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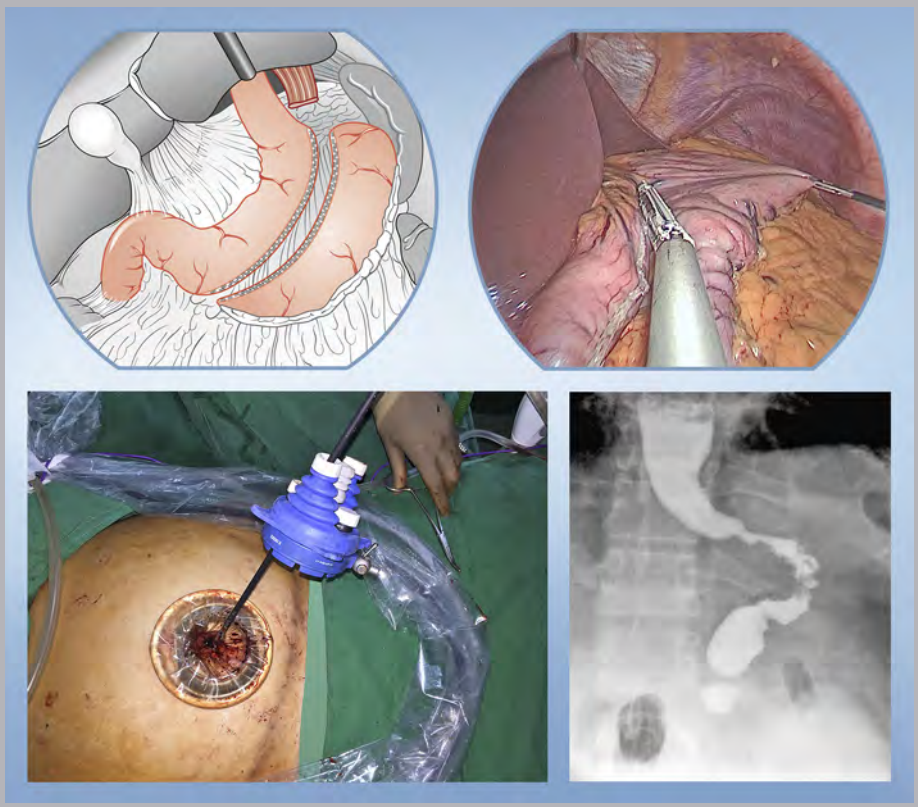
SLEEVE GASTRECTOMY



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SLEEVE GASTRECTOMY

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7.1 Laparoscopic sleeve gastrectomy

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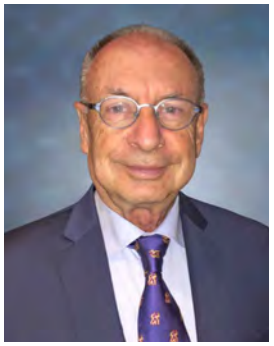
Foreword



The global prevalence of obesity and type 2 diabetes (diabesity) has increased dramatically since 1980. The World Health Organisation has estimated that worldwide obesity has doubled since 1980: in 2014, 1.9 billion people over 18 years of age were classified as overweight. Of these, 600 million were obese. This means that 39 % of adults over 18 are overweight and 13 % are obese. In addition to this, 42 million children under the age of 5 were overweight or obese in 2013.

In 2010, 284 million people or 6.4 % of the world's population had diabetes and this number is predicted to reach 439 million (7.7 %) by 2030.

Considering the health and economic impacts of obesity and diabetes, these figures are alarming. Such a rapid increase in worldwide obesity has led to a re-examination of the methods of treatment for obesity.

This began with the advent of bariatric surgery in the early 1970s, which provided a new alternative to conservative treatment options such as diet, exercise and medication. However, it took almost 15 years for it to be accepted by the surgical community as a valid and scientifically based method.

Bariatric surgery was initially directed towards weight loss via both restriction and malabsorption, but has now entered a new phase where its effects on obesity and associated comorbidities reflect the 'metabolic' change in response to the surgery.

This was preceded by the discovery in the 1960s that gastric cancer patients actually lost weight after partial gastrectomy despite the fact that the cancer had been eradicated. This led to the development of procedures for 'morbidly obese' patients, which included jejuno-ileal bypass, gastric bypass, vertical banded gastroplasty and gastric banding (both fixed and adjustable). However, due to changes in technique (open to laparoscopic), unacceptable complications (severe nutritional deficiencies) and even changing 'fashion' in surgery, these procedures are no longer popular.

This shows that sleeve gastrectomy is part of an ever-changing bariatric surgical scene. It also plays a key role in the development of new surgical approaches which incorporate both the physical changes and also the 'gut hormonal changes', with the goal of further benefits for the patient not just in terms of weight loss, but also regarding type II diabetes and other obesity-related comorbidities.

It is in this area that the theories relating to the mechanism of action of bariatric surgery, both the 'foregut' and 'hindgut' theories have been postulated, with their effect on gut hormones – 'incretins' (GLP, PYY, GIT) – leading to metabolic change in a wide range of organs targeted, together with weight loss.

In this eclectic volume, the authors give the historical background of sleeve gastrectomy, including how it evolved from the duodenal switch and the variations of the procedure that are seen in bariatric surgery today.

The mechanisms of action are discussed in detail, outlining both the historical and modern theories regarding the causative effect of the procedure, all of which have undergone strict scientific scrutiny.

The monograph also includes relevant information regarding both pre and postoperative management, anaesthesia, diet regime both pre and postoperatively, pain management and surgical techniques.

Furthermore, results, complications and all aspects of revisions are included making it a most comprehensive coverage of the subject.

The vast experience of the authors is seen in the clarity of description of all matters regarding 'sleeve gastrectomy'. This makes the book an excellent reference, not only for the surgical specialist, but for surgical trainees, allied health practitioners and general practitioners seeking an authoritative reading on the subject.

Harry Frydenberg, FRACS
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Past President, IFSO (International Federation for the Surgery of Obesity and Metabolic Disorders)

Preface

Laparoscopic Sleeve Gastrectomy (LSG) has emerged as a procedure to be reckoned with in the field of bariatric surgery. In terms of frequency, today, LSG has almost eclipsed the Roux-en-Y gastric bypass which is the most commonly performed bariatric procedure worldwide, while in most Asian countries LSG continues to rank in the first place.

Though commonly perceived as a technically simple procedure, LSG demands as much precision as any other surgery. It is almost like mathematics wherein you need to be correct to the last decimal point because getting it wrong can turn the patient's life into a nightmare. We have tried to standardize this procedure and simplified the basic steps for preventing complications.

In more than a third of all sleeve gastrectomies performed at our unit we adopt a single incision approach, the rest are performed using a standard laparoscopic or mini-laparoscopic technique.

This booklet aims to impart to the reader not only the basic steps of the surgical technique of sleeve gastrectomy, but also provides valuable information on complications and revision management in a pictorial format.

I am deeply indebted to Mrs. *Sybill Storz* for giving me the opportunity to share my experience and knowledge with the medical community. I also thank the entire KARL STORZ team for providing helpful assistance in this project.

I am grateful to *Shahzada Qaidjoher Ezzuddin*, Dr. *Moiz Nooruddin* and Mr. *Huzaifa Shehabi* from Saifee Hospital, for giving us an OR1 which is the best operation theater facility to perform any kind of advanced laparoscopic surgery. A great deal of gratitude is owed to our *operation theater team* for their constant support.

I am thankful to my teachers Dr. *Harikesh Buch* and Dr. *Hitesh Mehta* for their continuous guidance and support.

Most of all, I shall remain indebted to my *patients*, who trusted and believed in me through this journey.

Finally, the list shall be incomplete without acknowledging my wife *Priyanka Kaul,* for her unstinting support. She has been the brain and backbone behind the growth of CODS (Centre for Obesity and Digestive Surgery) as a center to reckon with in the field of Bariatric Surgery.

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1 Introduction

Sleeve gastrectomy (SG) is a bariatric operation in which the lesser curvature tube of the stomach is fashioned over a bougie with excision of the fundus and greater curvature of the stomach.

The numbers of sleeve gastrectomy have almost doubled from 2011 to 2013. SG currently ranks second after a Roux-en-Y Gastric Bypass (RYGB) and constitutes 37 % of all bariatric procedures performed across the world[6].

The technical ease of performing surgery coupled with excellent weight loss results in the short term have contributed to the accelerated growth of SG in a short span of time. Sleeve gastrectomy is also the preferred bariatric procedure in Asian countries like Japan and Korea – that are endemic for gastric cancer – as the postoperative stomach is still accessible to endoscopic surveillance. Additional advantages are preserved integrity of vagal innervation, comparatively fewer nutritional deficiencies, absence of a prosthesis and easy conversion to other bariatric procedures like Roux-en-Y gastric bypass (RYGB)/Duodenal Switch (DS)/Sleeve with Duodeno-Jejunal Bypass (S-DJB)/Sleeve with Ileal Transposition (SGIT)/Sleeve with Single Anastomosis Duodeno-Ileostomy (SADI) etc. While there are numerous advantages of SG, staple line leakage and GERD remain to be the major postoperative challenges associated with SG. Lack of long-term data is a source of concern and the incidence of weight regain in future is yet unknown.

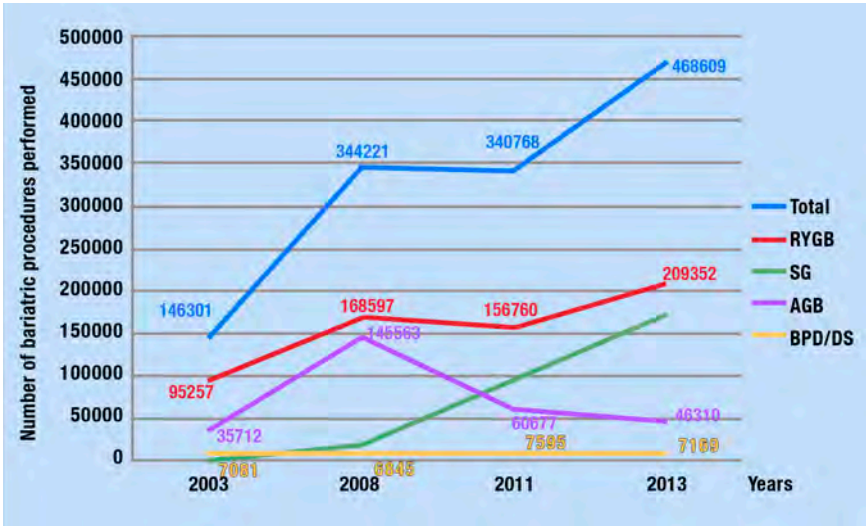


Fig. 1.1 Trends in numbers of procedures worldwide: from 2003, 2008, 2011 and 2013. Reproduced from 'Bariatric Surgery Worldwide 2013". *Angrisani et al.*[6]

2 Historical Background

Sleeve gastrectomy was first described in 1988 by *Hess* and *Marceau et al*. as the first part of a modified duodenal switch operation[30, 52]. They modified *Scopinaro's* technique of distal gastrectomy with gastro-ileostomy to a longitudinal sleeve of stomach with a duodeno-ileostomy. Preservation of the pylorus led to lesser incidence of marginal ulcers and dumping syndrome.

Around the same time, *David Johnston* described a gastroplasty technique without the use of any prosthesis. The Magenstrasse or '*the street of the stomach'* was a long narrow tube of the stomach that conveyed the food from esophagus to the antral mill. The procedure came to be known as the *'Magenstrasse and Mill operation'* and was a predecessor of the conventional sleeve gastrectomy performed today[37].

In 1997, *Almogy et al.* were performing an open DS on a patient with a history of choledocholithiasis. They were unable to clear the calculi in the common bile duct and terminated the procedure after creating the longitudinal sleeve of the stomach so as to have an endoscopic retrograde cholangiopancreatography (ERCP) access in the postoperative period. In the next four years, they performed the open longitudinal sleeve gastrectomy as the first stage of a DS procedure in 21 high risk patients. They reported a 12-month excess weight loss (EWL%) of 45.1 % with the longitudinal SG alone[4].

The first laparoscopic approach to a duodenal switch in a porcine model was reported by *De Csepel et al.* in 1999 and a sleeve gastrectomy was found to be feasible by the

laparoscopic technique[22]. *Gagner's* group reported the first laparoscopic DS in humans in 2000[39].

In 2003, *Regan et al.* reported one of the first series where a laparoscopic SG was performed as the first stage of a RYGB procedure in 7 super-obese patients. The mean duration between the two stages was 11 months and the authors reported an EWL% of 33 %[69].

By 2005, laparoscopic SG was being used as a standalone procedure by many surgeons as a first stage procedure that could be converted to a second-stage RYGB or DS, if required[7, 56].

SG is also one of the most common bariatric procedures to be performed employing a single incision technique. The first reports of single incision sleeve gastrectomy were published in 2008 by *Reavis* and *Saber et al.*[67, 74]. The first randomized study comparing the results of single incision sleeve gastrectomy with the conventional laparoscopic technique was published in 2011 by *Lakdawala et al.*[43]. In 2015, they proceeded to publish the largest comparative series of single incision SG and laparoscopic SG with 300 cases in each group. This technique showed decreased pain and better cosmetic outcomes compared to conventional laparoscopy[41].

3 Mechanism of Action

A sleeve gastrectomy entails longitudinal resection of almost two thirds of the stomach along with the entire fundus. This leads to restriction and induces early satiety. Initially classified as a purely restrictive procedure, SG is now known to have a much more complex mechanism of action. SG is also known to have an increased rate of gastric emptying, increased intestinal transit time and an increase in the levels of gut hormones like ghrelin, GLP-1, PYY and other incretins which also add to the effects of SG.

3.1 Increased Gastric Emptying

In 2007, *Melissas et al.* conducted scintigraphic measurements of gastric emptying on 11 patients who had undergone SG. At 6 months postoperatively, the gastric emptying half-time was found to be accelerated as compared to preoperative levels. It was observed that the stomach emptied its contents into the small intestine at a much faster rate[54]. *Shah et al.* reported similar results in morbidly obese type 2 diabetic patients in 2010. They studied the gastric emptying time along with the small bowel transit time and found out that even though the gastric emptying time was accelerated, the small bowel transit time was reduced. The authors also showed that the SG group had a greater satiety rate[78].

As a result of this increased rate of gastric emptying and a faster small bowel transit, the food bolus reaches the distal small bowel much faster and it is likely that it leads to an early increase in incretin (GLP-1, PYY) levels that may play a role in weight loss as well as in remission of type 2 diabetes mellitus after SG.

3.2 Ghrelin

Ghrelin is an orexigenic peptide that is secreted mainly from the stomach and to a certain extent from the small bowel. It plays a significant role in food intake and energy balance and also stimulates growth hormone secretion. *Langer et al.* have shown a sustained fall in ghrelin levels 6 months post SG[46]. *Karamanakos et al.* compared the ghrelin levels after RYGB and SG and found that the decrease in ghrelin levels after SG was much more significant than after RYGB[38]. In 2010, *Tong et al.* showed that exogenous ghrelin administration markedly reduced the first phase insulin response to intravenous glucose in healthy humans. Thus probably a reduction in ghrelin levels or ghrelin antagonists could lead to improvement in pancreatic beta cell function[85]. Many studies have demonstrated that SG leads to an early remission of type 2 diabetes mellitus and this could probably be one of the contributing factors[2, 71, 88]. *Lakdawala et al.* showed that the rate of remission of type 2 diabetes after RYGB and SG was comparable, even at the end of 1 year[42].

While ghrelin reduction has many beneficial effects, it also plays an important role in stress, mood and anxiety regulation. Ghrelin levels have been seen to rise in acute or chronic stress. It is yet to be seen whether post SG reduction in ghrelin has any ramifications on the mood or emotional well being of the patients[19].

4 Indications and Contraindications

4.1 Absolute Indications

- As a first stage procedure for super-obese patients.
- As a primary bariatric procedure for morbidly obese patients (BMI = 40 kg/m^2 – 2.5 BMI points lower for Asians) with multiple failed attempts at weight loss using conservative, non-surgical methods.
- As a primary bariatric procedure for patients with BMI = 35 kg/m^2 (BMI = 35 kg/m^2 – 2.5 BMI points lower for Asians) with 2 or more comorbidities.
- As an adjunct to metabolic procedures like iileal transposition, duodeno-jejunal bypass or jejuno-ileostomy.
- Preferred bariatric procedure in Asian countries like Korea and Japan which are endemic for cancer of the stomach.

4.2 Relative Indications

- Patients with inflammatory bowel disease.
- Patients with liver cirrhosis (Child-Pugh class A or B)

4.3 Absolute Contraindications

- Patients with a large hiatal hernia, grade 3 or 4 flap valve on endoscopy (as per Hill's classification) or grade C or D esophagitis, (as per LA classification).
- Pyloric outlet obstruction.
- Pregnant women.

4.4 Relative Contraindications

- Patients with severe psychiatric illness.
- Patients with liver cirrhosis (Child-Pugh class C)
- Medically unfit patients.

5 Preoperative Evaluation

5.1 Preoperative Workup

Patients must undergo preoperative counselling sessions with the nutritionist, psychologist and the bariatric surgeon. Evaluation by an endocrinologist, nephrologist, cardiologist, pulmonologist or any other specialist is recommended as per the requirement of every individual patient. The preoperative workup includes routine blood work like complete blood count, diabetic profile, kidney function tests, liver function tests, lipid profile, thyroid profile; an urine routine and urine for microalbuminuria; nutritional tests like serum vitamin B 12, serum vitamin D3, iron studies, folic acid, calcium, parathyroid hormone (PTH), homocysteine; a cardiac check that includes an electro-cardiogram, echocardiography with or without a stress test; radiological investigations like x-ray chest, ultrasound of the abdomen and pelvis; pulmonogical investigations like pulmonary function test, arterial blood gas, and a sleep study for patients suspected to have obstructive sleep apnea. At our center, it is mandatory to have a preoperative upper gastrointestinal endoscopy.

5.2 Preoperative Diet

Seven to ten days prior to surgery, all patients must be started on a preoperative high protein low carbohydrate diet which helps in shrinking the liver size and thus aids in optimizing the surgical time. This diet also provides an insight as to the postoperative compliance levels of patients.

Preoperative diet would ideally include a low carbohydrate intake of 1.000 kcals or less and a high protein intake of approximately 75 – 80 gm protein/day along with plenty of low calorie fluids.

All high-calorie foods as well as carbohydrate foods such as cereal and cereal products, starchy vegetables, fruits and fruit juices are to be avoided.

5.3 Sample Diet Plan

Meal	Menu
Early Morning	Tea (with skim milk and sugar free)
Breakfast	High-protein meal replacer in water / skim milk
Mid-morning	A glass of thin buttermilk / coconut water
Pre-lunch (20 min before)	1 glass of water with 1 tsp fiber supplement
Lunch	High protein meal replacer in water/skim milk and salad (optional)
Mid-afternoon	1 cup tea/1 glass buttermilk/vegetable juice
Pre-dinner (20 min before)	1 glass water with 1 teaspoon of fiber supplement
Dinner	High protein meal replacer in water/skim milk and salad (optional)
Bed-time	1 cup of skim milk (optional)

This diet needs to be modified in special conditions such as:

5.3.1 Patients with Diabetes

The preoperative diet is restricted in calories and carbohydrates, hence diabetics, especially those on insulin, should be counselled to check blood glucose levels frequently to avoid hypoglycemia. A consultation with their diabetologist/endocrinologist is critical in order to reduce insulin and oral hypoglycemic agents.

5.3.2 Patients with Compromised Renal Function

High biological value protein should be encouraged. Approximately 0.8 – 1 g / kg ideal body weight protein should be provided (renal specific protein supplements should be recommended). The amount of protein to be restricted should be based on serum creatinine and albumin levels. In case of electrolyte imbalance between potassium and sodium, restriction may be necessary. Fluid intake can be calculated: Fluid intake = urine output (previous 24 h) + 500 ml.

5.3.3 Patients with Liver Disease

Close monitoring of protein and albumin levels is needed in these patients. The goal is to provide adequate protein and avoid severe protein restriction. Approximately 1.0 – 1.5 g/kg ideal body weight protein should be provided (hepatic specific protein supplements should be recommended). Sodium and fluid restriction needs to be evaluated in cases of ascites and hyponatremia.

5.3.4 Patients with Hyperuricemia

Patients that have high uric acid should be counselled to avoid non-vegetarian protein and purine-rich foods. Fluid intake should be encouraged.

5.3.5 Patients with Cardiac Disease

Fluid and salt restriction has to be accounted for in these patients.

5.4 Prophylaxis of Venous Thromboembolism (VTE)

Deep vein thrombosis (DVT) and ensuing pulmonary embolism can be catastrophic and prophylaxis is a must in morbidly obese patients subjected to bariatric surgery. A combination of unfractionated heparin/low molecular weight heparin (LMWH), compression devices, elastic stockings and early mobilization has been recommended for prophylaxis.

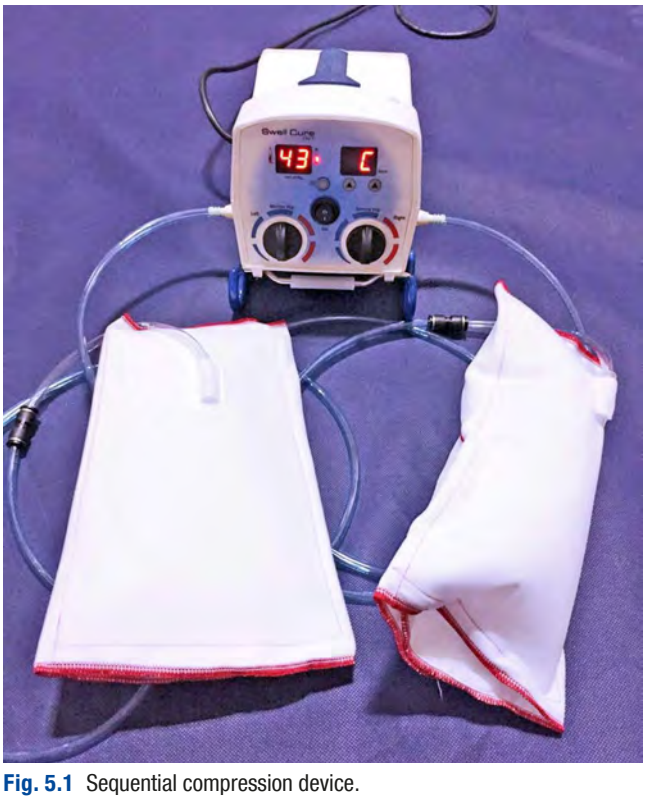


Fig. 5.1 Sequential compression device.

6 Anesthesia

6.1 Anesthesia Concerns in Morbidly Obese Patients

Anesthesia considerations and concerns for a morbidly obese patient include:

- Preoperative assessment and control of comorbidities linked to obesity such as hypertension, ischemic heart disease, insulin-dependent diabetes mellitus (IDDM) / noninsulin-dependent diabetes mellitus (NIDDM), obstructive sleep apnea, hypothyroidism etc.
- Anti-obesity medication like appetite suppressants such as fenfluramine combined with phenteramine can lead to perioperative complications. Fenfluramine has a catecholamine-depleting effect, so indirectly reacting vasopressors will be ineffective during hypotension. It also delays gastric emptying and potentiates the effect of insulin. Pulmonary hypertension which reverses after discontinuation of fenfluramine can also occur.
- Assessment of venous access is a must.
- Understanding the pathophysiology is of paramount importance. The core aspects are as follows:
  - Obesity is associated with an increase in absolute blood volume.
  - Increase in oxygen consumption by metabolically active adipose tissue.
  - Reduced functional residual capacity (FRC), which may encroach upon the closing capacity.
  - Oxygen desaturation occurs rapidly in apneic patients.
  - Obesity hypoventilation syndrome / Pickwickian syndrome.
  - Obstructive sleep apnea is more common in obese patients and its severity can be measured by the apnea-hypopnea index (AHI) to determine the need for utilizing a postoperative CPAP machine.
  - Increased gastric volume, raised intra-abdominal pressure and a higher incidence of hiatus hernia pose a risk of aspiration.
  - Volume of distribution of drugs is altered due to smaller portion of total body water, greater proportion of adipose tissue, higher lean body mass and higher blood volume and cardiac output.
- Airway assessment, shortness of neck, ASA scores – Wilson's score, Mallampati, Cormack Lehane score and Benumof's parameters – are a pre-requisite.

6.2 Premedication

- Preoperative assessment should guide premedication in the morbidly obese patient.
- Anxiolysis, analgesia, sedation and prophylaxis against pulmonary aspiration should be addressed.
- Oral ranitidine 150 or 300 mg at bedtime and repeated in the morning with metoclopropamide reduces gastric volume and increases gastric pH.
- Perioperative antibiotic prophylaxis is a must.

6.3 Induction of Anesthesia

- General anesthesia with controlled ventilation is the first-line modality of anesthesia for morbidly obese patients.
- All appropriate equipment must be on standby for an anticipated difficult intubation. The majority of obese patients have a short thick neck, large tongue and significant retropharyngeal soft tissue.
- Difficult airway management devices must be readily available (i.e., fast track laryngeal mask airway). This also applies to on-call duty of an additional airway anesthesia clinician during induction of anesthesia and during the immediate recovery period. All of these precautionary measures are of great importance. A polio handle and a long blade are useful for intubation.
- Patient's position is of paramount importance before induction. They are initially placed in a 'ramped' position (with the external auditory meatus and sternal notch aligned horizontally) and a reverse Trendelenburg, if required. Pre-oxygenation with 100 % oxygen for 3 to 5 minutes is then delivered under CPAP treatment (8–10 cm H_2O).
- Difficulties encountered during bag and mask ventilation can be overcome by a four-hand technique using anesthetic ventilator. PEEP for mask ventilation helps in maintaining functional residual capacity (FRC).

6.4 Video Laryngoscopy

Because of the improved quality of anatomical images, video laryngoscopy (VL) has been introduced as a potentially promising means of managing airways in the morbidly obese patients. VL reduces the risk of iatrogenic airway trauma or damage. The operator can place the endotracheal tube with greater precision and caution due to the enlarged image shown on the monitor. The assistant performing the maneuver is enabled to readily see the effect of his or her movements and thus can act accordingly to improve the laryngeal view.

Although ASA guidelines highlight the approach of awake intubation as the preferred method to manage anticipated difficult airways, consideration of VL under general anesthesia should be taken into account as a primary method.

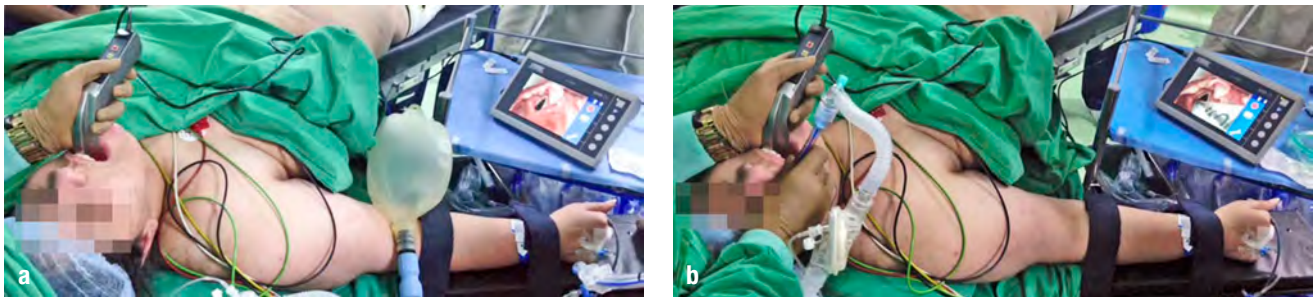


Fig. 6.1 Video-laryngoscopic intubation.

6.5 Anesthesia Drugs and Dosing

- Commonly used anesthetic drugs can be dosed on total body weight (TBW) or ideal body weight (IBW) based on the lipid solubility. Lean body mass is a good weight approximation to use when dosing hydrophilic medications.
- Volume of distribution is changed in obese patients with regards to lipophilic drugs. Exceptions to this are digoxin, procainamide and remifentanil.
- Commonly used anesthetic drugs dosing is according to IBW for propofol, vecuronium, rocuronium and remifentanil. Thiopental, midazolam, succinylcholine, atracurium, cisatracurium, fentanyl and sufentanyl must be dosed on the basis of TBW. Maintenance dose of propofol should be based on TBW.
- Complete neuro-muscular blockade is necessary not just for surgical purposes but also to facilitate mechanical ventilation.
- There is some evidence that desflurane may be the inhalational anesthetic of first choice based on its consistent and rapid recovery profile.
- Nitrous oxide does provide analgesia, but is better avoided in view of high oxygen demand and its tendency to increase bowel gas volume.

6.6 Monitoring

Obesity per se does not require invasive monitoring, but patients with serious comorbidities like pulmonary hypertension or pulmonary heart disease may require pulmonary artery catheterization (PAC). Rarely, patients may need a central line and an arterial line. Routine cases do not need a catheterization, but in cases where surgery is expected to last longer than 4 to 5 hours or in patients with a compromised renal function, catheterization for monitoring of urine output is required.

6.7 Intraoperative Considerations

- Using an operating table with appropriate weight bearing capacity and fixation of the patient with restraint straps is mandatory. Securing the patient to prevent slippage off the operating table is highly recommended.
- Thermal management is best accomplished by forced air warmer systems.
- Fluid requirements are larger than predicted and even a relatively short procedure taking 2–3 hours may raise the need for administration of 4–5 liters of crystalloid fluid in order to prevent acute tubular necrosis.
- Use of anti-thrombotics along with sequential compression devices is important to decrease the incidence of deep vein thrombosis (DVT) in morbidly obese patients.
- Intragastric calibration tube is used to size the sleeve.
- The sphygmomanometer cuff width should be 20% greater than the diameter of the arm. Sometimes, invasive blood pressure monitoring may be required.

6.8 Management of Postoperative Pain

Management of postoperative pain is challenging in obese patients as they have exaggerated respiratory depression from opioids and neuro-axial blocks are technically difficult.

A multi-modal approach is used for pain management:

- NSAIDS are the drugs of first choice as laparoscopic surgeries are less painful than their open counterparts.
- Intravenous opioids administered at graded doses.
- Local anesthesia infiltration into the wound and port sites.
- Neuro-axial blocks.
- Intraoperative infusion of dexmedetomidine decreases postoperative opioid requirement.
- Recently, the continuous intraperitoneal infusion of bupivacaine is used.

6.9 Perioperative Transfer of the Obese Patient

A special device such as an air mattress should be used as auxiliary means to facilitate patient transfer irrespective of his or her weight. At the end of surgery, the device should be used to transfer the patient to the bed. Alternatively, the operating table is raised higher than the patient bed and tilted at a 20–30 degree angle for the patient to be rolled on.

The patient should then be placed in a propped up position and a CPAP or a Bi-PAP machine may be used as and when required.

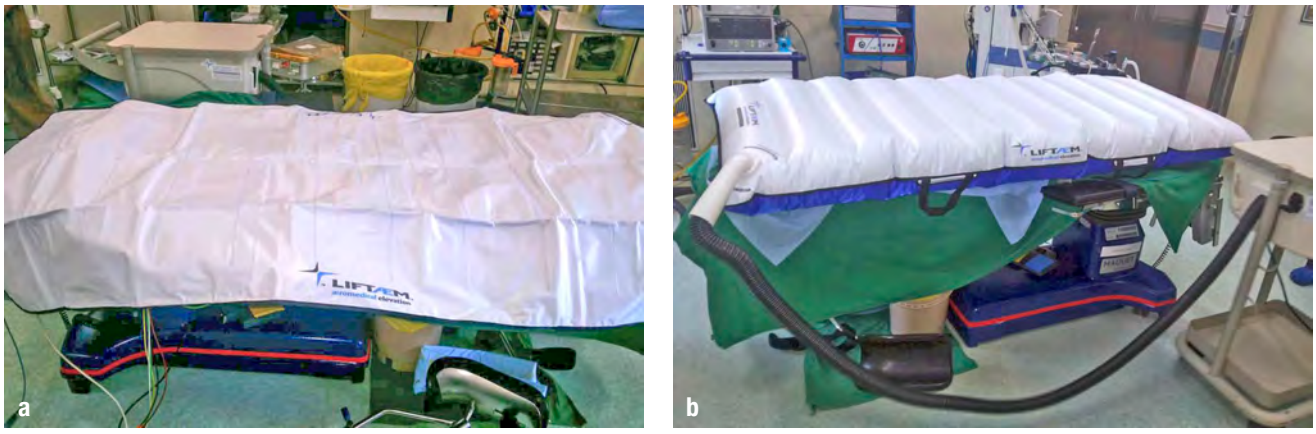


Fig. 6.2 Patient transfer device (inflatable mattress).

7 Surgical Technique

Step 1 – Patient Position

The patient is placed in the reverse Trendelenburg position with legs split apart (Fig. 7.1). The operating surgeon stands in between the patient's legs, the first assistant towards the left of the patient and the camera assistant towards the right. The nurse assistant is positioned towards the left of the patient.

The patient must be duly strapped at the chest and the legs to prevent slippage off the table. Cleaning and draping is done.

Fig. 7.1 Patient positioning.

7.1 Laparoscopic Sleeve Gastrectomy

7.1 Laparoscopic sleeve gastrectomy*

Step 2 – Trocar Positions

- First, a 12-mm trocar is inserted under vision about 4 to 5 finger breadths below the sub-costal margin in the right mid-clavicular line.
- 12-mm trocar just above the umbilicus in midline depending on the distance between xiphisternum and umbilicus.
- 5-mm trocar in the mid-clavicular line about 4 to 5 finger breadths below the left sub-costal margin.
- 5-mm trocar in the left anterior axillary line just below the costal margin.
- **a.** 5-mm trocar in the epigastrium may be used to retract the liver.
- **b.** A stitch through the right crus is brought out in the epigastrium to retract the left lobe.

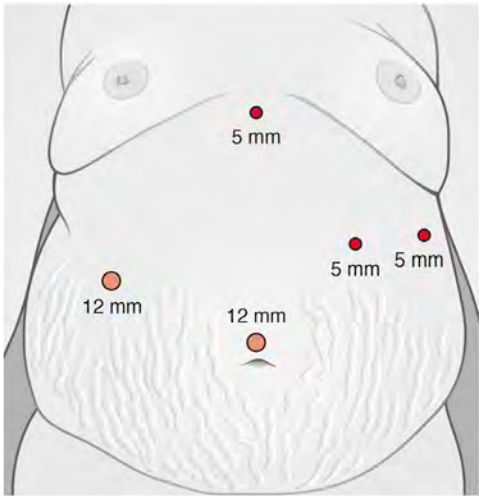


Fig. 7.2 Trocar positions.

Step 3

A gastric tube is inserted to decompress the stomach.

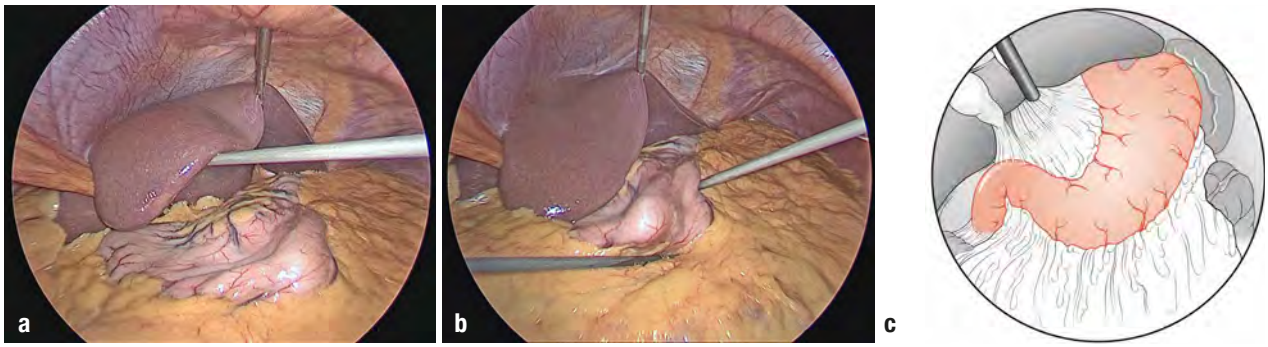


Fig. 7.3

* http://go.karlstorz.com/96115021-7-1

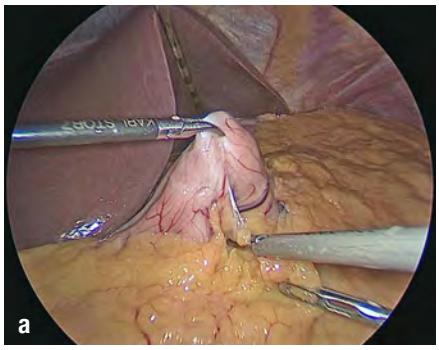


Fig. 7.4a, b

Step 4
Dissection is commenced with an energy device on the greater curvature exactly opposite the pes anserinus on the lesser curve or about 6 to 7 cm proximal to the pyloric ring.

Fig. 7.5

Step 5
Dissection is then continued cephalad towards the esophago-gastric junction close to the stomach wall.

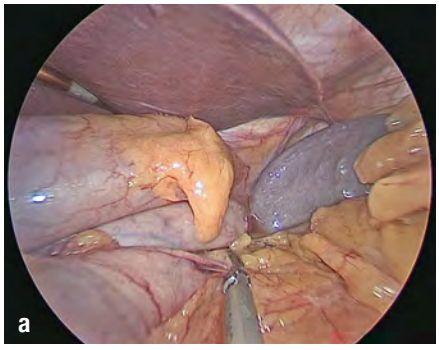


Fig. 7.6

Step 6
Dissection is continued cranially and the short gastric vessels are divided.

Step 7

Left crus is dissected. Angle of His is identified. Base of right crus is identified. In case of laxity in the region of the hiatus, a figure-of-eight suture is applied with non-absorbable monofilament suture.

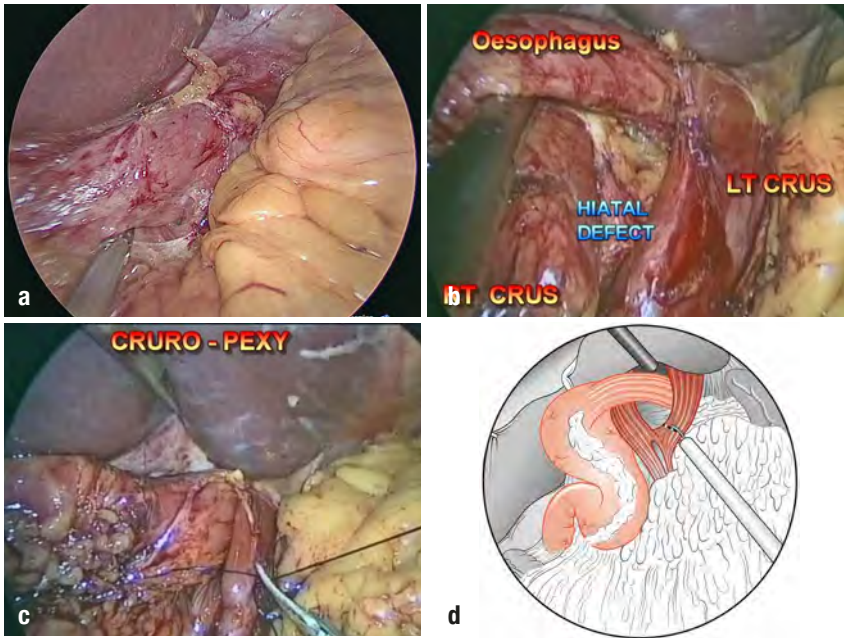


Fig. 7.7

Step 8

Dissection is then progressed caudally towards the pylorus. The distal limit of the dissection is about 2–3 cm from the pylorus. Fine adhesions of the posterior surface of the stomach to the pancreas are divided and the lesser sac is freed completely.

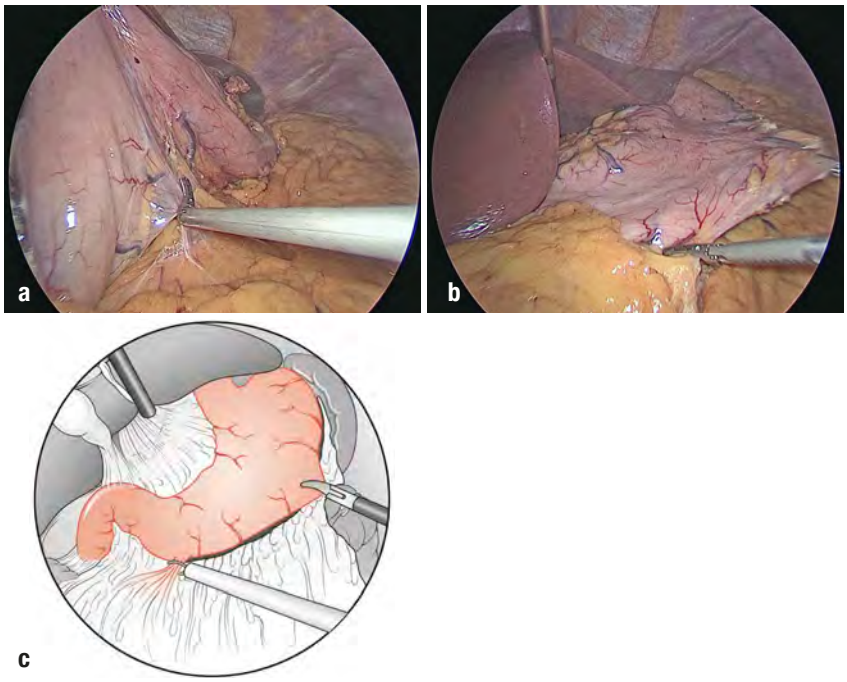


Fig. 7.8

Step 9

A linear stapler with a 60-mm cartridge 'Purple' (Endo-GIA™ Tri-Staple™ Technology, Covidien) or 'Green' (JnJ) is introduced through the right mid-clavicular port. If a black cartridge has to be used, then the 12-mm port in the right mid-clavicular line has to be replaced by a 15-mm port. Transection of the stomach begins at about 4 cm proximal to the pylorus. Care is taken to avoid narrowing at the incisura angularis.

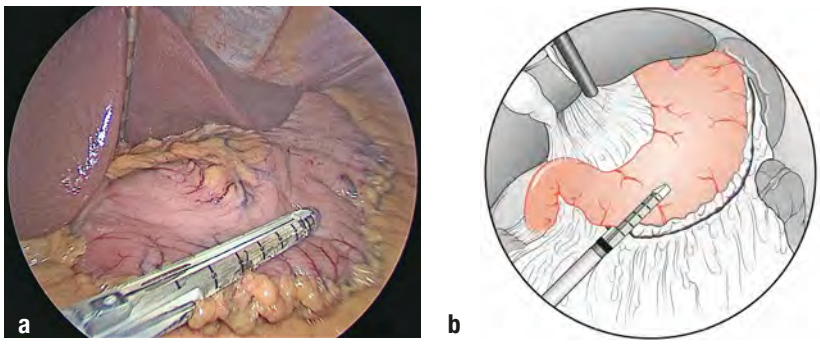
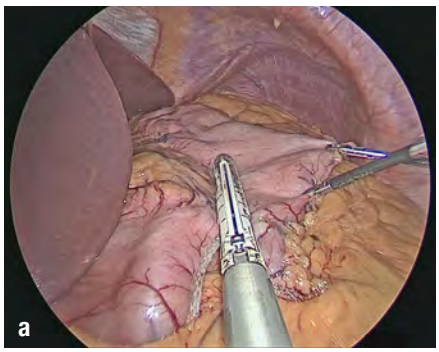


Fig. 7.9



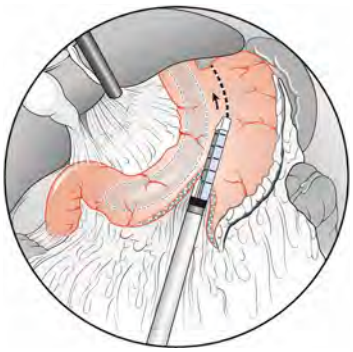


Fig. 7.10

Step 10

A 36 Fr bougie is passed into the stomach and guided into the antrum. A linear stapler with a 60-mm cartridge 'Purple' (Endo-GIA™ Tri-Staple™ Technology, Covidien) or Blue (JnJ) is then applied snug to the bougie. A distance of 0.5 cm should be maintained from the incisura angularis to avoid narrowing and subsequent torsion of the sleeve.

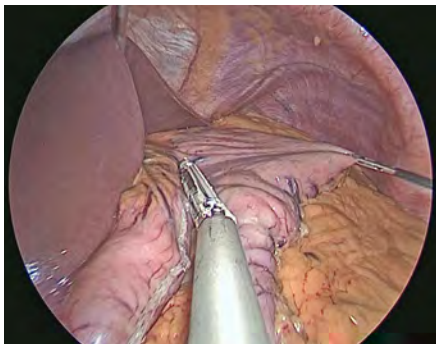
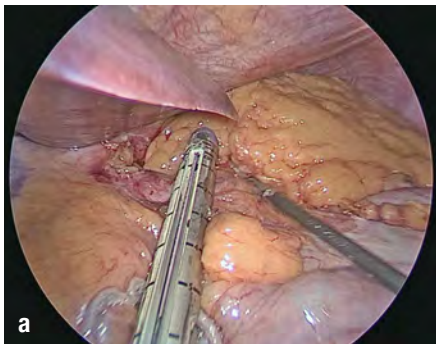


Fig. 7.11

Step 11

The sleeve is fashioned along the bougie which acts as a guide to the medial limit of the gastrectomy. The sleeve should be adapted to the bougie as snug as possible, neither too tight nor too loose. Care is taken to make sure that the staple line is neither predominantly on the anterior nor on the posterior surface.



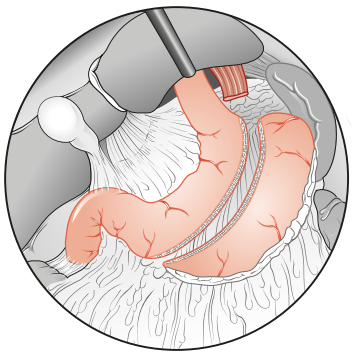


Fig. 7.12

Step 12

At the angle of His, care is taken while applying the stapler to prevent inadvertent stapling onto the esophagus and to make sure that the staple line is 0.5 cm lateral to the gastroesophageal junction (GEJ). Do not leave a boggy fundus behind here.

Step 13
The angle of His is buried using a 2-0 absorbable mono-filament suture. The entire staple line is imbricated and omentopexy is done. This is an optional step that we follow as a routine.

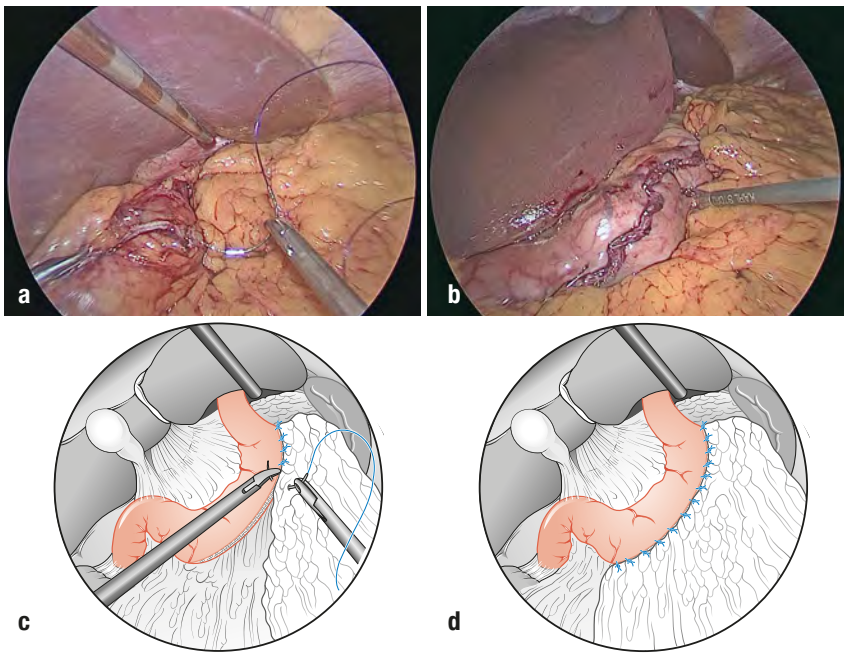


Fig. 7.13

Step 14
The resected part of the stomach is retrieved from the right subcostal port.

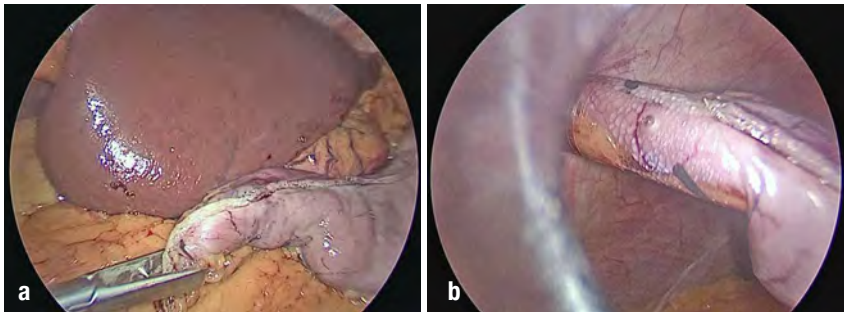


Fig. 7.14

Step 15
The 12/15-mm ports are closed using a suture passer needle.

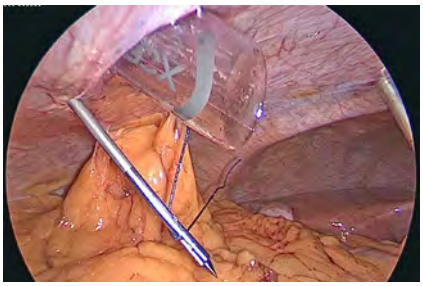


Fig. 7.15

Step 16
Inspection of the removed specimen.

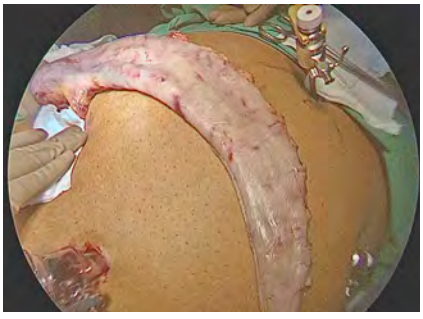


Fig. 7.16

7.2 Mini-Laparoscopic Sleeve Gastrectomy (MSG)

Fig. 7.17 Abdominal insufflation using a Veress needle.

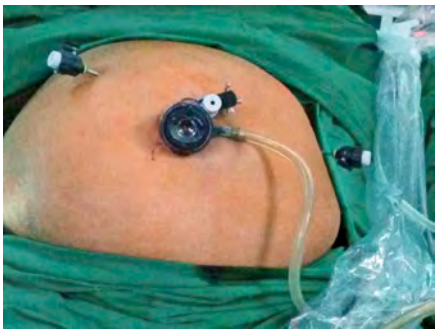


Fig. 7.18 Trocar insertion.

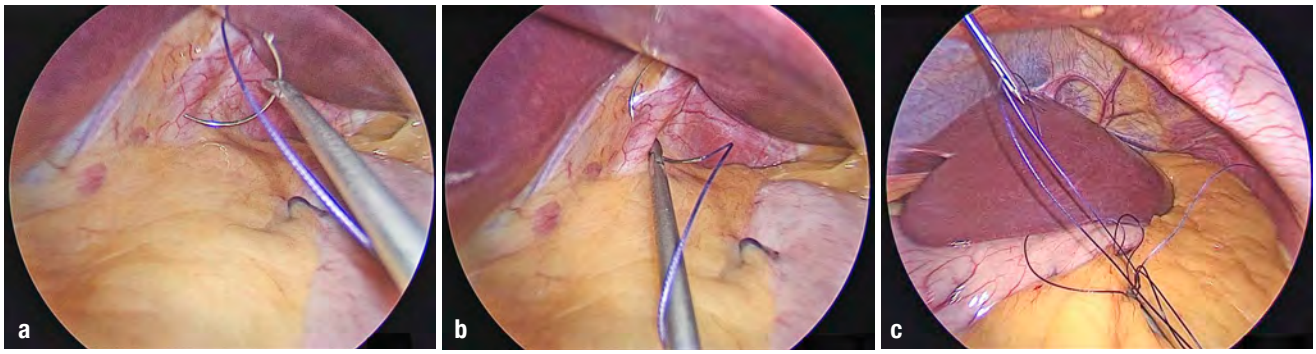


Fig. 7.19 Suture technique applied for liver retraction.

Fig. 7.20 Retrieval of suture through the epigastrium using the port closure needle.

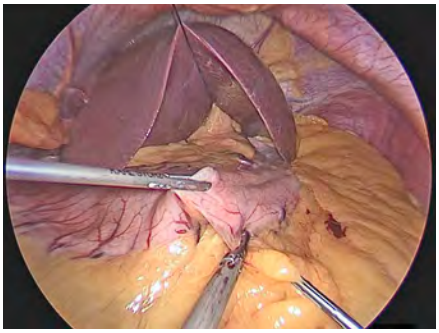


Fig. 7.21 Dissection is commenced just opposite the pes anserinus using 3-mm miniature laparoscopic instruments.

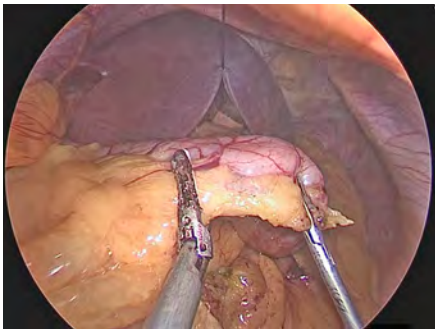


Fig. 7.22 Caudal dissection towards the pylorus.

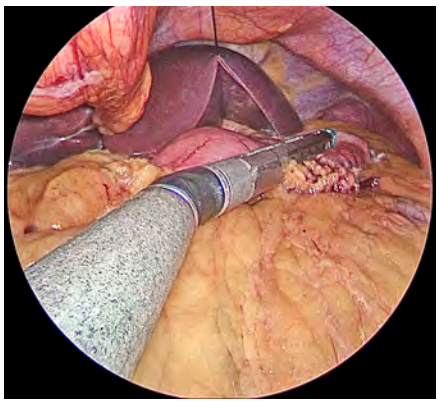


Fig. 7.23 First stapler applied 4 cm proximal to the pylorus.

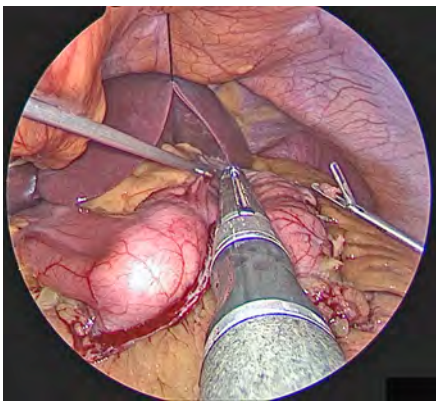


Fig. 7.24 Second stapler applied taking care not to narrow the angle at the incisura angularis.

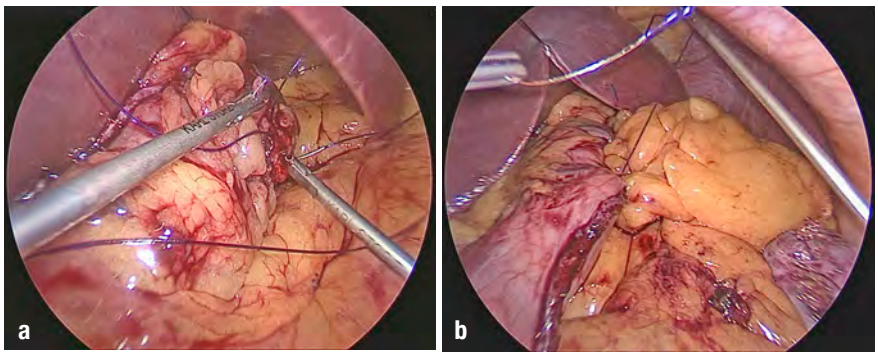


Fig. 7.25 Over-sewing of the staple line and omentoplasty.

7.3 Single Incision Sleeve Gastrectomy

7.3a Single incision LSG*

7.3b Single incision LSG**

Fig. 7.26 Shown is the 2-cm vertical incision in the umbilicus.

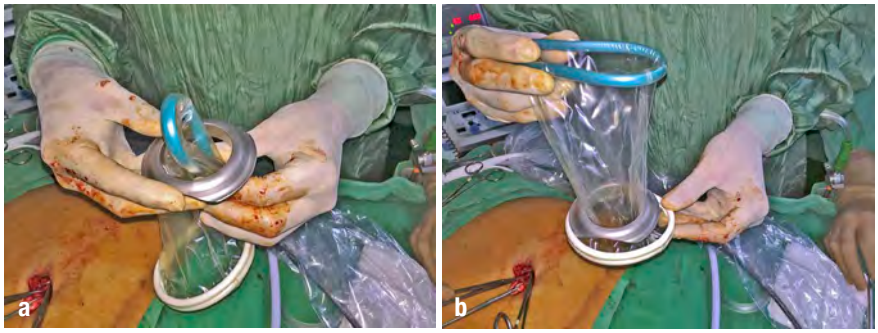


Fig. 7.27 Delivering the wound protector through the ring.

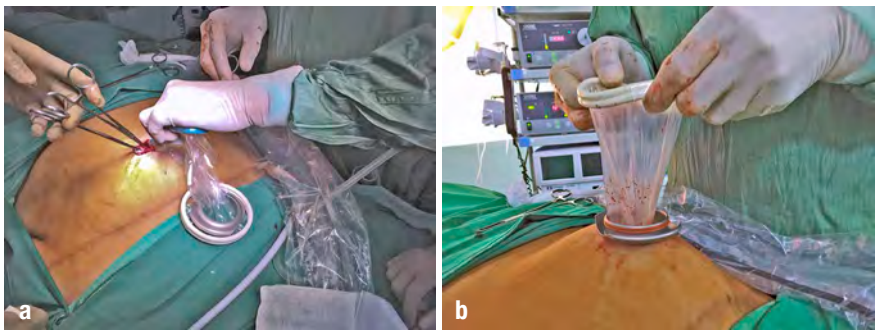


Fig. 7.28 Insertion of the wound protector through the incision into the abdomen.

* http://go.karlstorz.com/96115021-7-3a

** http://go.karlstorz.com/96115021-7-3b

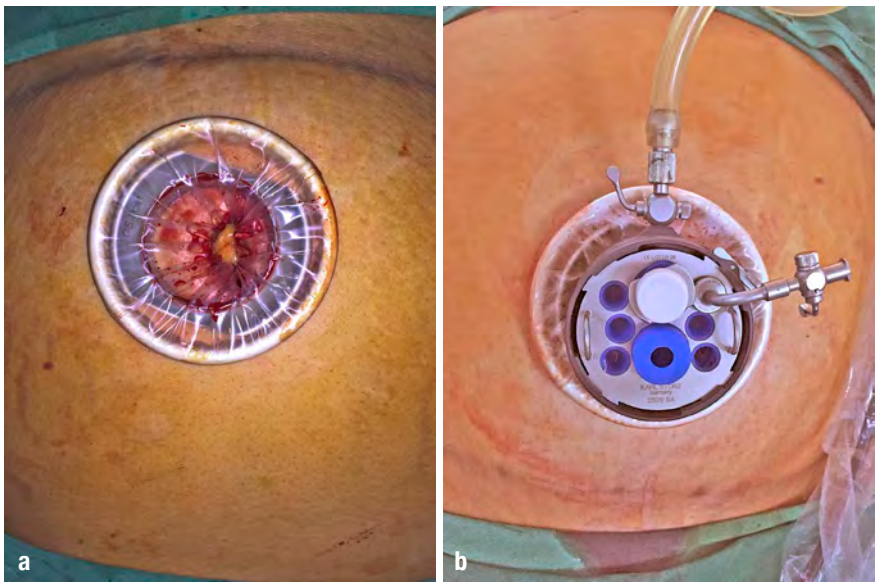


Fig. 7.29 Placement of the wound protector through the incision into the abdomen.

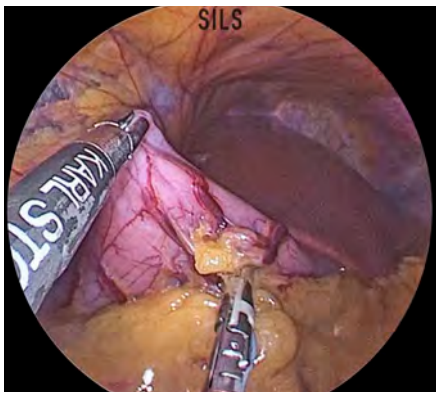


Fig. 7.30 Commencing the dissection just opposite the pes anserinus.

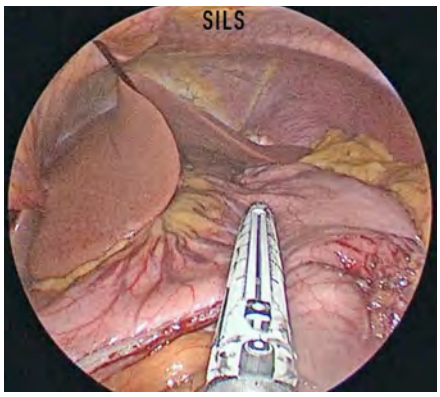


Fig. 7.31 Applying the second cartridge.

Fig. 7.32 External view of hand and telescope positions.

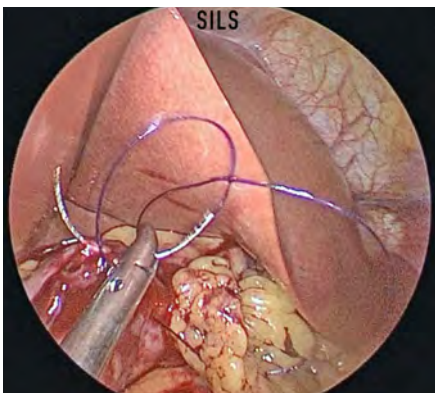


Fig. 7.33 Over-sewing of the staple line and omentoplasty.

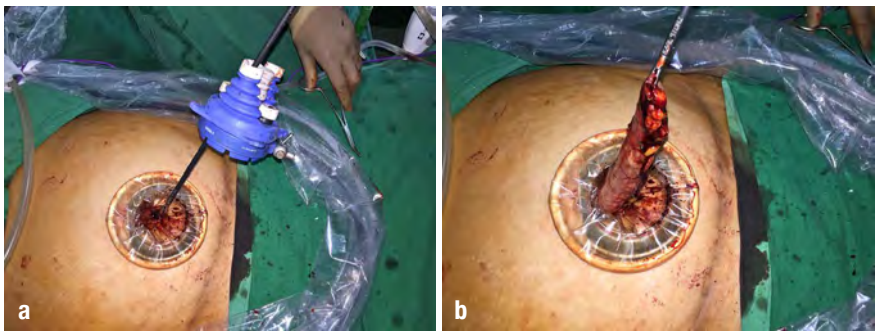


Fig. 7.34 Retrieval of specimen.

8 Postoperative Care

An oral contrast study with a water-soluble dye is done on postoperative day 1 to test for leakage or any kind of dye retention. Thereafter, patients are started on a clear liquid diet. Antibiotics and all intravenous (IV) fluids are discontinued and the IV line is removed. Most patients can be discharged by evening. LMWH and compression stockings are continued for 7 days postoperatively. Patients are prescribed urso-deoxycholic acid 600 mg twice a day for 6 months to prevent gall stone formation. Medications for other comorbidities like type-2 diabetes, hypertension, dyslipidemia, cardiac disease etc. are monitored by the endocrinologist/physician in charge. Exceptions are patients on Bi-PAP support, those with compromised renal function and those with cirrhosis, who may be admitted for a longer period.

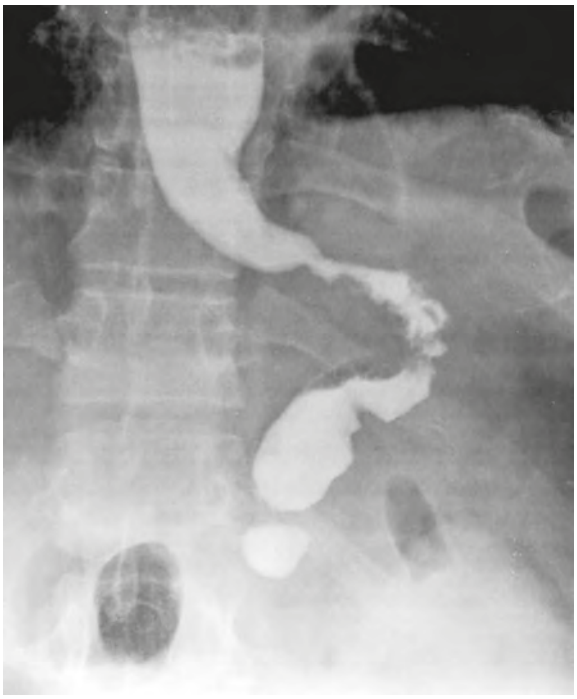


Fig. 8.1 Oral contrast study.

9 Postoperative Diet and Follow-Up

It is recommended that patients be seen after the first week of surgery for a wound check, and then again at 1 month when solid diet commences. This is necessary in order to counsel patients regarding the most appropriate food choices, calorie intake as well as common trouble foods and complaints.

9.1 Diet Progression

9.1.1 Immediate Postoperative Stage

At day 1 and 2 postoperatively, patients should be only on clear liquids to assess tolerance of oral intake. Start with 50 cc per hour and then progress accordingly. Monitor the urine output in patients with renal and cardiac disorders.

9.1.2 Early Postoperative Stage

From day 3 onwards, patients progress on to a full liquid diet. At this stage, protein supplementation should commence. It is important to counsel patients regarding the choice of liquids. Emphasis should be laid on nutritious liquids rather than sugary liquids. Protein supplements, low-fat dairy drinks, soy milk, pulses, lentils and beans should be prioritized. Soups and vegetable juices come next and lastly fruit juices with no added sugar. Sugary drinks, flavored syrups, carbonated beverages and alcohol should be strictly prohibited. The quantity can be stepped up to as much as the patient can tolerate. The patient should be advised against gulping fluids. Use of a teaspoon or sipper is recommended to prevent gulping. Use of straws is strictly avoided to prevent excessive intake of air, which can result in bloating and discomfort.

From day 16 onwards, patients can gradually introduce soft textured foods in their diet. Foods that do not require too much chewing and those that are soft and moist should be introduced at this stage.

Soft textured foods, overcooked vegetables, well-cooked rice preparations, semolina and broken wheat preparations, porridge, cottage cheese, scrambled or boiled egg whites, baked/steamed fish, chicken mince or chicken shreds can be introduced at this stage.

Foods that should be avoided at this stage are hard fruits with seeds, nuts, breads, tough meats and stringy vegetables.

9.1.3 Late Postoperative Stage

A regular low-fat diet is encouraged by the end of a month that includes all food groups with priority to protein-rich foods. Vegetarian patients should be encouraged to continue with protein supplements till about 3 months postoperatively.

Intake of water should be encouraged at each stage to prevent dehydration. Sipping of water in between meals (20 – 30 minutes prior or after) is advised to avoid overfilling the pouch and/or flushing food through the tract.

10 Results

10.1 Short-term Excess Weight Loss (EWL)

Year of publication	Author(s)	Patients (n)	EWL%	Follow-up
2003	Regan et al.[69]	7	33	11 months
2004	Almogy et al.[4]	21	61.4	18 months
2005	Langer et al.[46]	10	61	6 months
2005	Mognol et al.[56]	10	51	1 year
2005	Milone et al.[55]	20	35	6 months
2005	Baltasar et al.[7]	7 7 16	56.1 33.6–90 62.3	4–27 months 4- 16 months 3–27 months
2005	Moon Han et al.[57]	60	83.3	1 year
2006	Langer et el.[44]	23	57	18 months
2006	Roa et al.[72]	30	52.8	6 months
2006	Himpens et al.[31]	40	66	3 years
2006	Silecchia et al.[80]	41	NR	1 year
2006	Hamoui et al.[29]	118	47.3	2 years
2006	Cottam et al.[20]	126	46	1 year
2007	Lee et al.[47]	216	59	1 year
2010	Lakdawala et al.[42]	50	76.1	1 year
2010	Chowbey et al.[18]	75	65	2 years
2012	Prasad et al.[65]	108	66.09	3 years
2015	Lakdawala et al.[41]	300	69.1	2 years

Table 1 Studies reporting short-term EWL% after sleeve gastrectomy. Percentage of excess weight loss (EWL%).

10.2 Long-term Excess Weight Loss

Studies with five-year or more than five-year follow up were searched on PubMed (US National Library of Medicine National Institutes of Health) using the following key words: *sleeve gastrectomy, long term results, five year, weight loss outcomes*. The studies that came up are listed below.

Year of publication	Author(s)	Patients (n/d)	5-year-EWL%	5-year-EBMIL%
2010	Bohdjalian et al.[8]	21/26	55	
2011	D'Hondt et al.[21]	27/102	71.3	
2012	Rawlins et al.[66]	49/55	86	
2012	Lim et al.[50]	14/15	57.4	
2012	Abbatini et al.[1]	13/33	56	
2012	Braghetto et al.[10]	60/560	57.3	
2013	Zachariah et al.[91]	6/20	63.7	
2013	Catheline et al.[14]	45/65	50.7	
2013	Brethauer et al.[11]	23/297	49.5	
2014	Van Rutte et al.[87]	19/1041	58.3	
2014	Kular et al.[40]	76/118	51.2	
2014	Zhang et al.[93]	32/32	63.2	
2014	Boza et al.[9]	112/161	62.9	
2014	Sieber et al.[79]	37/41	57.4	
2015	Liu et al.[51]	44/140	57.2	
2015	Lemanu et al.[48]	55/96	40	
2015	Alexandrou et al.[3]	19	64.8	
2015	Pok et al.[64]	61/667	72.6	
2015	Perrone et al.[62]	160/162		78.8
2015	Hong et al.[34]	31/71		78.5
	Summary	904/3721	59.7	

Table 2 Studies reporting on 5-year EWL% after SG. Percentage of excess weight loss (EWL%); Percentage of body mass index loss (EBMIL%).

Year	Author(s)	Number of patients	Months of follow-up	Follow-up rate	EWL%
2010	Himpens et al.[32]	30	72	78 %	53.3
2011	Sarela et al.[75]	13	≥ 96	93 %	69
2012	Eid et al.[25]	19, 13, 21	72, 84, 96	93 %	52 %, 43 %, 46 %

Table 3 Studies reporting on EWL% with more than 5 years of follow-up after SG.

The problem, as one can see, lies in the fact that long-term data of more than 96 months follow-up is available only in 34 patients. Long-term efficiency of sleeve gastrectomy still remains a matter of controversy.

10.3 Remission of Comorbidities

10.3.1 Type 2 Diabetes Mellitus

Early remission of type 2 diabetes has been reported by many investigators and sleeve gastrectomy is now known to have an added metabolic potential[2, 71, 88]. Early gastric emptying, permanent reduction in ghrelin levels, increased GLP-1 levels and decreased small bowel transit time are a few mechanisms that render the sleeve gastrectomy to be a procedure with more metabolic potential than just restriction as is the case with a gastric band operation[38, 46, 54, 78, 85]. Type 2 diabetes mellitus was seen to either resolve or improve in 97.1 % patients in a systematic review of 27 studies done by *Gill et al.*[28]. Complete remission was seen in 66.2 % of patients. In a one-year comparative study done by *Lakdawala et al.*, rates of type 2 diabetes remission were similar after Roux-en-Y gastric bypass and sleeve gastrectomy[42]. *Abbatini et al.* have also

reported similar remission rates of type 2 diabetes after a sleeve gastrectomy and a Roux-en-Y gastric bypass[1]. In the recently published STAMPEDE* trial, it was seen that there was a significant reduction in antidiabetic medications of patients undergoing sleeve gastrectomy[77]. At the end of 3 years, the primary endpoint of HbA1c (glycated hemoglobin) = 6 gm% was achieved by 24 % of those in the sleeve gastrectomy group of this study.

10.3.2 Hypertension

Morbid obesity is closely associated with hypertension. Hypertension affects more than half of the patients who present for bariatric surgery. Sleeve gastrectomy has a significant impact on hypertension. In a systematic review including 33 studies and 3,997 patients, resolution of hypertension was achieved after surgery by 58 % of the patients and an additional 17 % showed improvement[76].

* Surgical Therapy And Medications Potentially Eradicate Diabetes Efficiently

10.3.3 Dyslipidemia

Bariatric procedures have shown beneficial effects on dyslipidemia. However, these effects are dependent on the type of surgery performed. Purely malabsorptive procedures like the duodenal switch lead to best results in terms of normalization of deranged lipid profile. Roux-en-Y gastric bypass has also shown good results. Remission of dyslipidemia after sleeve gastrectomy is still debatable as some studies show 50–78 % remission at the end of one year[57, 60] whereas other investigators have reported a limited impact[83]. *Zhang et al.* have reported significant improvements in the levels of high-density lipo-protein cholesterol and triglycerides but no change in low-density lipoprotein cholesterol and total cholesterol[92].

10.3.4 Other Comorbidities

In addition to a significant improvement in type 2 diabetes and hypertension, sleeve gastrectomy has also shown substantial improvement in other comorbidities like obstructive sleep apnea, asthma, joint pains, polycystic ovarian disease (PCOD), infertility etc.

11 Complications

11.1 General Complications of Bariatric Surgery

11.1.1 Venous Thromboembolism (VTE)

Obesity is regarded as a pro-thrombotic state and morbidly obese people are 2.5 times as likely to develop VTE as compared to their non-obese counterparts[82]. Morbidly obese patients undergoing bariatric surgery have an unexpectedly high rate of clinically silent pulmonary emboli and PE remains to be one of the biggest causes of perioperative mortality in patients undergoing bariatric surgery[53].

VTE can be catastrophic and prophylaxis is a must in morbidly obese patients undergoing bariatric surgery. A combination of unfractionated heparin/low molecular weight heparin (LMWH), compression devices, elastic stockings and early mobilization has been recommended. While weight-adjusted dosing is being practiced in most centers, it may lead to overdosing and hemorrhage, as total body weight does not have a linear relationship with intravascular volume. On the other hand, inadequate dosing may have its own perils. The *American College of Chest Physicians (ACCP)* in 2004 adopted a pragmatic view in this regard and stated that: '*In the absence of clear data, it seems prudent to consider a 25 % increase in the thromboprophylactic dose of LMWH in very obese patients*[36].'

There is no consensus yet on the optimum dose and duration for VTE prophylaxis or on the preoperative use of inferior vena cava filters.

11.1.2 Cholelithiasis

Rapid weight loss following bariatric surgery is associated with an increased incidence of gall stone formation. 7.8 % to 52 % patients tend to develop cholelithiasis within 10 months to 1 year post bariatric surgery[36, 49]. Patients may be asymptomatic or present with cholecystitis, cholangitis or acute gall stone pancreatitis. Definitive cholecystectomy is the treatment of first choice. Prophylactic ursodiol administration is said to decrease postoperative gall stone formation. *Sugerman et al.* reported that a daily dose of 600 mg ursodiol for the first 6 months significantly reduced gall stone formation[84].

11.1.3 Trocar Site Herniation

Trocar site hernias are known to occur after laparoscopic bariatric surgery[63]. Failure to close fascial defects at the time of surgery can lead to these hernias. If the bowel is involved, these can lead to intestinal obstruction and early strangulation due to the small size of defects. Intestinal obstruction may in turn lead to a leak from the proximal staple line as in the case of a sleeve gastrectomy. A high degree of suspicion for diagnosis of this condition and an early surgery to reduce the hernial contents and closure of hernia defects is warranted.

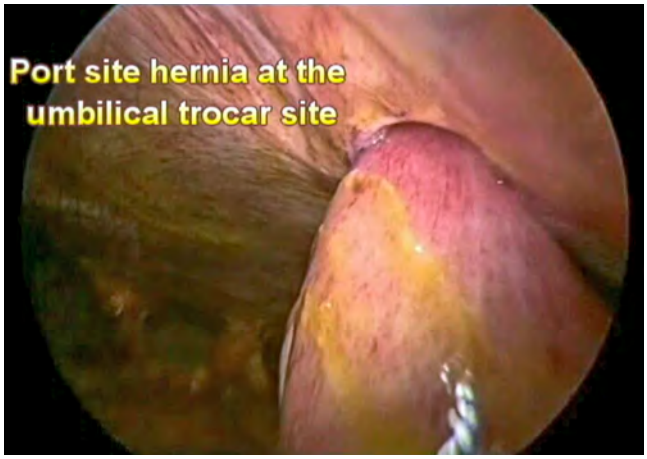


Fig. 11.1 Intraoperative view of small intestine herniating into the umbilical defect.

Fig. 11.2 Radiograph showing air fluid levels secondary to obstruction.

11.1.4 Gastro-intestinal Hemorrhage

The incidence of postoperative hemorrhage is seen in less than 4 % patients undergoing bariatric surgery[24]. Commonly, bleeding can occur from the omental vessels. A long staple line in sleeve gastrectomy may also cause postoperative hemorrhage. Use of appropriate staple length for the right tissue thickness especially in the presence of scar tissue plays a role in the prevention of postoperative hemorrhage. Techniques like over-sewing and buttressing may prevent hemorrhage from the staple line, although, to date, there is no hard evidence supporting the use of reinforcement of any kind[5, 58]. Even the use of biosurgical material like glue lacks evidence. If the patient receives hypotensive anesthesia during surgery, it is good practice to increase the patient's blood pressure to normal levels before extubation. Although hemorrhage is self-limiting in the majority of cases, an emergency laparoscopy may be warranted in patients who are hemodynamically unstable.

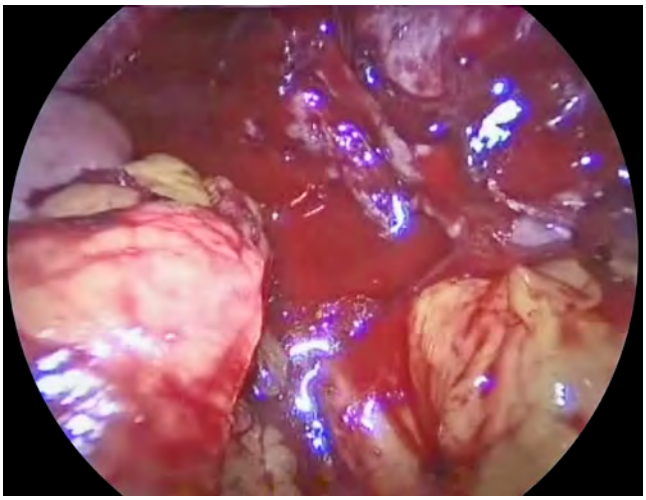


Fig. 11.3 Gastro-intestinal hemorrhage

11.1.5 Wound Infection

The incidence of wound infections has decreased significantly after the advent of laparoscopic surgery. In case of other bariatric procedures, the incidence of wound infection can be minimized by reducing the contact of the contents of the gut with the wound. It may be prudent to remove the resected stomach specimen in an endobag. Laparoscopic port site infections can be managed easily by a short course of antibiotics and local wound care. Care should be taken when using foreign material like a mesh, band or a ring.

Fig. 11.4 Wound infection.

11.2 Complications Specific to Sleeve Gastrectomy

11.2a Diagnostic laparoscopy for leak after LSG *

11.2.1 Staple Line Leaks

Reported in 1 %–7 % of patients, a leak is the most dreaded complication encountered after an LSG[79]. Staple line leaks after LSG are notoriously difficult to treat. They have been classified into acute (within 7 days), early (within 1–6 weeks), late (after 6 weeks), and chronic (after 12 weeks)[73]. 85.7 % of the leaks stem from the proximal third of the staple line and about 14.3 % from the distal third[13]. The three main causes of leaks are increased intraluminal pressure due to distal obstruction or strictures, ischemia and technical failure. Tachycardia, tachypnea, fever and vomiting must alert the surgeons and warrant further investigations. Blood work along with imaging in the form of contrast studies or a CT scan are useful diagnostic modalities.

Leaks after LSG have a high degree of morbidity and even mortality if not tackled in time with appropriate measures. Unresolved leaks can lead to chronic complications such as gastro-cutaneous, esophago-pleural and gastro-colic fistulas in the long term. Re-laparoscopy with or without stenting remains the mainstay of treatment for acute or early leaks after LSG. In case of a contained leak, a percutaneous drainage with or without a stent may be considered. Chronic leaks are the most difficult to treat and the treatment has to be tailor-made in such cases.

The third consensus summit for sleeve gastrectomy showed wide technical variations between surgeons which is why the use of staple line reinforcement/suturing for leak prevention and its effectiveness still remains a controversial issue[23].

* http://go.karlstorz.com/96115021-11-2a

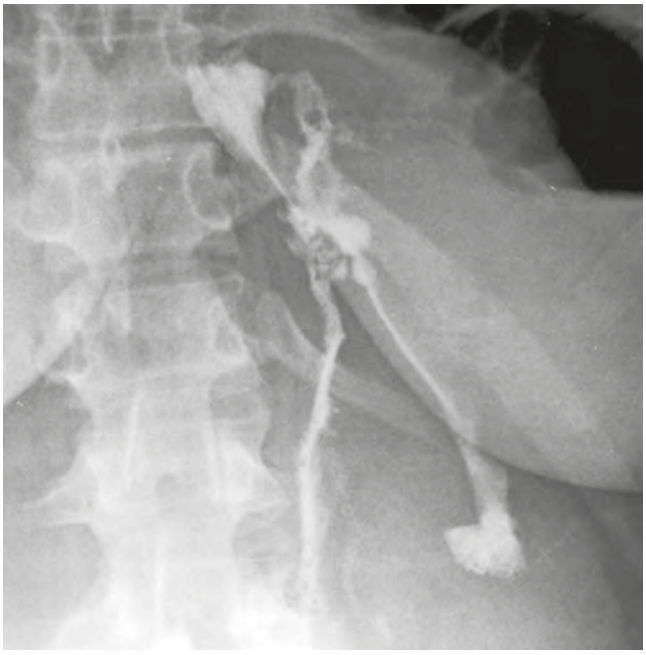


Fig. 11.5 Contrast study showing a leak from the gastro-esophageal junction.

Fig. 11.6 Contrast study showing an esophago-pleural fistula.

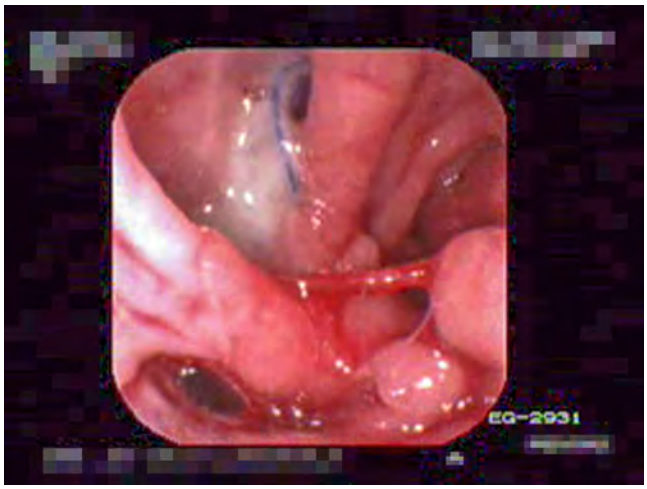


Fig. 11.7 Endoscopic image of multiple fistulas from the gastro-esophageal junction.

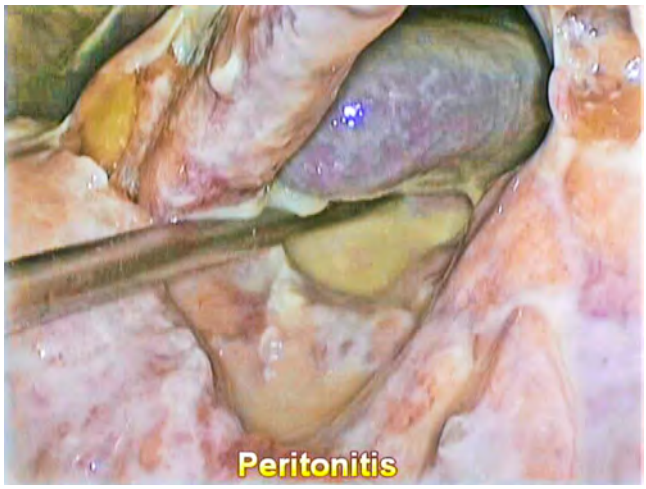


Fig. 11.8 Diagnostic laparoscopy in a case of peritonitis occuring after an acute leak.

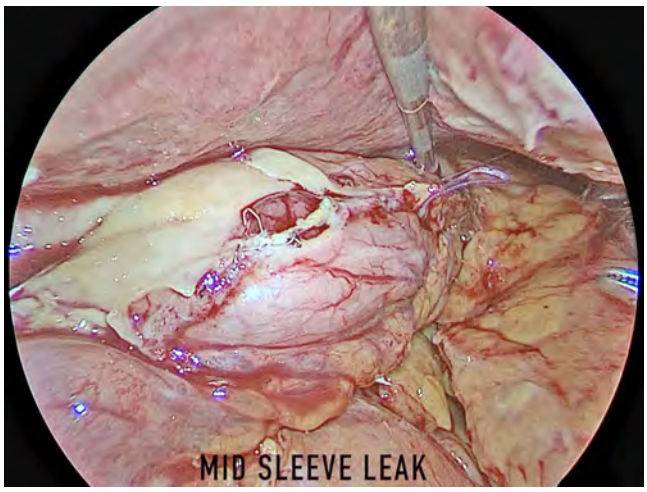


Fig. 11.9 Intraoperative image of a mid-sleeve leak.

Fig. 11.10 Radiograph with a mega-stent in situ.

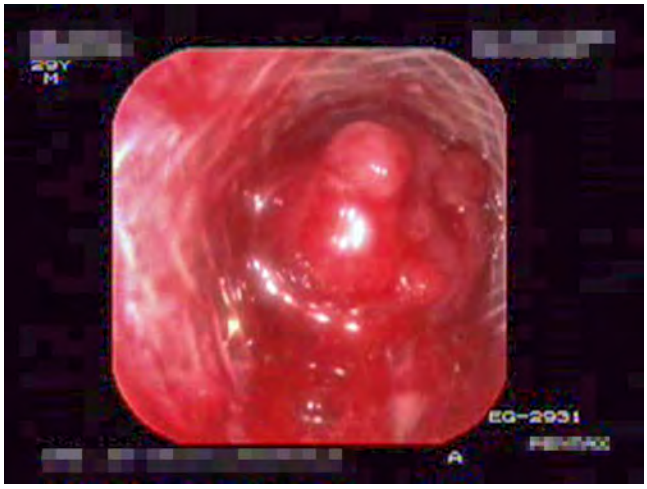


Fig. 11.11 Stent obstruction at the distal end due to mucosal prolapse.

11.2b Gastro-colic fistula post LSG*

Fig. 11.12 Gastro-colic fistula post a sleeve leak.

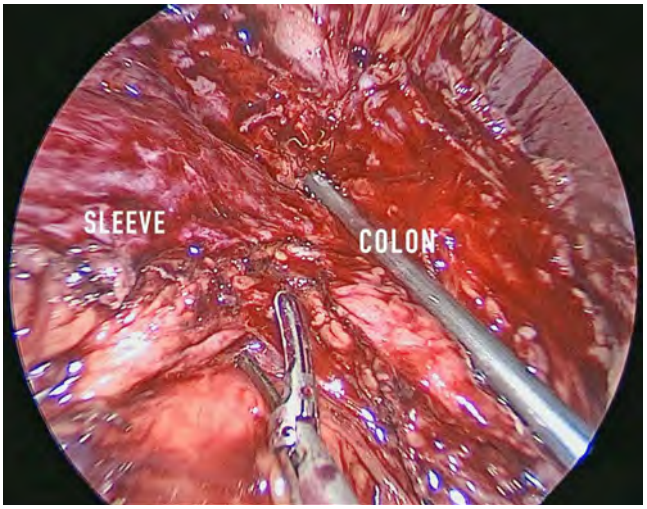


Fig. 11.13 Intraoperative picture of a gastro-colic fistula post sleeve leak.

* http://go.karlstorz.com/96115021-11-2b

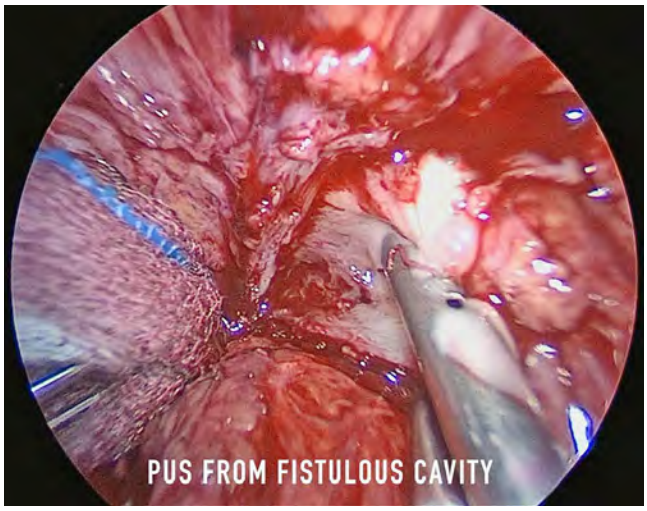


Fig. 11.14 Purulent collection in the fistulous cavity.

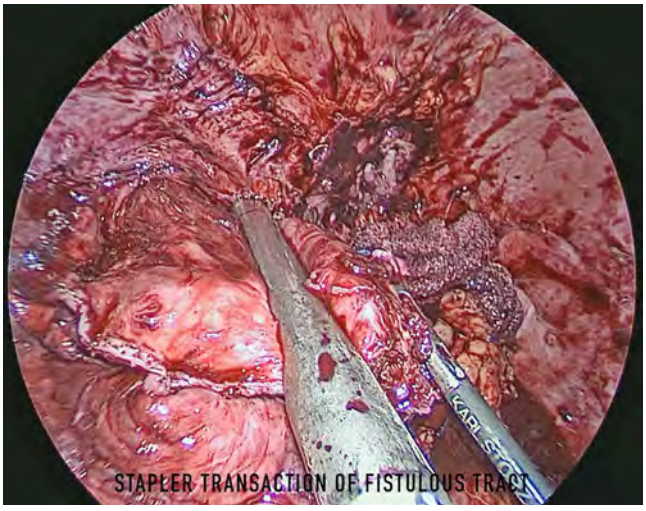


Fig. 11.15 Transection of the fistulous tract.

11.2.2 Strictures after Sleeve Gastrectomy

Strictures are a late complication of LSG and are seen in 0.7 % to 3.5 % of patients[26, 61, 76]. The most common site for stricture formation is at the incisura angularis[20]. Patients usually present with dysphagia, vomiting and excessive weight loss. Diagnosis is established on the basis of an upper gastrointestinal (UGI) endoscopy and a contrast series. Management depends on the site and length of the stricture. Management entails either endoscopic dilatation with an achalasia balloon (which may need a few sittings) or seromyotomy or conversion to an RYGB[61]. Torsion of sleeve may also be seen in a few patients and can be treated with balloon dilatation. In a worst-case scenario, the sleeve may be converted to a Roux en-Y gastric bypass.

Fig. 11.16 Endoscopic image of a kink in mid-sleeve.

Fig. 11.17 Placement of the guidewire prior to achalasia balloon dilatation.

Fig. 11.18 Positioning of the balloon and dilatation.

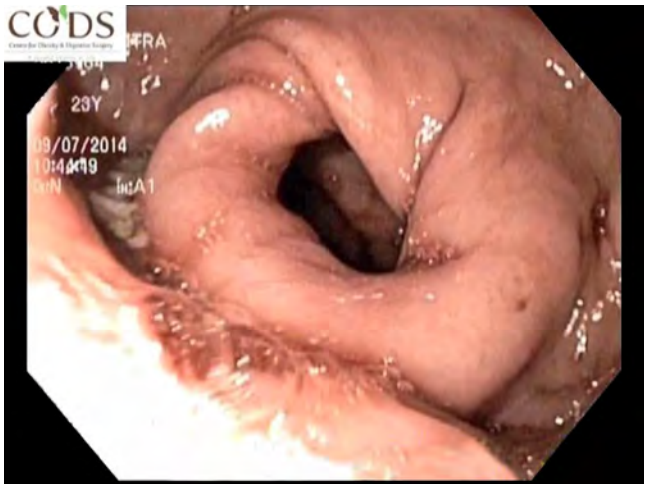


Fig. 11.19 Check endoscopy after dilatation.

11.2.3 GERD after Laparoscopic Sleeve Gastrectomy

Along with the rise in popularity of LSG, there are concerns about increasing incidence of postoperative gastroesophageal reflux disease (GERD) and future occurrence of Barrett's esophagus after LSG. *Himpens et al.* reported a decrease in GERD symptoms post LSG at 3 years and attributed it to the restoration of the angle of His. However, at 6-year follow-up, de novo GERD was observed in 21.9 % of the patients[31]. In a systematic review by *Chiu et al.*, the data regarding GERD post LSG was found to be inconclusive. Four studies reported an increase in the rate of GERD and 7 reported a decrease[17]. Some authors advocate the prescription of proton pump inhibitors to all patients over a period of 6 months after surgery, however, to date, there is no evidence supporting its validity. In a recent study, *Soricelli et al.* reported that LSG with crural repair may be a safe technique for prevention of postoperative GERD[81].

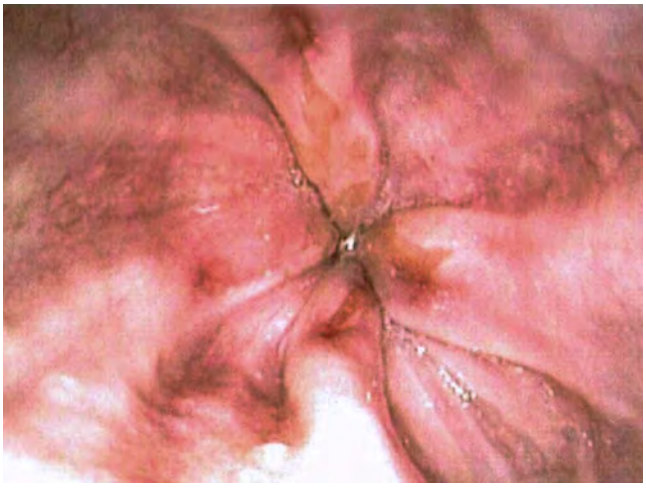


Fig. 11.20 Endoscopic image of reflux esophagitis.

An UGI endoscopy and contrast studies are useful for the diagnosis of GERD in post LSG patients. While most patients may be managed successfully with anti-reflux therapy, severe cases may require conversion to an RYGB.

We recommend a preoperative UGI endoscopy in all patients selected for undergoing bariatric surgery. Patients with grade B and above reflux esophagitis and large hiatal hernias must not be selected for an LSG in the first place.

11.2.4 Intraoperative Complications

Fig. 11.21 Ryle's tube stapled during laparoscopic sleeve gastrectomy (by courtesy of Dr. *Arun Prasad*).

Fig. 11.22 Gastric tube stapled during laparoscopic sleeve gastrectomy.

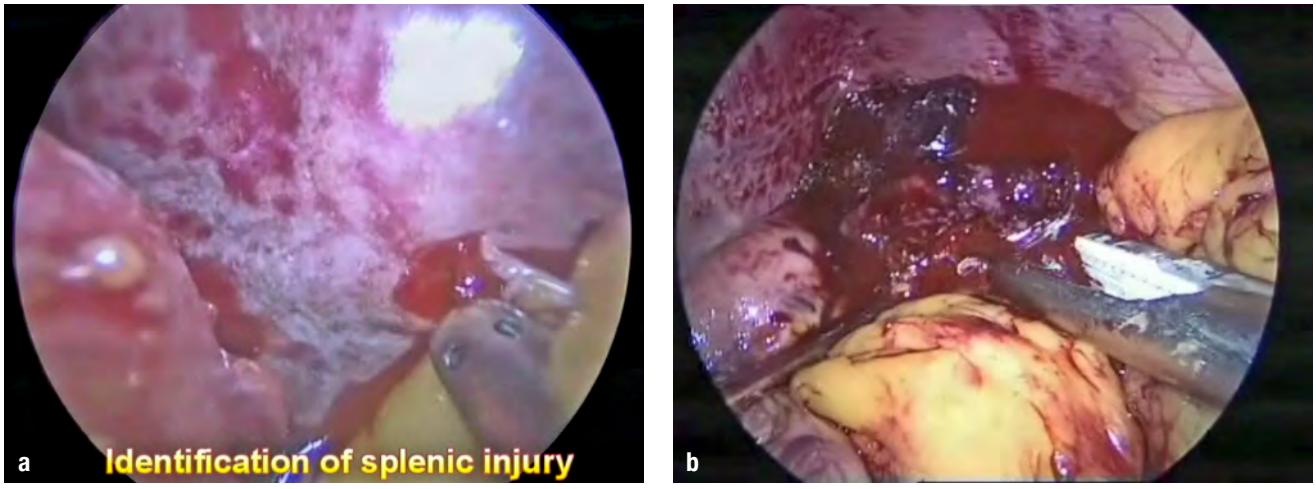


Fig. 11.23 Splenic injury.

11.2.5 Nutritional Complications

Hypoglycemia

This is one of the most devastating sequelae of some bariatric surgeries, but also one that can be easily avoided by simple dietary modification. A thorough dietary recall is required, preferably a 24-hour recall for three days can help in gauging food intake. A complex carbohydrate diet plan is sufficient to prevent hypoglycemia-like symptoms in most patients. Both soluble and insoluble fiber should be encouraged. A simple instruction like taking a gap between solids and liquids is essential to prevent 'flushing' down of the food. Care must be taken in diabetic patients that dosage of antidiabetic drugs has been reduced and adjusted appropriately.

Dumping Syndrome

This is mainly associated with the Roux en-Y gastric bypass surgery and is a result of large high-calorie food intake especially sugary foods, but not excluding fried, deep fried food stuff and alcohol. Early dumping syndrome occurs immediately after consuming a high-calorie meal and can cause bloating, abdominal cramps, pain or diarrhea. Late dumping, which results after 1 to 2 hours after consumption of a high-calorie meal, causes sweating, dizziness and a rapid heartbeat. A similar effect is seen in a few patients after a SG. In these patients, hypoglycemia is noticed about 2 hours after a meal. A five-hour oral glucose tolerance test may be helpful in diagnosis. A complex carbohydrate diet plan along with the use of fiber supplements can help to prevent symptoms of dumping syndrome in most cases.

Nutrient	Mechanism of Absorption	Need for Supplementation	Supplementation Protocol
Vitamin B12	Hydrochloric acid (HCl) from the stomach frees the bound form of Vitamin B12 from the food. ⇩ Vitamin B12 binds with intrinsic factor produced by the parietal cells. ⇩ Vitamin B12 is absorbed in the ileum.	Reduction of gastric acid production due to resection of the stomach. Resection of the fundus of the stomach with its parietal cell mass.	Severe deficiency: 500 mcg to 1000 mcg of vitamin B12 should be administered i.m. on a biweekly basis. Mild to moderate deficiency: Sublingual or nasal administration of 1000 – 1200 mcg vitamin B12 is recommended as a maintenance dose.
Iron	Iron enters the stomach. ⇩ It is reduced to a ferrous state by the HCl produced in the stomach. ⇩ HCl and ascorbic acid increase the absorbability of ferrous iron. ⇩ This iron absorbed in the duodenum and upper part of the jejunum.	Reduction of gastric cell mass with reduced HCl due to resection of the stomach.	28 – 30 mg / day either ferrous fumarate or glycinate preferably with added ascorbic acid to enhance absorbability. Severe deficiency: Injectable iron administration.
Folic Acid	Folic acid is absorbed in the jejunum, hence deficiency is not directly related to the procedure.	Reduced food intake secondary to bariatric surgery.	400 mcg in addition to a daily adult multivitamin supplement.
Protein	A pH < 5 is essential for conversion of pepsinogen into pepsin which is needed to cleave polypeptides.	Reduction in gastric acid and reduced number of pepsinogen secreting chief cells.	1 to 1.5 gm/kg of ideal body weight.

Table 4 Nutrients at risk of insufficient supply post sleeve gastrectomy.

12 Revision Surgery after LSG

12.1 Definition of Successful Outcome After Bariatric Surgery

There is no consensus yet on the definition of a successful outcome after bariatric surgery. While the Reinhold criteria defined excellent weight loss after surgery as achieving a BMI of 30 kg/m^2, an excess weight loss (EWL) of more than 50 % is considered as an acceptable definition of success by centers across the world[12, 70]. Inadequate weight loss, weight regain, recurrence of comorbidities, and complications as a result of the primary procedure are the most common cause for re-operation after any bariatric procedure.

Weight regain after bariatric surgery is a multifactorial process and it is imperative to understand the patient's psychology and nutritional behavior before considering a re-operation. Technical aspects of the primary surgery must be reviewed and the cause of failure must be determined before advising a re-operation. Re-operations after failed bariatric surgery are technically more demanding, come with a higher rate of complications and are more expensive.

At present, the data on the type of revision procedure chosen, and its timing, whether staged or concomitant, is insufficient and patient selection along with surgical expertise play major roles in decision-making.

12.2 Revision Options After LSG

Bohdjalian et al. reported weight regain in 19.2 % of their patients at the end of 5 years[8]. In a series of 937 patients, *Weiner et al.* reported a secondary bariatric procedure in 88 patients for insufficient weight loss or weight regain[90]. Currently, the reported re-operation rate after LSG is between 5.5 to 11 %[8, 45, 90].

There are multiple options for revision after a failed LSG: Re-sleeve gastrectomy, RYGB, single anastomosis gastric bypass (SAGB) and DS/single anastomosis duodeno-ileostomy (SADI) are some of the revision procedures commonly performed after sleeve gastrectomy. LSG can also be converted to newer procedures like the sleeve with duodenojejunal bypass (DJB) or a sleeve with ileal transposition.

12.3 Re-Sleeve Gastrectomy

Re-sleeve gastrectomy has been proposed by a few authors as a feasible revision option for weight regain after sleeve gastrectomy. The most common indications are incomplete removal of the fundus, dilatation of the fundus or antrum, or a CT volumetry showing a gastric volume of 250 cc or more. Most authors report an EWL ranging from 58.5 to 71.4 % with a follow up duration from 12 to 20 months[15, 35, 59, 68]. While a low complication rate is reported by most authors, *Rebibo L. et al.* stated that the complication rate of re-sleeve gastrectomy was twice the rate of a primary sleeve gastrectomy. They reported two cases of a gastric fistula and one mortality in their series of 15 patients[68].

12.3 Re-sleeve gastrectomy *

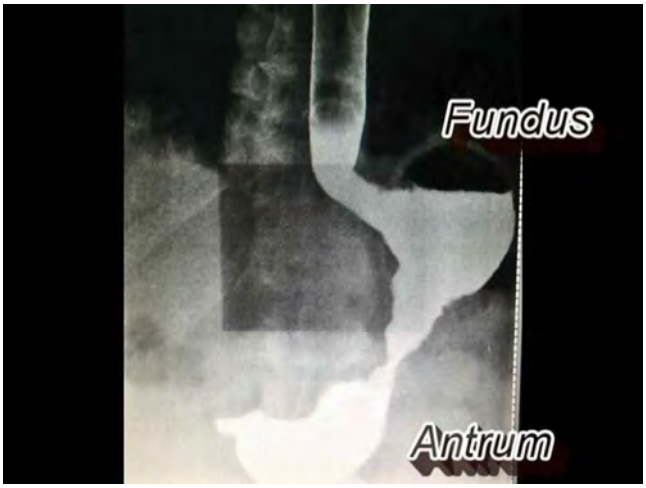


Fig. 12.1 Contrast study showing dilated fundus and antrum post sleeve gastrectomy.

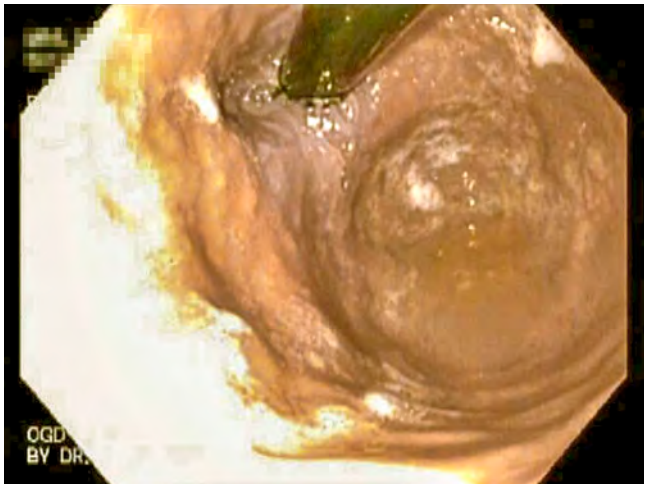


Fig. 12.2 Endoscopic image showing a dilated fundus post sleeve gastrectomy.

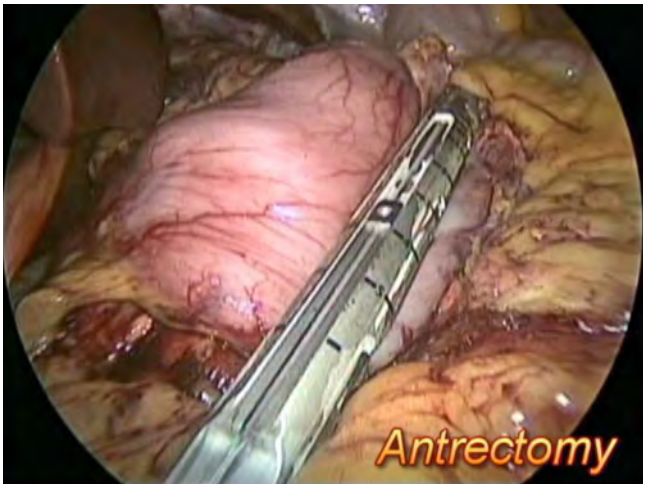


Fig. 12.3 Antrectomy for dilated antrum.

* http://go.karlstorz.com/96115021-12-3

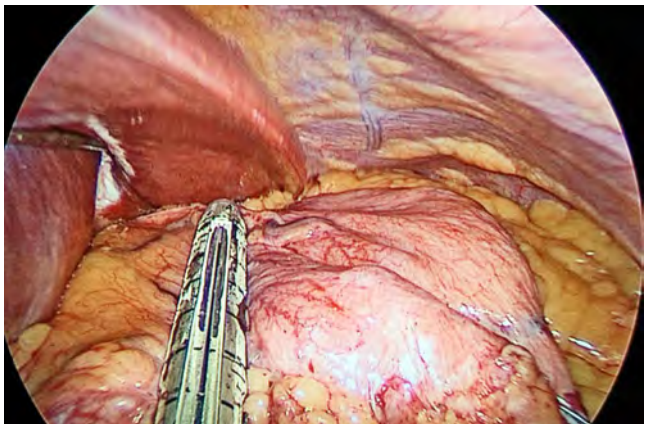


Fig. 12.4 Fundectomy of the fundus left behind during primary surgery.

Fig. 12.5 Specimen of resected fundus and antrum.

12.4 Revision of LSG to banded RYGB *

Fig. 12.6 Post re-sleeve gastrectomy contrast study.

12.4 Laparoscopic Sleeve Gastrectomy (LSG) to Roux-en-Y Gastric Bypass (RYGB)

Conversion of LSG to RYGB has been recommended for severe reflux, insufficient weight loss, weight regain and persistence of comorbidities like type 2 diabetes mellitus. In a systematic review published in 2014, 114 patients reportedly underwent conversion of LSG to RYGB[16]. Conversion to RYGB has been reported from 24 to 31 months after the primary procedure and EWL ranges from 27 to 54 % in a follow-up interval of up to 3 years[27, 45, 89].

Complication rate is low, with one small bowel injury reported by *Gautier et al.* and one leak at the gastro-jejunostomy by *Langer et al.* Even though the complication rates are lower and a lot of surgeons choose to perform RYGB as a revision procedure after LSG, further weight regain after revision RYGB has also been seen[86], hence a banded RYGB may be a better option.

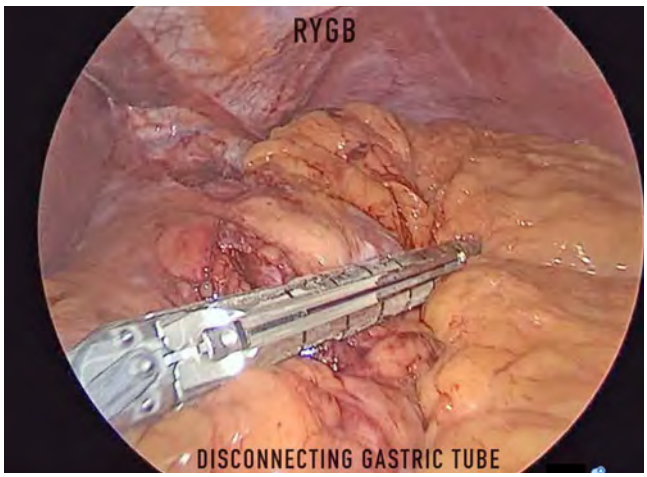


Fig. 12.7 Disconnecting the gastric tube for creation of a gastric pouch.

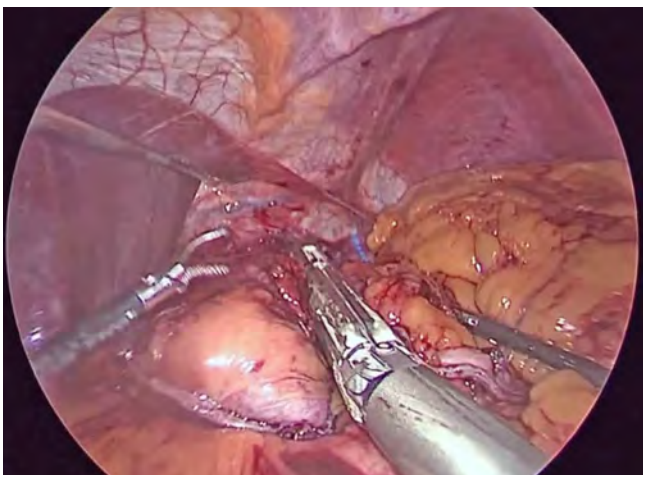


Fig. 12.8 Creation of gastric pouch.

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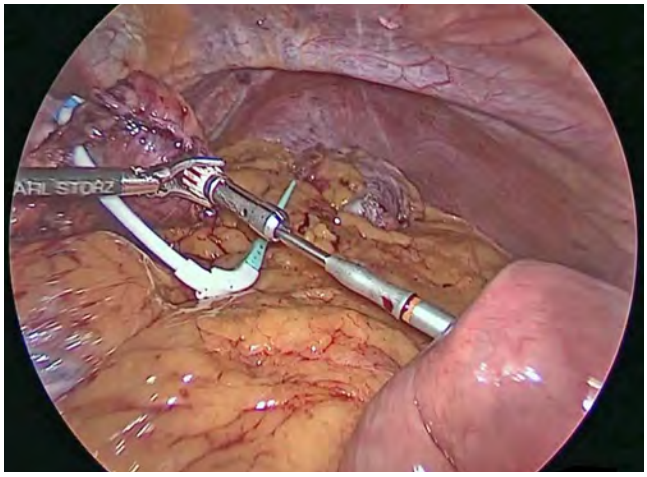


Fig. 12.9 Docking the circular stapler

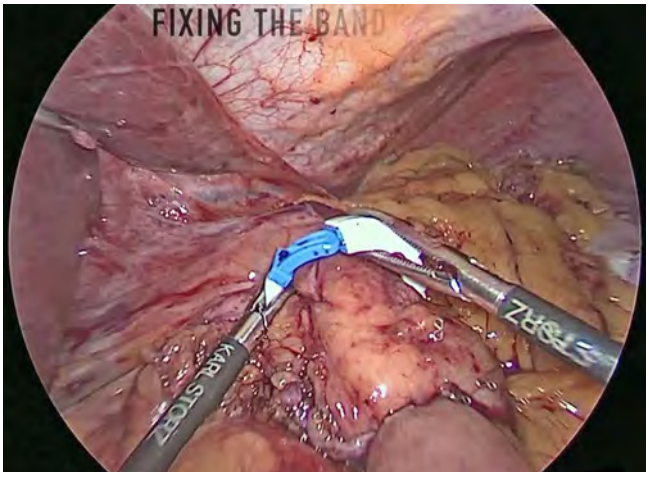
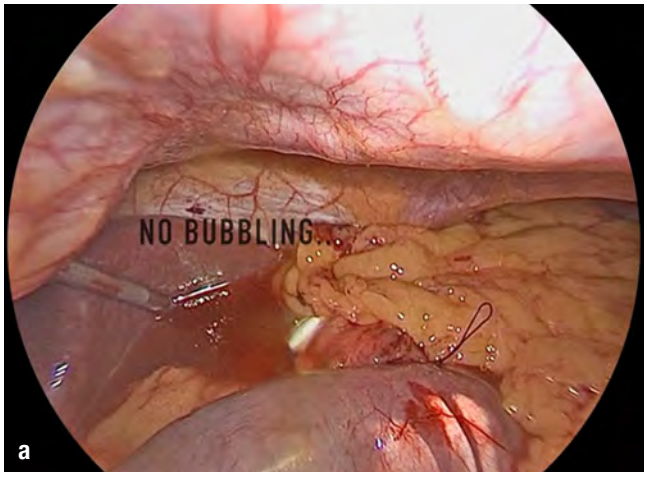


Fig. 12.10 Applying the Fobi ring on the gastric pouch.



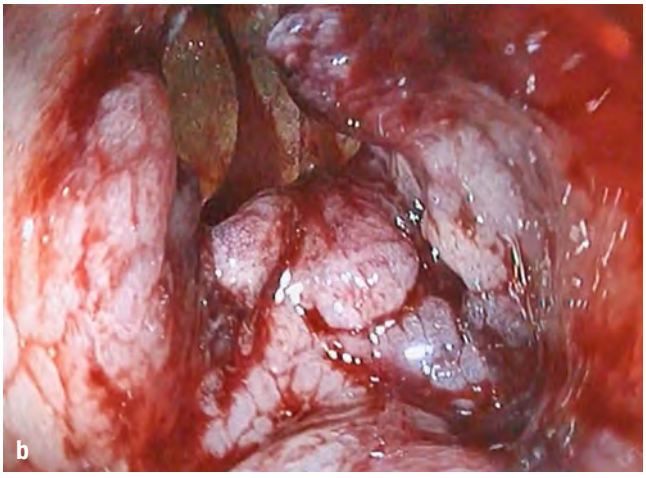


Fig. 12.11 Endoscopic image of underwater bubble test confirming the absence of leakage.

12.5 LSG to Mini Gastric Bypass

Conversion of LSG to Mini Gastric Bypass has been recommended for insufficient weight loss, weight regain and persistence of comorbidities like type 2 diabetes mellitus.

12.5 Revision of LSG to mini gastric bypass with fundectomy*

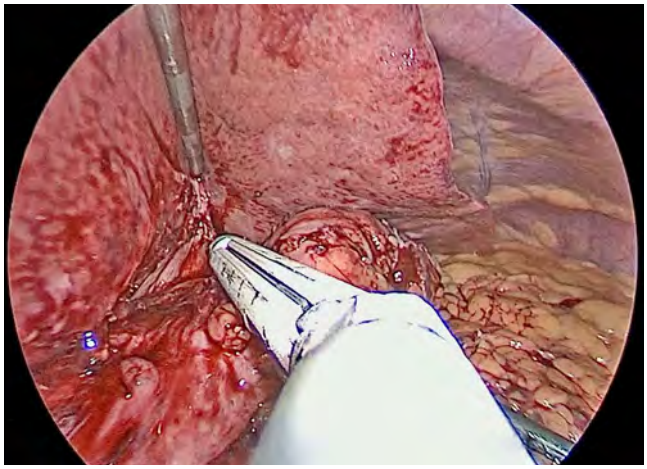


Fig. 12.12 Disconnecting the gastric tube for creation of gastric pouch.

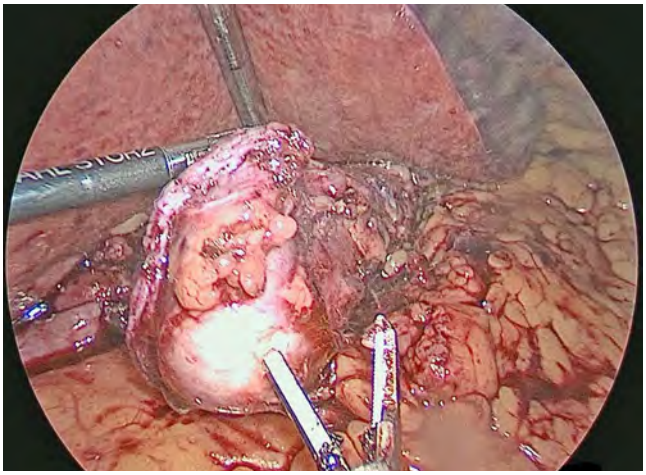


Fig. 12.13 Creation of gastrostomy.

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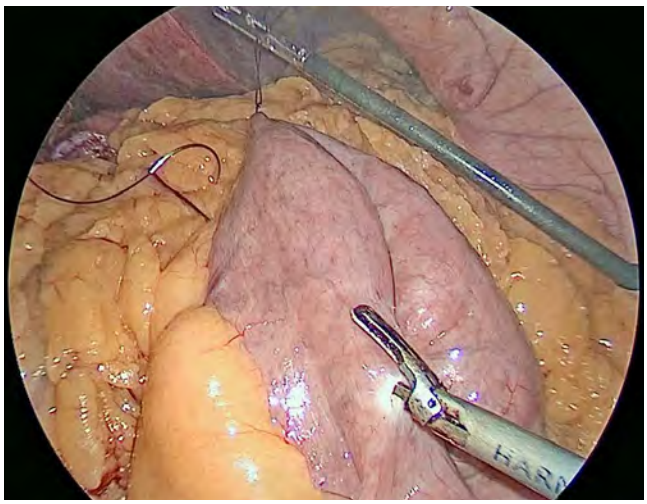

Fig. 12.14 Creation of enterotomy.

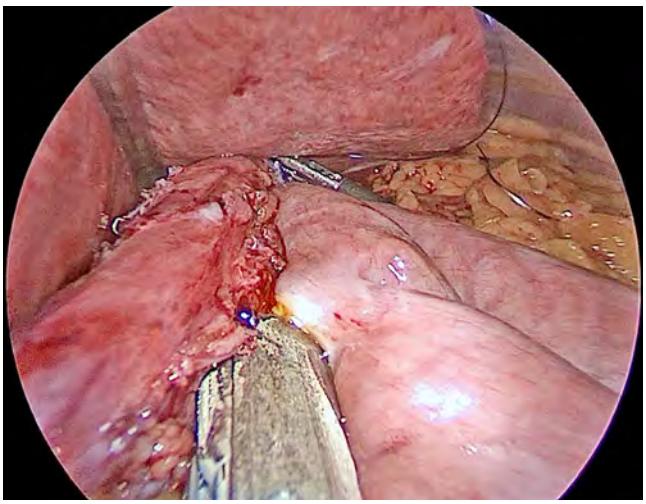

Fig. 12.15 Side to side gastro-jejunostomy.

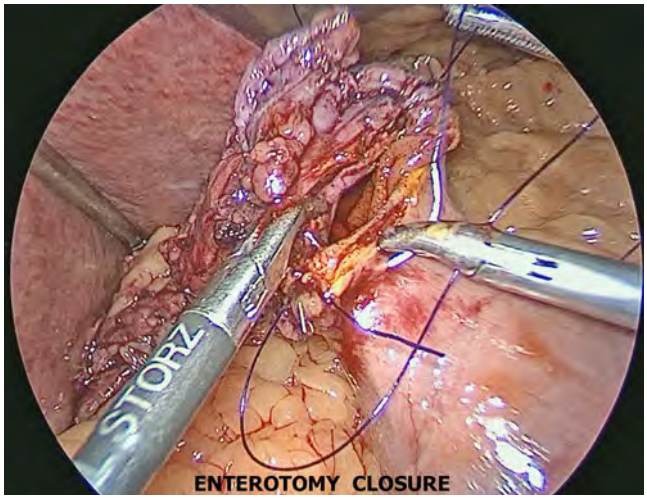

Fig. 12.16 Closure of enterotomy in two layers.

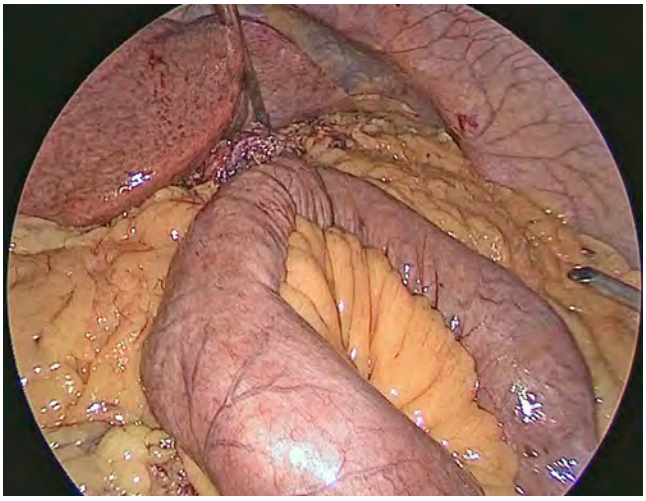

Fig. 12.17 Final aspect of the anastomosis.

12.6 LSG to DS

LSG was initially performed as the first stage of a DS in super-obese patients. There are numerous reports where a planned DS has been performed after a first-stage LSG for super-obese patients. However, DS as a revision procedure after LSG for inadequate weight loss and weight regain has been reported by only a few authors. As a revision procedure, a DS leads to better weight loss results after LSG as compared to RYGB, but is associated with a higher complication rate and nutritional problems[33, 90].

12.6 LSG with duodeno-jejunal bypass*

* http://go.karlstorz.com/96115021-12-6

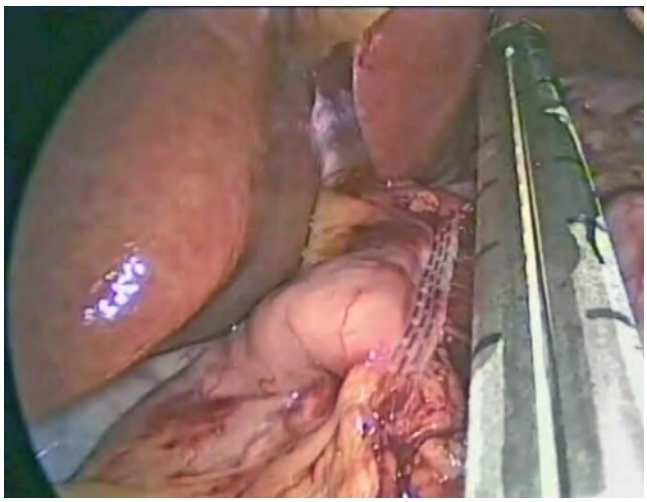

Fig. 12.18 Division of the first part of duodenum.

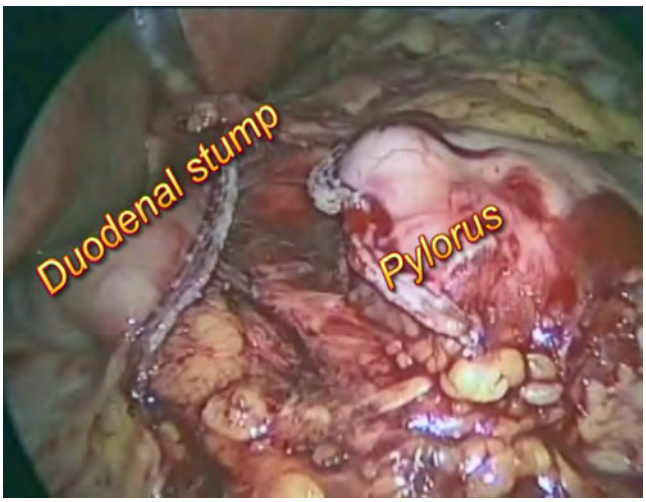

Fig. 12.19 Approximation of the ileum to the first part of duodenum.

Fig. 12.20 Two-layered duodeno-ileal anastomosis.

Fig. 12.21 Under-water leak test

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Recommended Instrumentation and Video Equipment for Sleeve Gastrectomy

Instruments for Sleeve Gastrectomy

Recommended Set acc. to Dr. LAKDAWALA

26003AA **HOPKINS® Straight Forward Telescope 0°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green

26003FEA **HOPKINS® Telescope 45°,** enlarged view, diameter 10 mm, length 42 cm, **autoclavable,** fiber optic light transmission incorporated, color code: black

30160MP **Trocar,** with pyramidal tip, with insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black,
including:
Cannula, without valve
Trocar only
Multifunctional Valve

30103MP **Trocar,** with pyramidal tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green,
including:
Cannula, without valve
Trocar only
Multifunctional Valve

30140DB **Reduction Sleeve,** reusable, instrument diameter 5 mm, trocar cannula outer diameter 11 mm, color code: green

30142HB **Double Reducer,** 13/10 mm, 13.5/10 mm, 13/5 mm and 13.5/5 mm

33352CC **CLICKLINE** CROCE-OLMI **Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, atraumatic, fenestrated, curved, size 5 mm, length 36 cm,
including:
Plastic Handle, with ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

33452CC **CLICKLINE** CROCE-OLMI **Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, atraumatic, fenestrated, curved, size 5 mm, length 43 cm,
including:
Plastic Handle, with ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

33351MD **CLICKLINE** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

33451MD **CLICKLINE** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

33451C **CLICKLINE Bowel Grasper,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, fenestrated, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

33451R **CLICKLINE Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, right-angled, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert

Instruments for Sleeve Gastrectomy

Recommended Set acc. to Dr. LAKDAWALA

33451UL **CLICKLINE** REDDICK-OLSEN **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, robust, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath, insulated
Forceps Insert

34451EH **CLICKLINE Hook Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath, insulated
Scissors Insert

34451MS **CLICKLINE** METZENBAUM **Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, curved, size 5 mm, length 43 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Scissors Insert

33422AV **CLICKLINE Anvil Grasper,** rotating, with connector pin for unipolar coagulation, double action jaws, size 5 mm, length 43 cm,
including:
Plastic Handle, with ratchet
Metal Outer Sheath
Forceps Insert

38751MD **ROBI**® KELLY **Dissecting and Grasping Forceps,** CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, suitable for dissection, size 5 mm, length 43 cm, color code: light blue,
including:
ROBI® Plastic Handle, without ratchet
ROBI® Metal Outer Sheat
ROBI® Forceps Insert

26178KAL KOH **Macro Needle Holder,** with tungsten carbide inserts, axial handle with disengageable ratchet, ratchet position right, jaws curved to left, size 5 mm, length 43 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26178KAR KOH **Macro Needle Holder,** with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position left, jaws curved to right, size 5 mm, length 43 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26178KPL KOH **Macro Needle Holder,** with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position left, jaws curved to left, size 5 mm, length 43 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26178KPR KOH **Macro Needle Holder,** with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right, size 5 mm, length 43 cm, for use with suture material size 0/0 to 7/0 and needle sizes BV, SH or CT-1

26778UF **Coagulation and Dissection Electrode,** L-shaped, with connector pin for unipolar coagulation, size 5 mm, length 43 cm

26778UE **Coagulation and Dissection Electrode,** insulated sheath, with connector pin for unipolar coagulation, spatula-shaped, blunt, size 5 mm, length 43 cm

26174BN **Suction and Irrigation Tube,** with lateral holes, with two-way stopcock for single hand control, size 5 mm, length 43 cm

26173AM BERCI **Fascial Closure Instrument,** for subcutaneous ligature of trocar incisions, size 2.8 mm, length 17 cm, for closure of trocar incision wounds

26178T **Palpation Probe,** with cm-markings, size 5 mm, length 43 cm

26002M **Unipolar High Frequency Cord,** with 4 mm plug, length 300 cm, for KARL STORZ, Erbe type T older models and Ellman models

26176LV **Bipolar High Frequency Cord,** length 300 cm, for AUTOCON® II 400 SCB system (112, 114, 116, 122, 125), AUTOCON® II 200, AUTOCON® II 80 and Valleylab coagulators

Minilaparoscopy

Basic Set

slimline

26003BA	**HOPKINS® Forward-Oblique Telescope 30°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
	or
26046BA	**HOPKINS® Forward-Oblique Telescope 30°,** diameter 5 mm, length 29 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
26007BA	**HOPKINS® Forward-Oblique Telescope 30°,** enlarged view, diameter 3.3 mm, length 25 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
495NCS	**Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, diameter 4.8 mm, length 250 cm
495NA	**Fiber Optic Light Cable,** with straight connector, diameter 3.5 mm, length 230 cm
533TVA	**Adaptor, autoclavable,** permits telescope changing under sterile conditions
26120JL	VERESS **Pneumoperitoneum Needle,** with spring-loaded blunt inner cannula, LUER-Lock, **autoclavable,** diameter 2.1 mm, length 13 cm
30160GYG	**Trocar,** with conical tip, with LUER-Lock connector for insufflation, size 6 mm, working length 10 cm, color code: black
30117GP	**Trocar,** with pyramidal tip, with LUER-Lock connector for insufflation, size 3.9 mm, working length 10 cm, color code: red-green
3x 30114GYG	**Trocar,** with conical tip, with LUER-Lock connector for insufflation and valve seal, size 3.5 mm, working length 10 cm, color code: green
31351ML	**CLICKLINE** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, double action jaws, long, with connector pin for unipolar coagulation, without ratchet, size 3.5 mm, length 36 cm
31366ONM	**CLICKLINE Grasping Forceps,** rotating, dismantling, single action jaws, fenestrated, with fine atraumatic serration, with disengageable ratchet, without connector pin for unipolar coagulation,size 3.5 mm, length 36 cm
31351MW	**CLICKLINE Scissors,** rotating, dismantling, double action jaws, serrated, curved, conical, with LUER-Lock irrigation connector for cleaning, without ratchet, with connector pin for unipolar coagulation, size 3.5 mm, length 36 cm
31351EH	**CLICKLINE Micro Hook Scissors,** rotating, dismantling, single action jaws, with connector pin for unipolar coagulation, without ratchet, size 3.5 mm, length 36 cm
25775CNL	CADIERE **Coagulation and Dissection Electrode,** L-shaped, distal tip tapered, with cm-marking, with connector pin for unipolar coagulation, size 3.5 mm, length 36 cm
26005M	**Unipolar High Frequency Cord,** with 5 mm plug for AUTOCON®, length 300 cm
38951MD	**ROBI®** KELLY **Grasping Forceps,** CLERMONT-FERRAND model, rotating, dismantling, double action jaws, with connector pin for bipolar coagulation, size 3.5 mm, length 36 cm
38951ON	**ROBI® Grasping Forceps,** CLERMONT-FERRAND model, rotating, dismantling, with fine atraumatic serration, fenestrated, double action jaws, with connector pin for bipolar coagulation, size 3.5 mm, length 36 cm
38951MW	**ROBI® Scissors,** CLERMONT-FERRAND model, rotating, dismantling, curved scissor blades, double action jaws, with connector pin for bipolar coagulation, size 3.5 mm, length 36 cm
26176LE	**Bipolar High Frequency Cord,** length 300 cm
26167ANL	**Suction and Irrigation Tube,** with lateral holes, size 3.5 mm, length 36 cm, for use with handles for irrigation and suction
30805	**Handle with Two-Way Stopcock,** for suction and irrigation, **autoclavable,** for use with suction and irrigation tubes size 5 mm
26167LNL	KOH **Ultramicro Needle Holder,** with tungsten carbide inserts, jaws curved to left, straight handle, with ratchet, size 3.5 mm, length 36 cm
26167RNL	KOH **Ultramicro Needle Holder,** with tungsten carbide inserts, jaws curved to right, straight handle, with ratchet, size 3.5 mm, length 36 cm

Single Port
Basic Set

S-PORTAL
SINGLE-PORTAL-ACCESS

26048BSA	**HOPKINS® Forward-Oblique Telescope 30°,** diameter 5.5 mm, length 50 cm, **autoclavable,** fiber optic light transmission incorporated, light connection offset by 180° and angled 45°, color code: red
23030PA	**S-PORT®**, single portal surgery access system, adaptable in sizes 15–45 mm
	or
23010PA	CUSCHIERI **ENDOCONE® Single Portal Surgery Access System,** size 34 mm
23451MUD	**ROTATIP®** KELLY **Dissecting and Grasping Forceps,** dismantling, with connector pin for unipolar coagulation, double action jaws, long, jaws and sheath rotatable, CUSCHIERI O-CON sheath curve, coaxially curved downwards, size 5 mm, length 36 cm
23451AUD	**ROTATIP® Grasping Forceps,** dismantling, with connector pin for unipolar coagulation, double action jaws, atraumatic, fenestrated, jaws and sheath rotatable, CUSCHIERI O-CON sheath curve, coaxially curved downwards, size 5 mm, length 36 cm
23451MSUD	**ROTATIP®** METZENBAUM **Scissors,** dismantling, with connector pin for unipolar coagulation, double action jaws, curved, jaws and sheath rotatable, CUSCHIERI O-CON sheath curve, coaxially curved downwards,size 5 mm, length 36 cm
38751MLU	**ROBI®** KELLY **Grasping Forceps,** CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, double action jaws, suitable for dissection, CUSCHIERI O-CON sheath curve, size 5 mm, length 43 cm

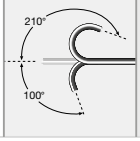
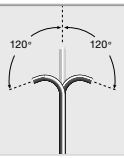
It is recommended to check the suitability of the product for the intended procedure prior to use.

SILVER SCOPE® Gastroscopes

Special Features:

- **High resolution**
- **Ergonomically shaped handle**
- **140° wide-angle telescope**
- **Torsion-proof insertion sheath**
- **Good instrument access, even at extreme angles**
- **Supply tube with standard connectors**
- **8x magnification for diagnostics**
- **Compatible for use with IMAGE1 S camera system**
- **Three individually programmable remote control buttons**

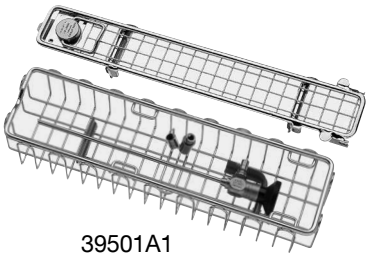
13821PKS/NKS

SILVER SCOPE®	Order No.		Sheath Outer Diameter	Working Channel Diameter	Working Length	Deflection		Field of View
	PAL	NTSC				up/down	left/right	
Standard Gastroscope	13821PKS	13821NKS	9.3 mm	2.8 mm	1100 mm			140°

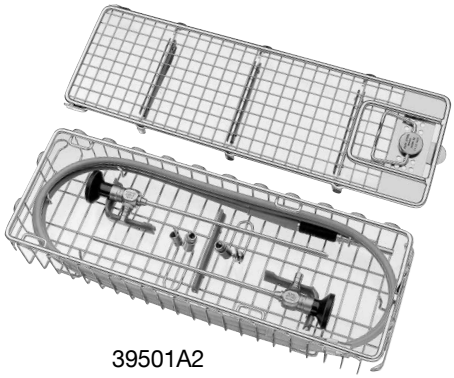
Wire Trays and Containers

for the cleaning, sterilization and storage of telescopes and instruments

Telescopes



39501A1



39501A2

39501A1 **Wire Tray for Cleaning, Sterilization and Storage** of one rigid endoscope, including holder for light post adaptors, silicone telescope holders and lid, external dimensions (w x d x h): 290 x 60 x 52 mm, for rigid endoscopes up to diameter 5 mm and working length 20 cm

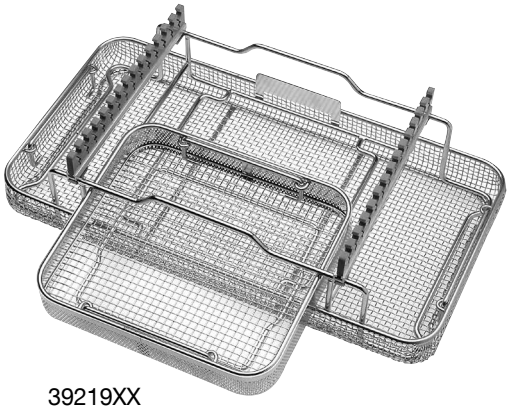
39501B1 **Wire Tray for Cleaning, Sterilization and Storage** of one rigid endoscope, including holder for light post adaptors, silicone telescope holders and lid, external dimensions (w x d x h): 430 x 65 x 52 mm, for rigid endoscopes up to diameter 10 mm and working length 34 cm

39501A2 **Wire Tray for Cleaning, Sterilization and Storage** of two rigid endoscopes and one light cable, including holder for light post adaptors, silicone telescope holders and lid, external dimensions (w x d x h): 352 x 125 x 54 mm, for rigid endoscopes up to diameter 10 mm and working length 20 cm

39501B2 **Wire Tray for Cleaning, Sterilization and Storage** of two rigid endoscopes and one light cable, including holder for light post adaptors, silicone telescope holders and lid, external dimensions (w x d x h): 487 x 125 x 54 mm, for rigid endoscopes up to diameter 10 mm and working length 34 cm

Instruments

39752A2



39219XX

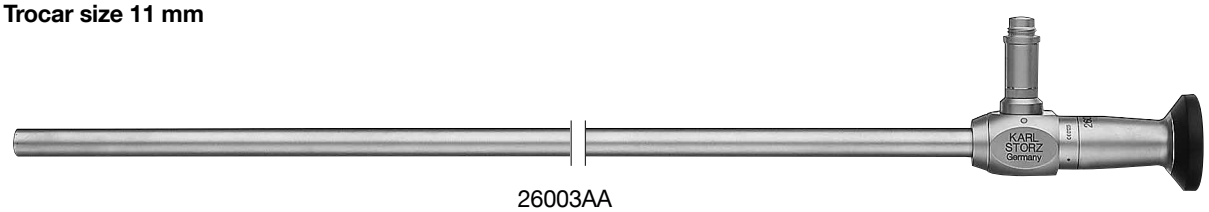
39752A2 **Sterilization Container,** with MicroStop® microbiological barrier, for sterilization and sterile storage, external dimensions (w x d x h) 600 x 300 x 160 mm, internal dimensions (w x d x h): 548 x 267 x 138 mm

39219XX **Instrument Rack for Cleaning, Sterilization and Storage** of up to 14 instruments with diameter 2.5 to 10 mm, incl. variable bars with silicone holders, rack with Tray 39502 V for drawer and Wire Tray 39502X, external dimensions (w x d x h): 480 x 250 x 125 mm

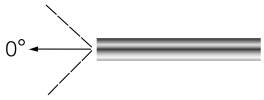
HOPKINS® Telescopes

Diameter 10 mm, length 31 cm

Trocar size 11 mm



26003AA

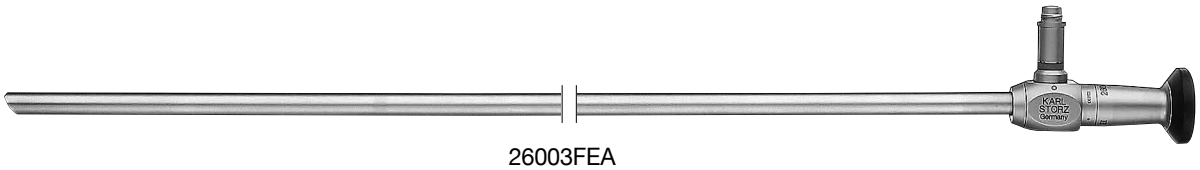


26003AA **HOPKINS® Straight Forward Telescope 0º,**
enlarged view, diameter 10 mm, length 31 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green

Diameter 10 mm, length 42 cm

Trocar size 11 mm
Recommended for use for surgery in the adipose patient

XL

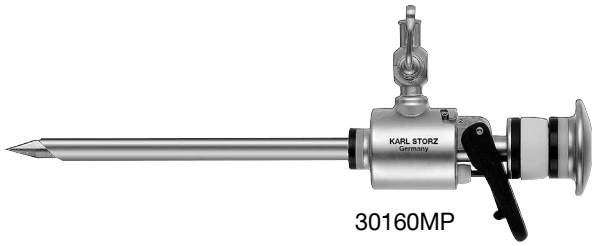


26003FEA

26003FEA **HOPKINS® Telescope 45°,**
enlarged view, diameter 10 mm, length 42 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: black

Trocars and Accessories

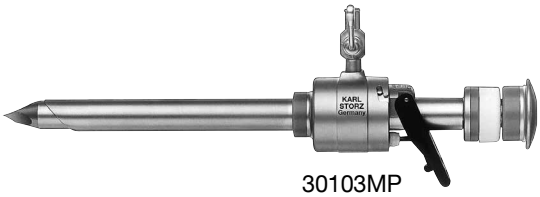
Size 6 mm



30160MP

30160MP **Trocar,** with pyramidal tip,
with insufflation stopcock, size 6 mm,
working length 10.5 cm,
color code: black,
including:
Cannula, without valve
Trocar only
Multifunctional Valve

Size 11 mm



30103MP

30103MP **Trocar,** with pyramidal tip,
with insufflation stopcock, size 11 cm,
working length 10.5 cm,
color code: green,
including::
Cannula, without valve
Trocar only
Multifunctional Valve

30140DB **Reduction Sleeve,** reusable,
instrument diameter 5 mm,
trocar cannula outer diameter 11 mm,
color code: green

30142HB **Double Reducer,**
13/10 mm, 13.5/10 mm, 13/5 mm
and 13.5/5 mm

Grasping Forceps

CLICKLINE – rotating, dismantling, insulated, with connector pin for unipolar coagulation

Size 5 mm

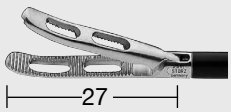
Operating instruments, **length 36 cm,** for use with **trocars size 6 mm**

Operating instruments, **length 43 cm,** for use with telescopes with inbuilt working channel and trocars size 6 mm

Length	Handle
	33152
36 cm	
43 cm	

Single action jaws

Working Insert	Complete Instrument
33310CC	33352CC
33410CC	33452CC



CLICKLINE CROCE-OLMI **Grasping Forceps,** atraumatic, fenestrated, curved

Dissecting and Grasping Forceps

CLICKLINE – rotating, dismantling, insulated, with connector pin for unipolar coagulation

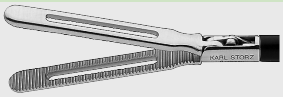
Size 5 mm

Operating instruments, **lengths 36 cm,** for use with **trocars size 6 mm**

Operating instruments, **length 43 cm,** for use with telescopes with inbuilt working channel and trocars size 6 mm

Length	Handle
	33151
36 cm	
43 cm	

Double action jaws

Working Insert	Complete Instrument
33310MD	33351MD
33410MD	33451MD
 16	**CLICKLINE** KELLY **Dissecting and Grasping Forceps**
33410C	33451C
 37	**CLICKLINE Bowel Grasper,** fenestrated
33410R	33451R
 16	**CLICKLINE Dissecting and Grasping Forceps,** right-angled
33410UL	33451UL
 13	**CLICKLINE** REDDICK-OLSEN **Dissecting and Grasping Forceps,** robust

Scissors

**CLICKLINE – rotating, dismantling,
with connector pin for unipolar coagulation**

Size 5 mm

Operating instruments, **length 43 cm,**
for use with telescopes with inbuilt
working channel and **trocars size 6 mm**

Length	Handle
	33151
43 cm	

Double action jaws

Working Insert	Complete Instrument
33410EH	34451EH
 ⊢10⊣	**CLICKLINE Hook Scissors**
33410MS	34451MS
 ⊢—15—⊣	**CLICKLINE** METZENBAUM **Scissors,** curved

Grasping Forceps

**CLICKLINE – rotating, dismantling,
with connector pin for unipolar coagulation**

Size 5 mm

Operating instruments, **length 43 cm,**
for use with **trocars size 6 mm**

Length	Handle
	33122
43 cm	

Double action jaws

Working Insert	Complete Instrument
33410AV	33422AV
	**CLICKLINE Grasping Forceps,** for stapler pressure plates

ROBI® Bipolar Grasping Forceps

rotating, dismantling, with connector pin for bipolar coagulation,
CLERMONT-FERRAND **model**

Size 5 mm

Operating instruments, **length 43 cm,**
for use with telescopes with inbuilt
working channel and **trocars size 6 mm**

Length	Handle
	38151
43 cm	

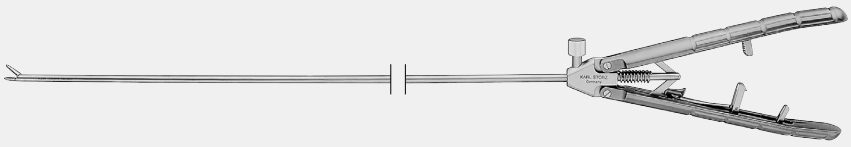
Double action jaws

Working Insert	Complete Instrument
38710MD	38751MD
	**ROBI®** KELLY **Dissecting and Grasping Forceps,** CLERMONT-FERRAND model, suitable for dissection

KOH **Macro Needle Holders**

Size 5 mm

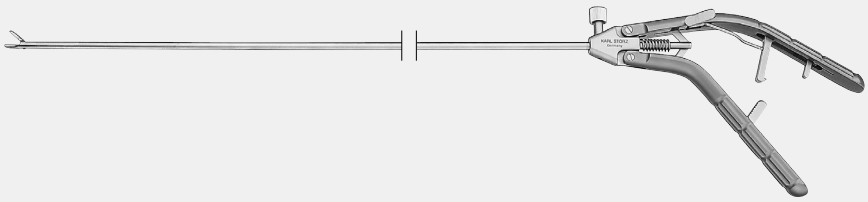
Operating instruments, **length 43 cm,**
for use with **trocars size 6 mm**

Length	Instrument
43 cm	

Distal tip	Instrument	
	26178KAL	KOH **Macro Needle Holder,** with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position right, jaws curved to left
	26178KAR	KOH **Macro Needle Holder,** with tungsten carbide insert, axial handle with disengageable ratchet, ratchet position left, jaws curved to right

Size 5 mm

Operating instruments, **length 43 cm,**
for use with **trocars size 6 mm**

Length	Instrument
43 cm	

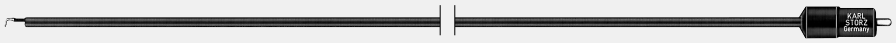
Distal tip	Instrument	
	26178KPL	KOH **Macro Needle Holder,** with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position left, jaws curved to left
	26178KPR	KOH **Macro Needle Holder,** with tungsten carbide insert, pistol handle with disengageable ratchet, ratchet position right, jaws curved to right

Coagulation and Dissection Electrodes

without suction channel, insulated sheath,with connector pin for unipolar coagulation

Size 5 mm

Operating instruments, **length 43 cm,**
for use with telescopes with inbuilt
working channel and **trocars size 6 mm**

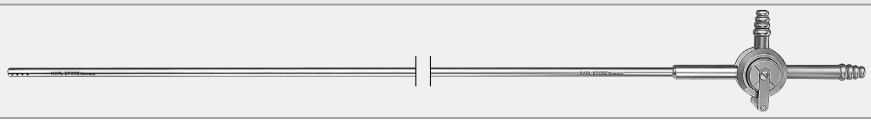
Length	Instrument
43 cm	

Distal Tip	Instrument	
	26778UF	**Coagulation and Dissection Electrode,** L-shaped
	26778UE	**Coagulation and Dissection Electrode,** spatula-shaped, blunt

Suction and Irrigation Tube

Size 5 mm

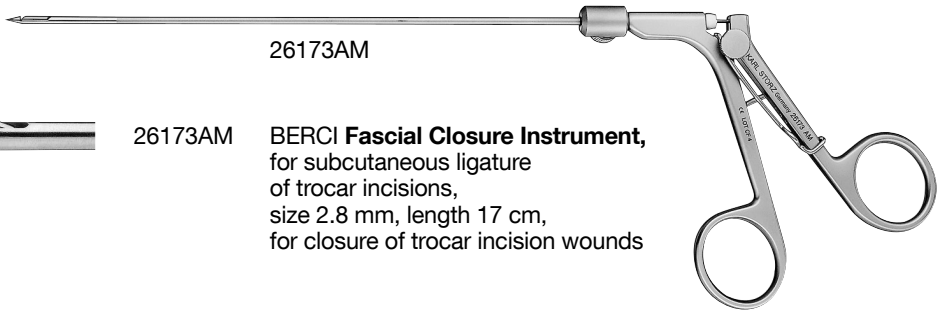
Operating instruments, **length 43 cm,**
for use with telescopes with inbuilt
working channel and **trocars size 6 mm**

Length	Instrument
43 cm	

Distal End	Instrument	
	26174BN	**Suction and Irrigation Tube,** anti-reflex surface, with lateral holes, with two-way stopcock for single-hand control

BERCI **Fascial Closure Instrument**

for subcutaneous fascial closure



26173AM

26173AM BERCI **Fascial Closure Instrument,** for subcutaneous ligature of trocar incisions, size 2.8 mm, length 17 cm, for closure of trocar incision wounds

Palpation Probe

Size 5 mm

Operating instruments, **length 43,** for use with laparoscopes with inbuilt working channel and **trocars size 6 mm**

26178T

26175T **Palpation Probe,** with cm-markings, size 5 mm, length 43 cm

Accessories

Unipolar and Bipolar High Frequency Cords

unipolar

Unipolar High Frequency Cords

26002M **Unipolar High Frequency Cord,** with 4 mm plug, length 300 cm, for models KARL STORZ, Erbe type T, older models and Ellman

bipolar

Bipolar High Frequency Cords

26176LV **Bipolar High Frequency Cord,** length 300 cm, for AUTOCON® II 400 SCB system (112, 114, 116, 122, 125), AUTOCON® II 200, AUTOCON® II 80 and Valleylab coagulators

Mobile Equipment Cart

Monitor:

9627NB	**27" FULL HD Monitor**

Camera System:

TC200DE	**IMAGE1 S CONNECT**, connect module
TC300	**IMAGE1 S H3-LINK**, link module
TH100	**IMAGE1 S H3-Z** **Three-Chip FULL HD Camera Head**

Light Source:

20133101-1	**XENON 300 SCB Cold Light Fountain**
495 NCSC	**Fiber Optic Light Cable**

HF-Device:

20535201-125	**AUTOCON® II 400**
20017830	**Two-Pedal Footswitch**

Insufflation:

UI400S1	**ENDOFLATOR® 40**
UP501S3	**S-PILOT™**

Pump System:

26331101-1	HAMOU® **ENDOMAT®**

Equipment Cart:

UG120	**COR™ Equipment Cart,** narrow, high
UG500	**Monitor Holder**
UG609	**Bottle Holder,** for CO_2-Bottles
29005DFH	**Foot-Pedal Holder,** for Two- and Three-Pedal Footswitches
UG310	**Isolation Transformer,** 200 V – 240 V
UG410	**Earth Leakage Monitor,** 200 V – 240 V

IMAGE1 S Camera System

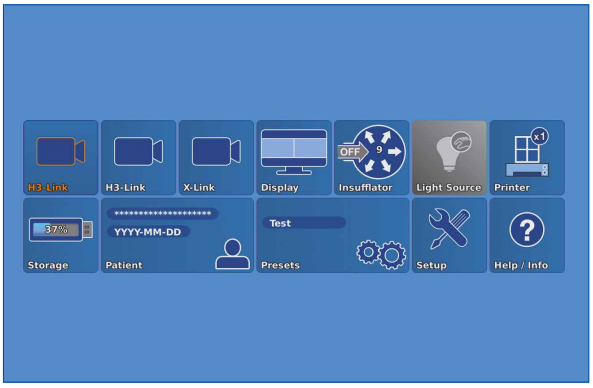
IMAGE1 S

Economical and future-proof

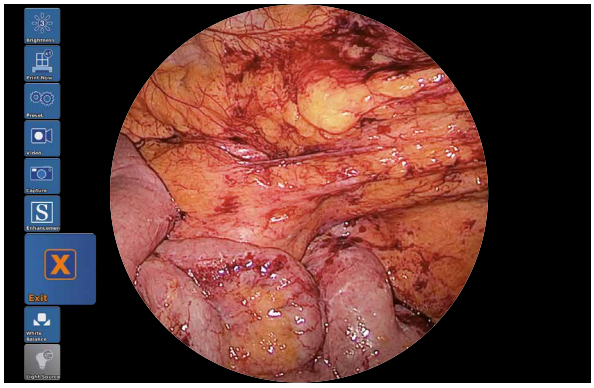
- Modular concept for flexible, rigid and 3D endoscopy as well as new technologies
- Forward and backward compatibility with video endoscopes and FULL HD camera heads
- Sustainable investment
- Compatible with all light sources

Innovative Design

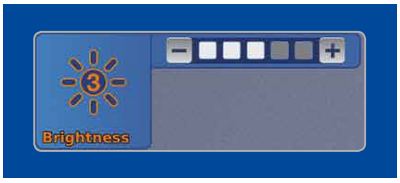
- Dashboard: Complete overview with intuitive menu guidance
- Live menu: User-friendly and customizable
- Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted
- Automatic light source control
- Side-by-side view: Parallel display of standard image and the Visualization mode
- Multiple source control: IMAGE1 S allows the simultaneous display, processing and documentation of image information from two connected image sources, e.g., for hybrid operations



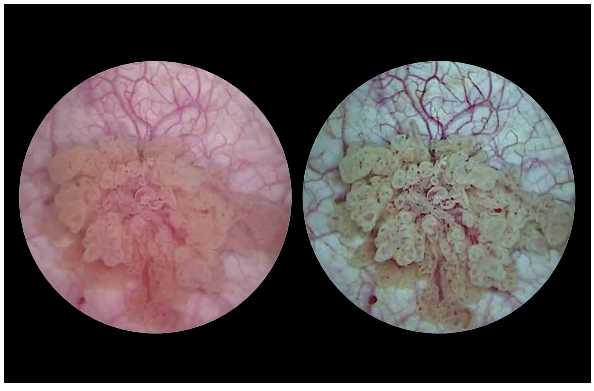
Dashboard



Live menu



Intelligent icons



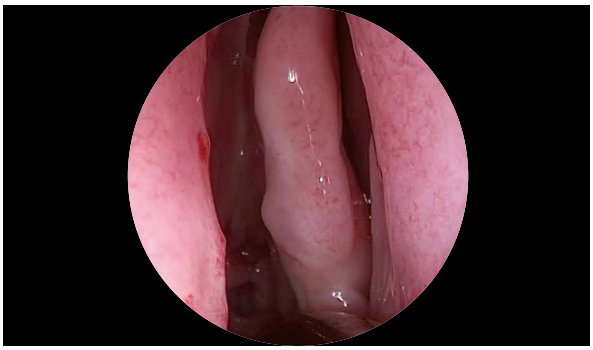
Side-by-side view: Parallel display of standard image and Visualization mode

IMAGE1 S Camera System

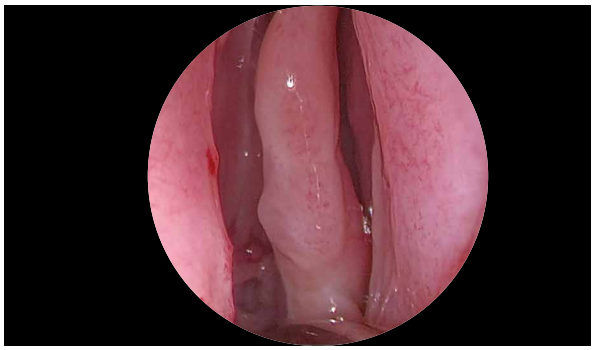
IMAGE1 S

Videoendoscopic Imaging

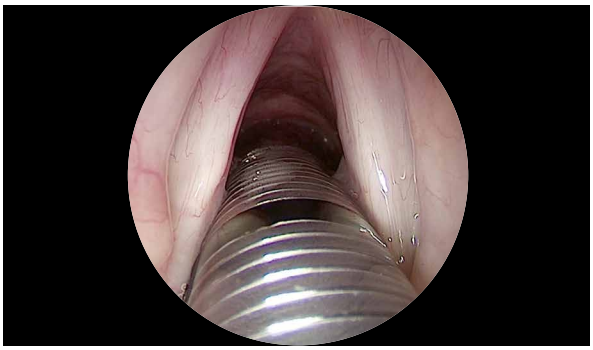
- **Very high quality of endoscopic images in FULL HD**
- **Natural color rendition**
- **Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting**



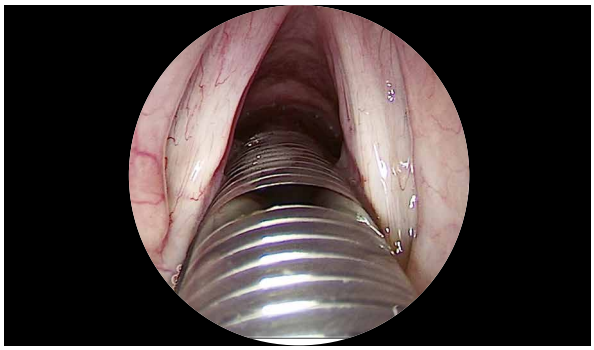
FULL HD image



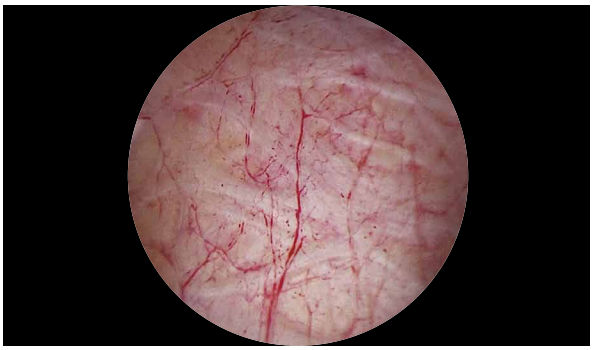
CLARA



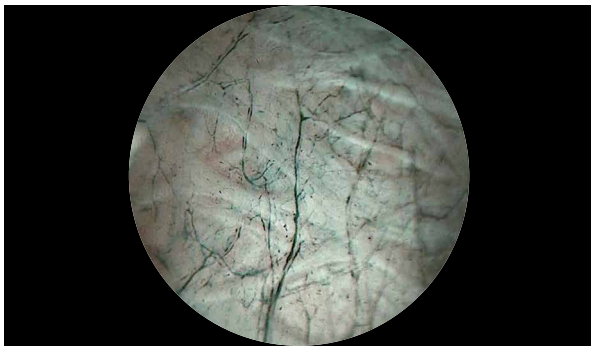
FULL HD image



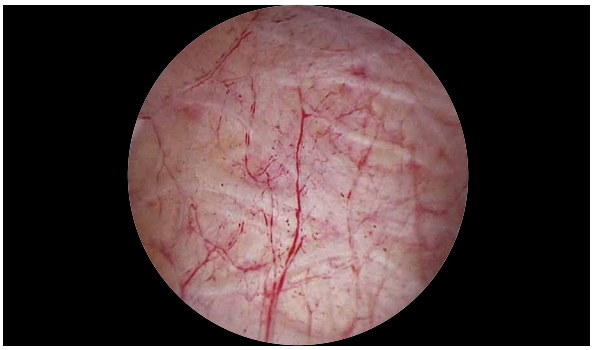
CHROMA



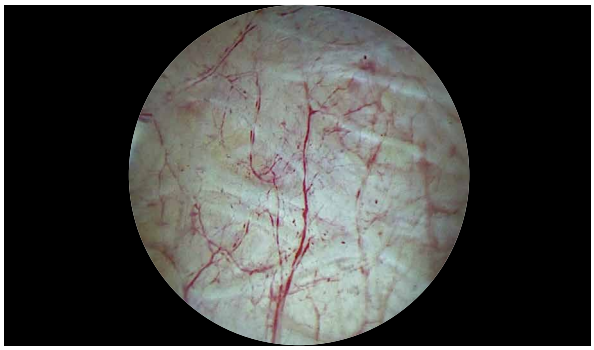
FULL HD image



*SPECTRA A**



FULL HD image



*SPECTRA B***

* *SPECTRA A:* **Not for sale in the U.S.**
** *SPECTRA B:* **Not for sale in the U.S.**

IMAGE1 S Camera System

TC200EN

TC200EN* **IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:
Mains Cord, length 300 cm
DVI-D Connecting Cable, length 300 cm
SCB Connecting Cable, length 100 cm
USB Flash Drive, 32 GB, USB silicone keyboard, with touchpad, US
***Available in the following languages:** DE, ES, FR, IT, PT, RU

Specifications:

HD video outputs	- 2x DVI-D - 1x 3G-SDI
Format signal outputs	1920 x 1080p, 50/60 Hz
LINK video inputs	3x
USB interface SCB interface	4x USB, (2x front, 2x rear) 2x 6-pin mini-DIN

Power supply	100–120 VAC/200–240 VAC
Power frequency	50/60 Hz
Protection class	I, CF-Defib
Dimensions w x h x d	305 x 54 x 320 mm
Weight	2.1 kg

For use with IMAGE1 S
IMAGE1 S CONNECT Module TC200EN

TC300

TC300 **IMAGE1 S H3-LINK,** link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, **for use with IMAGE1 S CONNECT TC 200EN** including:
Mains Cord, length 300 cm
Link Cable, length 20 cm

Specifications:

Camera System	**TC300 (H3-Link)**
Supported camera heads/video endoscopes	TH100, TH101, TH102, TH103, TH104, TH106 (fully compatible with IMAGE1 S) 22220055-3, 22220056-3, 22220053-3, 22220060-3, 22220061-3, 22220054-3, 22220085-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)
LINK video outputs	1x
Power supply	100–120 VAC/200–240 VAC
Power frequency	50/60 Hz
Protection class	I, CF-Defib
Dimensions w x h x d	305 x 54 x 320 mm
Weight	1.86 kg

* *SPECTRA A:* **Not for sale in the U.S.**
** *SPECTRA B:* **Not for sale in the U.S.**

IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC200EN, IMAGE1 S H3-LINK Module TC300
and with all IMAGE1 HUB™ HD Camera Control Units

TH100

TH100 **IMAGE1 S H3-Z Three-Chip FULL HD Camera Head,** 50/60 Hz, IMAGE1 S compatible, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

Specifications:

IMAGE1 FULL HD Camera Heads	IMAGE1 S H3-Z
Product no.	TH100
Image sensor	3x ⅓" CCD chip
Dimensions w x h x d	39 x 49 x 114 mm
Weight	270 g
Optical interface	integrated Parfocal Zoom Lens, f = 15–31 mm (2x)
Min. sensitivity	F 1.4/1.17 Lux
Grip mechanism	standard eyepiece adaptor
Cable	non-detachable
Cable length	300 cm

TH104

TH104 **IMAGE1 S H3-ZA Three-Chip FULL HD Camera Head,** 50/60 Hz, IMAGE1 S compatible, **autoclavable,** progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length f = 15–31 mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

Specifications:

IMAGE1 FULL HD Camera Heads	IMAGE1 S H3-ZA
Product no.	TH104
Image sensor	3x ⅓" CCD chip
Dimensions w x h x d	39 x 49 x 100 mm
Weight	299 g
Optical interface	integrated Parfocal Zoom Lens, f = 15–31 mm (2x)
Min. sensitivity	F 1.4/1.17 Lux
Grip mechanism	standard eyepiece adaptor
Cable	non-detachable
Cable length	300 cm

Monitors

9619NB

9619NB **19" HD Monitor,**
color systems **PAL/NTSC,** max. screen resolution 1280 x 1024, image format 4:3, power supply 100–240 VAC, 50/60 Hz, wall-mounted with VESA 100 adaption,
including:
External 24 VDC Power Supply
Mains Cord

9826NB

9826NB **26" FULL HD Monitor,**
wall-mounted with VESA 100 adaption,
color systems **PAL/NTSC,**
max. screen resolution 1920 x 1080,
image fomat 16:9,
power supply 100–240 VAC, 50/60 Hz
including:
External 24 VDC Power Supply
Mains Cord

Monitors

KARL STORZ HD and FULL HD Monitors	19"	26"
Wall-mounted with VESA 100 adaption	9619NB	9826NB
Inputs:		
DVI-D	●	●
Fibre Optic		
3G-SDI		●
RGBS (VGA)	●	●
S-Video	●	●
Composite/FBAS	●	●
Outputs:		
DVI-D	●	●
S-Video	●	
Composite/FBAS	●	●
RGBS (VGA)	●	
3G-SDI		●
Signal Format Display:		
4:3	●	●
5:4	●	●
16:9	●	●
Picture-in-Picture	●	●
PAL/NTSC compatible	●	●

Optional accessories:

9826SF **Pedestal,** for monitor 9826NB
9626SF **Pedestal,** for monitor 9619NB

Specifications:

KARL STORZ HD and FULL HD Monitors	19"	26"
Desktop with pedestal	optional	optional
Product no.	9619NB	9826NB
Brightness	200 cd/m² (typ)	500 cd/m² (typ)
Max. viewing angle	178° vertical	178° vertical
Pixel distance	0.29 mm	0.3 mm
Reaction time	5 ms	8 ms
Contrast ratio	700:1	1400:1
Mount	100 mm VESA	100 mm VESA
Weight	7.6 kg	7.7 kg
Rated power	28 W	72 W
Operating conditions	0–40°C	5–35°C
Storage	-20–60°C	-20–60°C
Rel. humidity	max. 85%	max. 85%
Dimensions w x h x d	469.5 x 416 x 75.5 mm	643 x 396 x 87 mm
Power supply	100–240 VAC	100–240 VAC
Certified to	EN 60601-1, protection class IPX0	EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2

Notes

Notes