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Chapter 25

Surgery for obesity

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Introduction

Obesity is epidemic worldwide and a serious threat to health. It is a paradox that obesity increases with national wealth but decreases with personal wealth and social standing. The dilemma is magnified by mass media that advertise high calorie, high fat foods while portraying the ideal human shape as thin and fit. The result is an obsession with dieting which feeds an enormous weight-loss industry. The desperation of the obese for thinness leads to extreme measures. Surgery for obesity is one of the most drastic. The risks of operation are significant but the benefits to mental and physical health and appearance can be dramatic. This field has evolved over 30 years but is changing quickly as laparoscopic procedures are adapted to very obese patients. Treatment alternatives for this group are limited but will appear as research on hunger and appetite progresses and new drugs and diets become available.

Definition and prevalence

Obesity is usually defined as weight more than 20 per cent above ideal. Body mass index (**BMI**) is commonly used to express degrees of obesity and is calculated as weight in kilograms divided by height in meters squared ($wt \text{ in kg}/(ht \text{ in m})^2$). Normal values are 20 to 25. A 70-kg man with a height of 175 cm would have a body mass index of 23. A body mass index of 25 to 30 represents preobesity, 30 to 35 is mild or class I obesity, 35 to 40 is moderate or class II obesity, and greater than 40 is class III or morbid obesity. A separate category of extreme or superobesity with a body mass index greater than 50 is sometimes recognized. Candidates for the surgical treatment of obesity usually have a body mass index greater than 40 and a weight more than 45 kg above ideal.

Recent data from the United States showed a stable population of adult citizens with preobesity at about 32 per cent but a large increase in obesity ($BMI > 30$) from 14.5 to 22.5 per cent between the surveys of 1976–1980 and 1988–1994. The prevalence of severe or class III obesity ($BMI > 40$) has been difficult to determine because such patients may be socially isolated and unwilling to respond to surveys. In some minority groups such as American black women the prevalence may exceed 10 per cent in the fourth and fifth decades. The prevalence is increasing most in those with the least education.

Cause

Both environmental and genetic causes contribute to obesity. The simple explanation is

that energy intake exceeds expenditure, but the control system is complex and still incompletely understood. Modern high-fat fast foods combined with limited exercise and excessive television viewing are significant environmental factors. Obesity runs in families, which may show a reduced rate of energy expenditure in comparison with thinner subjects. Studies on twins show a strong genetic component to the BMI of adults, but weight changes with time are strongly influenced by the environment. There are no characteristic emotional changes in obesity. Depression seems more the result than the cause of obesity.

Significance

The health and cost implications of obesity are significant. Severe obesity increases the mortality rate of men and women, especially from cardiovascular disease. Other cardiovascular problems include hypertension, thrombophlebitis, and venous stasis ulcers. Obstructive sleep apnoea and obesity hypoventilation syndrome are severe complications of obesity which can lead to significant disability, sudden death, and motor vehicle accidents. Arthritis in weight-bearing joints limits exercise and mobility in the obese. Obesity is a major and treatable cause of type II diabetes mellitus. Hyperlipidaemia is common in the obese and contributes to the risk of vascular disease. Abnormal liver function and cholelithiasis are common complications of obesity. Increased intra-abdominal pressure contributes to reflux oesophagitis, stress incontinence, and benign intracranial hypertension. Depression may contribute to abnormal eating and obesity, but often results from obesity. Central or truncal obesity increases the risk of diabetes, cardiovascular disease, and early death. Table 1 summarizes the complications of obesity.

General	Fatigue, shortness of breath, poor mobility Intertrigo, social isolation, inability to obtain work, buy clothes, use standard chairs
Cardiovascular	Hypertension, stroke, coronary artery disease Thrombophlebitis, venous stasis ulcers, pulmonary embolism
Pulmonary	Obstructive sleep apnea Obesity hypoventilation syndrome
Endocrine	Type II diabetes mellitus, hyperlipidemia
Obstetrics and gynecology	Irregular periods, infertility Endometrial carcinoma
Hepatobiliary	Fatty liver, abnormal liver enzymes, cholelithiasis
Gastrointestinal	Reflux esophagitis
Urinary	Stress incontinence
Central nervous system, psychology	Depression, benign intracranial hypertension
Musculoskeletal	Back pain, arthritis of knees and hips, gout

Table 1 Complications of severe obesity

The annual health and dieting costs of obesity may be as high as \$100 000 000 000 per

year in the United States. European data suggest that obesity contributes between 2 and 7 per cent of total health care costs. Quality of life is impaired in the severely obese. Prejudice among the general public and health care workers is severe. The obese have low social standing, are often unemployed or do menial work, and are often disabled. Even minimal exertion may be difficult. Clothing is difficult to find. Normal furniture and seats on public transportation may be too small.

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Abdominal compartment syndrome

Acute increases in abdominal pressure have recently been recognized in patients subject to trauma or recent surgery and can impair renal, cardiac, and respiratory function. Sugerman and colleagues have described a chronic increase in abdominal pressure as measured by bladder catheter which correlates with poor ventilation, gastro-esophageal reflux, venous stasis, stress incontinence, and a high risk of postoperative incisional hernias. These conditions are relieved or prevented by significant weight loss and decrease in abdominal pressure. Benign intracranial hypertension may have the same cause and cure in the morbidly obese.

Alternatives to operation

An astonishing range of methods have been used in an attempt to lose weight but there is virtually no long-term success. Behavior modification has been popular but of limited success. Fad diets and commercial plans have become a major industry but late success is rare. Appetite suppressants such as amphetamines and thyroxine were abandoned years ago. Fenfluramine and dexfenfluramine looked promising but were associated with a risk of rare but devastating primary pulmonary hypertension and a higher risk of cardiac valvular defects. Both have been taken off the market. New appetite suppressants and fat substitutes have been introduced but safety and long-term effectiveness are still to be established.

Patient selection

Patient demand for obesity surgery and weight loss is high because non-operative methods are ineffective. The problem is to select the patients who will benefit most, lose the most weight, and do so safely. Selection criteria are summarized in Table 2. Selection and follow-up should be carried out by a team including surgeon, internist, dietitian, and psychologist or psychiatrist. Assessment by a social worker, physiotherapist, nurse, or anaesthetist may be needed on occasion. Figure 1 shows the usual assessment process. Some studies show no significant psychological changes in morbidly obese people while others show an increase in mood disorders and depression, anxiety, bulimia, and tobacco dependence. Psychological criteria for patient selection are not well defined. Poor patient motivation demonstrated by skipped appointments or failure to change lifestyle suggest an unsuitable patient. In my experience teenagers do not have the discipline to follow postoperative diets. Patients as old as 65 years may occasionally be candidates when faced with a wheelchair or institution because of severe arthritis.



Fig. 1. Decision process for severely obese patients.



<p>Weight > 45kg above ideal Body mass index > 40 Dieting attempts made Age 18 to 50 Emotionally stable and co-operative Healthy enough for major operation Complications of obesity:</p>	<p>Sleep apnea, type II diabetes mellitus, hypertension, reflux esophagitis, stress incontinence, infertility, osteoarthritis</p>
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Table 2 Criteria for patient selection

The selection process also applies to the bariatric surgeon and centre. An experienced surgeon working as part of a team is required. Most operations are uncomplicated but facilities to handle major problems in high-risk patients are needed. Intubation may be difficult and respiratory support may be needed, especially in patients with sleep apnoea. Because of the potential for late nutritional problems and bone disease, a commitment to long-term follow-up is essential.

Surgery

Table 3 outlines many of the surgical methods used to achieve weight loss. Only the more common procedures will be reviewed. Operations such as jejunioileal bypass cause weight loss by malabsorption and bypass of most of the small bowel. Gastroplasty is classed as a restrictive procedure since it reduces intake by reduction in gastric capacity. Gastric bypass causes both malabsorption and restriction. Gastroplasty is safe and quick with moderate chance of poor weight loss and obstruction. Gastric bypass is a more difficult and dangerous operation with a low rate of failure but potential for dumping and late nutritional problems.

Operation	Year began	Advantages	Disadvantages	Present status
Jejunioileal bypass	1954	Good weight loss	Diarrhea, liver failure, renal stones	Rarely used
Jejunocolic bypass	1963	Dramatic weight loss	Uncontrolled diarrhea, liver failure	Dangerous—not used
Gastric bypass	1966 Mason	Excellent weight loss with small pouch	Iron and B ₁₂ deficiency, dumping, metabolic bone disease	Widely used
Inte wiring	1973	Simple and safe	Inability to vomit, weight regain when wires re-narrowed	Rarely used
Gastric banding	1976	Simple	Variable weight loss, mesh erosion, poor pouch emptying	Silastic adjustable band still used
Biliojejunostomy diversion	1979 Scopinaro	Best long-term weight loss	Complex operation, protein malnutrition, stomal ulcer, metabolic bone disease	Still procedure of choice in a few centres
Gastric balloon	1979	Simple	Balloon migration or deflation, not effective	Not used
Horizontal gastroplasty	1979	Simple, good early weight loss	Weight regain in most patients, stoma obstruction	Not used
Vertical banded gastroplasty	1980 Mason	Simple, good weight loss with small pouch, normal food absorption	Less weight loss than gastric bypass, weight regain, encourages high-calorie soft foods	Widely used
Laparoscopic gastric banding	1992	Quick patient recovery	Difficult operation, especially in superobese	Increasing, evaluation continues
Laparoscopic gastroplasty and gastric bypass	1994	Quick recovery	Technically difficult, same problems as open procedures	Still being developed

Table 3 Operations for obesity

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Preparation for operation

Selection of motivated patients and careful explanation of the risks and benefits of operation assist in patient preparation. Preoperative meetings with other gastroplasty patients helps to ease fears. The dietitian should review postoperative meals. Smoking should stop at least 6 weeks preoperatively to decrease pulmonary complications. Preoperative consultation with internal medicine can help in the assessment and management of problems like hypertension, cardiovascular disease, sleep apnoea, and diabetes. Even very obese patients can be admitted on the day of operation. Subcutaneous heparin and prophylactic antibiotics are started preoperatively.

Operation

An experienced anesthetist is needed because intubation may be difficult in a massive patient with thick neck. Measures to prevent aspiration are necessary in patients with high abdominal pressure, large residual gastric volume, and low pH. Ventilation and exposure are assisted by elevation of the head of the bed and by mechanical retractors. Careful closure of the abdominal wall is important. The thick layer of fat and high intra-abdominal pressure contributes to an increased risk of wound infection, disruption, and incisional hernia formation. Arterial lines are rarely needed but may help monitor blood pressure when a massive arm makes values inaccurate. To

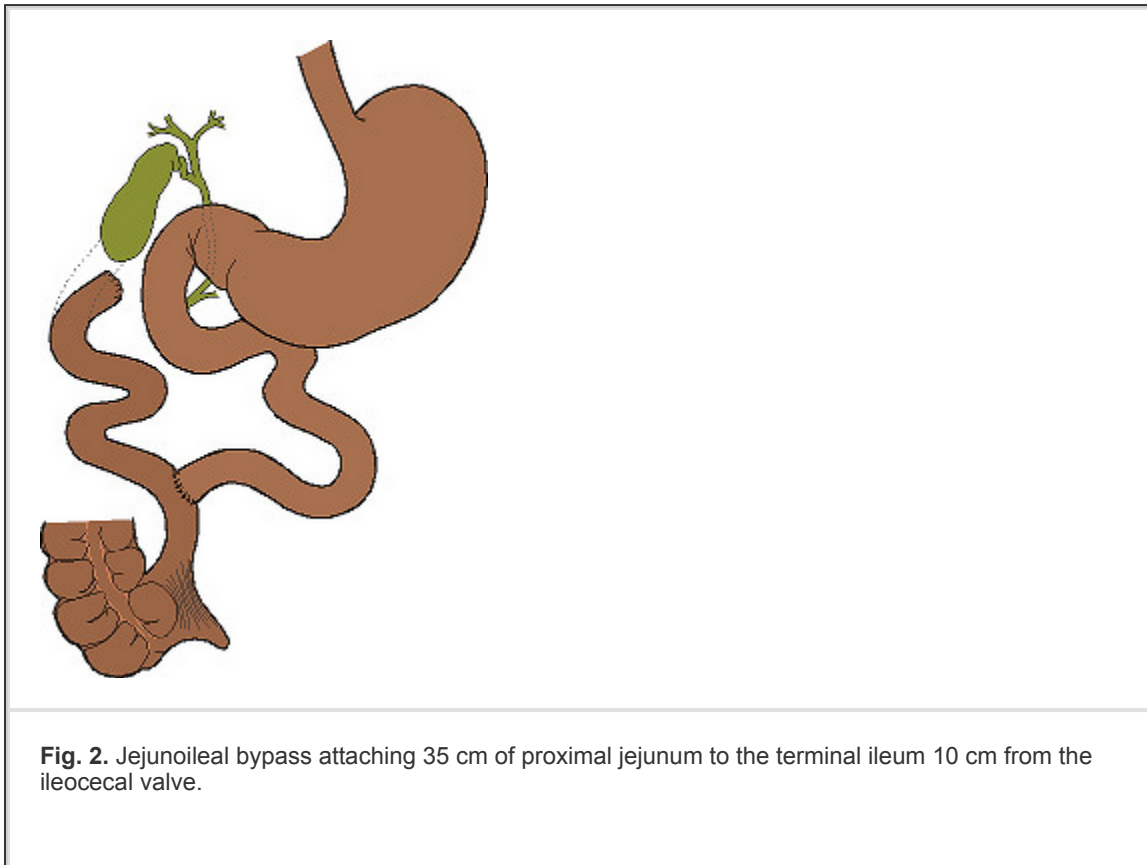
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encourage early ambulation we avoid urinary catheters and use an orthopaedic frame with trapeze handle. Nasogastric tubes are used for 24 h or avoided entirely. A large supportive dressing or external support encourages early ambulation.

Jejunioileal bypass

This operation was first performed in the early 1960s and was very popular in the 1970s. In the most common procedure 35 cm of proximal jejunum was anastomosed to the side of the terminal ileum 10 cm from the ileocecal valve (Fig. 2). Another procedure used a similar end-to-end anastomosis. The bypassed intestine was not removed but was anastomosed to the transverse or sigmoid colon and, more recently, the stomach. Theoretically, this technique alters flora in the bypassed bowel and decreases postoperative problems like diarrhea and liver failure. Weight loss with these procedures was good and sustained, but diarrhea and flatulence were severe with significant loss of potassium and aggravation of hemorrhoids. Fat malabsorption contributed to hypocalcemia and oxaluria with renal stones. Severe liver failure causing death or requiring liver transplantation occurred in some patients. Normal eating was tolerated although large meals increased diarrhea. Only a few centres still perform this procedure with gastric drainage of the bypassed intestine. Parenteral nutrition may be needed prior to intestinal reconstitution. Rapid weight gain may

result so gastroplasty may be considered for the patient who does not have liver disease.



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Gastric bypass

Mason, working at the University of Iowa, developed the gastric operations for obesity. He observed that patients who had a Billroth II gastrectomy for management of peptic ulcerations often lost weight. He designed and meticulously documented a series of gastric bypass and gastroplasty operations that gave rise to modern procedures. Although he has favoured the vertical banded gastroplasty since the early 1980s, he and Ito reported the first gastric bypass operations in 1966.

Randomized trials have shown that gastric bypass gives better weight loss than gastroplasty but at the expense of more early technical problems and late iron and vitamin B₁₂ deficiency and osteoporosis. A small upper gastric pouch is drained by gastrojejunostomy. In early years the stomach was divided and sutured, while in recent years staplers have been used to separate upper and lower stomach. Upper pouches may be horizontal (Fig. 3) or vertical (Fig. 4), separated (Fig. 4) or in continuity (Fig. 3), drained by loop or Roux-en-Y gastrojejunostomy with antecolic or retrocolic and antegastric or retrogastric anastomosis. The pouch is constructed small (< 30 ml) and may be surrounded by a band (Fig. 4) to limit dilatation. The vertical lesser curve pouch allows excellent blood supply and drainage and a short retrocolic and retrogastric route for anastomosis, but revision may be difficult if problems occur. Weight loss is excellent with these procedures

and sustained.

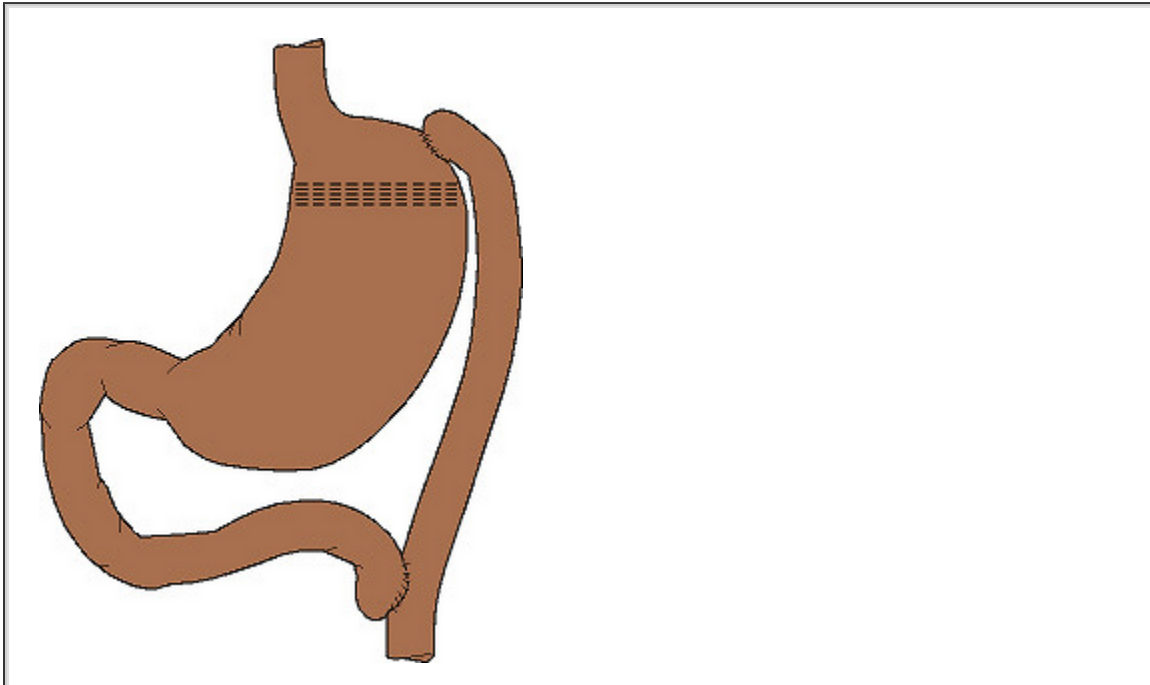


Fig. 3. Horizontal gastric bypass in which the proximal stomach is drained by a 45- to 75-cm Roux-en-Y limb of jejunum.

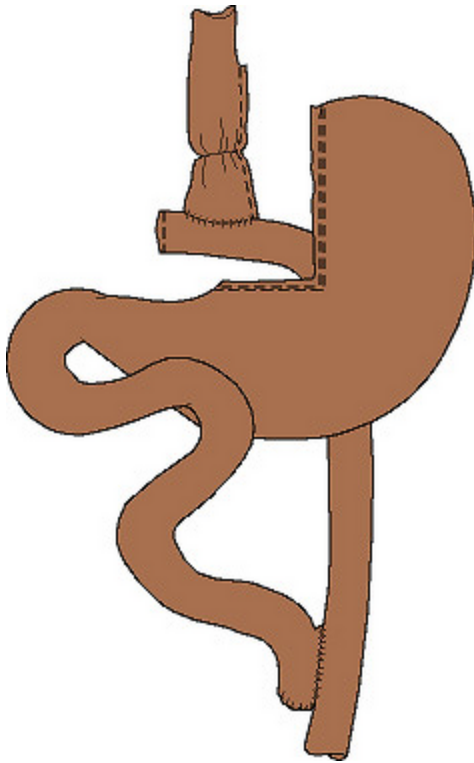


Fig. 4. Vertical gastric bypass with complete separation of the gastric pouch. A Silastic ring may be used to limit pouch dilatation.

Dumping will inhibit sugar intake for obese patients who like sweet foods. Stomal ulcers have been rare with a small pouch. Assessment of the distal stomach is difficult if abdominal pain is undiagnosed. Acute dilatation of the lower pouch postoperatively is fortunately rare because diagnosis is difficult. Severe nausea, tachycardia, elevated liver enzymes and amylase suggest this diagnosis. Gastric air–fluid level is absent so ultrasound or early operation may be needed and lifesaving. Small bowel obstruction may produce unusual symptoms.

Gastroplasty

Eating is restricted by a small proximal gastric pouch but there is no alteration of digestion or absorption. In the early 1980s horizontal staple lines were favoured. Early weight loss was good but weight regain was common due to staple line disruption or stoma dilatation. The modern operations followed the vertical banded gastroplasty of Mason (Fig. 5). Silastic ring gastroplasty is similar but does not

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require removal of any gastric tissue. Mason has achieved good early and late results by careful techniques using a very small and carefully measured pouch with a 5-cm ring of Marlex. He favours the procedure because it is simple, quick and safe, gives good weight

loss, and allows easy inspection of the pouch, stoma, and distal stomach by endoscopy or barium studies. In comparison with patients who have had a gastric bypass, vitamin B₁₂ and iron deficiency and osteoporosis are rare.

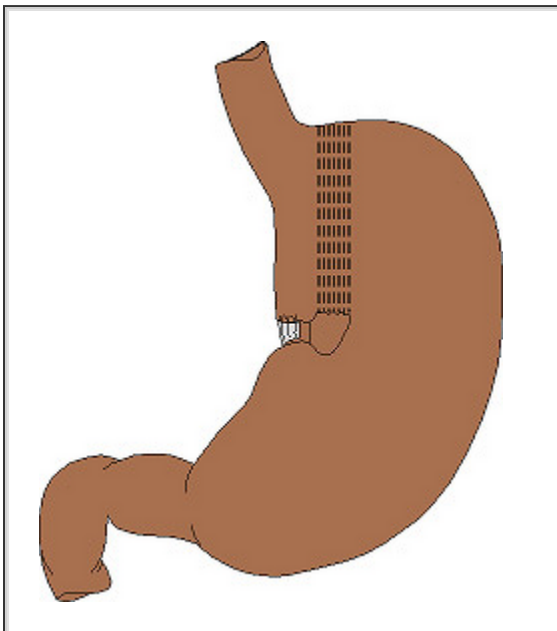


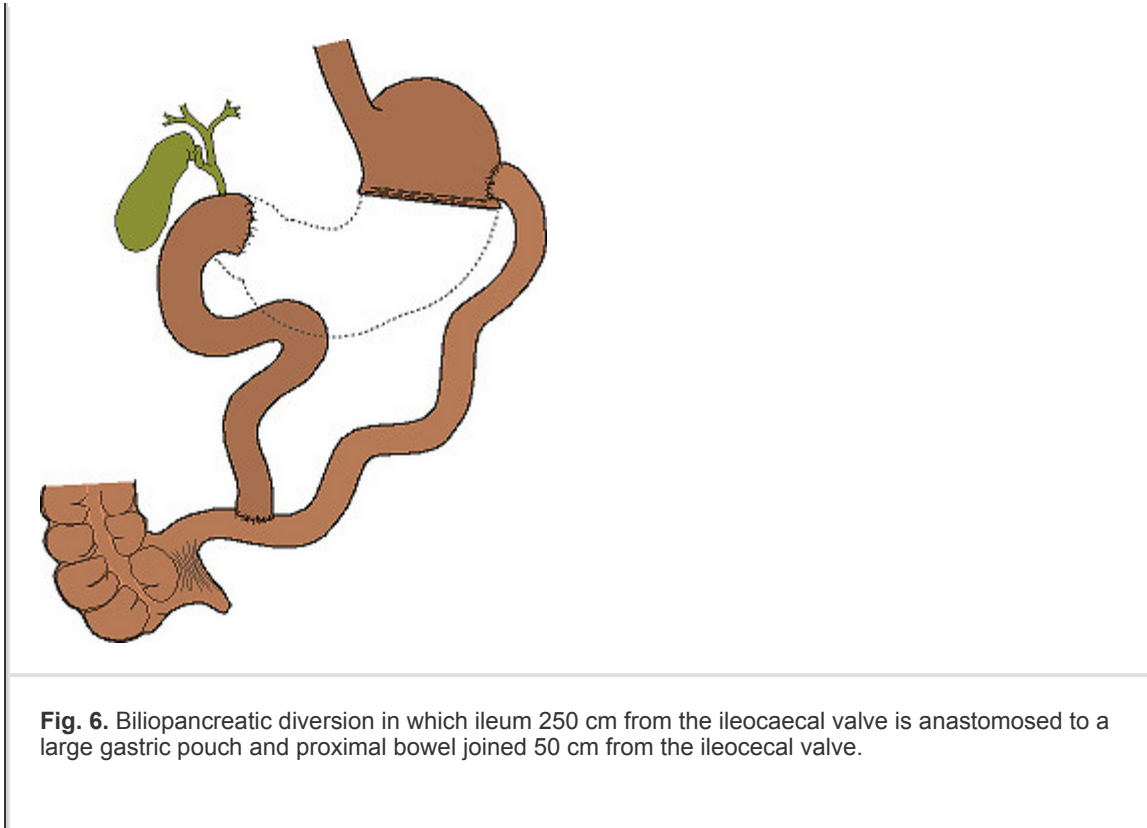
Fig. 5. Vertical banded gastroplasty of Mason.

Other surgeons have had difficulty duplicating his results. Failure to follow his exact technique may explain some of the differences. Staple line disruptions have been common and a cause of late failure. The small rigid stoma does inhibit ingestion of meat, raw fruit and vegetables, and encourages a 'soft calorie' syndrome. Ice cream, soft drinks, and potato chips are readily tolerated and may contribute to late weight gain.

Biliopancreatic diversion

Scopinaro is another of the pioneers of obesity surgery. After a series of dog experiments he developed an operation with some superficial resemblance to the gastric bypass. However, there are significant differences. The proximal gastric pouch is large (200 to 500 ml) and adjusted to patient size. The gastroenteric anastomosis allows ingestion of regular food. The distal stomach is removed. The small bowel is divided 250 cm from the ileocecal valve and a gastroileostomy performed. Bile and pancreatic juice are diverted into the terminal ileum 50 cm from the ileocecal valve (Fig. 6).





Scopinaro has described a series of 1610 patients of whom 916 had the above operation between 1984 and 1991. Average weight loss was 70 per cent of excess weight (weight above ideal) after 2 years and this was maintained for 12 years. Operative mortality of 7 patients (0.8 per cent) is higher than for other operations. However, weight loss is better than that achieved with any other procedure and complications of obesity are reversed. Poor fat absorption contributes to frequent bowel movements and flatulence. Fat-soluble vitamins are poorly absorbed. Calcium deficiency and osteoporosis may occur. In a few patients significant protein-calorie malnutrition develops.

Recent modification preserving the duodenum as a switch and lengthening the common limb may maintain weight loss and decrease complications. The magnitude of this operation combined with the complications have frightened most surgeons. In the hands of Scopinaro and a few North American surgeons excellent long-term weight loss has been achieved.

Gastric banding

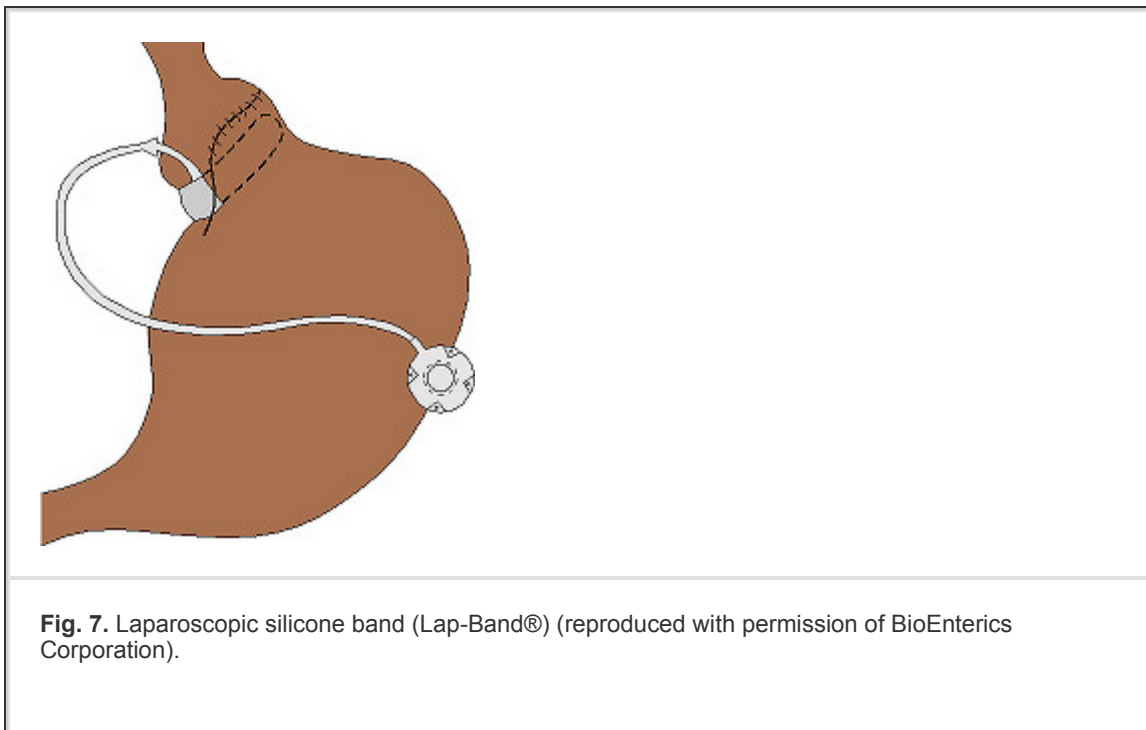
Application of a prosthetic band to the proximal stomach is a simple procedure in comparison with other operations. Early Marlex or Dacron bands gave variable weight loss with frequent stoma obstruction, mesh erosion, or poor emptying of the gastric pouch. Kuzmak developed a more effective silicone band. In 1986 he started to use an adjustable silicone band with subcutaneous chamber. Weight loss of 43 kg (32 per cent) after 4 years has been achieved with few complications. Band removal is easy in the event of late problems. Laparoscopic gastric banding is the direct result of this procedure.

Laparoscopic procedures

Laparoscopic surgery has developed quickly. Adjustable gastric banding has been the easiest operation to adapt to laparoscopy. The band is placed very high on the stomach (Fig. 7) and a small, measured gastric pouch is created. The band is sutured in position to prevent it from slipping. Vertical banded gastroplasty and gastric bypass have been carried out by laparoscopy. The operations are difficult and still in the development stages. Small series are now being reported with good safety and satisfactory weight loss. The procedure is most easily learned by surgeons who carry out laparoscopic hiatus hernia repair. Surgeons or physicians familiar with the selection and follow-up standards for obesity surgery must be involved. These procedures

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may be difficult or impossible in very obese patients with a body mass index greater than 50.



Complications

Mortality should be less than 0.5 per cent for these operations. Large series with no postoperative deaths have been reported. The most common causes of death are leak with sepsis and pulmonary embolism. Leak can occur from a staple line or anastomosis, beneath a prosthetic band, or from distended or ischaemic gastric pouches. Severe abdominal or left shoulder pain raise concern. Clinical examination of severely obese patients is difficult so postoperative fever and tachycardia are important signs. Abdominal ultrasound, CT scan, and soluble contrast studies may be needed but are difficult in the morbidly obese. Obstruction or leak in the distal gastric pouch after gastric bypass is particularly difficult to identify. Reoperation may be lifesaving. Pulmonary embolism may be

minimized by same day admission, subcutaneous heparin, compression stockings, and early ambulation.

Wound infection has been rare with prophylactic antibiotics, short hospital stays, and quick operations. Incisional hernias are common and may be related to high intra-abdominal pressures. Pulmonary complications decrease if smoking stops 6 weeks preoperatively.

Patients who see the surgeon and dietitian regularly have better weight loss and weight maintenance. Thiamine deficiency and Wernicke's encephalopathy may develop quickly in patients with persistent vomiting. Late vitamin B₁₂ and iron deficiency are common after gastric bypass. Folate replacement is especially important in women who may become pregnant. Dietary instruction and reduced sugar intake may prevent the dumping syndrome, especially after gastric bypass. Gallstone formation is common during rapid weight loss. Some surgeons perform prophylactic cholecystectomy. Others use ursodiol to prevent gallstones.

Results

Success includes weight loss of 25 per cent or more, absence of major complications, and reversal of obesity-related diseases like type II diabetes mellitus and sleep apnoea. With most procedures the average weight loss of 33 per cent has been achieved 1 year after operation. Best results occur with gastric bypass and biliopancreatic diversion. Late weight regain was common with horizontal gastroplasty and is more common after vertical banded gastroplasty than gastric bypass. Results 5 years after operation are needed to judge any procedure, but are rare. A few excellent long-term results have been published after gastric bypass and biliopancreatic diversion.

Conclusions

The National Institutes of Health Consensus Development Conference on the Surgical Treatment of Obesity in 1991 concluded that surgery for obesity was reasonable for patients who had failed conservative treatment, met strict selection criteria and had operations performed by experienced surgeons working in a group setting. Information is still needed on the natural history of severe obesity. Better long-term data are needed that compare complications and results of different operations. Two large databases have been established: the Swedish Obese Subjects trial and the International Bariatric Surgery Registry in Iowa City. Favourable early results are available but late results are not yet published.

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