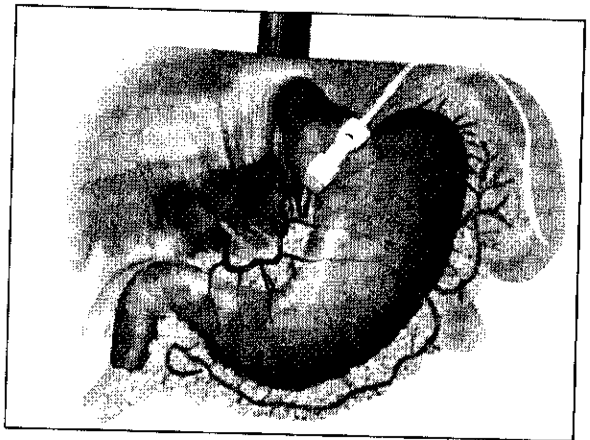

Figure 2. View of completed laparoscopic adjustable gastric bypass. (Reprinted from Schauer P, Hamad G, Ikramuddin S. Surgical management of gastroesophageal reflux disease in obese patients. *Semin Laparosc Surg.* 2001;8:256-264, with permission from Elsevier.)

cause of death. Weight loss, with follow-up of less than 3 years in most series, seems to be slightly higher than reported for open VBG (ie, 40%-50% excess weight loss) for unexplainable reasons.

LAPAROSCOPIC ADJUSTABLE SILCONE GASTRIC BANDING

Laparoscopic adjustable silicone gastric banding (**Figure 2**) was first introduced by Belachew et al[52] in 1993. It is a purely gastric restrictive procedure that involves the use of an adjustable silicone band placed around the gastric cardia to create a small (15-mL) gastric pouch with a narrow outlet similar to that of the VBG. Presently, in the United States only the BioEnterics Lap-Band System (Inamed Health, Santa Barbara, Calif) has been approved for use by the Food and Drug Administration. Among other adjustable gastric banding systems, the Swedish Adjustable Gastric Band (Obtech Medical, Baar, Switzerland), the Midband (Medical Innovation Development, Villerubane, France), and the Heliogast Band (Helioscopie, Vienne, France) are included. These banding systems have an inflatable saline reservoir that can adjust the luminal diameter postoperatively by percutaneous access of a subcutaneous port placed in the abdominal wall. Laparoscopic adjustable silicone gastric banding differs from VBG in that the band diameter may be decreased to minimize adverse effects such as vomiting, or may be increased to enhance weight loss.

Nearly a decade of experience with LASGB has been accumulated outside of North America, with an estimated patient experience of more than 100000. Findings from several large series (>200 patients) with intermediate follow-up (up to 6 years) have been published mostly by surgeons from Europe and Australia (**Table 3**).[53-76] Operative times ranging from 35 to 90 minutes seem shorter than those of LVBG, and conversion rates are generally less than 3%. The most common operative complications include bleeding (0%-1%) and gastric perforation (0%-1%). The most common early complications (<30 days) include food intolerance (0%-11%), wound infections (0%-1%), pneumonia (0.8%), deep vein thrombosis–pulmonary embolism (0.8%), and bleeding (0.5%). Late complications of the band that frequently require reoperation are relatively common and include food intolerance (13%), band slippage (2.2%-8%), pouch dilatation (5%), and band erosion (1%). Improved fixation techniques seem to lessen band slippage. Port-specific complications include infection (1%-2%), kinking (0.5%), and tube defects (0.5%), all of which may require replacement. Reoperation is variable (2%-41%), with band slippage being the most common cause. Reoperation for failure of adequate weight loss was not reported by most authors but may add to the reoperation rate over time. Technical complications of LASGB seem to decrease significantly with surgeon experience.[71] Mortality for laparoscopic banding seems consistently low (0%-0.5%).

Some surgeons have noted the occurrence of significant esophageal dilatation after band tightening.[63] This condition seems to be either rare or underreported since most LASGB series report no occurrence of esophageal dysfunction. This pseudoachalasialike condition has potentially harmful long-term implications for esophageal motility. Weiss et al[76] showed that in 28% of patients, an LASGB resulted in a 2-fold increase in impaired esophageal motility, a 2-fold decrease in lower esophageal sphincter relaxation, and a marked increase in esophageal diameter (28% of patients), even though patients denied dysphagia. Weiss et al did not address whether these changes were reversible after band loosening. Iovino et al,[77] however, found no significant changes in esophageal motility 18 months after band placement. The significance of these findings remains unclear and controversial, but these findings suggest that long-term surveillance of esophageal motility with motility studies and barium swallow tests may be indicated until the issue is resolved.

Only Favretti et al[71] and O'Brien et al[72] (Table 3) have published large laparoscopic band series with longer than 5-year results. They showed that the mean BMI changed from 42.7 and 45.0, respectively, to 29.7 and 31.0.[71,72] O'Brien et al[72] found that at 4 to 6 years after surgery their patients achieved a mean estimated weight loss between 52% and 57% with an overall band removal rate of 11% (most were replaced with new repositioned bands). Favretti et al[71] showed that at 3 years 70% of their patients were able to achieve an estimated weight loss exceeding 30%. In their study, weight loss was best in patients with lower BMIs. The super obese patients (BMI >55) had a mean BMI of 55.7 preoperatively and a BMI of 56.0 at 5 years while those with a mean BMI of 42.7 preoperatively had a BMI of 29.7 at 5 years. Chevallier et al[65] had similar findings to Foureth. Contrary to these findings, Fielding et al[78] showed that super obese patients (mean preoperative BMI of 67) can achieve equally good weight loss with a resultant BMI in the 35 to 36 range.

The findings from these studies suggest that laparoscopic banding techniques are associated with a short hospital stay, rapid recovery, minimal perioperative morbidity and mortality, and good intermediate-term weight loss in a European and Australian population of patients with morbid obesity. Potential advantages include adjustability and complete reversibility on removal of the device, with no stapling or dividing of native tissue required. Disadvantages include the development

Table 3. Selected Laparoscopic Adjustable Silastic Banding Series

Source	Total No. of Patients	Female, %	BMI*	Preoperative Length of OR Time, min	Conversion Rate, %	Early Complication Rate, %	Length of Hospital Stay, d	Mortality, %	Reoperation Rate, %	Duration of Follow-up, mo	Type of Weight Loss: EWL, %	Type of Weight Loss: Postoperative BMI
Fielding et al,[53] 1999	335	82	47	71	0.9	2.1	1.4	0	3.6	18	62	NA
O'Brien et al,[54] 1999	277	88	45	57	1.8	4.3	3.9	0	4.0	48	70	NA
Zimmerman et al,[55] 1998	894	85	42	35	0.1	30.3	3.0	0	2.0	12	40	NA
Dargent,[56] 1999	500	80	43	NI	NI	0.8	NI	0	3.6	28	65	NA
Miller and Hell,[57] 1999	158	83	44	NI	2.0	1.2	4.3	0	7.0	36	NA	28
Doldi et al,[58] 2000	172	76	46	150	9.0	NI	3.8	0	NI	36	63	NA
Blanco et al,[59] 2001	407	NI	49	62	5.9	NI	NI	0	5.9	24	58 kg loss	NA
Angrisani,[60] 2001†	1265	79	44	NI	1.7	NI	NI	0.5	2.2	48	NA	32
Szold and Abu-Abeid,[61] 2001	715	76	43	78	0.8	1.6	1.2	0	12.0	17	NA	32
Nowara,[62] 2001	108	84	49	95	2.0	12	2.2	0	3.7	24	NA	34
DeMaria et al,[63] 2001	37	92	45	NI	3.0	NI	NI	0	41.0‡	36	38	NA
Nehoda et al,[64] 2001	320	81	47	65	0.3	NI	3.5	0	12.0	24	71	NA
Chevallier et al,[65] 2002	400	88	44	116	3.0	16.0	4.5	0	10.0	24	53	NA
Bacci et al,[66] 2002	130	NI	44	NI	NI	NI	NI	0	NI	12	NA	36
Rubenstein,[67] 2002	63	NI	NI	120	0	9.0	1.4	0	27.0	24	47	NA
Pontiroli et al,[68] 2002	143	81	45	NI	2.8	NI	2.2	0	8.3	36	NA	37
Doherty et al,[69] 2002	22	78	47	NI	NI	32.6	NI	0	40.0	72	15	NA
Belachew et al,[70] 2002	763	78	42	NI	1.3	13.9	NI	0.1	11.1	48	NA	30
Favretti et al,[71] 2002	830	78	46.4	NI	2.7	0.2	NI	0	16.8	72	NA	29
O'Brien et al,[72] 2002	655	85	45	55	1.0	1.2	NI	0	18.9	72	57	NA

Abbreviations: BMI, body mass index; EWL, excessive weight loss; NA, not applicable; NI, not indicated; OR, operating room.
*The BMI is calculated as the weight in kilograms divided by the height in meters squared.
† This is a multicenter study.
‡This is the percentage of bands that was subsequently removed and does not include the immediate reoperative rate which was unreported.

of device-specific complications such as band migration, band erosion into the gastrointestinal tract, dilatation of the esophagus, significant rate of reoperation, long learning curve for the surgeon, frequent adjustments of the band, and its lack of proven efficacy in the super obese patient. Laparoscopic adjustable silicone gastric banding is the dominant operation for severe obesity in Europe and Australia. Its role in the North America remains to be determined.

LAPAROSCOPIC ROUX-EN-Y GASTRIC BYPASS

The gastric bypass operation for severe obesity is the most commonly performed bariatric operation in the United States (**Figure 3**) and has evolved considerably (with many variations) since the loop gastric bypass described by Mason and Ito[2] in 1969. Laparoscopic Roux-en-Y gastric bypass simulates the open procedure and was first described by Wittgrove et al.[79] They have reported on their experience with 500 patients and an up to 5-year follow-up.[80] **Table 4** summarizes the results of reported series of LRYGBP.[80-84] Significant variations include variable Roux-limb lengths (75-250 cm), antecolic vs retrocolic Roux limbs, and banded vs nonbanded gastric pouch outlets.

As opposed to the LVBG and the LASGB series, the gastric bypass series have heavier patients with mean BMIs in the high 40s or low 50s. Some series include patients with BMIs exceeding 70.[81] Operating time generally ranges from 2 to 4 hours and seems to lengthen with an increasing BMI but shortens with the surgeon's experience. Conversion rates are less than 3%. Although there seems to be significant variability in methods for detecting and reporting complications, both early and late complication rates (3.3%-15.0% and 2.2%-27.0%, respectively) are reasonably low. The mean hospital stay (including complications) is typically 2 to 3 days. Most series have a mean follow-up of less than 2 years but consistently demonstrate a favorable estimated weight loss of 62% to 77%.

Noteworthy specific complications after LRYGBP include leaks (1%-3%) and bowel obstructions (1%-3%). The larger series report a slightly higher leakage rate, particularly at the gastrojejunal anastomosis, in their early experience that seems to decrease with additional experience. Leaks, however, did not appear to contribute directly to mortality in these series. Most groups reported bowel obstructions related to internal hernias resulting from unclosed mesenteric defects. We advocate, as do others, closure of all potential mesenteric defects at the enteroenterostomy window through the transverse mesocolon, and between transverse mesocolon and Roux-limb mesentery (Petersen defect). An antecolic Roux-limb may reduce the risk of herniation through the transverse mesocolon. In a series of more than 1000 cases, Higa et al[82] reported the most common complications to be stenosis at the gastrojejunostomy (4.9%), internal hernia (2.5%), marginal ulcer (1.4%), and staple-line leaks (1%). The overall mortality in that series was 0.5%.

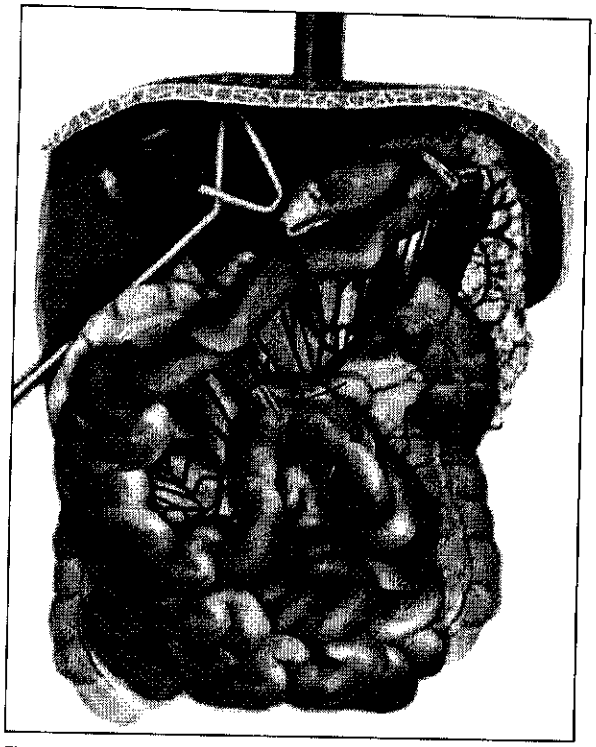

Figure 3. View of completed antecolic, antegastric Roux-en-Y gastric bypass. (Reprinted from Schauer P, Hamad G, Ikramuddin S. Surgical management of gastroesophageal reflux disease in obese patients. *Semin Laparosc Surg*. 2001;8:256-264, with permission from Elsevier.)

The early results of LRYGBP compare favorably with open RYGBP. Most notable is the reduced rate of cardiopulmonary and wound-related complications. Nguyen et al[37] showed in a randomized trial that during the first 3 postoperative days patients who underwent LRYGBP had significantly less pulmonary impairment than did the patients who underwent open bypass surgery. In addition, fewer patients developed hypoxemia after LRYGBP than after open surgery (31% vs 76%, $P<.001$). Only 6% of the patients who underwent laparoscopic procedures developed segmental atelectasis on the first postoperative day, compared with 55% of the patients in the open bypass group ($P=.003$). Wound-related complications, including infections and hernias, are virtually nonexistent after laparoscopic gastric bypass surgery. Contemporary data on recovery after open RYGBP are elusive; however, a fair estimate is at least 6 to 12 weeks before the patient is able to return to normal activities. The recovery after LRYGBP seems to be half as long. The mortality rate (0%-0.4%) after LRYGBP is comparable to that of the open bypass approach.

LBPD AND DUODENAL SWITCH

Laparoscopic approaches to malabsorption procedures such as the biliopancreatic diversion, the duodenal switch operation (**Figure 4**), or distal gastric bypass are more complex and technically difficult.[85-88] These malabsorption procedures compose fewer than 15% of all bariatric operations performed in North America. These procedures allow patients to maintain unrestricted eating patterns and result in effective weight loss but carry a

Table 4. Selected Large Laparoscopic Roux-en-Y Gastric Bypass Series

Source	Total No. of Patients	Female, %	BMI*	Mean Length of OR Time, min	Conversion Rate, %	Complication Rate, % Early	Complication Rate, % Late	Mean Length of Hospital Stay, d	Mortality, %	Length of Follow-up, mo	Type of Weight Loss
Wittgrove and Clark,[80] 1999	500	NI	NI	120	NI	10.4	2.2	2.6	NI	60	73% at 54 mo
Schauer et al,[81] 2000	275	81	48	247	1.0	3.3	27.0†	2.6	0.4	30	77% at 30 mo
Higa et al,[82] 2001	1500	82	35-78†	50-75	NI	2.3	12.5	1.5	0.2	36	62% EWL at 36 mo
DeMaria et al,[83] 2002	281	87	48.3	162	2.8	7.3	16.8	4.0	0	12	BMI 30.5 at 12 mo
Gould et al,[84] 2002	223	90	49	127	4.7	10.2	6.4	4.7	0	12	56% EWL at 12 mo

Abbreviations: BMI, body mass index; EWL, excess weight loss; NI, not indicated; OR, operating room.
*The BMI is calculated as the weight in kilograms divided by the height in meters squared.
†In this series, 13% had BMI values between 35 and 39, 60% had BMI values between 40 and 49, 22% had BMI values between 50 and 59, and 5% had BMI values between 60 and 78.

higher risk of nutritional complications such as protein malnutrition and vitamin deficiencies. Because of higher long-term risks some surgeons prefer to reserve the malabsorbtion procedures for select groups of refractory patients, that is, those with a BMI exceeding 60 or those who have failed other weight loss operations.

The results of 4 studies of laparoscopic malabsorptive procedures have been published to date. These studies have investigated either the LBPD or the duodenal switch (**Table 5**).[85-90] The conversion rate and the operative times varied widely depending on the surgeon's experience. Major morbidity was reported to be 7.5% to 15.0%; mortality was from 0% to 2.5%. Weight loss was comparable to open BPD at 1 year in 3 of the studies.[87-90] These studies collectively demonstrate that LBPD and the doudenal switch are feasible with a reasonable perioperative morbidity and mortality in the appropriate populations. Presently, only preliminary data are available; further long-term outcome-based studies with larger sample populations are required before these procedures can be widely recommended.

Figure 4. View of completed laparoscopic biliopancreatic diversion with duodenal switch. (Reprinted from Schauer P, Hamad G, Ikramuddin S. Surgical management of gastroesophageal reflux disease in obese patients. *Semin Laparosc Surg.* 2001;8:256-264, with permission from Elsevier.)

HAND-ASSISTED LAPAROSCOPIC BARIATRIC SURGERY

The large technical hurdles involved in laparoscopic bariatric surgery have led some surgeons to adopt hand-assisted modifications.[91,92] Laparoscopic vertical banded gastroplasty and LRYGBP have both been performed with hand-assisted techniques although experience is limited.[93-97] The results of all recent series[98-100] showed faster recovery rates after hand-assisted LVBG compared with the recovery rates of subjects who underwent open or those of historic control subjects. All but 2 studies reported a relatively high staple-line leakage rate early in their series of 4% to 6%[98,101] and a 12% to 20% hernia rate at 1 year at the hand port site. DeMaria et al[95] concluded that despite the increased cost, the hand-assisted approach may be valuable in bariatric surgery in the following 5 areas: (1) to repair a concomitant ventral hernia, (2) to salvage a total laparoscopic case, (3) to use when a skilled assistant for a total laparoscopic approach is unavailable, (4) to use in a patient with a high BMI, and (5) to aid the surgeon's learning curve in acquiring the skills to do the total laparoscopic approach.

TRAINING ISSUES FOR LAPAROSCOPIC BARIATRIC OPERATIONS

Laparoscopic bariatric surgery is technically challenging because it requires unique skills that surgeons do not gain with traditional, more common laparoscopic procedures. Additionally, obesity-related factors and the complexity of these reconstructive procedures create major technical barriers. These barriers may translate into steep learning curves for surgeons, longer initial operating times, potentially higher rates of perioperative compli-

Table 5. All Laparoscopic Malabsorptive Procedure Series

Source	Total No. of Patients	Female, %	Preoperative BMI*	Length of OR Time, min	Conversion Rate, %	Early Complication Rate, %	Length of Hospital Stay, d	Reoperation Rate, %	Length of Follow-up, mo	EWL, %	BPD or DS	Mortality, %
Ren et al,[87] 2000	40	70	60	210	2.5	15.0	4	7.5	9	58.0	DS	5.0
Paiva et al,[88] 2002	40	72	43.6	210	0	12.0	4.3	0	NI	NI	BPD	2.5
Scopinaro et al,[89] 2002	26	73	43	240	26.0	NI	NI	NI	12	68.0	BPD	0
Baltasar et al,[90] 2002	16	NI	>40	195-270	NI	NI	5-8	12.5	NI	NI	DS	0

Abbreviations: BMI, body mass index; BPD, biliopancreatic diversion; DS, duodenal switch; EWL, excess weight loss; NI, not indicated; OR, operating room.
*The BMI is calculated as the weight in kilograms divided by the height in meters square.

cations, and a high rate of conversion. The surgeon's learning curve for laparoscopic gastric bypass surgery seems to be steep compared with other advanced laparoscopic procedures.[98] Acquisition of advanced laparoscopic skills is essential for safe and efficient performance of any laparoscopic bariatric operation. It is critical that surgeons interested in performing laparoscopic bariatric operations prepare for these advanced procedures. Short introductory courses with didactics and hands-on experience can be helpful, but they are the beginning and not the end of preparation. Animal laboratory experience and proctoring by an experienced surgeon are highly recommended. Equally important to laparoscopic skill development is the acquisition of bariatric surgery practice management skills, especially for surgeons entering the field of bariatric surgery. Guidelines for establishing a bariatric surgery program published by the American College of Surgeons,[99] American Society for Bariatric Surgery,[100] and the Society of American Gastrointestinal Endoscopic Surgeons (SAGES)[101] are highly recommended for those interested in performing open or laparoscopic operations.

SUMMARY

Minimally invasive approaches to bariatric surgery offer significant advantages over those of open surgery. Early results of LVBG suggest a significant decrease in perioperative morbidity compared with the open approach, yet there seems to be less overall enthusiasm in adoption of this technique. An LASGB may have the lowest perioperative morbidity and mortality of all current bariatric operations. However, it does seem to have a significant reoperation rate for device-related complications, which may be related to the experience of the surgeon. Intermediate-term weight loss for LASGB seems to be good (50%-55% of estimated weight loss), but some patients (ie, those who are classified as super obese) may achieve less than adequate weight loss. Findings from outcome-based studies of LRYGBP are accumulating and suggest that it is feasible, safe, and delivers weight loss equivalent to that found with open surgical methods. The LRYGBP is associated with relatively low perioperative morbidity, short hospital stay, and rapid recovery compared with an open RYGBP. Thus, for patients in the United States, demand for LRYGBP seems to exceed that of the open approach. The value of hand-assisted bariatric procedures and LBPD procedures must await further study. The laparoscopic era of bariatric surgery has arrived.

Accepted for publication December 21, 2002.

Corresponding author and reprints: Philip R. Schauer, MD, Department of Surgery, University of Pittsburgh, Magee–Women's Hospital, Suite 5500, Halket, Pittsburgh, PA 15213 (e-mail: schauerpr@msx.upmc.edu).

REFERENCES

1. American Society for Bariatric Surgery. Membership survey. Presented at: 18th Annual Meeting of the American Society for Bariatric Surgery; May 2000; Gainesville, Fla.
2. Mason EE, Ito C. Gastric bypass. *Ann Surg.* 1969;170:329-339.
3. Griffen WO Jr, Bivins BA, Bell RM, Jackson KA. Gastric bypass for morbid obesity. *World J Surg.* 1981;5:817-822.
4. Linner JH. Comparative effectiveness of gastric bypass and gastroplasty. *Arch Surg.* 1982;117:695-700.
5. Sugerman HJ, Londrey GL, Kellum JM, et al. Weight loss with vertical banded gastroplasty and Roux-Y gastric bypass for morbid obesity with selective vs random assignment. *Am J Surg.* 1989;157:93-102.
6. Hall JC, Watts JM, O'Brien PE, et al. Gastric surgery for morbid obesity: The Adelaide Study. *Ann Surg.* 1990;211:419-427.
7. Brolin RE, Kenler HA, Gorman JH, Cody RP. Long-limb gastric bypass in the super obese: a prospective randomized trial. *Ann Surg.* 1991;215:387-395.
8. MacLean LD, Rhode BM, Sampalis J, Forse RA. Results of the surgical treatment of obesity. *Am J Surg.* 1993;165:155-162.
9. Pories WJ, Swanson MS, MacDonald KG, et al. Who would have thought it? an operation proves to be the most effective therapy for adult-onset diabetes mellitus. *Ann Surg.* 1995;222:339-352.
10. Capella JF, Capella RF. The weight reduction operation of choice: Vertical banded gastroplasty or gastric bypass. *Am J Surg.* 1996;171:74-79.
11. Fobi MA, Lee H, Holness R, Cabinda D. Gastric bypass operation for obesity. *World J Surg.* 1998;22:925-935.
12. MacLean LD, Rhode BM, Nohr CW. Late outcome of isolated gastric bypass. *Ann Surg.* 2000;231:524-528.
13. Capella JF, Capella RF. An assessment of vertical banded gastroplasty: Roux-en-Y gastric bypass for the treatment of morbid obesity. *Am J Surg.* 2002;183:117-123.
14. Rhode BM, MacLean LD. Vitamin and mineral supplementation after gastric bypass. In: Deitel M, Cowan G, eds. *Update: Surgery for the Morbidly Obese Patient.* Toronto, Ontario: FD–Communications; 2000:chap 19.
15. Kellum JM, DeMaria EJ, Sugerman HJ. The surgical treatment of morbid obesity. *Curr Probl Surg.* 1998;35:791-851.
16. Mason EE, Tang S, Renquist KE, et al, for the National Bariatric Surgery Registry (NBSR) Contributors. A decade of change in obesity surgery. *Obes Surg.* 1997;7:189-197.
17. Schauer PR. Physiologic consequences of laparoscopic surgery. In: Eubanks WS, Soper NJ, Swanstrom LL, eds. *Mastery of Endoscopic Surgery and Laparoscopic Surgery.* Philadelphia,Pa: Lippincott Williams & Wilkins; 2000:22-38.
18. Schauer PR, Sirinek KR. The laparoscopic approach reduces the endocrine response to elective cholecystectomy. *Am Surg.* 1995;61:106-111.
19. Trokel MJ, Bessler M, Treat MR, Whelan RL, Nowygrod R. Preservation of immune response after laparoscopy. *Surg Endosc.* 1994;8:1385-1387.
20. Williams LF Jr, Chapman WC, Bonau RA, McGee EC Jr, Boyd RW, Jacobs JK. Comparison of laparoscopic cholecystectomy with open cholecystectomy in a single center. *Am J Surg.* 1993;165:459-465.
21. Schauer PR, Luna J, Ghiatas AA, Glen ME, Warren JM, Sirinek KR. Pulmonary function after laparoscopic cholecystectomy. *Surgery.* 1993;114:389-399.
22. Garcia-Caballero M, Vara-Thorbeck C. The evolution of postoperative ileus after laparoscopic cholecystectomy: a comparative study with conventional cholecystectomy and sympathetic blockade treatment. *Surg Endosc.* 1993;7:416-419.
23. Lundorff P, Hahlin M, Kallfelt B, Thorburn J, Lindblom B. Adhesion formation after laparoscopic surgery in tubal pregnancy: a randomized trial versus laparotomy. *Fertil Steril.* 1991;55:911-915.
24. Steiner CA, Bass EB, Talamini MA, Pitt HA, Steinberg EP. Surgical rates and operative mortality for open and laparoscopic cholecystectomy in Maryland. *N Engl J Med.* 1994;330:403-408.
25. Borow M, Goldson H. Postoperative venous thrombosis: evaluation of five methods of treatment. *Am J Surg.* 1981;141:245-251.
26. Choban PS, Heckler R, Burge JC, Flancbaum L. Increased incidence of nosocomial infections in obese surgical patients. *Am Surg.* 1995;61:1001-1005.
27. Jackson CV. Preoperative pulmonary evaluation. *Arch Intern Med.* 1988;148:2120-2127.
28. Messerli FH, Ketelhut R. Left ventricular hypertrophy: an independent risk factor. *J Cardiovasc Pharmacol.* 1991;17(suppl 4):S59-S66.
29. Prasad US, Walker WS, Sang CT, Campanella C, Cameron EW. Influence of obesity of the early and long-term results of surgery for coronary artery disease. *Eur J Cardiothorac Surg.* 1991;5:67-73.
30. Sugerman HJ, Windsor A, Bessos M, Wolfe L. Intra-abdominal pressure, sagital abdominal diameter, and obestity co-morbidity. *J Intern Med.* 1997;24:71-79.
31. Sugerman HJ, Kellum JM Jr, Reines HD, DeMaria EJ, Newsome HH, Lowry JW. Greater risk of incisional hernia with the morbidly obese than steroid-dependent patients and low recurrence with prefascial polypropylene mesh. *Am J Surg.* 1996;171:80-84.
32. Velanovich V. Ponderal index as a predictor of postoperative complications. *Am Surg.* 1990;56:659-661.
33. Choban PS, Flancbaum L. The impact of obesity on surgical outcomes: a review. *J Am Coll Surg.* 1997;185:593-603.
34. Postlethwait RW, Johnson WD. Complications following surgery for duodenal ulcer in obese patients. *Arch Surg.* 1972;105:438-440.
35. Schirmer BD, Dix J, Edge SB, Hyser MJ, Hanks JB, Aguilar M. Laparoscopic cholecystectomy in the obese patient. *Ann Surg.* 1992;216:146-152.
36. Sirinek K, Page C, Miller J, et al. Laparoscopic approach is procedure of choice for cholecystectomy in morbidly obese patients. *Surg Endosc.* 1998;12:387.
37. Nguyen NT, Lee SL, Goldman C, et al. Comparison of pulmonary function and postoperative pain after laparoscopic vs open gastric bypass: a randomized trail. *J Am Coll Surg.* 2001;192:469-476.

38. Nguyen NT, Goldman C, Rosenquist CJ, et al. Laparoscopic versus open gastric bypass: a randomized study of outcomes, quality of life, and costs. *Ann Surg.* 2001;234:279-291.
39. Mason EE. Vertical banded gastroplasty for obesity. *Arch Surg.* 1982;117:701-706.
40. Balsiger BM, Poggio JL, Mai J, Kelly KA, Sarr MG. Ten and more years after vertical banded gastroplasty as primary operation for morbid obesity. *J Gastrointest Surg.* 2000;4:598-605.
41. Maclean LD, Rhode BM, Forse RA. Late results of vertical banded gastroplasty for morbid obesity and super obesity. *Surgery.* 1990;107:20-27.
42. Sugerman HJ, Starkey JV, Birkenhauer R. A randomized prospective trial of gastric bypass versus vertical banded gastroplasty for morbid obesity and their effects on sweets vs non-sweets eaters. *Ann Surg.* 1987;205:613-624.
43. Alle JL, Poortman M, Chelala E. Five years' experience with laparoscopic vertical banded gastroplasty. *Obes Surg.* 1998;8:373-374.
44. Champion JK, Hunt T, DeLisle N. Laparoscopic vertical banded gastroplasty and Roux-en-Y gastric bypass in morbid obesity. *Obes Surg.* 1999;9:123-144.
45. Goergen M, Azagra JS, Ansay J, et al. Laparoscopic vertical banded gastroplasty (Mason's procedure) for morbid obesity. *J Coelio-Chir.* 1999;29:33-37.
46. Lonroth H, Dalenback J. Other laparoscopic bariatric procedures. *World J Surg.* 1998;22:964-968.
47. Naslund E, Freedman J, Lagergren J, Stockeld D, Granstrom L. Three-year results of laparoscopic vertical banded gastroplasty. *Obes Surg.* 1999;9:363-373.
48. Salval M, Allieta R, Bocchia P, et al. Laparoscopic Mason-MacLean vertical banded gastroplasty(LVBG) in the treatment of morbid obesity: results in 87 patients with 6-18 months follow-up. *J Coelio-Chir.* 1999;29:77.
49. Toppino M, Morino M, Garrone C, et al. Coelioscopic vertical banded gastroplasty: 3-years experience on 170 cases. *J Coelio-Chir.* 1999;29:81-82.
50. Morino M, Toppino M, Bonnet G, Rosa R, Garrone C. Laparoscopic vertical banded gastroplasty for morbid obesity: assessment of efficacy. *Surg Endosc.* 2002;16:1566-1572.
51. Azagra JS, Goergen M, Ansay J, et al. Laparoscopic gastric reduction surgery: preliminary results of a randomized, prospective trial of laparoscopic vs open vertical banded gastroplasty. *Surg Endosc.* 1999;13:555-558.
52. Belachew M, Legrand MJ, Defechereux TH, Burtheret MP, Jacquet N. Laparoscopic adjustable silicone gastric banding in the treatment of morbid obesity: a preliminary report. *Surg Endosc.* 1994;8:1354-1356.
53. Fielding GA, Rhodes M, Nathanson LK. Laparoscopic gastric banding for morbid obesity: surgical outcome in 335 cases. *Surg Endosc.* 1999;13:550-554.
54. O'Brien PE, Brown WA, Smith A, McMurrick PJ, Stephens M. Prospective study of a laparoscopically placed, adjustable gastric band in the treatment of morbid obesity. *Br J Surg.* 1999;86:113-118.
55. Zimmermann JM, Mashoyan Ph, Michel G, et al. Laparoscopic adjustable silicon gastric banding: Une etude preliminaire personnelle concernant 900 cas operas entres juillet 1995 et Decembre 1998. *J Coelio-Chir.* 1999;29:77-80.
56. Dargent J. Laparoscopic adjustable gastric banding: lesson from 500 patients in a single institution. *Obes Surg.* 1999;9:446-452.
57. Miller K, Hell E. Laparoscopic adjustable gastric banding a prospective 4-year follow-up study. *Obes Surg.* 1999;9:183-187.
58. Doldi SB, Micheletto G, Lattuada E, Zappa MA, Bona D, Sonvico U. Adjustable gastric banding: 5-year experience. *Obes Surg.* 2000;10:171-173.
59. Blanco ER, Gascon M, Weiner R, et al. Video laparoscopic placement of adjustable gastric banding in the treatment of morbid obesity: preliminary results after 407 interventions. *Gastroenterol Hepatol.* 2001;24:381-386.
60. Angrisani L, Alkilani M, Basso N, et al. Laparoscopic Italian experience with the Lap-Band. *Obes Surg.* 2001;11:307-10.
61. Szold A, Abu-Abeid S. Laparoscopic adjustable silicone gastric banding for morbid obesity: results and complications in 715 patients. *Sug Endosc.* 2002;16:230-233.
62. Nowara HA. Egyptian experience in laparoscopic adjustable gastric banding (technique, complications and intermediate results). *Obes Surg.* 2001;11:70-75.
63. DeMaria EJ, Sugerman HJ, Meador JG, et al. High failure rate after laparoscopic adjustable silicone gastric banding for treatment of morbid obesity. *Ann Surg.* 2001;233:809-818.
64. Nehoda H, Hourmont K, Sauper T, et al. Laparoscopic gastric banding in older patients. 2001;136:1171-1176.
65. Chevallier JM, Zinzindohoue F, Elian N, et al. Adjustable gastric banding in a public university hospital: prospective analysis of 400 patients. *Obes Surg.* 2002;12:93-99.
66. Bacci V, Basso MS, Greco F, et al. Modifications of metabolic and cardiovascular risk factors after weight loss induced by laparoscopic gastric banding. *Obes Surg.* 2002;12:77-82.
67. Rubenstein RB. Laparoscopic adjustable gastric banding at a US center with up to 3-year follow-up. *Obes Surg.* 2002;12:380-384.
68. Pontiroli A, Pizzocri P, Librenti M, et al. Laparoscopic adjustable gastric banding for the treatment of morbid (grade 3) obesity and its metabolic complications: a 3-year study. J Clin Endocrinol Metab. 2002;87:3555-3561.
69. Doherty C, Maher JW, Heitshusen DS. Long-term data indicate a progressive loss in efficacy of adjustable silicone gastric banding for the surgical treatment of morbid obesity. *Surgery.* 2002;132:724-727.
70. Belachew M, Belva PH, Desaive C. Long-term results of laparoscopic adjustable gastric banding for the treatment of morbid obesity. *Obes Surg.* 2002;12:564-568.
71. Favretti F, Cadiere GM, Segato G, et al. Laparoscopic banding: selection and technique in 830 patients. *Obes Surg.* 2002;12:385-390.
72. O'Brien PE, Dixon JB, Brown W, et al. The laparoscopic adjustable gastric band (Lap-Band): a prospective study of medium-term effects on weight, health and quality of life. *Obes Surg.* 2002;12:652-660.
73. Favretti F, Cadiere GB, Segato G, et al. Laparoscopic adjustable silicone gastric banding (Lap-Band): how to avoid complications. *Obes Surg.* 1997;7:352-358.
74. Greenstein RJ, Martin L, MacDonald K, et al. The Lap-Band system as surgical therapy for morbid obesity: intermediate results of the USA, multicenter, prospective study. *Surg Endosc.* 1999;13:S1-S18.
75. Evans JD, Scott MH, Brown AS, Rogers J. Laparoscopic adjustable gastric banding for the treatment of morbid obesity. *Am J Surg.* 2002;184:97-102.
76. Weiss HG, Nehoda H, Labeck B, et al. Treatment of morbid obesity with laparoscopic adjustable gastric banding affects esophageal motility. *Am J Surg.* 2000;180:479-482.
77. Iovino P, Angrisani P, Tremolaterra F, et al. Abnormal esophageal acid exposure is common in morbidly obese patients and improves after a successful Lap-Band system implantation. *Surg Endosc.* 2002;16:1631-1635.
78. Fielding G. Laparoscopic adjustable gastric banding for massive super obesity. *Obes Surg.* 2002;12:203.
79. Wittgrove AC, Clark GW, Schubert KR. Laparoscopic gastric bypass, Roux-en-Y: technique and results in 75 patients with 3-30 months follow-up. *Obes Surg.* 1996;6:500-504.
80. Wittgrove AC, Clark GW. Laparoscopic gastric bypass: a five-year prospective study of 500 patients followed from 3 to 60 months. *Obes Surg.* 1999;9:123-143.
81. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich J. Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Ann Surg.* 2000;232:515-529.
82. Higa KD, Ho T, Boone KB. Laparoscopic Roux-en-Y gastric bypass: technique and 3-year follow-up. *J Laparoendosc Adv Surg Tech A.* 2001;11:377-382.
83. DeMaria EJ, Sugerman HJ, Kellum JM, et al. Results of 281 consecutive total laparoscopic Roux-en-Y gastric bypasses to treat morbid obesity. *Ann Surg.* 2002;235:640-647.
84. Gould JC, Nedleman BJ, Ellison EC, Muscarella P, Schneider C, Melvin WS. Evolution of minimally invasive bariatric surgery. *Surgery.* 2002;132:565-572.
85. Scopinaro N, Gianetta E, Adami GF, et al. Biliopancreatic diversion for obesity at eighteen years. *Surgery.* 1996;119:261-268.
86. Marceau P, Hould FS, Simard S, et al. Biliopancreatic diversion with duodena switch. *World J Surg.* 1998;22:947-954.
87. Ren C, Patterson E, Gagner M. Early results of laparoscopic biliopancreatic diversion with duodenal switch: a case series of 40 consecutive patients. *Obes Surg.* 2000;10:514-523.
88. Paiva D, Bernardes L, Suretti L. Laparoscopic biliopancreatic diversion: technique and initial results. *Obes Surg.* 2002;12:358-361.
89. Scopinaro N, Marinari GM, Camerini G. Laparoscopic standard biliopancreatic diversion: technique and preliminary results. *Obes Surg.* 2002;12:362-365.
90. Baltasar A, Bou R, Miro J, Bengochea M, Serra C, Perez N. Laparoscopic biliopancreatic diversion with duodenal switch: technique and initial experience. *Obes Surg.* 2002;12:245-248.
91. Memon MA, Fitzgibbons RJ Jr. Hand-assisted laparoscopic surgery (HALS): a useful technique for complex laparoscopic abdominal procedures. *J Laparoendosc Adv Surg Tech A.* 1998;8:143-150.
92. Naitoh T, Gagner M. Laparoscopically assisted gastric surgery using Dexterity Pneumo Sleeve. *Surg Endosc.* 1997;11:830-833.
93. Watson DI, Game PA. Hand-assisted laparoscopic vertical banded gastroplasty: initial report. *Surg Endosc.* 1997;11:1218-1220.
94. Gerhart CD. Hand-assisted laparoscopic vertical banded gastroplasty: report of a series. *Arch Surg.* 2000;135:795-798.
95. DeMaria EJ, Schweitzer MA, Kellum JM, Meador J, Wolfe L, Sugerman HJ. Hand-assisted laparoscopic gastric bypass does not improve outcome and increases costs when compared to open gastric bypass for the surgical treatment of obesity. *Surg Endosc.* 2002;16:1452-1455.
96. Sundbom M, Gustavsson S. Hand-assisted laparoscopic Roux-en-Y gastric bypass: aspects of surgical technique and early results. *Obes Surg.* 2000;10:420-427.
97. Bleier JI, Krupnick AS, Kreisel D, Song HK, Rosato EF, Williams NN. Hand-assisted laparoscopic vertical banded gastroplasty: early results. *Surg Endosc.* 2000;14:902-907.
98. Schauer PR, Ikramuddin S, Hamad G, et al. The learning curve for laparoscopic Roux-en-Y gastric bypass in 100 cases. *Surg Endosc.* 2003;17:212-215.
99. American College of Surgeons' recommendations for facilities performing bariatric surgery. *Bull Am Coll Surg.* September 2000;85:9.
100. American Society for Bariatric Surgery. SAGES/ASBS guidelines for laparascopic and conventional surgical treatment of morbid obesity. Available at: http://www.asbs.org/html/lab_guidelines.html. Accessed February 17, 2003.
101. Society of American Gastrointestinal Endoscopic Surgeons (SAGES) and the American Society for Bariatric Surgery (ASBS). *SAGES Guidelines for Laparoscopic and Conventional Surgical Treatment of Morbid Obesity.* Santa Monica, Calif: SAGES; 2000. SAGES publication 30. Also available at: http://www.sages.org/sg_pub30.html. Accessed February 17, 2003.

VGHKS92-99 from the Kaohsiung Veterans General Hospital, and VTY92-P3-19 from the Taipei Veterans General Hospital Joint Research Program, Tsou's Foundation, Taipei (Dr L.-W. Chen).

Corresponding author: Ching-Mei Hsu, PhD, Department of Biological Sciences, National Sun Yat-Sen University, 70 Lien-Hai Rd, Kaohsiung 804, Taiwan (e-mail: chingmei@mail.nsysu.edu.tw).

REFERENCES

1. Gianotti L, Alexander JW, Pyles T, James L, Babcock GF. Relationship between extent of burn injury and magnitude of microbial translocation from the intestine. *J Burn Care Rehabil.* 1993;14:336-342.
2. Baron P, Traber LD, Traber DL, et al. Gut failure and translocation following burn and sepsis. *J Surg Res.* 1994;57:197-204.
3. Tokyay R, Zeigler ST, Traber DL, et al. Postburn gastrointestinal vasoconstriction increases bacterial and endotoxin translocation. *J Appl Physiol.* 1993;74:1521-1527.
4. Takeda K, Shimada Y, Okada T, Amano M, Sakai T, Yoshiya I. Lipid peroxidation in experimental septic rats. *Crit Care Med.* 1986;14:719-723.
5. Furchgott RF, Zawadzki JV. The obligatory role of endothelial cells in the relaxation of arterial smooth muscle by acetylcholine. *Nature.* 1980;288:373-376.
6. Miller MJ, Sadowska-Krowicka H, Chotinaruemol S, Kakkis JL, Clark DA. Amelioration of chronic ileitis by nitric oxide synthase inhibition. *J Pharmacol Exp Ther.* 1993;264:11-16.
7. Goode HF, Howdle PD, Walker BE, Webster NR. Nitric oxide synthase activity is increased in patients with sepsis syndrome. *Clin Sci (Lond).* 1995;88:131-133.
8. Sorrells DL, Friend C, Koltuksuz U, et al. Inhibition of nitric oxide with aminoguanidine reduces bacterial translocation after endotoxin challenge in vivo. *Arch Surg.* 1996;131:1155-1163.
9. Chen LW, Hsu CM, Cha MC, Chen JS, Chen SC. Changes in gut mucosal nitric oxide synthase (NOS) activity after thermal injury and its relation with barrier failure. *Shock.* 1999;11:104-110.
10. Carsin H. Human albumin solutions in the treatment of burned patients: current indications [in French]. *Presse Med.* 1997;26:474-476.
11. O'Brien R, Murdoch J, Kuehn R, Marshall JC. The effect of albumin or crystalloid resuscitation on bacterial translocation and endotoxin absorption following experimental burn injury. *J Surg Res.* 1992;52:161-166.
12. Erstad BL, Gales BJ, Rappaport WD. The use of albumin in clinical practice. *Arch Intern Med.* 1991;151:901-911.
13. Cochrane Injuries Group Albumin Reviewers. Human albumin administration in critically ill patients: systematic review of randomised controlled trials. *BMJ.* 1998;317:235-240.
14. Goodwin CW, Dorethy J, Lam V, Pruitt BA Jr. Randomized trial of efficacy of crystalloid and colloid resuscitation on hemodynamic response and lung water following thermal injury. *Ann Surg.* 1983;197:520-531.
15. Carvajal HF, Parks DH. Optimal composition of burn resuscitation fluids. *Crit Care Med.* 1988;16:695-700.
16. Hansbrough JF, Wikstrom T, Braide M, et al. Effects of E-selectin and P-selectin blockade on neutrophil sequestration in tissues and neutrophil oxidative burst in burned rats. *Crit Care Med.* 1996;24:1366-1372.
17. Walker HL, Mason AD Jr. A standard animal burn. *J Trauma.* 1964;8:1049-1051.
18. Spaeth G, Berg RD, Specian RD, Deitch EA. Food without fiber promotes bacterial translocation from the gut. *Surgery.* 1990;108:240-247.
19. Baskaran H, Yarmush ML, Berthiaume F. Dynamics of tissue neutrophil sequestration after cutaneous burns in rats. *J Surg Res.* 2000;93:88-96.
20. Sir O, Fazal N, Choudhry MA, Goris RJ, Gamelli RL, Sayeed MM. Role of neutrophils in burn-induced microvascular injury in the intestine. *Shock.* 2000;14:113-117.
21. Otamiri T, Sjodahl R, Tagesson C. An experimental model for studying reversible intestinal ischemia. *Acta Chir Scand.* 1987;153:51-56.
22. Chen LW, Hsu CM, Wang JS, Chen JS, Chen SC. Specific inhibition of *i*NOS decreases the intestinal mucosal peroxynitrite level and improves the barrier function after thermal injury. *Burns.* 1998;24:699-705.
23. Judkins K. Burns resuscitation: what place albumin? *Hosp Med.* 2000;61:116-119.
24. Sheridan RL, Prelack K, Cunningham JJ. Physiologic hypoalbuminemia is well tolerated by severely burned children. *J Trauma.* 1997;43:448-452.
25. Demling RH, Kramer G, Harms B. Role of thermal injury–induced hypoproteinemia on fluid flux and protein permeability in burned and nonburned tissue. *Surgery.* 1984;95:136-144.
26. Soejima K, Traber LD, Schmalstieg FC, et al. Role of nitric oxide in vascular permeability after combined burns and smoke inhalation injury. *Am J Respir Crit Care Med.* 2001;163:745-752.
27. Fujii E, Yoshioka T, Ishida H, Irie K, Muraki T. Evaluation of *i*NOS-dependent and independent mechanisms of the microvascular permeability change induced by lipopolysaccharide. *Br J Pharmacol.* 2000;130:90-94.
28. Arkovitz MS, Wispe JR, Garcia VF, Szabo C. Selective inhibition of the inducible isoform of nitric oxide synthase prevents pulmonary transvascular flux during acute endotoxemia. *J Pediatr Surg.* 1996;31:1009-1015.

Correction

Numerical Error. In the Special Article by Cottam et al published in the April issue of the ARCHIVES (2003;138:367-375), the value of the second entry in Table 4 on page 372 under the column titled "Mean Length of Hospital Stay, d" should have been 3.6 rather than 2.6.