# Reconstructive Surgery of the Gastrointestinal Tract

*Edited by*

**Alfred Cuschieri**

*and*

**David B. Skinner**

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# Preface

Reconstructive surgery on the gastrointestinal tract entails the performance of surgical procedures designed to correct primary malfunction of the alimentary tract, or that secondary to previous operative intervention with resultant altered anatomy or loss of tissue. Reconstruction may be performed at the time of excision or may be delayed. The term remedial surgery is often used for those procedures designed to correct sequelae after major excisional surgery, when the primary reconstructive technique adopted to restore gastrointestinal continuity has resulted in an altered physiology with persistent and undesirable symptoms and side-effects.

The success of such surgical endeavours entails good clinical judgement, sound knowledge of the gastrointestinal physiology, familiarity with specialized investigations, careful selection of patients and experience with the management of these difficult problems. This book has been constructed with the above considerations in mind and covers the principles of reconstructive surgery and methods of investigation of the gastrointestinal tract before dealing with specific topics. It is manifestly impossible to deal with the entire subject in one review volume. We have therefore chosen problematic topics which are important, either because of their common occurrence in clinical practice or because new information has become available on the subject during the past decade.

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# Contents

# 1
# Principles of reconstructive gastrointestinal surgery

David B. Skinner and Alfred Cuschieri

## INTRODUCTION

Reconstruction of the gastrointestinal tract may be necessary because of loss of tissues from disease or previous surgery, or because of malfunction of portions of the alimentary tract. Examples of the former include such destructive diseases as severe ulcerative colitis requiring total proctocolectomy, advanced carcinoma, or the extensive surgical resections necessary when curative efforts at treating cancer are employed. Reconstruction may be necessary for malfunctioning portions of the gut such as gastroesophageal reflux with the resulting esophageal stricture, malabsorption, or diarrheal syndromes. Functional disabilities may follow primary surgery, such as the postgastrectomy syndromes which require further reconstructive surgery to relieve symptoms and complications.

In many instances reconstructive surgery is reoperative surgery. In some, the reconstruction may be a planned part of the original operation, but in many patients the reconstructive procedure is a subsequent operation following previous extirpative or unsuccessful primary surgery. Specific examples of reconstructive surgery are discussed in detail in the following chapters. The purpose of this chapter is to describe general principles which govern the successful planning and execution of reconstructive gastrointestinal surgery. The presentation is based upon the authors' own practices, and is not meant to be an exhaustive review of pertinent publications.

Reconstructive surgery must be based upon a thorough and detailed knowledge of the anatomy and function of each unit of the gastrointestinal tract and adjacent tissues (see Chapter 2). Experience in dealing with complicated reconstructive problems is essential and can be obtained initially by working with highly experienced surgeons in this field and later from acquired personal experience. In each case there are important phases to the reconstructive process. These include preoperative considerations with emphasis upon diagnosis of the precise condition, general assessment of the patient's ability to withstand major complicated surgery, nutritional preparation of the patient, and attention to specific details of preoperative preparation. Principles guiding reconstructive surgery during the operation include details of the anesthetic management, incisions, exposure,

anastomotic techniques, special techniques, dealing with coexistent problems, wound management, and drainage. The important principles involved in the postoperative care may be discussed under the headings of postoperative routines, nutritional support, infections, bleeding, pulmonary embolism, and long-term assessment of results. Each of these areas requires thoughtful planning and decision-making, and each is discussed in detail in the following paragraphs.

## PREOPERATIVE CONSIDERATIONS

Prior to surgery involving complicated reconstructive procedures, an intense period of evaluation and treatment of the patient is frequently necessary. When multiple investigations must proceed in parallel with nutritional support and specific preparation for surgery, this is best accomplished as an inpatient in the hospital. Less extensive investigations may be accomplished in the outpatient setting. An advantage of the inpatient setting for preoperative evaluation is that the patient gets to know the medical and nursing staff well and should gain confidence in the medical team. This encourages the patient to be more cooperative with what may be a complicated and lengthy course of treatment.

### Diagnostic considerations

#### Symptoms

In patients with anatomical or functional abnormalities of the gastrointestinal tract not much reliance can be placed upon symptoms for purposes of precise diagnosis. However, the objective of most reconstructive surgery is the relief of the patient's symptoms, so a detailed knowledge and analysis of the patient's complaints is an essential starting place in the process of planning for surgery. The gastrointestinal tract has a limited number of ways in which disease can manifest symptomatically. These include pain, obstruction, diarrhea, bleeding, and weight loss or gain. Pain may be one of the most difficult symptoms to analyze, and time spent in understanding the precise nature of the patient's painful symptoms is helpful in pinpointing the nature and location of the problem. Specific types of pain are commonly associated with disease processes. For example, the pain associated with gastroesophageal reflux is frequently described as a burning sensation under the sternum or in the epigastrium, but may migrate to the back between the scapula. Elicitation of this pain by postural maneuvers is highly suggestive of gastroesophageal reflux, whereas a burning epigastric pain not altered by posture may herald ulcer disease in the stomach or duodenum. Pain elicited and localized by physical examination more frequently denotes a localized disease process. Evidence of peritoneal irritation on physical examination is particularly important in localizing the source of pain and probable inflammatory nature. Intermittent intense pain of the cramping nature is highly suggestive of an obstruction or functional malady of the gut, whereas more diffuse pain which is difficult to localize, and not specifically related to events such as eating, position, or activity, raises the possibility of a functional or even psychosomatic cause of pain which may be difficult to attribute to a specific organ or disease process.

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Obstruction of the gastrointestinal tract may be obvious as in acute small bowel obstruction, but is more frquently subtle in its symptomatic presentation. Intermittent vomiting may be part of the symptom complex associated with gastroesophageal reflux, but may also accompany partial or near total gastric outlet obstruction or partial high small bowel obstruction. Abdominal distention may herald ascites, tumor, or partial colonic or gastric obstruction. Dysphagia may be caused by an esophageal lesion blocking passage, but may also be part of a functional disorder or extrinsic disease involving the esophagus. Obstruction must always be a diagnostic consideration in any patient with vomiting, distention, dysphagia, change in bowel habits, constipation, or cramping abdominal pain.

The differential diagnosis of diarrhea includes a broad range of possible causes. It is especially important to start with a description of what the patient considers to be normal bowel habit, and then to obtain a precise description of what is considered by the patient to be diarrhea. The actual number of bowel motions daily, time pattern of these, consistency of the excreta, color changes, associated cramps or pain, associated abdominal noises, relationship to meals, medication history, and presence of blood in the stool may all be helpful details.

Gastrointestinal bleeding should be analyzed as to whether the likely source is the upper or lower gastrointestinal tract. Assessment of the acuteness or chronicity of the bleeding can be determined from a discussion of symptomatology. It is especially important to have the opportunity to examine the patient during an actual episode of bleeding. In such instances a nasogastric tube should always be passed for analysis of gastric aspiration even if it seems evident that the bleeding is coming from the colon. Documentation of bleeding by examination of gastric contents and stool is important. More exact localization during an acute bleeding episode is strongly recommended. Esophagogastroscopy is especially valuable for suspected esophageal or upper gastric bleeding, and flexible sigmoidoscopy or colonoscopy is diagnostic for bleeding sources low in the colon. Difficulty is encountered in obtaining clear visualization of bleeding sites in the lower stomach or duodenum when the bleeding is heavy, or similarly in the upper reaches of the colon when a large amount of bloody stool is encountered as the instrument is passed from below. In these cases arteriography during acute bleeding may be of particular value. A radionuclide bleeding scan may localize the general region of the bleeding source but does not provide as specific a diagnosis as does arteriography. The demonstration of a lesion by barium studies is never definitive in indicating the site of bleeding but can be helpful in providing knowledge of pathological processes.

Weight loss and the state of nutrition can be initially assessed from discusion with the patient. It is valuable to obtain knowledge of the patient's exact weight at various times in the past. A detailed discussion of the actual meal by meal dietary intake gives useful insight as to whether the problem is one of ingestion of food and faulty dietary habits as opposed to a malfunction of the gut after food is ingested.

In considering the significance of symptoms the question must be asked for each of the patient's complaints as to whether it is likely to be induced by a specific disease and, if so, what sort of disease, or whether the symptom may have been induced by a previous surgical or medical therapy. A complete inventory of all drugs, including over-the-counter medications which the patient might not consider significant, is of great importance in this analysis. Similarly, obtaining the operative report from previous surgical procedures in the vicinity of the gastrointestinal tract is helpful in explaining symptoms which followed after such an operation.

## Assessments

In patients in whom the symptoms, previous surgical history, and disease process suggest a complicated or multifactorial problem, a full assessment of the entire gastrointestinal and pancreatico-bilary tract may be necessary before the surgical plan is established (*see* Chapter 2 for greater detail and references). For abnormalities of the upper tract the distal tract should be assessed carefully as well to be certain that correcting the proximal problem will not bring to light distal disease. A variety of techniques should be available and used liberally to ascertain the mechanical and functional integrity of the entire alimentary tract.

As always, the best evidence available is that which is most directly related to the organ under investigation. For this reason, examination of the stools, gastric contents, or intestinal contents may provide the most valuable information. These examinations include bacteriological and chemical analyses as well as searching for the presence of occult blood. The presence of malignant cells is determined by cytological study.

In most instances radiographic investigations are among the first ordered. Careful study of plain abdominal and chest films may be useful in directing subsequent investigations. For contrast studies of the upper and lower alimentary tract, double contrast investigations using barium and air to bring out detail are particularly helpful. There is little place for water-soluble contrast agents such as gastrografin, as these are too readily diluted, do not give sufficient detail, and may place an osmotic load in the gut which may be dangerous in a patient with intrinsic disease. The value of radiographic studies may be extended by employing techniques to assess function as well as anatomy. For example, the barium impregnated bolus such as a barium burger or barium marshmallow may give helpful information related to the esophagus or to gastric emptying. The use of pharmacological agents such as glucagon to alter gut motility may enable more precise radiographic diagnoses.

The availability of computerized axial tomography (CT scans) is of particular value in assessing the status of the liver, pancreas, abdominal masses, and presence of enlarged lymph nodes. Abscesses and cystic lesions are especially well defined by this investigation. The proximity of abnormalities to adjacent organs is helpful in analyzing symptoms and outlining an operative approach. The CT scans are of little use, however, in functional types of gastrointestinal disease or in evaluation of the small intestine and colon.

Radionuclide scanning may provide help in special circumstances. The role of esophageal scintiscans is not yet quantitatively defined, but current investigations relating results of the passage of an isotope through the esophagus to other types of esophageal investigations are under way (Ferguson *et al.*, 1985). It is hoped that specific patterns of esophageal passage can be helpful in reclassifying motor disorders, and the role of esophageal scintiscanning in detection of gastro-esophageal reflux is promising. The value of scans in measuring gastric emptying is well established. It is important to recognize that liquids and solids may have quite different emptying times from the stomach. The use of a solid substance carrying an isotope marker is especially valuable. Chicken liver with the isotope incorporated *in vivo* prior to preparation of the meal has become the classical standard for solid state gastric emptying (Meyer *et al.*, 1976). Mixing soluble isotope into a solid or semi-solid substance does not provide an accurate measurement of solid emptying as the isotope is quickly dissolved and empties in the liquid phase. The results of

comparative liquid and solid gastric emptying studies may show wide discrepancy (Heading *et al.*, 1976).

The use of the TcHIDA scan technique can provide valuable information not only about biliary tract function but about bile regurgitation into the stomach and esophagus when bile gastritis or alkaline esophageal reflux is suspected. In patients with occult bleeding the use of both the labelled sulfur colloid investigation and the chromium tagged red blood cell technique can be helpful in demonstrating less rapid bleeding than that seen on the angiographic investigation (Winzelberg *et al.*, 1982).

Angiography plays an important role in planning reconstructive surgery. When operation is to be carried out in the upper abdomen, the multiple vascular anomalies of the foregut must be kept in mind. These are of particular importance when pancreatic resection may be part of the procedure. The origin of the left hepatic artery from the left gastric artery is a common finding, and the origin of the right hepatic artery from the superior mesenteric is important information to have available when operations in the heavily scarred upper abdomen may be undertaken. The possibility of mesenteric ischemia may be suggested by the patient's symptoms, malnutrition, and bowel function. The angiographic demonstration of all three gut arterial systems, celiac, superior mesenteric, and inferior mesenteric is essential when mesenteric ischemia is considered. When the extent of previous operations is uncertain but may be critical, as when a previous bowel resection may have interrupted major collateral pathways which might be used during an intestinal reconstruction, an angiogram may give helpful information as to the presence or absence of particular vessels. The importance of angiography in localizing bleeding sites has been mentioned previously.

Endoscopic visualization of much of the gastrointestinal tract is now possible. Prior to any operation on the esophagus or stomach it is generally helpful for the surgeon to inspect the lesion personally and identify its location relative to other surgical landmarks. For abnormalities of the esophagus, the distance from the aortic arch may be critical in determining a left or right sided surgical approach. Proximity to the cardia may forecast the need for reconstructive reflux procedures as part of the operative plan. Endoluminal evaluation of the extent of gastric ulceration or neoplasm may give a somewhat different picture from that seen when the organ is evaluated externally. The actual demonstration of bleeding from a lesion is critical in determining the source of gastrointestinal bleeding. The duodenum is now readily accessible by endoscopy, and may be the source of unexpected lesions. The questionable role of a large duodenal diverticula in causing symptoms may be raised, and can be settled by inspection of this area and aspiration of the contents of the diverticulum. Endoscopic retrograde cholangiography and pancreatography through the endoscope is an invaluable source of information concerning the biliary tract and pancreas. The availability of flexible colonoscopy frequently makes inspection of this entire organ feasible for diagnostic and functional assessment. Through most of the endoscopes, biopsies of superficial mucosa and aspirations for culture and cytology can be obtained. Unfortunately, biopsy forceps available for most flexible endoscopies do not permit deep or substantial biopsies. For this purpose, biopsies taken through the solid open tube esophagoscope or sigmoidoscope may be more useful. The use of capsule biopsies under radiographic control may provide samples from the stomach and small intestine when deeper tissue sampling is desirable (Trier, 1971).

Functional assessment of the esophagus, stomach, and colon may be advanced by manometric pressure recordings. While some of these techniques are currently under investigation for the small intestine, difficulty in the placement of recording equipment has precluded widespread use of manometry for small bowel investigations. For functional disorders of the duodenum, stomach and esophagus, the differing pH of normal saliva, esophageal contents, stomach, and pancreaticobiliary juices makes pH recordings helpful in analyzing events. Documentation of duodenogastric reflux in cases of suspected bile gastritis and documentation of gastroesophageal reflux by the pH studies are particularly valuable.

Among the diagnostic considerations for reconstructive surgery the possibility of malignancy must always be considered. This is obvious in patients whose initial diagnosis was neoplastic, but occult malignancy may be a new factor in patients whose prior diagnosis or surgical treatment was that of benign disease. For this reason the investigation of any masses found on physical examination, radiographic studies, and especially the CT scan, must be carried to the point of a precise tissue diagnosis. Obviously palpable abnormalities can be readily biopsied. The use of the thin needle aspiration biopsy approach has made masses of the liver, pancreas and retroperitoneum available to biopsy under radiographic control in regions that were previously inaccessible. Such tissue biopsies should be obtained prior to undertaking any major surgery.

## Nutrition

Assessment of the nutritional status of the patient requiring reconstructive surgery is a frequent problem. Malnutrition is the obvious consequence of chronic and severe gastrointestinal disease. Although controversy persists as to the best methods for measuring nutritional status, several techniques can be readily employed to give a qualitative judgement as to the need for preoperative therapy. The comparison of the patient's current weight and height tables and the patient's normal weight at a previous time of good health are the most obvious starting point. Measurement of the serum albumin and serum iron binding capacity provide helpful assessment of liver protein synthesis. The half time of serum albumin in the plasma is approximately three weeks, so rapid changes in this parameter are not to be expected. For more exact short-term analysis of nutritional change, measurement of serum pre-albumin, transferrin or retinol binding protein is more helpful (Young, Chem and Hill, 1978). Other useful assessments are the standardized measurement of triceps skinfold thickness, and mid-arm muscle circumference compared to normal values. Measurement of the body's immune responses to common skin test antigens including mumps, tricophyton, candida, histoplasmosis, and PPD antigens are helpful. The absence of reactivity to these challenges suggests an anergy since most people have reactivity from prior exposure to at least one or more of these common antigens. Efforts to sensitize the patient with an allergen such as DNCB are advocated by some (Meakins *et al.*, 1977), but are probably not necessary in most instances.

When malnutrition is detected its origin may be obvious from the extent of previous surgery or disease, or an absorptive abnormality of the gut may be suspected. When the latter is the case, a detailed examination for absorption should be carried out. This starts with examination of the stool for fat content and fiber as well as ova and parasites. Specific absorption tests such as those using d-xylose,

labelled bile acids, or labelled lactose and measurements of serum carotene and folic acid may pinpoint the type of abnormality (Hepner, 1974).

When a patient is clearly malnourished as evidenced by weight loss, low albumin, anergy to skin test, or other parameters, restorative therapy should be undertaken before elective reconstructive surgery. In fact, if any one or two of the multiple methods to assess nutrition are abnormal, time invested in nutritional therapy is likely to reduce the risk of complications following further surgery. Whenever possible, nutritional restoration should be accomplished by a enteral route. Patients may be able to take dietary supplements in liquid form and a variety of these are commercially available. Several may be tried to find a product which suits the patient's taste, as well as ability to absorb. When the patient is unable to take sufficient oral nutrition because of esophageal obstruction, high fistula or other abnormality, a small tube passed distal to the pathology may enable enteral feeding. Such a small diameter tube is most easily passed transnasally and is fairly well tolerated in this location. When a gastrostomy is necessary, this can be accomplished by the percutaneous technique. In this method, an endoscope is passed into the stomach and directed anteriorly until the light is seen directly under the abdominal wall in a thin, malnourished patient. A small incision can then be made and a tube inserted directly without an extensive laparotomy. In some patients insertion of a tube or catheter jejunostomy may be a worthwhile minor surgical procedure as part of the preparation for later major surgery.

When enteral alimentation is not possible for any of a variety of reasons, then parenteral hyperalimentation is undertaken. This is always done through a centrally placed venous line. If the time of nutrition is expected to be lengthy, placement of a semi-permanent subcutaneous catheter such as the Hickman® line may be advantageous (Riella and Scribner, 1968). Careful evaluation of the fluid volume, electrolyte management, and caloric intake is undertaken. Attention is paid to providing necessary trace elements and a balance of protein and fat intake. The availability of nutritional assessment and therapy has greatly improved the outcome from reconstructive surgery, and provided solutions to problems that previously had no reasonable answer.

## General assessment of the patient

Prior to major reconstructive surgery other organ systems must be thoroughly evaluated to ensure that the patient can tolerate a major operation. Most reconstructive gastrointestinal surgery is performed for non-fatal conditions. As such, the risk of undertaking surgical reconstruction must be acceptably low to make the operation a reasonable proposition. Abnormalities of the upper gastrointestinal tract may cause epigastric and chest pain, so cardiovascular disease is frequently a consideration in the differential diagnosis. An electrocardiogram alone is usually insufficient to rule out significant heart disease. When any doubt arises, an echocardiogram and a coronary artery stress test are reasonable steps. In highly suspicious cases, coronary angiography may be undertaken.

Upper alimentary tract disease is frequently associated with regurgitation into the esophagus with the possibility for aspiration and respiratory problems. Any respiratory symptoms should be evaluated, and pulmonary function tests are commonly obtained prior to major reconstructive surgery. When respiratory infections are encountered, they should be treated preoperatively. Pulmonary

physical therapy and postural drainage are important parts of the preoperative preparation in patients with productive sputum and respiratory illness.

Because of the high volumes of fluid and electrolyte shifts which may occur during gastrointestinal suction, parenteral hyperalimentation and fluid replacement, renal function should be close to normal. A creatinine clearance test is frequently obtained. The possibility of diabetes should always be considered in a patient with alimentary tract disease and particularly with pancreatic involvement. Maintenance of the blood sugar at a near normal level throughout the course of a long complicated operation is important in diabetics. Intermittent or continuous monitoring of blood sugar during operation and in the early postoperative period is advocated and should be planned when the preoperative diagnosis of diabetes is made (Meyer *et al.*, 1979).

Patients with chronic illness often undergo psychological disturbances, and these may play a part in the symptomatology and the patient's reaction to disease. A psychiatric evaluation of the patient by a psychiatrist skilled in analysis of psychosomatic problems and used to dealing with chronically ill patients is frequently valuable. Psychogenic medication may be helpful in the depressed chronically ill patient.

### Specific preoperative preparation

Immediately prior to surgery, several steps are taken to improve conditions for the operation., When necessary, packed red blood cells are given to raise the hematocrit to greater than 30%. The patient may be frequently dehydrated from the preparation and performance of multiple tests. An intravenous infusion given overnight prior to surgery is often helpful. For all reconstructive gastrointestinal surgery a bowel preparation is recommended. This involves both cleansing of the bowel by laxatives the day before surgery and restriction to a liquid diet for several days prior to surgery. Enemas are avoided the night before surgery to avoid a contaminated fluid load in the bowel. We prefer to add an antibiotic bowel preparation for the 12 hours prior to surgery, using neomycin and erythromycin base. Systemic antibiotics are given on call to the operating room, during the operation and for 48 hours after surgery on a prophylactic basis. When a specific infection is likely to be encountered, specific antibiotics are given. In other instances a broad spectrum cephalosporin is chosen. The risk of postoperative pulmonary embolism is dramatically reduced by the use of anticoagulants prophylactically. Presently we prefer a minidose heparin, 5000 units every 8 hours, given subcutaneously. Prior to operation an informed consent is obtained with a full explanation of the possible side-effects and extent of surgery. The patient's cooperation is frequently greatly improved by thorough understanding of the problem to be encountered and approaches to be used in its treatment.

## OPERATIVE PRINCIPLES

### Anesthetic considerations

For reoperative surgery especially, the duration of the operation is difficult to predict because of variability of adhesions or unexpected findings which may be

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