ARTÍCULO ORIGINAL

Enhanced recovery after bariatric surgery: Implementation of program and clinical outcomes from a bariatric surgery and metabolic diseases reference center

Recuperación mejorada tras cirugía bariátrica: aplicabilidad y resultados clínicos en un centro de referencia de cirugía bariátrica y enfermedades metabólicas

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Abstract

Background: *Enhanced recovery after bariatric surgery (ERABS) protocols involve a series of multimodal perioperative procedures based on evidence designed to reduce physiological stress, improve recovery, and reduce costs on medical attention by decreasing length of hospital stay (length of stay [LOS]).* **Objective:** *The objective of the study was to report the viability and results of the ERABS application in a reference bariatric center.* **Materials and methods:** *A prospective, observational, and descriptive study on bariatric procedures conducted over 12 months in the ERABS context which includes pre-procedure, intraprocedure, and post-procedure measures. The collected data include demographic data, comorbidity, morbimortality, LOS, and readmission to hospital.* **Results:** *Sixty-four patients within a median of 38.8 ± 9.5 years and 44.1 ± 6.20 kg/m^2 BMI underwent surgery. Fifty-five (85.93%) were Roux-en-Y gastric bypass (RYGB) cases and 9 (14.06%) were sleeve gastrectomy (SG). Related comorbidities were hypertension 37%, diabetes 34%, dyslipidemia 23%, and obstructive sleep apnea 21%. Two (3.12%) patients developed post-operative morbidity (respiratory and thromboembolic complications). LOS for RYGB was 1.16 ± 0.97 and 1 ± 0 days for SG. The successful discharge rate on the 1st day after procedure was 96% and 100%, respectively. Readmission to hospital within a 30-day period presented itself on 4 patients (6.25%).* **Conclusion:** *Applying ERABS protocols is feasible, safe, morbidity low, LOS acceptable, and a low readmission rate within 30 days.*

Key Words: *Morbid obesity. Laparoscopic bariatric surgery. Enhanced recovery after surgery. Morbimortality. Length of hospital stay. Readmission.*

Resumen

Antecedentes: *Los protocolos de recuperación mejorada tras cirugía bariátrica (ERABS, Enhanced Recovery After Bariatric Surgery) implican intervenciones perioperatorias multimodales basadas en la evidencia diseñadas para reducir el estrés fisiológico, facilitar el retorno temprano de la función corporal y reducir los costos de atención médica al disminuir la duración*

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de la estancia intrahospitalaria. **Objetivo:** *Reportar la viabilidad y los resultados de la utilización de ERABS en un centro bariátrico de referencia.* **Método:** *Estudio prospectivo, observacional y descriptivo de procedimientos bariátricos realizados durante 12 meses en contexto ERABS, que incluyó medidas preoperatorias, intraoperatorias y posoperatorias. Los datos recopilados fueron demografía, comorbilidad, morbimortalidad, estancia intrahospitalaria y reingresos.* **Resultados:** *64 pacientes, edad 38.8 ± 9.5 años, índice de masa corporal 44.1 ± 6.20 kg/m², 55 (85.93%) bypass gástricos en Y de Roux (BGYR) y 9 (14.06%) mangas gástricas. Comorbilidad: hipertensión 37%, diabetes 34%, dislipidemia 23% y apnea obstructiva 21%. Dos (3.12%) pacientes desarrollaron morbilidad posoperatoria (complicaciones respiratorias y tromboembólicas). La estancia intrahospitalaria para el BGYR fue de 1.16 ± 0.97 días y para la manga 1 ± 0 días. El alta exitosa al primer día posoperatorio fue del 96% para el BGYR y del 100% para la manga. El reingreso hospitalario a 30 días se produjo en cuatro (6.25%) pacientes.* **Conclusión:** *La aplicación de protocolos ERABS es factible, segura, de baja morbilidad, con una estancia intrahospitalaria aceptable y una baja tasa de reingresos a 30 días.*

Palabras Clave: *Obesidad mórbida. Cirugía bariátrica laparoscópica. Recuperación mejorada tras la cirugía. Morbimortalidad. Estancia intrahospitalaria. Reingresos.*

Introduction

Obesity is a severe psychometabolic disorder which involves high socioeconomic costs with an increasing worldwide prevalence. It is a chronic disease with a preventable multifactorial origin, distinguished for the excessive fat accumulation, or general hypertrophy of the fat tissue on the body. Bariatric surgery is the most effective therapy for a long-term weight control and results on an improvement or reversal of comorbidities associated with the obesity such as type 2 diabetes mellitus, hypertension, obstructive sleep apnea, and hyperlipidemia, among others[1,2].

The enhanced recovery after bariatric surgery (ERABS) protocols are a series of procedures that aim to reduce the surgical perioperative stress, improve mobility, reduce pain, and ease an early postoperative oral nutrition to sustain the organism's physiological functions[3]. Most information on ERAS comes from lower gastrointestinal colorectal surgery and, even though many ERAS individual components have been introduced to bariatric surgery, there is little available literature on the effects of applying these ERAS protocols on these patients. Despite it all, applying these measures in specialized centers has proved effective in terms of reduced morbidity, faster recovery, and shorter length of hospital stay[4-8].

This study's objective is to determine the applicability of ERAS protocols after bariatric surgery, as well as reporting their clinical results on relation to morbidity, mortality, length of hospital stay, and readmission on patients who underwent obesity management procedures on the bariatric surgery and metabolic diseases unit part of the *Centro Médico Nacional de Occidente del Instituto Mexicano del Seguro Social*.

Materials and methods

A prospective, observational, and descriptive study was made. Bariatric patients with primary gastric sleeve and gastric bypass procedures were treated by implementing the measures described on the ERAS protocols from January 2018 to December 2018. A single bariatric surgeon works evening shift and two fellow minimally invasive gastrointestinal surgeons were in charge of the procedures in the bariatric surgery and metabolic diseases unit of *Centro Médico Nacional de Occidente del Instituto Mexicano del Seguro Social*, a reference bariatric center. The study was approved by the hospital regulatory authorities.

The data collected include demographic details and the implementation of the protocols during pre-operative, intraoperative, and post-operative periods.

Pre-operative measures include granting pre-surgery information, education, and counseling to all the patients on the appointment before the bariatric surgical procedure, mandatory cease of smoking habits for at least 4 weeks previous to surgery, pre-operative weight loss of at least 10% weight excess, and pre-operative low-carb diet (800 kcal daily) to reduce liver's size and visceral fat for 2 weeks before surgery.

Measures of the enhanced protocol during the intraoperative period included rapid sequence orotracheal intubation, with intubation and extubation on the same surgical procedure, controlled perioperative fluid management, (patients received 1.5-2 L crystalloid fluids during surgery), avoiding of long-acting opioids, multimodal analgesia with paracetamol and tramadol, avoiding intraoperatory steroids or benzodiazepines, intraoperatory dose of ondansetron for nausea and vomit management, and infiltrating local anesthesia on surgical port sites (20 ml of ropivacaine 0.75%).

Patients were positioned at 60° reverse Trendelenburg to allow optimal intra-abdominal space in the supracolic compartment. All patients wore anti-embolism medium compression stockings (22-29 mmHg). All procedures were successfully conducted through laparoscopy.

Surgical technique

Laparoscopic antecolic and gastric Roux-en-Y gastric bypass (RYGB) was conducted with 5 ports, using 120 cm of biliopancreatic limb and 120 cm of Roux limb length, conducting the mechanical gastrojejunal anastomosis with a linear cutter stapler. Vertical sleeve gastrectomy (SG) was conducted with 5 ports and calibrated using an orogastric 36-Fr tube, the staple line was reinforced with polydioxanone 3-0 in all cases. No intra-abdominal drains were placed at the end of surgery, no urinary catheters were used and no nasogastric tubes were placed in any patient.

Post-operative measures included guarantying patient's mobility within the first 12 h after surgery, breathing exercises 10 min/h with an incentive spirometer, supplementary oxygen through nasal cannula (5 L/min) for the first 12 immediate post-operative hours, a standard post-operative regimen of intravenous liquids avoiding a fluid overload (35 ml/kg/day), non-opioid intravenous analgesics (ketorolac 30 mg + metamizole 500 mg every 8 h), and ondansetron (4 mg every 8 h) as antiemetic. Prokinetics and laxatives were not used, and all patients underwent thromboprophylaxis through subcutaneous low-molecular-weight heparin (60 mg) 12 h after surgery and every 24 h afterward. Patients with diagnosis of type 2 diabetes mellitus were to register their capillary glycemia and, if necessary, apply a rapid-acting insulin plan. All patients began their early post-operative feeding 6-8 h after surgery, clear liquids intake in a proportion of 50 ml in 30 min with no need for routine contrast radiography studies to confirm anastomotic integrity. All patients using CPAP before the procedures were given it back on the recovery area immediately after procedure.

To fulfill these previously described post-operative procedures, measures were reinforced with nursing staff and residents in the unit. Patients were postoperatively examined 3 times: first by the residents at 7 am, then by fellow surgeons at 12 pm and finally by the bariatric surgeon at 3 pm. Vitals and symptomatology were registered and patient was checked for alarming symptoms or signs to guarantee that clinical concerns and doubts on discharge were solved and treated early. Twenty-four hours after surgical procedure, at approximately 4 pm, the patients were given informative sheets containing information on post-operative recovery, diet, and alarm signs and symptoms. Discharge criteria included (1) tolerance for liquid diet and drinking 1.5 L of liquid per day; (2) the analgesics established controlling pain adequately; (3) adequate mobility; (4) adult supervision at home; and (5) comprehension and acceptance of the suggested postoperative diet sheet. Once discharged, the follow-up was realized 30 days after procedure in the external appointments for bariatric surgery.

Table 1. Demographic and comorbidity data of the study's participants

	Total: 64
Women, n (%)	52 (81.25)
Age, mean±SD	38.8±9.5
Weight, mean±SD, kg	115.33±27.72
BMI, mean±SD, kg/m^2	44.1±6.20
Arterial hypertension, n (%)	24 (37.50)
DM2, n (%)	22 (34.37)
Dyslipidemia, n (%)	15 (23.43)
OSA, n (%)	14 (21.87)

SD: standard deviation; kg: kilograms; BMI: body mass index; kg/m^2: kilogram (weight) divided by square meters; DM2: type 2 diabetes mellitus; OSA: obstructive sleep apnea.

Results

During the 12-month period of the study, 121 bariatric procedures were conducted. Of these, 76 corresponded to the evening shift bariatric surgeon (study universe), in which there are primary surgeries and revisional bariatric surgeries (conversion, reversion, or correction). Of 76 procedures, 64 (84.21%) were primary bariatric procedures covered in this study. The other 12 patients underwent secondary or revisional surgeries, thus not complying with the inclusion criteria. There were 55 (85.93%) RYGB and 9 (14.06%) vertical SG. Demographic and comorbidity data are presented in Table 1.

All procedures were successfully conducted through laparoscopy. There was no rate for conversion to open surgery.

Two complications surged. One due to a deep venous thrombosis of the low left limb of a male treated with a gastric bypass, who came back on the 7th post-operative day. The second due to an acute respiratory failure type 1 of a female treated with gastric bypass which was solved with support measures

Table 2. Post-operative morbidity and hospital readmissions

	Total: 64
Post-operative morbidity, n (%)	2 (3.12)
Deep vein thrombosis, n (%)	1 (1.56)
Acute respiratory failure, n (%)	1 (1.56)
Resurgery, n (%)	1 (1.56)
Anastomotic leak G-J, n (%)	1 (1.56)
Post-operative mortality, n (%)	1 (1.56)
Anastomotic leak G-J, sepsis, and multiple organ failure, n (%)	1 (1.56)
Post-operative readmission, n (%)	4 (6.25)
Non-specified abdominal pain, n (%)	2 (3.12)
Deep vein thrombosis, n (%)	1 (1.56)
Vomit and dehydration, n (%)	1 (1.56)

G-J: gastrojejunal.

Table 3. Length of hospital stay

	Total: 64
Total surgeries, LOS, mean±SD, days	1.14 ± 0.90
Gastric bypass, mean±SD, days	1.16 ± 0.97
Gastric sleeve, mean±SD, days	1 ± 0
Successful discharge on the 1st day after procedure of total surgeries, n (%)	62 (96.87)
Gastric bypass, n (%)	53 (96.36)
Gastric sleeve, n (%)	9 (100)

LOS: length of hospital stay; SD: standard deviation.

without further complication, thus postponing her discharge up to 72 h post-operative.

There was one post-operative death 7 days after surgery caused by a leak of the gastrojejunal anastomosis with subsequent abdominal sepsis and multiple organ failure. In this case, there were two post-operative procedures.

The length of hospital stay was 1.14 ± 0.90 days: 1.16 ± 0.97 days for RYGB and 1 ± 0 days for gastric sleeve. About 96.87% of the procedures were successfully discharged on the 1st post-operative day after surgeries, 96% for RYGB and 100% for gastric sleeve.

There were 4 (6.25%) readmissions within the first 30 days. Two cases (3.12%) for development of non-specified abdominal pain (all studies for this resulted negative), one case for deep vein thrombosis on the lower left limb (as previously stated) and 1 case (1.56%) of the patient presenting vomit and dehydration. All of them required to be readmitted for an average of 5 ± 3.36 days without this being related to mortality.

Morbidity, mortality, and post-operative readmission within 30 days after surgery, as well as length of hospital stay are presented in Tables 2 and 3, respectively.

Discussion

This study demonstrated that applying ERABS protocols is feasible, safe and can be related to a low rate for complications and readmission (3.12% and 6.25%, respectively) within 30 days after surgery. It focused on determining whether applying ERABS protocols in a real environment would present results similar to those observed on studies with a larger volume of patients or resources. The applied actions suggested by ERABS protocols are presented in Table 4.

About 3.12% of this series had poor mobility and did not begin the early post-operative liquid diet within 6-8 h after surgery. This usually related to the appearance of complications (acute respiratory failure in one case and gastrojejunal anastomosis leak in another), situations which influenced the recovery speed and delayed the hospital discharge. On the other hand, only 71.87% of the sample avoided the use of long-acting opioids intraoperatively in the anesthetic services, which is the measure to which personnel less adhered in the study due to the experience and preference of the anesthetics team. This is followed by the infiltration of local anesthesia in the surgical ports in 89.06% of the sample due to the shortage of local anesthesia indicated for the ports on 7 of the 64 procedures. The use of short-acting anesthesia and the decrease in the use of opioids in the ERAS protocol has been clearly related to the decrease in post-operative nausea and vomit, besides reducing costs, complication rates, and length of stay (LOS)[9,10]. Furthermore, the infiltration techniques previous to the incision have proved the safety and efficiency of post-operative pain management, where the use of ropivacaine or levobupivacaine is more effective than short-acting agents, such as lidocaine[11].

LOS global media were 1.14 days for all bariatric procedures, 1.16 days for RYGB, and 1 day for gastric sleeve. Besides, over 90% of the RYGB and 100% of the gastric sleeves were successfully discharged on the 1st day after surgery. It is important to highlight that these results were achieved with a low readmission rate of 6.25% (4 patients) within 30 days, none of which presented any fatal complication. This

Table 4. Adherence to ERABS recommended actions (percentage of compliance with recommendations) on the study

	Sample (%)
Pre-operative measures	
Granting pre-operative information, education, and counseling	100
Mandatory cease of smoking habits for at least 4 weeks previous to surgery	100
Pre-operative weight loss of at least 10% weight excess	100
Pre-operative low-carb diet (800 kcal daily) for 2 weeks before surgery	100
Intraoperative measures	
Endotracheal intubation and extubation on the same surgical procedure	100
Controlled perioperative fluid management, patients receive 1.5-2 L of crystalloid fluids during surgery	100
Avoidance of long-acting opioids	71.87
Multimodal analgesia with paracetamol and tramadol	100
Post-operative nausea and vomit management (intraoperatory dose of ondansetron 8 mg)	100
Infiltration of local anesthesia on surgical port sites (20 ml of ropivacaine 0.75%)	89.06
Procedures conducted through laparoscopy	100
Patients with anti-embolism medium compression stockings (22-29 mmHg)	100
Avoid using urinary catheters, nasogastric tubes, or abdominal drainages	100
Post-operative measures	
Patient's mobilization within the first 12 h after surgery	96.87
Breathing exercises with incentive spirometer (10 min/h)	100
Supplementary oxygen through nasal cannula (5 L/min for the first 12 immediate hours post-operative)	100
Standard post-operative regimen of intravenous liquids avoiding a fluid overload (35 ml/kg/day)	100
Non-opioid intravenous analgesics (ketorolac 30 mg+metamizole 500 mg every 8 h)	100
Post-operative nausea and vomit management with ondansetron (4 mg every 8 h)	100
Thromboprophylaxis through subcutaneous low-molecular-weight heparin (enoxaparin 60 mg SC 12 h after surgery and afterward every 24 h)	100
Capillary glycemia and, if necessary, rapid-acting insulin plan for patients with diagnosis of type 2 diabetes mellitus	100
Early post-operative feeding (6-8 h after surgery, clear liquids intake in a proportion of 50 ml in 30 min)	96.87
Provide CPAP for users on the recovery area immediately after procedure	100

CPAP: continuous positive airway pressure; ERABS: enhanced recovery after bariatric surgery

situation can be compared to 20% readmission rate found in an aleatory study of SG patients[12].

The conventional ERAS recommendations were used in our sample, accepting that there is a shortage of evidence on bariatric population. Despite this, different applied components in the study have a firm sustained base on the colorectal surgery and, as such, are nowadays considered the best surgical practice[13,14]. Some other ERAS measures not included in the study which have a variable evidence level and commendation are reduced pre-operative fast (6 h) and oral pre-operative carbohydrates charge. These situations have presented a relation with the decrease LOS after a major abdominal surgery, but, presently, there are no studies on the gastric emptying and the metabolic effects of these pre-operative drinks in the bariatric population[15,16]. Within intraoperative measures are humidification and warming of insufflated CO_2 required for the creation of pneumoperitoneum to perform laparoscopic surgery, a measure that is related to decreased postoperative pain. Other useful measures that concern to the anesthesiologist are: volume-controlled ventilation, high use of positive end-expiratory pressure (6-8 cm/H_2O), to promote lung protection and permissive hypercapnia (end-tidal CO_2 > 6,5 kPa), this latter promotes vasodilation and can identify some intraoperative bleeding in the stapler line not detected previously. Another measure consists on monitoring the anesthetic depth with a bispectral index to guide and minimize the intraoperative anesthetic requirements besides the use of a deep neuromuscular block to improve the surgical performance but with a low evidence level[17]. This opens the door for future studies to identify the feasibility, adherence, and results of these other measures in the bariatric population.

The standardization of the surgical technique in anesthetic management and in the fellow surgeons, residents, and nursing personnel contribute to obtain the good clinical results (low rate of complications and readmission) observed in this series since there is evidence that the standardization of the perioperative care is associated with better results[18]. This study has several limitations. First of all, it lacks a control group to compare the results on the ERABS measures applied, is a small sample of only 64 patients treated by the same bariatric surgeon, and lacks data on the in-hospital stay previous to the ERABS protocol application since the information is not available. Finally, there is no analysis on the economic benefit on the application of the ERABS measures, a situation that allows for a different field of study when applying these enhanced recovery measures after surgery on the bariatric area.

Conclusion

This study has proved that applying ERABS protocols in our population and medical unit is feasible and safe, can be related to a low morbidity, a remarkably short LOS in hospital and a low readmissions rate within 30 days after bariatric surgery. The presence of multiple medical comorbidities must not stop the

use and application of these enhanced recovery protocols in patients who undergo bariatric surgery. New studies with a higher sample volume, more applied ERABS measures and counseling, as well as the economic benefits for the institution result of its implementation are promising for the future of bariatric surgery in our hospital unit.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Ethical Disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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