Research Article

ERAS protocols for bariatric surgery

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Abstract
Background: Enhanced recovery after surgery had been introduced with success in many surgical fields, including bariatrics. There are numerous studies presenting how ERAS® has positively affected the outcomes following weight loss surgery. **Methods:** This is a prospective study that has been held in general Surgery department , Minia University Hospital on 20 patients managed with enhanced recovery protocol after bariatric surgery, between February 2019 and February 2020. Informed consents from all patients have been taken before entering the study. **Results:** There is significant increase of age in cases with postoperative morbidity (P value 0.021). There is significant increase of length of hospital stay in cases with postoperative morbidity (P value 0.023).
Conclusion: Implementing ERAS did not reduce the percentage of patients discharged on postoperative day 1 in a bariatric surgery program with historically low length of stay, but it led to significant reductions in perioperative opioid use, decreases in postoperative nausea, and early emergency room visits.
Keywords: ERAS**,** Bariatric Surgery, Protocol

Introduction
Enhanced recovery after bariatric surgery protocol (ERABS) decreased length of hospital stay (LOS) without influencing clinical outcomes. ERABS improved logistics aspects in operating room (OR) with OR time savings. Lean management was used to reorganize OR logistics and to improve its efficiency. This study analyzed clinical and OR logistic aspects in ERABS protocols[(1)].

Enhanced recovery after surgery (ERAS) has changed the approach of perioperative care towards mainly surgical procedures[2,3]. While in the first period of its implementation, the ERAS endpoint was focused on improvement of logistic aspects, especially to increase the number of surgical procedure as well as to achieve cost savings[4], recent data reported its positive impact also on clinical outcomes[2]. Literature reported strong evidence of consistent benefits for some surgical specialties (i.e., colorectal surgery) in terms of reduced length of hospital stay (LOS) and early return to functional activity[5, 6]. Obesity is an endemic disease and surgery remains a consistent and successful method of managing this disease[7].

The growing demand for bariatric surgery[8] has been accompanied by an increased number of procedures and the necessity to improve the quality of care[9]. ERAS applied to the bariatric setting (ERABS) represented the answer to this necessity. Despite ERABS being widely adopted in bariatric surgery[7,8,9,10,11,12,13,14,15,16,17], evidence concerning the implementation of ERAS programs for obesity patients is still scarce. Two systematic reviews with meta-analysis have shown that ERABS compared to standard protocol in bariatric surgery decreased LOS without influencing clinical outcomes in terms of postoperative complications and re-hospitalization[11,12].

Recent ERABS studies revaluated logistic aspects[9,10,18], but they did not report a clear correlation with clinical outcomes.

In reality, clinical and logistic issues could be considered two sides of the same program.
Logistic efficiency was aimed to eliminate useless hurdles and to standardize clinical and surgical pathways. Despite the fact that initially the ERAS philosophy was mainly focused on cost saving, recent literature[9,10,18] underlines

also the importance of the logistic pathway to improve patient's prognosis in an ERAS program.

A useful methodology to improve the logistic pathway in an operating room (OR) was the implementation of lean management[19]. Lean methodologies were developed in the manufacturing industry to increase efficiency by eliminating non-value-added steps (waste or hurdles). Lean in healthcare improved the logistic process, particularly in OR settings[19].

Patients and Methods

This is a prospective study that has been held in general Surgery department , Minia University Hospital on twenty patients managed with enhanced recovery protocol after bariatric surgery, between February 2019 and February 2020. Informed consents from all patients have been taken before entering the study .

Inclusion criteria:-

- Both sexes.
- Morbide obese patients underwent first bariatric surgery.
- Age group 25 -40 years old

Exclusion criteria:

- **Age group less than 25 and more than 40 years old**
- patients underwent more than one bariatric surgery .
- Patients underwent other GIT surgery .
- Patients associated with debilitating diseases such as cardiac and renal diseases
- GIT surgery needing resectional anastomosis

Methods:

All the patients were subjected to the following work-up assessment:

- **Pre-operative procedures:**

I. Through Clinical Assessment:

1. History taking.

- **Personal history:** Name, Age, Sex and Address.
- **History of present illness:**

- Pain: Site, Character, Radiation

- Swelling: Site, Size, Onset and Course., Onset, Course and Duration.

- Disturbance of function:

1. **Vomiting:** Onset, Contents of vomitus, Frequency.
2. **Constipation:** Duration, Passage of flatus or not.
3. **Distention:** Onset, Course, Duration.
4. **Bleeding:** Bleeding per rectum or Melena.

- History of other systems:

AS Urinary symptoms.

- History of investigations or medication.

- **Past history:** Similar attacks, Common diseases and Previous operations.
- **Family history:** Consanguinity and Similar condition in one of the members of the family.

2. Examination:

A - General examination:

- **Vital signs:** Temperature, Heart rate, Respiratory rate and Blood pressure using an appropriate sized cuff.
- **General look:** Conscious, Alert, Toxic, Body built and Decubitus.
- **Head and Neck.**
- **Chest and Heart.**

B - Local examination:

- **Exposure:** from nipple till mid thigh.
- **Inspection:** Abdominal contour, Movement with respiration, Visible intestinal movements, Umbilicus, Hernial orifices, Skin and External genitalia.
- **Palpation: Superficial;** Tenderness, Rigidity and Guarding. **Deep;** Masses.
- **Percussion:** Normally abdomen is resonant in percussion.
- **Auscultation:** Intestinal sounds; loud or dead silent.
- **P\R: Inspection;** perineum.
- **Digital Examination;** Red current jelly stool, Empty rectum, or Impacted faeces.

II. Radiological investigation:

1- Abdominal X-ray.
2- Abdominal ultrasonography.
3- Barium(swallow, meal, follow through)
4- CT scan.

III. Laboratory Work-Up:

Routine laboratory tests including:

- Complete blood count (CBC).
- Blood sugar.
- Liver function tests.
- Renal function tests.
- Blood Electrolytes (Na, K, Ca).
- Coagulation profile (Prothrombin time, concentration and INR).
- Blood grouping, and cross matching.

IV. Preoperative fitness:

Consulting the pediatric & anesthesia physicians.

Operative procedures:

Anesthesia:

Intestinal anastomosis is performed with the patient under general anesthesia. A double-lumen endotracheal tube.

Positioning:

Patient positioning depends upon the type of surgical procedure. Most abdominal operations are performed in the supine position with arms abducted at right angles to the body or sometimes by the side of the body. Pelvic procedures are performed with the patient in the lithotomy position,Care should be taken to avoid excessive flexion or abduction, Adequate padding of pressure points should be ensured to avoid neurologic damage and pressure ulcerations.

Type of operation :

Sleeve gastrectomy :

The sleeve gastrectomy has become increasingly common in the last few years, yet it is still not technically standardized. Controversy exists over bougie size and pouch calibration, extent of antral resection, management of reflux and hiatal hernias, and the use of buttress materials and staple line suturing methods. Moreover, postoperative problems from a suboptimal technique may not present for months or years after surgery, and thus, it is difficult to evaluate differing technical preferences. This article describes one surgeon's technical preferences.

Step 1: patient positioning and port placement

The patient is placed in the supine position and then Trendelenberg once ports have been placed. A 12mm or 15mm port is placed either at the umbilicus or superior and to the right, depending on the size of the patient and the pannus. A 5mm or 3mm subxiphoid Nathanson liver retractor is placed to retract the left lateral segment of the liver.

Assisting ports can be a 5mm right upper paramedian port for the surgeon's left hand and a 5mm left anterior axillary line port for the assistant's right hand. A 5mm left upper paramedian port is placed for the scope .

Step 2: gastric mobilization

Mobilization of the fundus. Using the energy source, make a window into the omental bursa approximately 4 to 6cm proximal to the pylorus. Proceeding superiorly, seal and divide the short gastric vessels directly on the serosa of the stomach. Stop and reverse direction once exposure becomes difficult.

Mobilization of the antrum. As the pylorus is approached, be aware of the gastro-duodenal and right gastric artery becoming the gastroepiploic artery. Usually, stopping the dissection about 2cm proximal to the pylorus will prevent injuring one of these vessels and preserve perfusion of the distal antrum and pylorus.

Mobilization of the cardia. Once the antrum has been mobilized, it will be easier to retract the stomach toward the patient's right and thus inferiorly allowing better exposure of the cardia, spleen, and left crus. The final posterior short gastric can be divided along the left crus. The anterior fat pad is often enlarged and obstructs the view of the medial cardia and the distal esophagus. Mobilize this to provide adequate exposure of this area for optimal stapling and placement of sutures .

Step 3: Gastrectomy

Antrum. A 32 French orogastric bougie is placed adjacent to the pylorus. The 32 French bougie is used as this is the smallest size that avoids stenosis yet minimizes the chance of antral and pouch dilation. A 60mm black or green cartridge is used to staple 2 to 3cm proximal to the pylorus . Seromuscular fracturing in this region is common with any type of staple cartridge and must be reinforced with sutures.

Angularis/fundus. The second cartridge is in proximity to the angularis and care must be taken to avoid stenosis here Cartridge placement is optimized by checking the locations of the anvil and cartridge both anteriorly and posteriorly

Black, green, or purple cartridges may be used in this region. Smaller stapler cartridges are not advised. The additional hemostasis that may be provided can be offset by staple line disruption later. Buttress material may be used for

hemostasis, but avoid undersizing the cartridge when using thicker materials.

Cardia. Placement of the last two cartridges at the top of the stomach can be the most difficult for proper calibration. It is important to rotate the stomach and the stapler anteriorly to carefully examine and retract the posterior gastric wall through the cartridge prior to closing it. The final cartridge should be placed 1 to 2cm from the gastroesophogeal (GE) junction to allow for suture reinforcement of the cardia. Suture invert the apical staple line with 1 or 2 Lembert type sutures.

Step 4: Omentopexy
Identify the divided edge of the omentum superiorly and, using absorbable interrupted sutures, attach it to the staple line junctions. Approximately 3 to 4 sutures are used above the angularis and 2 to 3 sutures at and below the angularis. This omentopexy provides additional reinforcement to the staple line but also creates gentle traction that can reduce the incidence of postoperative gastric volvulus or coiling.

Bipartite operation:
Step 1: Port Placement and General Inspection
The patient is placed in supine position, with both arms straight against the torso. For port placement, a line is drawn from the umbilicus to the xiphoid, which is divided into three equal parts. The 10-mm camera port is then put at the level of the caudal third part, 2–4 cm from the midline, and the open Hasson technique is performed to establish pneumoperitoneum.

On the contralateral side, at the same level, 3–4 cm from the midline a 12-mm working port is introduced under direct vision. At this time, a diagnostic laparoscopy is performed to rule out metastatic disease.

From this point on, two 5-mm working trocars are placed bilaterally at the subcostal level and the mid-clavicular lines. Finally, a 12 mm port is introduced at the right flank and used for liver retraction with the Endo Paddle Retract.
Step 2: Division of Hepatogastric Ligament
The Endo Paddle Retract is placed underneath the left liver lobe. We use the Endo Paddle Retract™ as it also helps us further up in the procedure, when the stomach is lifted up for retrogastric resection. Initially, the assistant retracts the stomach caudally, and the surgeon divides the hepatogastric ligament. The line of transection is below the left lobe of the liver and on top of the caudate lobe. After the hepatogastric ligament is divided, and if adequate retraction is maintained, the right crus and its white line can be visualized by the surgeon, and the dissection is continued perpendicular until the esophageal hiatus.

Step 3: Division of Gastro-Colic Omentum and Short Gastric Vessels
The patient is positioned in a slight reverse Trendelenburg, which allows the transverse colon to descend. An entry point to the lesser sac is identified; usually it is easier to start towards the left side of the patient. We stay on top of the transverse colon, with care not to injure the transverse mesocolon vasculature. The omentum is not divided en bloc, as we experienced that the bulk of the omentum connected to the stomach made the exposure for gastric mobilization more difficult. Thus, the omentum is resected at a later stage.

The dissection is continued towards the left upper quadrant. The surgeon's left hand retracts the stomach towards the patients right lower quadrant, and the assistant retracts the mesocolon caudally. After dissection along the splenic flexure, a "tunnel vision" is established demonstrating the route under the short gastric vessels, with important landmarks: the posterior gastric wall at the left side, the spleen at the right side, and the retroperitoneum with the splenic artery vein and pancreas hilum at the dorsal side. The short gastric vessels are divided cautiously with the use of an energy device. The dissection is continued until the angle of His and the left crus. It is very helpful to create space between the spleen and stomach by dividing the retrogastric adhesions first. The lymph nodes along the greater curvature (stations 4sa, 4sd and 4b) are left en bloc with the specimen.

Step 4: Division of Left Gastric
The gastrocolic omentum that is connected to the stomach after dissection of the gastrocolic ligament, is flipped anteriorly between the stomach and the liver. The Endo Paddle Retract is then placed underneath the stomach to retract it upwards. At this point the pedicle of the left gastric artery and the hepatic artery node are

clearly visible. In the background, the caudate lobe and vena cava are seen. The assistant may retract the stomach and pedicle of the left gastric artery upwards through the window underneath the stomach at the level of the caudate lobe. The surgeon starts the dissection proximal to the station 8 node and continues towards the left gastric artery pedicle . Usually the left gastric vein is encountered first and divided with the coagulating device. During further dissection at this level more cranially the artery is found, which is ligated with Hem-o-lock® clips .

Step 5: Celiac Trunk and Splenic Artery Lymphadenectomy
After completing step 4, the surgeon continues further posteriorly to harvest the celiac node, and continues on the superior border of the splenic artery to obtain the splenic nodes (stations 11p and 11d). This step must be done with great care, as the splenic artery coils along its trajectory and can be easily injured. In about 62%, a posterior gastric artery is present between the splenic artery and the posterior gastric wall, which can be divided by coagulation. Additionally, if it is an upper third tumor involving the greater curvature, the chance of lymph node involvement is around 9–20%, and therefore lymphadenectomy of station 10 is indicated, otherwise it is not necessary to do so. There is no benefit for routine splenectomy during D2 dissections, and on the contrary there is evidence of increased morbidity.

Step 6: Common Hepatic Lymphadenectomy and Right Gastric Ligation
The stomach is placed again in its natural position, and retracted downwards. The Endo Paddle Retract is placed under the liver again. The previously identified hepatic artery node is found, following the superior border of the common hepatic the origin of the gastroduodenal artery and proper hepatic will be found. The dissection is continued towards the anterior aspect of the hepatoduodenal ligament to harvest station 12a nodes. Subsequently the origin of the right gastric artery is identified, and the vessel is ligated and divided.

Step 7: Hiatal Dissection
The dissection plane along the right crus (step 2) is found again and restarted posteriorly towards the left crus until the aorta is visualized, then continued at last finalized on the anterior aspect. The pericardial lymph nodes (stations 1 and 2) are dissected en bloc with the specimen. Now the only remaining attachments of the stomach should be the esophagus and duodenum and its tributaries.

Step 8: Duodenal Dissection and Gastric Resection
The remaining gastrocolic omentum, located towards the duodenum, is resected. During this step, the right gastroepiploic pedicle is visualized, dissected, and ligated with the use of Hem-o-locks®. The inferior and superior border of the duodenum is cleared en bloc with the inferior and superior pyloric nodes (station 5 and 6), and a retroduodenal passage is created to allow passage of the stapler. Much care should be taken not to thermally damage the thin duodenal wall at this level during station 5, 6 dissection with a coagulation device.

The pylorus is identified and the duodenum is transected 1–2 cm distal to it, we prefer to use the Endo-GIA Purple Tri-staplers™ (Medtronic, Minneapolis, USA) to create a secure sealing of the duodenal bulb. Before firing the stapler, the surgeon should always verify that the nasogastric or nasojejunal (feeding) tube has been removed.

The stomach is then retracted caudally, and just above the site of the future proximal transection, two stay sutures are placed, one on each side of the esophagus. These are placed to avoid retraction of the esophageal stump into the thorax and control the stump during the anastomosis. With suturing, the camera is placed in the opposite 12-mm port at the right side of the patient switching with the needle driver to allow for sufficient space and angulation during suturing. Again an Endo-GIA Purple Tri-stapler is used to divide the esophagus or the proximal stomach.

Step 9: Frozen section and Greater Omentectomy
A muscle sparing transverse incision of 3–5 cm is made at the level of the 10 mm camera port and an Endopath Dextrus is inserted in order to extract the stomach through it. This Dextrus allows temporarily closure of the wound with a seal to continue the laparoscopic procedure.

Step 10: Reconstruction
The camera port is now inserted in the Dextrus port. Once tumor involvement of the proximal transection line has been ruled out, a 25-mm OrVil anvil connected to a gastric tube (Medtronic, Minneapolis, USA) is passed trans-orally. The tube is pushed into the distal esophageal stump. Once it has been visualized, the esophagus is incised with the cautery and the OrVil tube is extracted through the right 12 mm port until the Anvil itself is seen. The suture is cut to un-tilt the Anvil, and the tube is disconnected from it. A purse-string suture (Mersilene 3-0) is placed around the anvil to secure it, and to prevent the retraction of the esophageal mucosa, increasing the possibility of obtaining complete donuts during the anasto-mosis. We use suture material with a different color, so the purse-string suture is not confused with the stay sutures.

Minigastric bypass operation:
The operation begins with the dissection of the esophagogastric angle and the opening of the left gastrophrenic ligament with a harmonic scalpel, so as to expose the lateral aspect of the left diaphragmatic crus. Then, the ressection of the fat pad of the esophagogastric junction (Belsey's fat) is performed. Then, the surgeon proceeds the ligation of the distal lesser sac, next to the insertion of the Latarjet nerve, using a harmonic scalpel until the exposure of the posterior gastric wall. The gastric pouch must be lengthy and narrow, measuring around 15-18 cm, with a 50-150 ml reservoir capacity. The pouch is created using 01 unit of 45mm blue cartridges to perform the horizontal section and 02 to 03 units to perform the vertical section. The stapling lines of the pouch and excluded stomach are then reinforced with a 3-0 polydioxanone continuous suture. The Treitz ligament is then identified and the small bowel is counted until 200 cm from the Treitz angle, determining the exclusion of part of the stomach, duodenum, and proximal jejunum from the food pathway. This segment is then attached to the pouch and a vertical or slightly oblique omega-loop, isoperistaltic, antecolic, and side-to-side 25mm-gastrojejunostomy is performed using a 45mm white cartridge; the orifice for the cartridge insertion is closed by means of a continuous suture with 3-0 polydioxanone reinforced with separate stitches of 3-0 polyester. The Petersen's defect is closed by means of a continuous suture with 3.0 silk. The placement of a silicone ring around the gastric pouch is randomly opted following the study protocol for evalution of the effects of the ring. The randomization is performed by means of an electronic device and the individuals are notified of the result of the randomization process prior to the surgery. Among the individuals which have a 6.5-cm silicone ring placed, it is attached to the pouch with 3-0 polypropylene stitches. presents a schematic representation of the surgical technique.

SASI operation:
Operations were done under general anesthesia. Prophylactic doses antibiotics was adminis-trated on induction. Patients were positioned with legs apart in anti-Trendelenburg position, five tracers were used and placed as follows: camera tracer (10mm), handbreadth below the xyphoid process, a 12mm tracer on the left midclavicular line between the first and the second tracers, a 12mm tracer on the right midclavicular line, 5mm tracer on right anterior axillary line and a 5mm tracer placed below xiphisternum for liver retraction. After oral Ryle insertion dissection was started on the greater curvature 3 cm-5 cm from the pylorus up to the cardio-oesophageal junction until full mobilization of the gastric fundus was achieved. Careful dissection of adhesions between the pancreas and the posterior wall of the stomach (which is very common with IGB) is done to avoid injury of major vessels. After detaching the stomach from the great curvature, a 40-French orogastric tube was inserted in the stomach and into the duodenum. Stomach resection was done by using linear staplers that were applied parallel to the lesser curve starting 5 cm from the pylorus up to the angle of Hiss.

In cases that underwent SASI same steps of LSG were performed in addition to the following after the creation of the sleeved gastric tube, the patient's position was changed to Trendelenburg position. Then retracting transverse mesocolon toward the head of the patient and 300 cm of jejunum was measured from the ileocecal junction then an ante colic side to side gastro-jejunostomy at the posterior wall of the area between antrum and body of the stomach was performed with 45 mm linear stapler.

The stapler gastroentrotomy was closed with a Vicryl 2/0 continuous stitch. A nasogastric tube was placed in the gastric pouch and the resected stomach was then removed through the left midclavicular port. Therefore, the operation ended with a gastric tube having two outlets; one to the duodenum and one to ileum. A leak test was performed twice by methylene blue. Nelaton drain was then placed. Patients were kept on NPO for 24 hours and on intravenous fluids, antibiotics, analgesics, proton pump inhibitor, and anticoagulants in a prophylactic dose, oral intake was started on the first postoperative day after gastrograffin study. Patients were discharged on the second postoperative day after drain removal. Drugs prescribed for the patients were antibiotics, analgesics, proton pump inhibitors, and anticoagulants for one week and multivitamin supplements for one year. Follow up was scheduled one week after surgery than after 3, 6, 9, and 12 months. During each visit, the operation was evaluated as regard BMI changes, postoperative complications, and any nutritional complications such as decrease plasma levels of albumin, hemoglobin, and calcium.

Post-operative procedures:

All complication will be mentioned within the follow up period.

- **Postoperative Complications:**
- Wound condition.
- Paralytic ileus.
- Postoperative fever.
- Postoperative sepsis.
- Leakage.
- **Postoperative hospital stay**.

Enhanced recovery protocol components:

1. Preoperative:

Pre-admission: Patients and their families should be very knowledgeable about the process. It is very important to make them a partner in the process and give them the responsibility for their reco-very and they should be clearly informated about the perioperative care, normal course of the protocol, discharge criteria, possible complications and the outpatient follow-up after discharge

Pre-operative fasting and carbohydrate loading:

Preoperative fasting for about 6 hours to 12 hours before anesthesia is as safe.

Non-diabetic patients should receive carbohydrate (CHO) loading pre-operatively because they increase glycerol deposits, reduce thirst, hunger and postoperative insulin resistance, reducing protein catabolism, postoperative ileus and loss of lean muscle mass.

Mechanical bowel preparation:

Avoid mechanical bowel preparation due to bowel preparation can cause dehydration and fluid and electrolyte abnormalities, only clear liquids for 24 h before operation and may be do rectal wash for fecal impaction after general anesthesia by diluted betadine

Medication:

* Antibiotic prophylaxis with single-dose antibiotic prophylaxis against both anaerobes and aerobes about one hour before surgery is recommended.

* Prophylactic antiemetic.

Intraoperative:

Normothermia:

Changes in body temperature can lead to coagulopathy, adverse cardiac events, and decreased resistance to surgical wound infections. An upper-body forced-air heating cover should be used routinely.

Approach:

An open procedure, transverse incisions should be made preferentially to reduce postoperative pain.

Nasogastric tube:

Nasogastric tubes should not be used routinely and they should be reinserted only if ileus developed.

Surgical drains:

Drains are avoided, as there is no evidence of beneficial effect in reducing post-operative morbidity, mortality, or reduce the effect of anastomotic leakage.

Postoperative;

Hydration:

we generally administer 75–80% of the calculated maintenance rate, and then if a patient demonstrates a need for more fluid (low urine

output, tachycardia), we give a bolus of crystalloid solution (10–20 mL/kg) rather than just increasing the maintenance rate. (Urine output of approximately 0.8 mL/kg/h).

Nutrition support:
The enteral diet in this group was begun within 12 hours to 24 hours, usually in the morning of the first postoperative day.

Analgesia:
We minimized the administration of narcotics, we used the combined agonist–antagonist narcotic drug nalbuphine (0.1 mg/kg IV every 3 h, as needed for pain), we also typically used ketorolac (0.5 mg/kg IV every 6 h, maximum dose 30 mg), intravenous acetaminophen is another useful adjunct in patients who have a contraindication to ketorolac Patients for approximately 48 hours following elective colonic surgery and approximately 72 hours following pelvic surgery and we used low-dose local anesthetic.

Nausea and vomiting:
Regular using antiemetic and prokinetics to prevent nausea and vomiting.

Urinary catheter:
Early removal of urinary catheter should be performed after the patient allowed oral fluid within 12 hours to 24 hours post-operative.

Early mobilization:
The aim is to reduce muscle loss and improve respiratory function, reducing the risk of pneumonia, and maximizing oxygen delivery to tissues. This is also essential to reducing the risk of venous thromboembolism. The breathing exercises should be done, especially in patients with previous lung pathology and these exercises must be trained before surgery.

Early discharge:
At the end, early discharge, when the discharge criteria have been reached.

Discharge criteria:

- Good mobilization.
- Adequate oral intake for liquids and solids.
- Gastrointestinal bowel function, at least one bowel movement.
- Normal urinary function.
- No wound problems.

Methods of statistical analysis :
Data were collected, revised, verified, coded, then entered PC for statistical analysis done by using IBM SPSS statistical package version 20 (Chicago, USA).

Results

Table (1): Socio-demographic data of studied sample

Variables	Mean ±SD	Range
Age	33.2±4.5	27-43
Weight	136.8±35.5	100-230
Height	165.05±6.6	157-176
BMI	49.2±9.6	36-75

As regarding the age ,it ranged from 27 to 43 years with a mean age 33.2 years, the weight, it ranged from 100 to 230 Kg with a mean weight 136.8 Kg, the height , it ranged from 157 to 176 meters with a mean height 165.05 meters, and the BMI, it ranged from 36 to 75 kg/m2 with a mean BMI 49.2 Kg/m2 as shown in table (1).

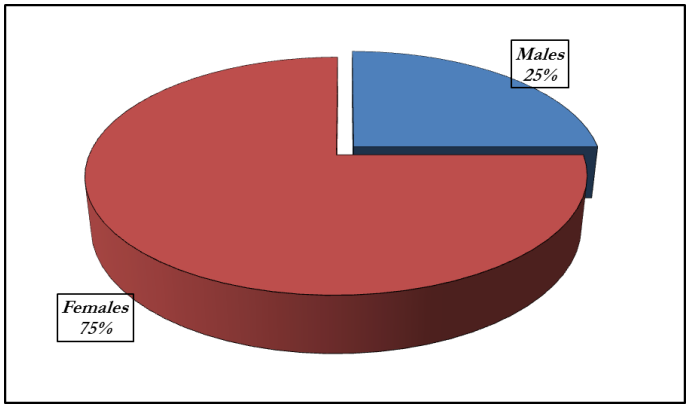

Figure (1): Distribution of sex among studied sample .

Table (2): Clinical data of studied sample

Variable		Frequency	Percent (%)
Diabetes	**Yes**	6	30
	No	14	70
Hypertension	**Yes**	4	20
	No	16	80
Type of operation	**Bipartite**	3	15
	Minigastric bypass	5	25
	SASI operation	2	10
	Sleeve gastrectomy	10	50

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Table (3): Complications among studied sample

Variable		frequency	Percent (%)
Obstructive sleep apnea	**Yes**	8	40
	No	12	60
Limited mobility	**Yes**	8	40
	No	12	60
Postoperative morbidity	**Attacks of constipation**	2	10
	Attacks of hypotension	1	5
	Hypo-albuminemia	1	5
	Vomiting	4	20
	No	12	60

Table (4): Operative data of studied sample

Variables	Mean ±SD	Range
length of hospital stay (days)	1.5±1.1	0.5-4
Abstinence (hours)	8.5±2.7	6-12
Oral feeding allow (hours)	15.8±6.2	10-24
Postoperative mobility (hours)	11.2±7.1	4-24

Table (5): Correlation between length of hospital stay, Oral feeding allow and Abstinence

		length of hospital stay (days)
Oral feeding allow (hours)	**Pearson Correlation**	0.257
	p-value	0.273
Abstinence (hours)	**Pearson Correlation**	0.439
	p-value	0.053

*No significant correlation between oral feeding allow and length of hospital stay .
*No significant correlation between abstinence and length of hospital stay .

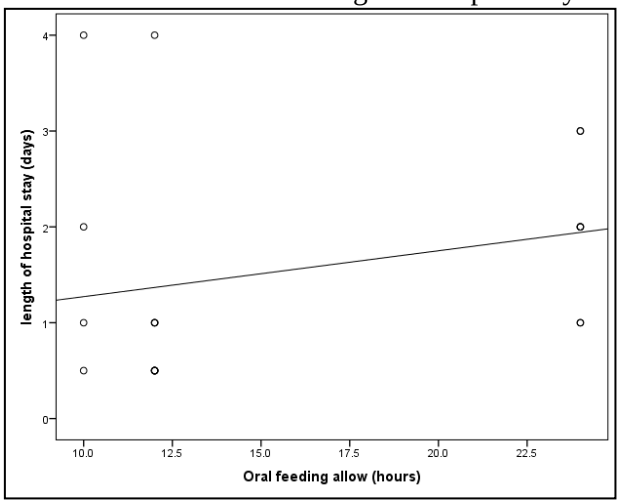

Figure (2): Correlation between length of hospital stay and Oral feeding allow

The figure show correlation between oral feeding allow and length of hospital stay .

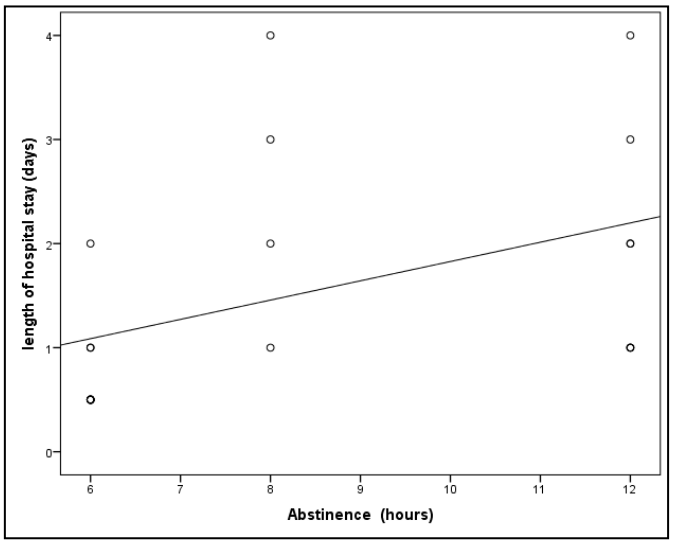

Figure (3): Correlation between length of hospital stay and abstinence

The figure show that decrease duration of abstinence leads to decrease length of hospital stay .

Table (6): correlation between postoperative morbidity, clinical and operative data

	postoperative morbidity	
	Pearson Correlation	**p-value**
Age	0.510*	0.021*
BMI	0.081	0.736
Preoperative morbidity	0.043	0.858
Limited mobility or not	0.167	0.482
length of hospital stay	0.507	0.023*
postoperative mobility hours	0.741*	<0.001*
Oral feeding allow hours	0.465*	0.039*
Abstinence hours	0.763*	<0.001*

* There is significant positive correlation between age and postoperative morbidity at P value 0.021
* There is no significant correlation between postoperative morbidity and (BMI, preoperative morbidity and limited mobility).
* There is significant positive correlation between length of hospital stay and postoperative morbidity at P value 0.023
* There is highly significant positive correlation between postoperative mobility and postoperative morbidity at P value <0.001
* There is significant positive correlation between oral feeding allow and postoperative morbidity at P value 0.039
* There is highly significant positive correlation between abstinence and postoperative morbidity at P value <0.001

Table (7): Correlation between postoperative morbidity and other variables

	Postoperative morbidity (n=3)	**No Postoperative morbidity (n=17)**	**p-value**
Age (years)	36±4.2	31.3±3.9	0.021*
BMI (kg/m2)	50.1±8.4	48.5±10.6	0.736
Preoperative morbidity:			0.848
No	5(62.5%)	8(66.7%)	
Yes	3(37.5%)	4(33.3%)	
Limited mobility:			0.456
No	4(50%)	8(66.7%)	
Yes	4(50%)	4(33.3%)	
length of hospital stay (days)	2.2±1.03	1.08±1.01	0.023*
postoperative mobility (hours)	17.5±6.9	7±2.8	<0.001*
Oral feeding allow (hours)	19.2±6.5	13.5±4.9	0.039*
Abstinence (hours)	11±1.8	6.8±1.8	<0.001*

* There is significant increase of age in cases with postoperative morbidity (P value 0.021)
* There is significant increase of length of hospital stay in cases with postoperative morbidity (P value 0.023)
* There is significant increase of duration of postoperative mobility in cases with postoperative morbidity (P value <0.001)
* There is significant increase of duration of oral feeding allow in cases with postoperative morbidity (P value 0.039)
* There is significant increase of duration of abstinence in cases with postoperative morbidity (P value <0.001)

Discussion

Enhanced Recovery After Surgery (ERAS) pathways integrate multimodal perioperative interventions which are designed to reduce physiological stress, facilitate early return of bodily function and reduce healthcare costs by reducing length of hospital stay (LOS)[20].

Enhanced recovery after surgery (ERAS) is a Perioperative care pathway designed to ate-nuate the stress Response during the patients' journey through a surgical procedure to facilitate the maintenance of preoperative bodily compositions and organ function and in doing so achieve early recovery[21].

Patients frequently remain in the hospital after bariatric surgery due to pain, nausea, and inability to tolerate oral intake. Enhanced recovery after surgery (ERAS) concepts address these perioperative complications and therefore improve length of stay for bariatric surgery patients[22]

Our study assessed the outcome of the patients managed with enhanced recovery protocol after bariatric surgery, assessing their outcome mainly according to post-operative compli-cation and post-operative hospital stay.

Our study included 20 patients managed with enhanced recovery protocol, 3 patients develop-ped postoperative morbidity, 17 patients showed no postoperative morbidity.

In a study done by Marco Barreca et al.,[22], 30 patients included in the study and managed with enhanced recovery protocol, 10 patients developed postoperative morbidity, 20 patients showed no postoperative morbidity.

As regarding age in our study, 20 patients included with mean age 33.2 years.
In the study done by [22], 30 patients included in the study with mean age 35.6 years.
In our study, as regarding the BMI, it ranged from 36 to 75 kg/m2 with a mean BMI 49.2 Kg/m2.

As regarding type of operation in our study:

- 3 patients operated on Bipartite operation, represents 15% of all studied cases
- 5 patients operated on Minigastric bypass operation, represents 25% of all studied cases.
- 2 patients operated on SASI operation, represents 10% of all studied cases.
- 10 patients operated on sleeve gastrectomy operation , represents 50 % of all studied cases.

As regarding preoperative morbidity in our study:

- 8 patients complain obstructive sleep apnea, represents 40% of all studied cases.
- 8 patients complain limited mobility, repre-sents 40% of all studied cases.

As regarding postoperative morbidity, in our study:

- 2 patients complain attacks of constipation, represents 10% of all studied cases
- 1 patient complain attacks of hypotension, represents 5% of all studied cases.
- 1 patient complain hypoalbuminemia, repre-sents 5% of all studied cases.
- 4 patients complain vomiting, represents 20% of all studied cases.

In our study as regarding to abstinence , it ranged from 6 to 12 hours with mean duration 8.5 hours.
In our study as regarding postoperative motility, it ranged from 4 to 24 hours with mean duration 11.2 hours.
In a study done by Khorgami Z et al., 2017 it ranged from 6 to 24 hours with mean duration 12.3 hours.
In a study done by Cheverie JN et al., 2018, it ranged from 4 to 12 hours with mean duration 8.2 hours.
In our study as regarding Length of hospital stay, it ranged from 0.5 to 4 days with mean duration 1.5 days.
In our study, there is significant increase of age in cases with postoperative morbidity at (P value 0.021)
In our study, there is increase of length of hospital stay in cases with postoperative morbidity (P value 0.023) which is significant.
In our study there is increase duration of postoperative mobility in cases with post-operative morbidity at (P value <0.001) which is highly significant.
In our study there is increase of duration of oral feeding allow in cases with postoperative mor-bidity at (P value 0.039) which is significant.
In our study there is increase of duration of abstinence in cases with postoperative morbi-

dity at (P value<0.001) which is highly significant.

According to the results of the present study, ERAS in primary and revisional bariatric surgery is safe and feasible, with short LOS, low morbidity and readmission rates, and no mortality. A significant reduction of mean LOS was progressively noted over the study period.

Conclusion

- The implementation of an enhanced recovery program after bariatric surgery is feasible, well tolerated, and can significantly reduce the length of hospital stay without increasing readmission rates. Controlling for several possible confounders, implementation of the ERAS protocol remained the strongest predictor of discharge on the first postoperative day after laparoscopic bariatric surgery
- Implementing ERAS did not reduce the percentage of patients discharged on postoperative day 1 in a bariatric surgery program with historically low length of stay, but it led to significant reductions in perioperative opioid use, decreases in postoperative nausea, and early emergency room visits.

Conflict and Interest: None

References

1. Fantola, G., Agus, M., Runfola, M., Podda, C., Sanna, D., Fortunato, F., ... & Moroni, R. (2020). How can lean thinking improve ERAS program in bariatric surgery?. *Surgical Endoscopy*, 1-11.
2. Spanjersberg WR, van Sambeeck JDP, Bremers A, Rosman C, VAN Laarhoven CJHM (2015): Systematic review and meta-analysis for laparoscopic versus open colon surgery with or without an ERAS programmme. Surg Endosc 29(12):3443–3453.
3. Beamish AJ, Chan DSY, Blake PA, Karran A, Lewis WG (2015): Systematic review and meta-analysis of enhanced recovery programmes in gastric cancer surgery. Int J Surg Lond Engl 19:46–54
4. Dogan K, Kraaij L, Aarts EO, Koehestanie P, Hammink E, van Laarhoven CJHM et al., (2015): Fast-track bariatric surgery improves perioperative care and logistics compared to conventional care. Obes Surg 25(1):28–35.
5. Brindle M, Nelson G, Lobo DN, Ljungqvist O, Gustafsson UO (2020): Recommendations from the ERAS® Society for standards for the development of enhanced recovery after surgery guidelines. BJS Open 4(1):157–163
6. Stone AB, Grant MC, Pio Roda C, Hobson D, Pawlik T, Wu CL et al., (2016). Implementation costs of an enhanced reco-very after surgery program in the United States: a financial model and sensitivity analysis based on experiences at a quarter-nary academic medical center. J Am Coll Surg 222(3):219–225.
7. Schauer PR, Bhatt DL, Kirwan JP, Wolski K, Aminian A, Brethauer SA et al., (2017) Bariatric surgery versus intensive medical therapy for diabetes: 5-year outcomes. N Engl J Med 376(7):641–651.
8. Angrisani L, Santonicola A, Iovino P, Vitiello A, Higa K, Himpens J et al., (2018) IFSO worldwide survey 2016: primary, endoluminal, and revisional procedures. Obes Surg 28(12):3783–3794
9. Trotta M, Ferrari C, D'Alessandro G, Sarra G, Piscitelli G, Marinari GM (2019): Enhanced recovery after bariatric surgery (ERABS) in a high-volume bariatric center. Surg Obes Relat Dis Off J Am Soc Bariatr Surg 15(10):1785–1792.
10. Mannaerts GHH, van Mil SR, Stepaniak PS, Dunkelgrün M, de Quelerij M, Verbrugge SJ et al., (2016): Results of implementing an enhanced recovery after bariatric surgery (ERABS) protocol. Obes Surg 26(2):303–312.
11. Taylor J, Canner J, Cronauer C, Prior D, Coker A, Nguyen H et al., (2019): Implementation of an enhanced recovery program for bariatric surgery. Surg Endosc. 34: 2675–2681
12. Meunier H, Le Roux Y, Fiant A-L, Marion Y, Bion AL, Gautier T et al., (2019) Does

the implementation of enhanced recovery after surgery (ERAS) guidelines improve outcomes of bariatric surgery? A propensity score analysis in 464 patients. Obes Surg 29(9):2843–2853
13. Nagliati C, Troian M, Pennisi D, Balani A (2019) Enhanced recovery after bariatric surgery: 202 consecutive patients in an Italian Bariatric Center. Obes Surg 29(10): 3133–3141
14. Małczak P, Pisarska M, Piotr M, Wysocki M, Budzyński A, Pędziwiatr M (2017): Enhanced recovery after bariatric surgery: systematic review and meta-analysis. Obes Surg 27(1):226–235.
15. Ahmed OS, Rogers AC, Bolger JC, Mastrosimone A, Robb WB (2018): Meta-analysis of enhanced recovery protocols in bariatric surgery. J Gastrointest Surg Off J Soc Surg Aliment Tract 22(6):964–972
16. Lemanu DP, Singh PP, Berridge K, Burr M, Birch C, Babor R et al., (2013): Randomized clinical trial of enhanced recovery versus standard care after laparoscopic sleeve gastrectomy. Br J Surg 100(4):482–489.
17. Thorell A, MacCormick AD, Awad S, Reynolds N, Roulin D, Demartines N et al., (2016): Guidelines for perioperative care in bariatric surgery: enhanced recovery after surgery (ERAS) society recommendations. World J Surg 40(9):2065–2083
18. Goretti G, Marinari GM, Vanni E, Ferrari C (2020): Value-based healthcare and enhanced recovery after surgery implementtation in a high-volume Bariatric Center in Italy. Obes Surg. 30:2519–2527.
19. Cima RR, Brown MJ, Hebl JR, Moore R, Rogers JC, Kollengode A et al., (2011) Use of lean and six sigma methodology to improve operating room efficiency in a high-volume tertiary-care academic medical center. J Am Coll Surg. 213(1):83–92.
20. Lassen K, Soop M, Nygren J, et al., Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. Arch Surg. 2019.
21. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth. 2016.
22. Barreca M, Renzi C, Tankel J, Shalhoub J, Sengupta N.Surg Obes Relat Dis. 2016 Jan;12(1):119-26. doi: 10.1016/j. soard. 2015.03.008. Epub 2015 Mar 20. PMID: 25892343.