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ORIGINAL CONTRIBUTIONS

First Successful Large-Scale Introduction of an Enhanced Recovery after Bariatric Surgery (ERABS) Program in the Middle East: The Results and Lessons Learned of Tawam Hospital/Johns Hopkins, a Tertiary Governmental Center in the UAE

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Abstract

Background Although enhanced recovery after bariatric surgery (ERABS) has proven to be safe and cost-effective, this concept is relatively new in the Middle East.

Methods A retrospective analysis of consecutive registered cohorts of patients who underwent primary and purely laparoscopic sleeve gastrectomy (LSG) or laparoscopic Roux-en-Y gastric bypass (LRYGB) were compared before introduction of ERABS (2010–2014) and after ERABS (2015–2017) at Tawam Hospital/Johns Hopkins, the UAE.

Results A total of 462 eligible bariatric patients (LSG 414 and LRYGB 48) were operated on before and 1602 (LSG 1436 and LRYGB 166) after introduction of the ERABS. Significant improvements of mean patient time of the patient being within the OR for LSG (from 2:27 to 1:23 min, $p = 0.000$) and LRYGB (from 3:17 to 1:59 min, $p = 0.000$) were achieved when comparing pre-ERABS with after introduction of ERABS. Furthermore, there was a significant decrease in LOS in both LSG (from 3.2 to 1.5 days, $p = 0.000$) and in LRYGB (from 3.5 to 1.7 days, $p = 0.000$). Major (CD classification III–IV) complications decreased significantly in LSG (from 13.8 to 0.8%, $p = 0.000$) and were similar in LRYGB (from 4.2% to 3.0%, p = NS). The readmission rate for LSG (from 2.9 to 2.6%, p = NS) or LRYGB (from 0 to 4.8%, p = NS) and the reoperation rates after LSG (from 0.7 to 0.5%, p = NS) and LRYGB (from 0 to 2.4%, p = NS) did not differ between both groups following introduction of ERABS.

Conclusions Implementation of a standardized ERABS program in the Middle East is feasible and safe and leads to reduced LOS and OR times.

Keywords Fast-track · ERAS · ERABS · Bariatric surgery · Enhanced recovery · Enhanced recovery after surgery · Laparoscopic · Sleeve gastrectomy · Gastric bypass · Cost-efficiency · Lessons · Obesity

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Introduction

Morbid obesity and its related comorbidities have grown to epidemic proportions. This is especially so in the Arab Gulf region, which has the world's highest obesity penetration rate [1, 2]. It is forming a major threat to society in terms of health, (future) costs, and workforce. Bariatric surgery has been proven to be the only effective treatment to realize sustainable substantial weight loss in large groups of patients. Although the costs of bariatric surgery is much less than the cost to manage the long-term consequences of morbid obesity [3–6], bariatric surgery will consume an increasing part of the health budget and limit hospital capacities. Fast-track surgery consisting of standardized optimization of logistic processes and an enhanced recovery after surgery (ERAS) program for high-volume surgical procedures has been proven to improve quality as well as cost-efficiency in different types of surgery [7–12]. Although ERAS has been adopted in the Western world, it is still a relatively new concept in the Middle East. However, recently, hospitals in this region are becoming more enthusiastic for ERAS in order to save costs.

Tawam Hospital is a large tertiary-care governmental university hospital which runs in affiliation with John Hopkins Medicine in Al Ain city, the United Arab Emirates (UAE). It already had a regional well-known bariatric program since 2001. At end of 2014, the first author of this manuscript joined the bariatric team, who initiated an international well-known bariatric fast-track course program in Rotterdam, the Netherlands [13], to boost its existing bariatric program in Tawam Hospital.

This study evaluates the effects of implementation of a large-scale fast-track/enhanced recovery after bariatric surgery (ERABS) program for primary bariatric procedures in a tertiary referral governmental bariatric center in the Middle East. Moreover, it describes the lessons learned on how to successfully implement such a program.

Patients and Methods

This study was approved by the scientific board of Tawam Hospital/Johns Hopkins, Al Ain, UAE (AAMDHREC Protocol No. 527-17).

Retrospectively collected outcome data of all cases that underwent bariatric surgery between January 2010 and December 2017 were reviewed. Primary bariatric cases, being laparoscopic sleeve gastrectomy (LSG) or laparoscopic Roux-en-Y gastric bypass (LRYGB), without any other simultaneous surgical procedure were analyzed. Results of the patients operated on during the period before ERABS (2010–2014) were compared with those who were operated on in the period after introduction of the ERABS protocol (2015–2017).

ERABS Protocol of Tawam Hospital

Changes in comparison with the pre-ERABS era protocol were:

Organization

- Formation of a new multidisciplinary bariatric team to make a complete standardization of all processes (based on EBM, cost-efficiency, service, quality, and simplicity).
- Full compliance by all involved staff to the new approved ERABS protocol.
- Formation of dedicated bariatric OR teams (including anesthesiology and OR nurses).
- Introduction of two bariatric-nurse navigators to enhance the information supply to the patient, facilitate easy access, and improve in- and outpatient logistics.
- One consultant bariatric surgeon and one bariatric fellow/specialist surgeon, while before the ERABS era there were two other bariatric consultant surgeons who both left Tawam Hospital in the beginning of 2015.

Preoperative assessment

- Same inclusion criteria based on IFSO selection criteria: BMI 35–40 kg/m^2 plus two obesity-related comorbidities or > 40 kg/m^2 [14].
- One-day complete multidisciplinary work-up was introduced (including surgery, family medicine/endocrine, psychology, dietician, anesthesia, and diagnostics) instead of having separate appointments on different days.
- Pre-anesthesia clinic with special focus on OSA using the STOP-BANG questionnaire instead of standard sleep apnea tests on all patients.
- Gastroscopy only in case of GERD instead of being a standard for each patient.
- Same recommendation for LRYGB to patients with GERD, DM-2, or sweet-eater patients.

In-patient care

- All patients are admitted on the day of surgery instead of 1 day prior.
- High-risk patients are scheduled first on the list so that they can stay longer at the recovery and avoid ICU admission (e.g., patients with OSA, BMI > 55 kg/m^2, cardiac or renal impairment).
- No premedication, urinary catheter, or abdominal drains as a routine, which used to be the standard before the introduction of ERABS.
- IV line placement in Day-case Unit if possible instead insertion in the OR.

- Thromboprophylaxis (for 10–14 days post-op) and pneumatic sequential as before.
- Rapid sequence induction, instead of routine intubation.
- Use of more short-acting (low lipophilicity) medications, lower doses of non- depolarizing muscle relaxants, decrease the use of morphine, and more usage of multimodality anti-emetic and analgesia medications (see Fig. 1).
- Tapering down of anesthesia during the surgery (after the anastomotic leak test) instead of after finishing the whole surgery.
- Standardization of the surgical technique in which the LSG was now done by a three-port technique instead of five ports and the LRYGB by a five-port linear technique as before [15, 16]. The trocars were placed higher (on a horizontal line 12 cm below the sternum) in both LSG and LRYGB in the ERABS era compared to before. Moreover, an additional focus was added to perform bloodless surgery aiming to avoid or immediately deal with the smallest bleedings as part of the standardized techniques.
- Aim for a fast and safe surgical procedure with a special focus on minimizing blood loss.
- Drinking clear fluids and early mobilization (within 2 h after the surgery) instead of drinking after the result of the swallow test next day and late mobilization.
- Aim for discharge at day 1 post-op instead of after 3 days.

The primary outcome parameter is length of hospital stay (LOS) and secondary outcomes are surgical procedural times, 30-day complication rates, readmission, and reoperation rates. Complications were graded according to the Clavien–Dindo classification [17, 18].

All analyses were performed using SPSS (PASW) 18.0 software (SPSS Inc., Chicago, Illinois, USA). Categorical data were described as percentage of the total cohort. Continuous variables were presented as mean ± standard deviation (SD). Differences between before and after introduction of the ERABS program in continuous data were analyzed using independent tests. The differences in categorical data were analyzed using the χ^2 test. All results were evaluated at a significant threshold of $p < 0.05$ and 95% confidence intervals were calculated of all procedural times.

Results

Patient Characteristics

Between January 2010 and December 2017, 2487 consecutive patients had bariatric surgery in Tawam Hospital, of which 2064 had a primary LSG or LRYGB without a simultaneous secondary procedure (see Table 1). Of these eligible patients, 462 (LSG 414 and LRYGB 48) were operated on before the introduction of the ERABS program (between 2010 and 2014) and 1602 (LSG 1436 and LRYGB 166) after this program introduction (between 2015 and 2017), thus having a similar percentage of 10% of LRYGB in both groups. Baseline characteristics of the eligible patients are listed in Table 2. Patient characteristics did differ significantly on BMI (LSG, 45.7 vs. 44.1, $p = 0.000$; LRYGB, 46.5 vs. 42.8, $p = 0.000$), diabetes (LSG, 36% vs. 9.7%, $p = 0.000$; LRYGB, $p =$ NS), hypertension (LSG, 25.1% vs. 15.1, $p = 0.000$; LRYGB, $p =$ NS), and OSA (LSG, 26.8% vs. 6.4%, $p = 0.000$; LRYGB, 35.4 vs. 13.3%, $p = 0.000$) when comparing before and after introduction of ERABS.

Logistic Times

There was a significant decrease in the mean patient total inside OR times (time that the patient actually spends in the OR) for LSG (from 2:27 to 1:23 min, $p = 0.000$) and LRYGB (from 3:17 to 1:59 min, $p = 0.000$) when comparing before versus after introduction of ERABS (see Table 3). Most of this time gain was realized by shortening of the surgical time of the LSG (from 1:43 to 0:56 min, $p = 0.000$) and LRYGB (from 2:31 to 1:33 min, $p = 0.000$) and the remaining by reducing the non-surgical anesthesia time (LSG, from 0:43 to 0:27 min, $p = 0.000$; and LRYGB, from 0:46 to 0:26 min, $p = 0.000$). Patients stayed around 25 min longer in the recovery after introduction of ERABS for both procedures.

The mean total LOS decreased in a similar significant fashion for both LSG (from 3.2 to 1.5 days, $p = 0.000$) and in LRYGB (from 3.5 to 1.7 days, $p = 0.000$).

Complications (< 30 Days)

The rate of major (CD classification III–IV) complications decreased significantly in LSG (from 13.8% to 0.8%, $p = 0.000$) and pneumonia (from 1.2% to 0.1%, $p = 0.002$) (see Table 4). There was no significant decrease of major complications in LRYGB (from 4.2% to 3.0%, $p =$ NS) when comparing before and after introduction of ERABS.

The rate of minor (CD I–II) complications increased for both LSG (from 14.3% to 32.7%, $p = 0.000$) and LRYGB (from 14.6% to 42.2%, $p = 0.000$). This was mainly due to an increase of postoperative ER visits for complaints of pain which (LSG, from 1.4% to 10.2%, $p = 0.000$; and LRYGB, from 6.3% to 9.0%, $p = 0.000$) and dehydration (LSG, from 0.7% to 5.2%, $p = 0.000$; and LRYGB, from 0% to 4.8%, $p = 0.000$). However, this did not result in a higher readmission rate for LSG (from 2.9% to 2.6%, $p =$ NS) or LRYGB (from 0% to 4.8%, $p =$

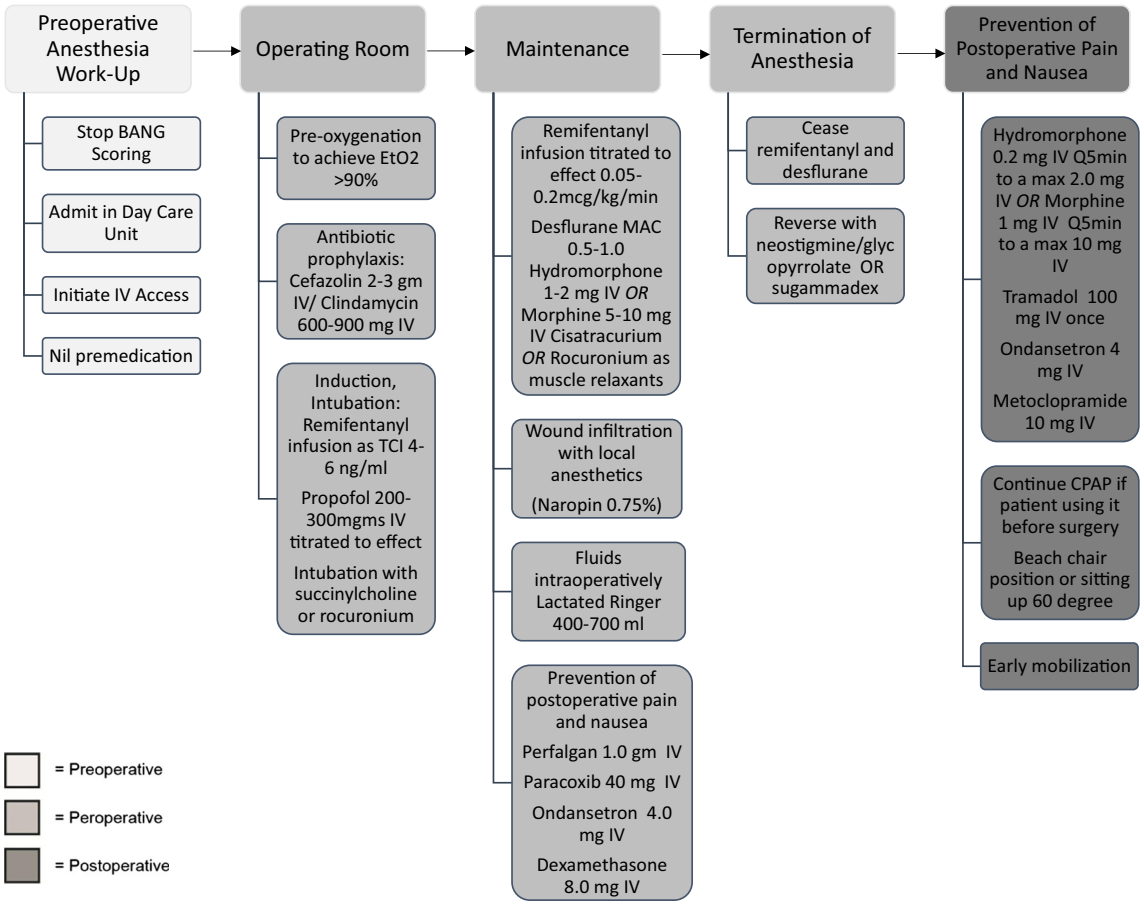

Fig. 1 ERABS anesthesia protocol Tawam Hospital

NS). Also, the reoperation rates after LSG (from 0.7% to 0.5%, p = NS) and LRYGB (from 0% to 2.4%, p = NS) did not differ between both groups following introduction of ERABS. These four reoperations (2.4%) in the LRYGB group were for GJ-leak, JJ-stomy leak, infected hematoma, and closure of an acute internal hernia despite the closure of the mesenteric defect at the initial operation.

Super Obese (BMI ≥ 50 kg/m^2)

In 188 patients (10% LRYGB) of the ERABS group, the BMI was ≥ 50 kg/m^2. The mean surgical time (LSG and LRYGB combined) was non-significantly longer (59 min vs. 63 min, $p = 0.055$), but the patient in-OR time was with a mean 8 min difference significantly higher in the super obese group

Table 1 Number of all bariatric patient procedures and eligible patients (Jan 2010 until Dec 2017)

	Before ERABS						ERABS			
	2010	**2011**	**2012**	**2013**	**2014**	**Total**	**2015**	**2016**	**2017**	**Total**
Eligible patients										
Pure primary	88	89	88	92	105	**462**	361	596	645	**1602**
Primary with other procedure	8	16	10	14	17	**65**	31	33	18	**82**
Revision	26	27	16	19	18	**106**	33	36	84	**153**
Band insertion	8	4	2	2	1	**17**	0	0	0	**0**
Total	**130**	**136**	**116**	**127**	**141**	**650**	**425**	**665**	**747**	**1837**
Eligible patients/primary procedure										
Sleeve	65	76	84	88	101	**414**	337	529	570	**1436**
Bypass	23	13	4	4	4	**48**	24	67	75	**166**
Total	**88**	**89**	**88**	**92**	**105**	**462**	**361**	**596**	**645**	**1602**

Table 2 Baseline characteristics in mean (± SD) or absolute number (%)

	Before ERABS ($n = 462$)			ERABS ($n = 1602$)			*P* value (CI)		
	Sleeve ($n = 414$)	Bypass ($n = 48$)	Total	Sleeve ($n = 1436$)	Bypass ($n = 166$)	Total	Sleeve vs. sleeve	Bypass vs. bypass	Total
Sex (female)	278 (67.1%)	37 (77.1%)	315(68.2%)	913 (63.6%)	123 (74.1%)	1036(64.7%)	0.018	0.675	0.162
Age	31.02 ± 9.76	36.1 ± 9.6	31.55 ± 9.87	29.52 ± 9.87	38.1 ± 12.1	30.41 ± 10.47	0.006	0.285	0.053
Height	162.38 ± 8.63	162.2 ± 10.0	162.36 ± 8.78	163.79 ± 90.76	162.04 ± 9.19	163.61 ± 9.10	0.005	0.918	0.319
Weight	121.33 ± 24.56	121.98 ± 20.69	121.39 ± 24.17	119.45 ± 20.25	113.41 ± 18.01	118.82 ± 20.12	0.114	0.005	0.000
BMI	45.74 ± 7.57	46.47 ± 5.922	45.82 ± 7.4	44.08 ± 5.591	42.8 ± 5.61	43.95 ± 5.60	0.000	0.000	0.000
DM	149(36%)	28(58.3%)	177 (38.3%)	140(9.7%)	59(35.5%)	199 (12.4%)	0.000	0.160	0.000
HTN	104(25.1%)	18(37.5%)	122 (26.4%)	217(15.1%)	58(34.9%)	275 (17.2%)	0.000	0.744	0.000
DLP	52(12.6%)	12(25%)	64 (13.9%)	208(14%)	57(34.3%)	265 (16.5%)	0.398	0.398	0.346
OSA	111(26.8%)	17(35.4%)	128 (27.7%)	92(6.4%)	22(13.3%)	114 (7.1%)	0.000	0.000	0.000
GERD	73(17.6%)	15(31.3%)	88 (19.0%)	192(13.4%)	61(36.07%)	253 (15.8%)	0.620	0.480	0.168

Table 3 Mean operative times, length of stay and postoperative ICU admission

	Before ERABS ($n = 462$)			ERABS ($n = 1602$)			*P* value		
	Sleeve ($n = 414$)	Bypass ($n = 48$)	Total	Sleeve ($n = 1436$)	Bypass ($n = 166$)	Total	Sleeve vs. sleeve	Bypass vs. bypass	Total
Surgical time	01:43 ± 00:56	02:31 ± 00:30	01:48 ± 56:43	00:56 ± 00:24	1:33 ± 00:37	01:00 ± 28:00	0.000	0.000	0.000
Total in-OR time	02:27 ± 00:37	03:17 ± 00:40	02:32 ± 00:41	1:23 ± 00:29	01:59 ± 00:41	01:26 ± 00:33	0.000	0.000	0.000
Recovery time	01:44 ± 00:58	01:39 ± 00:52	01:43 ± 00:58	02:09 ± 01:04	02:02 ± 1:06	02:08 ± 01:04	0.000	0.031	0.021
Length of stay	3.2 ± 7.4	3.5 ± 2.325	3.23 ± 7.124	1.53 ± 2.74	1.7 ± 2.40	1.55 ± 2.708	0.000	0.000	0.000

Table 4 Complications (< 30 days)

	Before ERABS ($n = 462$)			ERABS ($n = 1602$)			*P* value		
	Sleeve ($n = 414$)	**Bypass ($n = 48$)**	**Total**	**Sleeve ($n = 1436$)**	**Bypass ($n = 166$)**	**Total**	**Sleeve vs. sleeve**	**Bypass vs. bypass**	**Total**
Anastomotic leak	6 (1.4%)	0 (0%)	6 (1.3%)	5 (0.3%)	1 (0.6%)	6 (0.4%)	0.100	0.590	0.021
Bleeding/hematoma	5 (1.2%)	1 (2.1%)	6 (1.3%)	19 (1.3%)	5 (3%)	24 (1.5%)	0.855	0.731	0.752
DVT	1 (0.2%)	0 (0%)	1 (0.2%)	0 (0%)	1 (0.6%)	1 (0.1%)	0.062	0.590	0.349
Wound infection	4 (1%)	1 (2.1%)	5 (1.1%)	10 (0.7%)	2 (1.2%)	12 (0.7%)	0.577	648.000	0.485
UTI	1 (0.2%)	0 (0%)	1 (0.2%)	1 (0.1%)	1 (0.6%)	2 (0.1%)	0.348	0.590	0.649
Pneumonia	5 (1.2%)	0 (0%)	5 (1.1%)	2 (0.1%)	0 (0%)	2 (0.1%)	0.002	NA no cases	0.002
Pancreatitis	0 (0%)	0 (0%)	0 (0%)	1 (0.1%)	0 (0%)	1 (0.1%)	0.591	NA no cases	0.591
Paresthesia	1 (0.2%)	0 (0%)	1 (0.2%)	2 (0.1%)	0 (0%)	2 (0.1%)	0.649	NA no cases	0.649
Dehydration	3 (0.7%)	0 (0%)	3 (0.6%)	74 (5.2%)	8 (4.8%)	82 (5.1%)	0.000	0.121	0.000
Cardiac complications	0 (0%)	0 (0%)	0 (0%)	6 (0.3%)	0 (0%)	6 (0.4%)	0.188	NA no cases	0.188
Anastomotic stenosis	2 (0.5%)	0 (0%)	2 (0.4%)	3 (0.2%)	1 (0.6%)	4 (0.2%)	0.344	0.590	0.519
Splenic infarction	1 (0.2%)	0 (0%)	1 (0.2%)	0 (0%)	1 (0.1%)	1 (0.1%)	0.348	NA no cases	0.349
Constipation	1 (0.2%)	0 (0%)	1 (0.2%)	9 (0.6%)	0 (0%)	9 (0.6%)	0.346	NA no cases	0.346
Abdominal pain	6 (1.4%)	3 (6.3%)	9 (1.9%)	146 (10.2%)	15 (9%)	161 (10.0%)	0.000	0.540	0.000
Hyperglycemia	1 (0.2%)	0 (0%)	1 (0.2%)	1 (0.1%)	1 (0.6%)	29 (0.1%)	0.348	0.590	0.649
Complication type	**Before ERABS ($n = 462$)**			**ERABS ($n = 1602$)**			***P* value**		
	Sleeve ($n = 414$)	**Bypass ($n = 48$)**	**Total**	**Sleeve ($n = 1436$)**	**Bypass ($n = 166$)**	**Total**	**Sleeve vs. sleeve**	**Bypass vs. bypass**	**Total**
ER visit within 30 days	12 (2.9%)	4 (8.3%)	16 (3.5%)	172 (12%)	16 (9.6%)	188 (11.7%)	0.000	0.784	0.000
Readmission within 30 days	12 (2.9%)	0 (0%)	12 (2.6%)	38 (2.6%)	8 (4.8%)	46 (2.9%)	0.780	0.121	0.754
Long-term complications	5 (1.2%)	0 (0%)	5 (1.2%)	1 (0.1%)	1 (0.6%)	2 (0.1%)	0.000	0.590	0.002
Reoperation	3 (0.7%)	0 (0%)	3 (0.6%)	7 (0.5%)	4 (2.4%)	11 (0.7%)	0.562	0.278	0.931
Complication type	**Before ERABS ($n = 462$)**			**ERABS ($n = 1602$)**			***P* value**		
	Sleeve ($n = 414$)	**Bypass ($n = 48$)**	**Total**	**Sleeve ($n = 1436$)**	**Bypass ($n = 166$)**	**Total**	**Sleeve vs. sleeve**	**Bypass vs. bypass**	**Total**
Minor	59 (14.3%)	7 (14.6%)	66 (14.3%)	470 (32.7%)	70 (42.2%)	540 (33.7%)	0.000	0.000	0.000
Major	57 (13.8%)	2 (4.2%)	59 (12.8%)	12 (0.8%)	5 (3%)	17 (1.1%)	0.000	0.692	0.000
Clavien–Dindo classification complications	**Before ERABS ($n = 462$)**			**ERABS ($n = 1602$)**			***P* value**		
Minor (CD I–II)	**Sleeve ($n = 414$)**	**Bypass ($n = 48$)**	**Total**	**Sleeve ($n = 1436$)**	**Bypass ($n = 166$)**	**Total**	**Sleeve vs. sleeve**	**bypass vs. bypass**	**Total**
Grade I	14 (3.4%)	4 (8.3%)	18 (3.9%)	198 (13.8%)	19 (11.4%)	217 (13.5%)	0.000	0.540	0.000
Grade II	45 (10.9%)	3 (6.3%)	48 (10.4%)	272 (18.9%)	51 (30.7%)	323 (20.2%)	0.000	0.001	0.000
Major									
Clavien–Dindo classification complications	**Before ERABS ($n = 462$)**			**ERABS ($n = 1602$)**			***P* value**		
Major (CD III–IV)	**Sleeve ($n = 414$)**	**Bypass ($n = 48$)**	**Total**	**Sleeve ($n = 1436$)**	**Bypass ($n = 166$)**	**Total**	**Sleeve vs. sleeve**	**bypass vs. bypass**	**Total**
Grade IIIa	51 (12.3%)	1 (2.1%)	52 (11.3%)	4 (0.3%)	0 (0%)	4 (0.2%)	0.000	0.062	0.000
Grade IIIb	0 (0%)	0 (0%)	0 (0%)	3 (0.2%)	2 (1.2%)	5 (0.3%)	0.352	0.445	0.229
Grade IVa	5 (1.2%)	1 (2.1%)	6 (1.3%)	4 (0.3%)	1 (0.6%)	5 (0.3%)	0.017	0.348	0.010
Grade IVb	1 (0.2%)	0 (0%)	1 (0.2%)	1 (0.1%)	2 (1.2%)	3 (0.2%)	0.348	0.445	0.900

(86 min vs. 94 min, $p = 0.001$). The LOS (1.52 vs. 1.77, $p =$ NS), severe (CD III–IV) complication rate (1% vs. 1.6%, $p =$ NS), readmission rate (2.8% vs. 3.7%, $p =$ NS), and reoperation rate (0.7% vs. 0.5%, $p =$ NS) did not differ in the ERABS group comparing BMI < 50 kg/m^2 with the super obese patients group (see Table 5).

Discussion

Obesity has become one of the biggest health problems for UAE and other Gulf region countries [19]. It records more than 60% obesity rate (which is double the world's average) and its related diseases like type 2 diabetes is reaching 20% prevalence. As a result, this will have a tremendous future medical, social, and economic burden on the region. Bariatric surgery has been proven to be the only effective therapy to achieve a substantial long-term sustainable weight loss as well as significant resolution of obesity-related comorbidities in large groups of patients [20–22].

Fast-track/ERAS bariatric programs optimizing both logistics and perioperative enhanced recovery care by standardization of the whole process have been proven to significantly improve cost-efficiency by reducing hospital stay and improve OR productivity without compromising patient safety [11, 12, 23].

Although the evidence of ERAS programs on a variety of other surgical procedures is substantial, such protocols have not yet been adopted in most parts of the Middle East. To our knowledge, this is the first study analyzing the effects of introduction of a large-scale ERABS program in this region. Moreover, it is, to the best of our knowledge, the current world's largest ERABS case series. The main limitation of this cohort study and all other ERABS studies is the lack of blinding and subsequent risk of performance bias. Blinding is almost impossible in ERAS because patients and staff must be made aware of what is expected from them. For this reason, there are no large-scale randomized controlled trial ERABS studies available [23]. One more possible bias was the difference in obesity-related comorbidities between both groups. This could be caused by the fact that the easy cases used to go to private to avoid the long waiting list in the pre-ERABS era. However, these factors did not result in any different approach to any patient in the used ERABS protocol.

An important point that we would like to address is that although primary LSG and LRYGB are different procedures, when performed in a high-volume standardized similar ERABS setting, most things outside the part of the surgery itself becomes very alike as shown in this study.

Tawam Hospital has had a bariatric program since 2001, which has been well known in the Gulf area. As in most governmental centers in this region, around two to three bariatric cases were performed per 8 h OR-day and the annual numbers that were done in Tawam Hospital used to be stable around 130 annual bariatric cases in the period between 2010 and 2014. Cultural aspects of patients not accepting to be discharged early and the extreme fear of any possible complication from such early discharge in combination with fixed salaries for healthcare professionals not being related to productivity are believed to be the cause of that. Therefore, the predictions expressed by many colleagues at the introduction of the fast-track/ERABS program in our hospital were that it would fail.

Furthermore, as bed capacity is always an issue in tertiary governmental centers, this rapid growth could only be possible by reducing the overall mean LOS from 3.7 days to 1.5 days after introduction of ERABS and even to 1.2 days in 2017. This effect was similar for both procedures (LSG, from 3.2 to 1.5; and LRYGB, from 3.5 to 1.7 days). It is much lower than the average 2.8 days LOS as published in a meta-analysis on 3475 ERABS cases by Malczak et al. [23]

This might be due to that fact that the overall (LSG and LRYGB) rate of severe complications (CD III–IV) of 1.1% in this study after introduction of ERABS was lower when compared to the 5% rate published by others [23], and way lower than the 11.8% of the era before ERABS in this study. These severe complications (CD III–IV) reduced from significantly (13.8% to 0.8%) for LSG and NS from 4.2% to 3% for LRYGB, when comparing pre-ERABS to the ERABS era. On the other hand, this significant shorter LOS when

Table 5 ERABS super obese (BMI > 50 kg/m^2) versus morbid obese patients (with BMI < 50 kg/m^2) OR times, LOS, complications, readmissions, and reoperations

	BMI < 50 (n = 1414) (1266 sleeves and 148 bypass)	**Super obese patients (n = 188) (170 sleeves and 18 bypass)**	***P* value**
Surgical time (min)	00:59 ± 00:28	1:03 ± 00:27	0.055
Total time OR (min)	01:26 ± 00:32	01:34 ± 00:33	0.001
Length of stay (days)	1.52 ± 2.72	1.77 ± 2.62	0.229
Minor complications (CD I–II)	477 (33.7%)	68 (33.5%)	0.951
Major complications (CD III–IV)	14 (1%)	3 (1.6%)	0.446
Readmission within 30 days	39 (2.8%)	7 (3.7%)	0.457
Reoperation within 30 days	10 (0.7%)	1 (0.5%)	0.785

compared to the benchmark is probably also the reason why our rate of minor complications of 33.7% was higher compared to the 11.9% published in the meta-analysis [23]. This negative effect of an increased minor complications rate (CD I–II) was similar in both procedure groups (LSG, from 14.3% to 32.7%; and LRYGB, from 14.6% to 42.2%). It was mainly caused by the increased number of patients coming to ER with complaints of pain or dehydration. As a result, we have decided to increase the bariatric nurse navigator communication with the patients by up-scaling their briefing with the patients pre- and postoperatively. Additionally, we started a closer follow-up in the form of telephonic call from this navigator in the early first days postoperatively. Finally, more attentions were made to stress the importance of drinking a minimum of 1.5 L per day in frequent small sips and to adhere to the prophylactic pain medication regiment. This helped to overcome an important influential factor of a regional cultural resistance to take drugs like morphine and morphinomimetica. Utilization of a standardized postoperative discharge checklist might also be beneficial to reduce additional post-op outpatient visits for complications [24].

Despite the fact that the rate of minor complications had increased, most of these patients did not require readmission as readmission rates for both LSG and LRYG did not increase after introduction of ERABS in this study. Our ERABS readmission rates of LSG (2.6%) and LRYGB (4.8%) are much better than the average 7.5% readmission rate in the ERABS meta-analysis. Also, our ERABS reoperation rates for LSG (0.5%) and LRYGB (2.4%) are good when compared to the reported 2.5% in ERABS literature [13]. Moreover, the difference in a slightly higher severe complication rate in the pre-ERABS era but a slightly higher reoperation rate in the ERABS era can be explained by a more aggressive approach of the surgeons toward severe complications in the ERABS era.

Within this study, the rate of minor and major complications, readmissions, and reoperations is slightly higher in LRYGB when compared to our LSG group, which is comparable to what is being reported by other authors when comparing LSG to LRYGB [25].

The same ERABS protocol was applied for all consecutive patients, including those with higher BMI (super obese patients; BMI > 50 kg/m^2). In this subgroup, there were, besides a slightly (8 min) longer mean patient in-OR time, no other significant differences in all other outcome measurements like LOS, complications, readmissions, and reoperations. A similar LOS for super obese patients (for the BMI < 50 versus > 50 groups) operated on in an ERABS protocol was also found by Loots et al. [26], though their LOS was with 3 versus 3.3 days much longer than the 1.5 versus 1.8 days LOS that is shown this study. However, it does show that in high-volume bariatric centers, almost any patient enrolled can be successfully treated according to the same ERABS protocol.

Despite the fact that there were two bariatric consultant surgeons before the introduction and only one consultant and one bariatric fellow (who was executing 51% of the procedures) after the introduction of the ERABS program, our team managed to boost the total annual bariatric case productivity to a 5.6-fold increase in 2017 (total of 747 bariatric cases done in 2017) when compared to the period before the introduction of the fast-track program. This was partially achieved by doubling the amount of bariatric cases done per OR day as an average of more than 1 h OR time could be saved per OR case for both LSG and LRYGB. Around two thirds of this OR-time saving was found to be due to improvement on the surgical and one third on the anesthesia part.

These improvements in overall OR times are comparable with other ERABS studies [13].

Lessons Learned

One of the most challenging components of implementing fast-track/ERAS protocols is achieving the buy-in from non-surgeons in the hospital. Using the normalization process theory (NPT) on how to incorporate a new process into an existing system helps in this matter [27]. First step of the four steps in this NPT process and proven crucial in the set-up of a successful ERAS program is that it should "make sense" and that participating staff really believes in it (1. Coherence) [28]. In order to make a new protocol, it is important to set up a multidisciplinary team of enthusiastic clinicians and nursing staff ("champions"), who are mandated by their respective subspecialties to describe and approve a shared understanding of ERAS and standardize the complete process based on the factors EBM, simplification, cost-efficiency, and improving service and quality to the patient. It is important in the discussion of formalizing the ERABS protocol not to compromise and when needed to break with old traditions.

An example of this is the creation of bariatric surgical trays that have only a limited number of instruments and bariatric disposable kits, but also standardization of medications etc. In a way, it is a shift from the old medical dogma where every patient is considered different toward the concept that once you do large numbers of similar surgeries, patients become more or less the same. It is essential to start with a small dedicated team where everybody understands his/her role (individual specification) and next to start engaging and enrolling others (2. Cognitive participation). This can be done very effectively by creating an official training program, what we used for our OR team and our bariatric nurse navigators. Although there is always the fear of people unwilling to change their old practice, doing something new can also create enthusiasm among participants, which facilitates successful implementation. Third NPT step is getting the new practice done (3. Collective action). Especially, the word collective is

important in this as surgeons have a tendency to walk out of the OR before ending the procedure or even leave the OR complex and then being surprised that the turnover of patients slows down. By staying and helping in the OR, especially so in the starting phase of ERABS, you as a surgeon will gain the essential trust of the anesthesiologists and nursing staff necessary to make ERABS a success. Furthermore, it is important to start working parallel to each other instead of waiting until the other party is finished with their task. For example, we can start scrubbing the patient once the patient is asleep but not yet intubated or you can start terminating the anesthesia during instead of after the surgical procedure. All these minutes of gain by creating collateral efficiency will make operating times a lot shorter as shown in this study. It will also minimize the variance coefficient and thus make the length of the surgery very predictable, enabling to schedule more cases in the OR program as published by our group before [29]. Due to this predictability of ERABS, there is less irritation or discussion among staff, and it will allow the team to finish on time despite the increased number of cases done per OR day. For this, it is also important to arrange with the OR management that booking of acute cases on the busy ERABS-OR is avoided, that the OR team stays the same the whole day, and that preferably the same type of surgical procedures are scheduled on an OR day [30, 31]. All of this will create a great atmosphere and the staff will be very willing to work and achieve within the bariatric OR team. Moreover, when surgeons put an additional focus in place to perform bloodless surgery as part of their standardized technique, it also lowers the stress in the OR contributing to a good productive high-quality working environment. Once you increased the productivity and decreased the LOS, management support will follow automatically. Especially so if the MDT calculates and reports the results like in an annual report as we do. Next, the ERAS program will come in the fourth NPT stage of appraisal of the new practice (4. Reflective monitoring). In that phase, ERAS has become a routine practice and the visibility will normally diminish as it has become normal practice. A problem with that can be, if no compensation, protected time or additional manpower has been given to the "champions," that these resources will not anymore be provided for the long term. On the other hand, the ERAS concept at that point might also get a boost when ERAS is picked up by the higher management and transplanted to other specialties that have high-volume surgical procedures, provided that the receptivity in other specialties is there. This process actually happened in the previous setting in Rotterdam, where there used to be an OR-capacity shortage and additional OR capacity was only given to specialties that had proven to use their OR time in such cost-efficient fashion. Performing an accreditation might also help to regain management attention at stage 4 as well as to boost further improvement of processes.

The main barrier in establishing a successful ERAS program is the lack of staff motivation to change their practice resulting in poor compliance to the new protocol, especially so as it is a bottom-up process. The champions real belief and enthusiasm in ERAS, the trust that it will sustain the individual fit and cohesion of the MDT, their abilities to communicate and negotiate, and the support of division leaders by supporting the process and providing additional manpower are all important factors in realizing successful implementation [28, 32, 33]. Poor protocol compliance has been proven to be the best measurement of failure of implementation of ERAS [32]. Cultural barriers, as assumed by our hospital colleagues when we initiated ERABS in Tawam Hospital, did not play a (different) role when compared to the previous experience of successful implementation of ERABS in the Rotterdam setting [13].

In conclusion, successful implementation of ERABS is possible in a governmental hospital setting in the Middle East leading to shorter LOS and increased OR utilization without jeopardizing patient safety for all eligible patients. An expected increase of ER visits for minor complaints not leading to more readmissions can be expected and should be anticipated. Real belief and compliance of the involved MDT in the ERABS process is crucial to achieve successful implementation, while globally different cultural aspects might be less relevant to achieve successful implementation of ERABS.

Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflicts of interest.

Ethical Approval Ethical approval for this study was obtained from the scientific board of Tawam Hospital/Johns Hopkins, Al Ain, The United Arab Emirates (AAMDHREC Protocol No. 527-17).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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