

Iatrogenic Problems Following Gastric Surgery

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Abstract. It is difficult to truly define iatrogenic complications in the postsurgical state in that the surgery is a condition originated by physician intervention and thus any problems that occur may be technically considered as physician created. In this article we attempt to demonstrate problems that occur both due to technical errors and the choice of operative procedure. In addition, unusual postsurgical anatomy is illustrated with the hope of avoiding further iatrogenic problems from lack of recognition.

Key words: Gastrointestinal tract, surgery — Stomach, abnormalities — Surgery, complications.

Many postsurgical patients will suffer complications, concurrent illness, recurrent disease, and generalized debilitation. Often these are a necessary price to pay to relieve the original symptoms or reduce the original risk and it is not always clear which of these problems should be called truly 'iatrogenic'. In this article, we will discuss:

1. Problems which may be created by and related to specific surgical procedures and do not necessarily imply any error in technique.

2. Problems related to surgical errors.

3. Unusual appearances which may be created by the surgical procedures and simulate other diseases.

In many comparative long term studies of surgical versus medical treatment of peptic ulcer disease, the results in terms of physical fitness, ability to work, and time spent in hospital seems to have favored the surgically treated patients. This has led to earlier surgical intervention, especially in peptic ulcer disease [1].

Three major operations are currently in vogue for the treatment of peptic ulcer disease. They are: partial gastrectomy, vagotomy with a drainage procedure, and vagotomy and hemigastrectomy [2–4]. Their mortality generally ranges between 1–2% with vagotomy and partial gastric resection at the higher end of the spectrum [3–5]. In a twenty-five year review of truncal vagotomy and partial gastric resection by Herrington et al. [6] a 1.6% mortality rate was seen in three thousand five hundred patients. In comparison, a mortality rate of 0.5% was seen in one thousand patients undergoing truncal vagotomies and a drainage procedure.

The recurrence rate of ulcers is another important consideration. One review by Dodsworth [5] noted a recurrence rate of less than 2% after vagotomy/hemigastrectomy procedures versus a recurrence rate of 6–8% after vagotomy/drainage procedures. Other reviews confirm this reduced incidence of recurrent ulceration with vagotomy and partial resection which is offset by slightly increased morbidity [7, 8].

Three types of vagotomy are available: truncal (most widely used), selective (total gastric), and highly selective (proximal vagotomy) [9]. It appears that the proximal vagotomy has the least postvagotomy sequelae of all. Severe dumping and diarrhea occur rarely. According to Johnston [10] there is a decreased incidence of diarrhea with selective vagotomy. The recurrence rates after this vagotomy have been reported from ten centers, but the follow-up is only a few years and longer term follow-up is needed for statistical accuracy. However, one may infer from several studies reviewed, that the incidence of recurrent ulceration is probably as low as, or lower than that of other vagotomies [11, 12].

In addition to the surgical morbidity and recurrence rates, immediate and long-term complications of surgery are important. Dumping occurs in approximately 10% of patients. A 10–25% incidence of diar-

rhea seen with truncal vagotomy and hemigastrectomy can be decreased with selective vagotomy without a drainage procedure. A generalized decrease in weight may be related to decreased appetite and malabsorption. Anemia and metabolic bone disease are also frequent problems in patients who have undergone gastric surgery [5].

Presently in the United States, the most popular operation for duodenal ulcers is antrectomy or limited distal gastrectomy (25–40% of the stomach) combined with a truncal vagotomy. Reconstitution is either via a Billroth I or II procedure [3].

Multiple procedures directed towards reducing gastroesophageal reflux have been widely used. An excellent review by DeMeester et al. [13] strongly favors the Nissen repair over the Belsey Mark IV and Hill repairs. It best controlled the gastroesophageal reflux and competency of the lower esophageal sphincter. All three procedures were limited by postoperative dysphagia and a high incidence (50%) of inability to vomit.

Normal Radiographic Anatomy of the More Common Surgical Procedures

Numerous individual variations of surgical procedures are in widespread use and delineating these in any depth is beyond the scope of this article.

The Billroth I and Billroth II procedures are currently used to refer to a broad category of partial gastrectomies; gastroduodenostomy and gastrojejunostomy respectively [14]. Knowledge of the normal radiographic appearance of these common procedures is a key to a thorough evaluation of the postoperative stomach (Figs. 1 and 2).

Characteristic deformities are also produced by the three most common pyloroplasties: (1) Heineke-Mikulicz, (2) Finney, and (3) Jaboulay procedures. Familiarity with their appearance is essential [15].

A baseline study of the postoperative patient is essential. For more detailed information, the interested reader is referred to several references contained within the bibliography [15–19].

Postoperative Complications

Many of the complications which postoperative patients encounter are related to the cardiopulmonary system, i.e., atelectasis, pneumonitis, pulmonary embolism, shock lung, etc. These are not related to specific surgical procedures but are seen in all types of abdominal surgery. It is not within the scope of this article to further detail these complications.

Postoperative ileus and *acute gastric dilatation* occur frequently postoperatively. The degree of ileus is directly related to the amount of bowel manipulation during surgery. Although ileus is generalized after surgery, gastric atony may be a striking component. The proximal portion of the stomach does not display any significant motility. Therefore, emptying when the stoma is in the dependent position is necessary to distinguish atony from obstruction. It is not unusual for this to persist for two or three days postoperatively [20]. *Acute gastric dilatation* is to be distinguished from gastric atony. It is a serious complication. The stomach becomes distended with fluid and gas leading to nausea, vomiting, dehydration, and possibly shock. The mechanisms for this are unclear, but nasal oxygen, respirators, and aerophagia have been implicated [21]. Radiographs make an important contribution in this diagnosis.

Pneumoperitoneum is extremely common after intra-abdominal surgery. The degree of pneumoperitoneum is not dependent on the type of operation or the presence of peritonitis. It is stressed that pneumoperitoneum may increase when multiple abdominal drains are in place and should not be mistaken for perforation or stump blowout [22, 23]. The duration of pneumoperitoneum is variable and is affected by body habitus. It disappears fastest in children and thin individuals.

Pseudolesions

Several surgical procedures cause unusual radiographic findings which may be mistaken for more serious disorders. Insight into these potential problems can assist physicians in avoiding pitfalls in their subsequent management.

In the late 1950's Nissen developed a *fundoplication* for hiatal hernia repair [24]. By means of an abdominal approach, the distal esophagus and upper portion of the stomach are mobilized and the gastric fundus is wrapped around the exophagus. If an esophageal hiatal hernia is present, it is reduced and the hiatus is closed posteriorly. In order to avoid excessive narrowing of the esophagus, the plication procedure is performed with a large-bore (#36 or #38 Ewald) nasogastric tube within the esophagus. The postoperative radiographic appearance is characteristic (Fig. 3). A filling defect resembling a fundic tumor is seen. The mass is large and generally anterior in position [25]. Another approach, the *Belsey Mark IV* hiatal hernia repair also distorts the radiographic appearance of the esophagogastric junction. The object of this operation is to use the fundus and diaphragm together to create an intra-abdominal eso-

POSTOPERATIVE STOMACHS

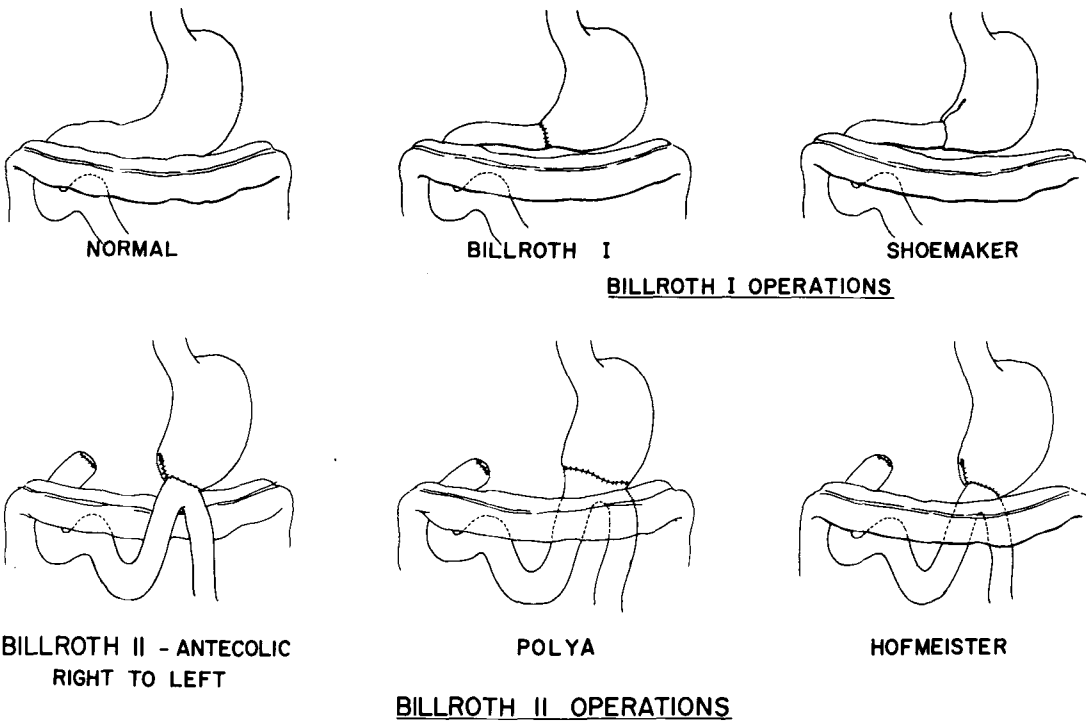
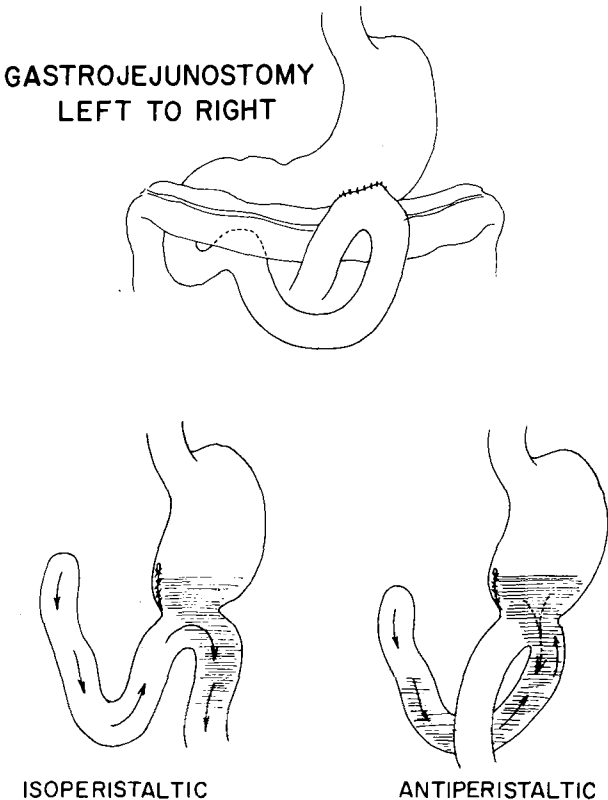


Fig. 1. Diagrammatic representation of the Billroth I and Billroth II type procedures. Variations shown include partial oversewing of the stoma, as with the shoemaker and Hofmeister approaches, and the antecolic and retrocolic position of the anastomosis. (See acknowledgment on page 255)



phagus. A left thoracotomy is used and the attachments between the cardia and diaphragm are incised to expose the fundus. Sutures are then placed through the right diaphragmatic crus with upward tension on the esophagus. The fundus is sutured to the lower esophagus and the sutures then tightened. The fundus is secured to the anterior wall of the esophagus. Sutures are then placed through the diaphragm to the stomach fundus and esophagus so that all three structures are bound together around the lower esophagus, which is now intra-abdominal [24]. Similarly, a large nasogastric tube is used to avoid excessive narrowing of the esophagus. Because of the suture placement in this procedure, two distinct angles can often be seen on a barium esophageal study [25]. Radiographs

Fig. 2. The terms isoperistaltic and antiperistaltic originally conceived to imply emptying of the post-surgical stomach with and against peristaltic waves respectively, have been given varying interpretations by different surgical authorities. It is probably best to define the anatomic situation in terms of 'left-to right' when the proximal or efferent loop has been hooked up in the direction of greater to lesser curvature and 'right-to-left' for a lesser to greater curvature direction. This standardizes the anatomic description and avoids the confusion of varying surgical interpretations of peristaltic direction. (See acknowledgment on page 255)

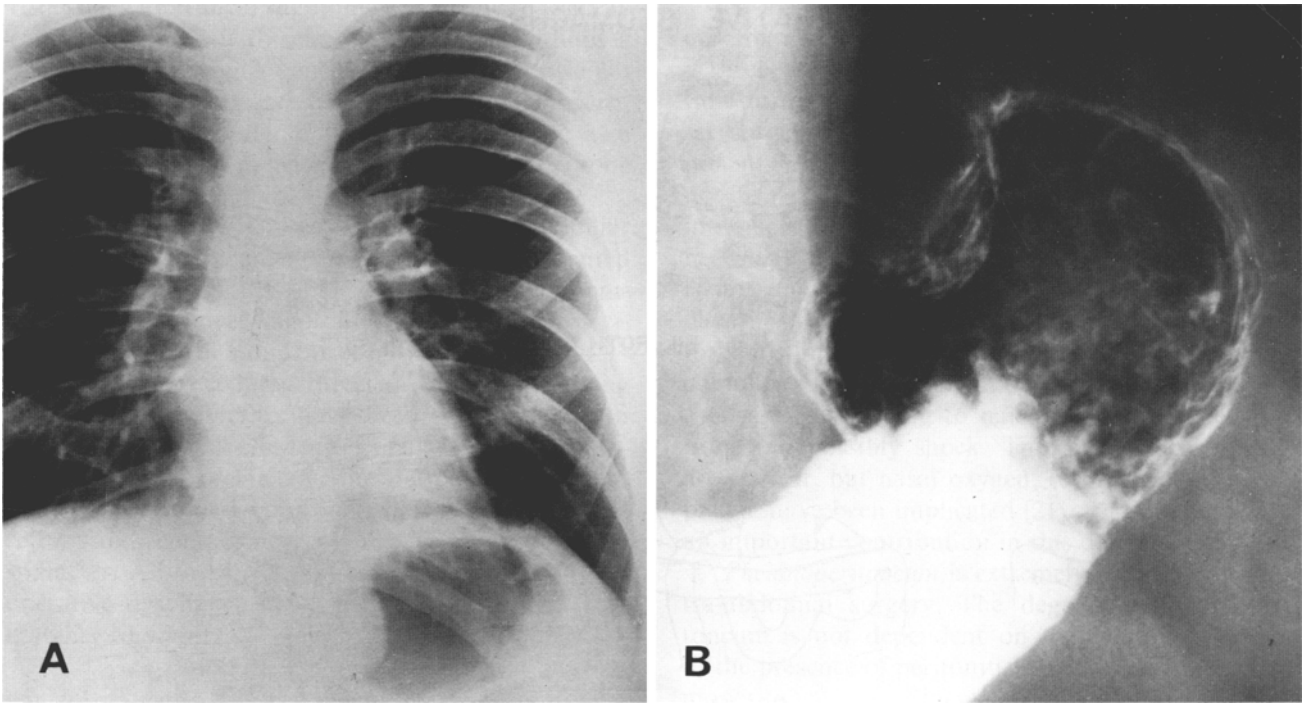


Fig. 3 A and B. Nissen fundoplication. **A** The characteristic mass in the area of the gastric cardia is well seen in this PA chest radiograph. **B** Barium examination reveals a smoothly marginated mass distorting the gastric outline in the area of the exophagogastric junction. Despite the absence of surgical clips the possibility of surgery should always be considered when evaluating a stomach with this appearance. (See acknowledgment on page 255)



Fig. 4. Characteristic deformity seen on lesser curvature just proximal to Billroth II type anastomosis is known as Hofmeister defect

may reveal an appearance of a stenosing esophageal lesion or a fundic filling defect [26].

A characteristic defect is seen radiographically in patients who have had a gastroenterostomy with a Hofmeister type of anastomosis (Figs.4 and 5). This procedure was developed to minimize the problems

associated with a large gastric stoma. Here, the open end of the gastric stump is closed with a line of sutures extending from the lesser curvature one-half to two-thirds of the distance to the greater curvature. The anastomosis is then performed [14]. In a study by Fisher [27], out of one hundred patients who had

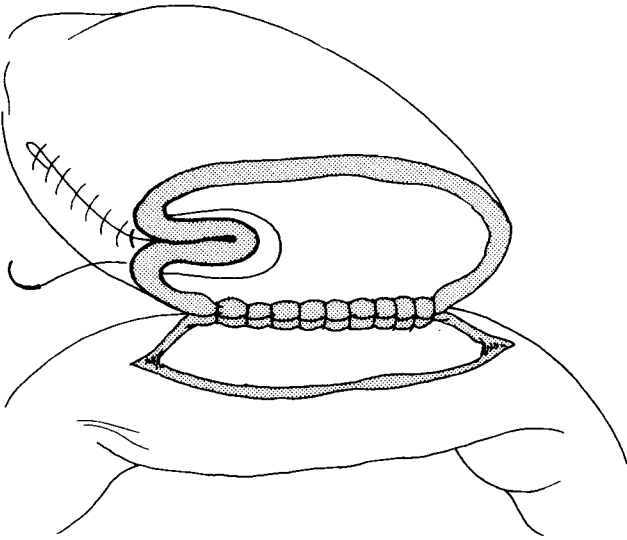


Fig. 5. Diagrammatic representation of the surgical infolding of stomach to reduce anastomotic size that is responsible for the radiographic appearance of the Hofmeister defect. (See acknowledgment on page 255)

a Hofmeister operation, six showed this defect. The filling defect corresponds to the closure line of the invaginated cut surface of the stomach. The defect is more apparent on the first studies postoperatively and on later studies may be decreased in size or actually absent. Similar changes are seen with other surgical procedures where there is a plication proximal to the stoma, e.g., Shoemaker procedure with a Billroth I (Fig. 6).

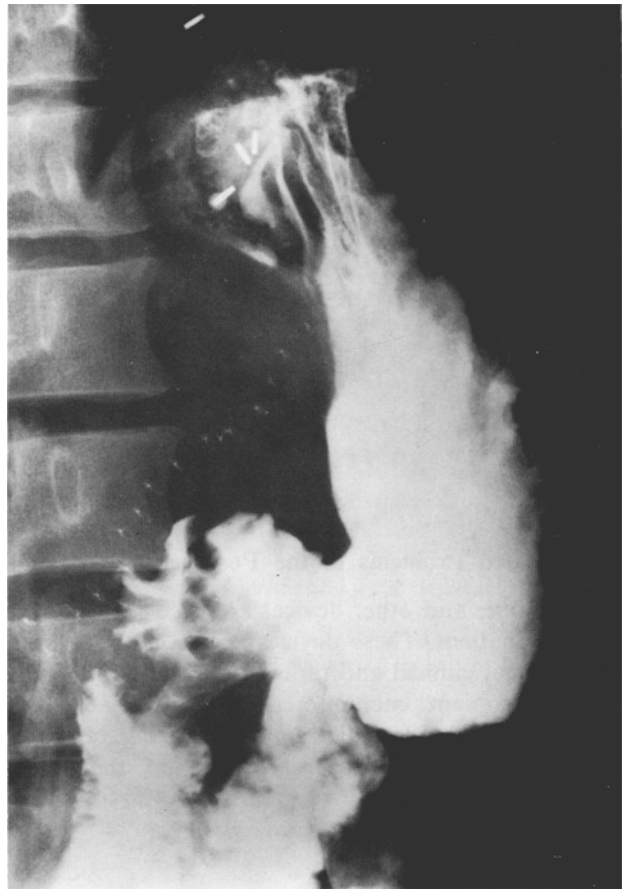


Fig. 7. The deformed duodenum and surgically created gastroduodenostomy channel are characteristic features of a Jaboulay pyloroplasty

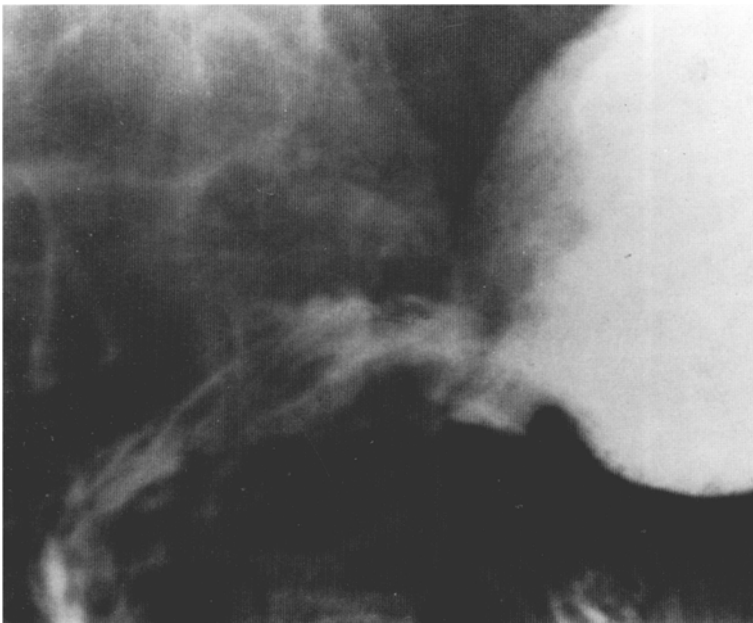


Fig. 6. A defect is seen on the lesser curve above the anastomosis in this patient who underwent a Shoemaker type Billroth repair. (See acknowledgment on page 255)

Following pyloroplasties of various types, the lines of sutures produce irregularity of the pyloric and duodenal contours and to this is added the deformity caused by the lesion for which the operation was performed. Barium studies of this area present typical radiographic findings [18, 28, 29] (Fig. 7). Occasionally the deformity does not fit into the classical mold (Fig. 8). This again emphasizes the value of baseline studies.

Eklof and Ohlsson described three cases of post-operative plication deformity with foreign-body granuloma simulating gastric tumor [30]. These lesions, if large enough, may cause symptoms and actually ulcerate. Radiographically, the findings consist of a well-defined filling defect appearing as a benign tumor (Fig. 9).

Tube-Related Problems in the Postoperative Patient

Various tubes and other devices are used in the post-operative patient. These devices occasionally present with unusual clinical and radiographic findings.

One problem encountered infrequently occurs with the usage of long *intestinal tubes*, e.g., Cantor or Miller-Abbot tubes. *Accordioning* of the small bowel along the length of the tube may occur (Fig. 10). Also, actual *intussusception* [31] of small bowel may be induced by the tube (Fig. 11). Another complication is actual entrapment of the nasogastric or intestinal tube. The treatment for these problems is simply repositioning or removal of the tubes. In the case of tube entrapment, manipulation under fluoroscopy or passage of an obturator may be necessary to remove the tube [32].

Gastrostomy tubes may cause varying complications. These are used in the immediate postoperative state, as well as for long term feeding purposes. The feeding gastrostomy was first successfully used in 1876 [33]. The postsurgical complication rate varies between 1–5% [34]. Complications consist of hemorrhage, leakage, gastric prolapse through the ostia of the tube, and partial or complete obstruction from the tube [34, 35]. In order to avoid partial or complete obstruction from a gastrostomy tube, care must be taken in properly positioning the tube. The onset of severe vomiting and dehydration in a patient with recent insertion of a gastrostomy tube or in patients with chronic feeding tubes, should alert the physician to this potential complication [36]. Without immediate diagnosis and treatment, death may ensue shortly. The treatment is simple and consists of repositioning the tube. Gastrostomy tubes, after removal, produce filling defects and irregularity of the stomach contour which may be observed on barium studies. These defects are generally seen along the greater curve of

the stomach and may persist permanently (Fig. 12). Recognition of the nature of these defects will avoid unnecessary diagnostic studies or surgical intervention.

Prosthetic tubes have recently been introduced to treat inoperable esophageal carcinoma [37]. These tubes may be inserted surgically (Celestine tube) or passed endoscopically (Silastic tube) [38]. The Celestine tube is sutured in place while the Silastic tube is simply positioned within the esophagus [39]. We recently have seen slippage of both of these tubes. The potential complications consist of leakage, aspiration, and obstructive symptoms. Radiographs with or without the addition of contrast assist in locating these slipped prosthesis (Fig. 13).

'Gas-Bloat' Syndrome

The 'gas-bloat syndrome' generally occurs in patients who have undergone fundoplication procedures. It can occur with all types of hiatal hernia repairs (Nissen, Belsey, Hill, Thal repairs) [40]. The incidence is highest and reported most frequently after the Nissen procedure. It varies from 10 to 25%. One observer noted an incidence of 54% in a study of sixty-eight patients [40–44].

The patient generally complains of an inability to eructate or vomit. Air is trapped in the stomach producing early satiety and epigastric fullness. As the patient attempts to relieve the discomfort by eructating or vomiting, he swallows air. This vicious cycle leads to more entrapment of air thus increasing symptoms of bloating and fullness. Radiographs show significant gastric distention and marked narrowing of the newly created intra-abdominal esophagus (Fig. 14).

Goldstein and Butterfield [40] evaluated the 'gas-bloat syndrome' experimentally in animal models with complete and incomplete fundoplications. They noted that the extent of the fundoplication is not in itself important and contend that this syndrome is the result of a technically imperfect repair.

As noted in the prior description of pseudolesions, current surgical technique for either the Nissen or Belsey repairs includes the usage of a large bore nasogastric tube within the distal esophagus during the surgical procedure to allow for adequate patency of the esophagogastric surgical junction and hopefully minimize this problem [43].

Gastroileostomy

Another potential iatrogenic complication is an inadvertent gastroileostomy. Clinical distinction from a

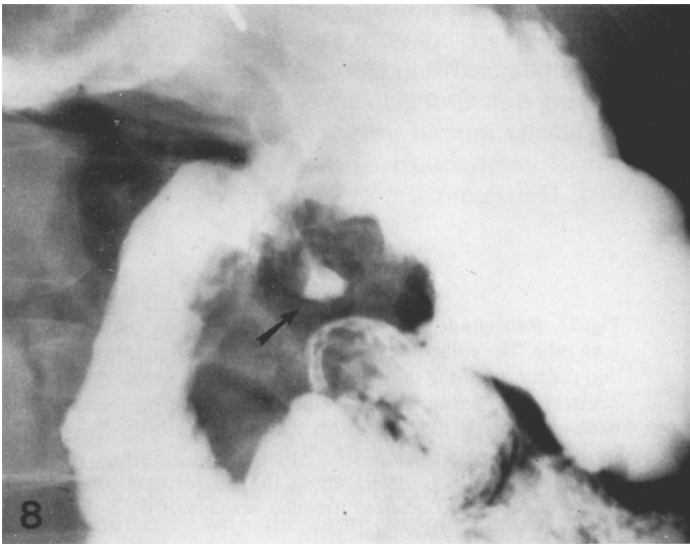


Fig. 8. The large outpouching (*arrow*) is somewhat unusual for a Finney pyloroplasty although the loss of a clear-cut pyloric canal and scalloping of the pyloroduodenal area is common



Fig. 9. This greater curvature mass was due to a foreign body granuloma about retained sutural material. The patient had previous colon surgery and a bleeding point in the gastrocolic ligament was ligated at that time

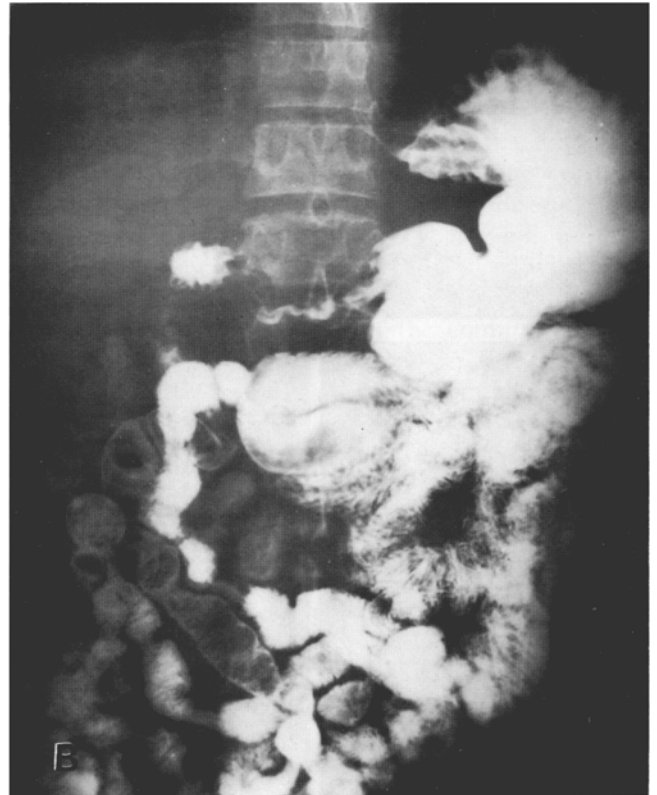


Fig. 10. **A** Marked foreshortening and pleating of the bowel along the path of the long intestinal tube. **B** The normal configuration of the bowel resumes following removal of the tube. (Case courtesy of C. Kaye, M.D., Connecticut)

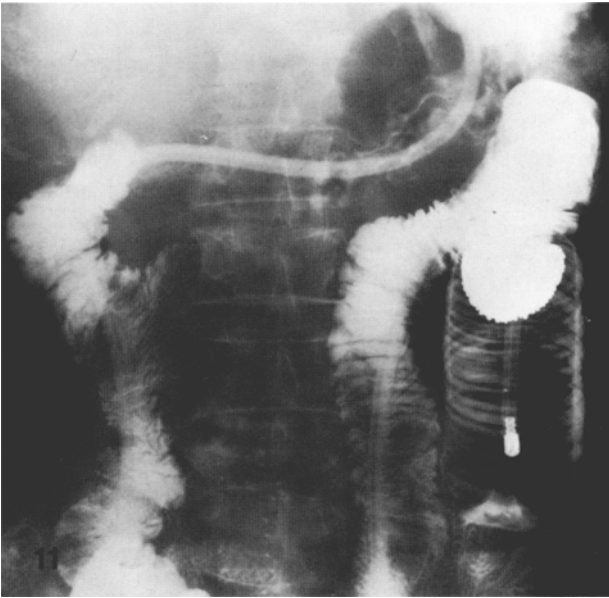


Fig. 11. Retrograde jejuno-jejunal intussusception associated with long tube. The coilspring appearance of the dilated intussusceptum and the lumen of the intussusceptum are both demonstrated. (Case courtesy of S. Schwartz, M.D. Connecticut, and *American Journal of Roentgenology* 125:717, 1975)

Fig. 12. A The large defect about the gastrostomy tube is seen on initial study. **B** Localized irregular scar is noted on the greater curvature several years later

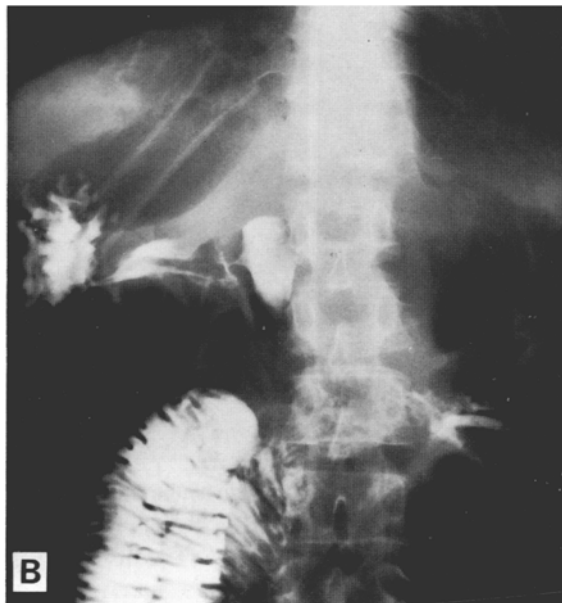
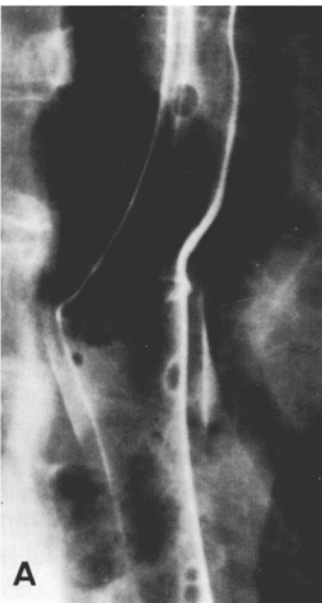
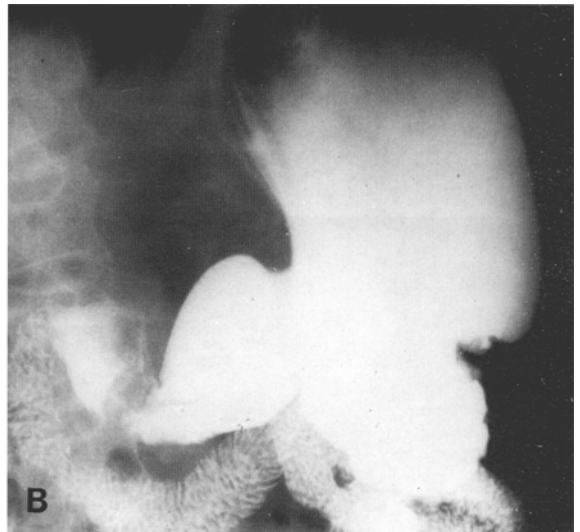
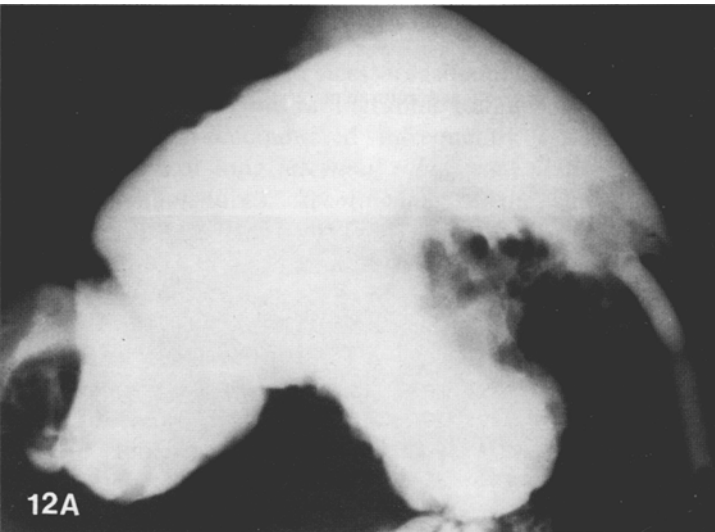


Fig. 13. A Silastic tube placed endoscopically to maintain patency of upper gastrointestinal (GI) tract. **B** The patient subsequently had an episode of steak impaction in the tube and following attempted endoscopic removal the tube was accidentally pushed into the stomach. Another iatrogenic complication occurred when the surgeon in attempting to remove the tube from the stomach could not find it and did a feeding 'gastrostomy' into the jejunum, failing to recall the presence of situs inversus and making too small an incision to appreciate true topography

gastrojejunal-colic fistula is readily made. Patients with a gastroileostomy have early onset of symptoms which include inanition, marked diarrhea, and malabsorption. In distinction to the diagnosis of a gastrojejunal-colic fistula best made by barium enema, the diagnosis of an inadvertent gastroileostomy is more readily made by an upper gastrointestinal series (Fig. 15).

Foreign Bodies

Inadvertent retained foreign bodies fortunately are rare complications of surgery (Figs. 16 and 17). Their radiographic appearance may be confusing. Hemostats, needles, clamps, etc., present little problems in detection. The detection of sponges is more difficult and familiarity with the radiographic appearance of sponges in current use is most helpful. Various opaque markers are used to simplify detection of sponges. However, sponges may go undetected for years even when marked [45].

Bezoars

Although not directly related to surgery, it is the physician's directives to the patient in the postoperative period which are extremely important in preventing bezoar formation. Adequate instruction of the patient in proper dietary habits is essential to prevent bezoar formation.

Gastric bezoars are more commonly associated with the Billroth I anastomosis whereas small bowel bezoars are most commonly associated with the Billroth II anastomosis [46]. Findings clinically may consist of mild satiety, epigastric fullness, to symptoms of complete obstruction. The onset of symptoms varies from days to years following surgery. The etiology is related to many things including improper diet (especially oranges), delayed emptying, narrowed stoma, decreased secretions, and improper mastication. The most common site for obstruction is at the terminal ileum [46-48].

The bezoar type is a phytobezoar. It is a combination of fibrous matter, skin, seeds, leaves, etc. The most common cause of these are oranges. Rarely, bezoars form from fungus balls (candida) and antacid concretions. The radiographic diagnosis consists of the demonstration of irregular masses coated with barium retained in the gastric antrum or elsewhere. The diagnosis may well be made on the plain films where irregular, mottled areas of air trapped within a bezoar may suggest this diagnosis. Treatment consists of gastroscopic removal, lavage, enzyme dissolution, and surgery in the case of obstruction [49].

Post-Vagotomy Dysphagia

Dysphagia may occur postoperatively after a vagotomy. Several mechanisms which may explain this problem consist of: vagal denervation of the esophagus, periesophageal edema, and postoperative esophagitis. A review by Wirthlin and Malt of one thousand and ninety-six patients found a 5% complication rate [50]. Similar results are evident from several other more recent studies [11].

An esophageal motility study in patients with vagotomies demonstrates failure of the esophagogastric sphincter to relax. This can look similar to early changes of achalasia (Fig. 18).

Afferent and Efferent Loop Syndromes

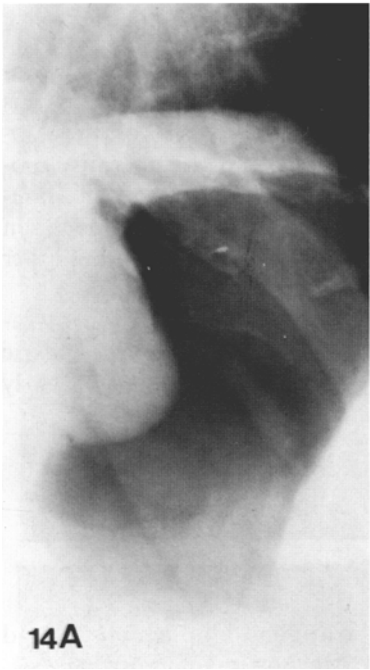
Acute Afferent Loop Obstruction

Acute obstruction of the afferent loop is unusual and disastrous if untreated. Markowitz [51] found no significant difference in incidence of acute afferent loop obstruction comparing ante and retrocolic anastomoses. In his series, 19 of 21 cases were noted to occur with right to left anastomosis. Appropriate surgical anastomosis (with suturing of the potential retroanastomotic space created) may prevent occurrence of this problem.

The incidence of this varies from 0.5-1% with a 50% or greater mortality [52, 53]. The onset may be acute or years after surgery. The syndrome consists of severe upper abdominal pain, non-bilious vomiting, and sometimes a tender left upper quadrant abdominal mass. Pancreatitis and jaundice may occur secondary to obstruction of the common bile duct [52]. Herniation of the afferent loop through a surgical defect behind the gastroenteric anastomosis is the most common finding at surgery (Fig. 19). With appropriate clinical suspicion, non-filling of the afferent limb associated with a left upper quadrant mass on upper gastrointestinal series suggests the diagnosis. Non-filling of the afferent loop occurs commonly on routine upper gastrointestinal series and this alone does not imply the diagnosis.

Chronic Afferent Loop Obstruction

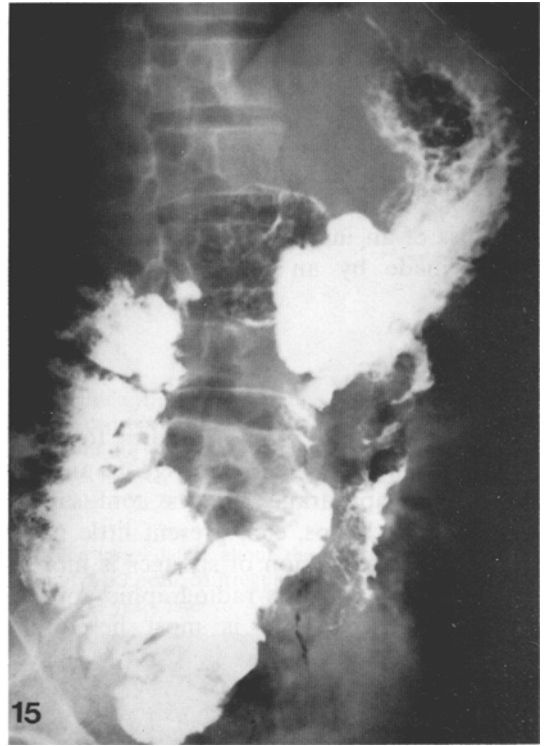
Burhenne [54] has described an iatrogenic form of chronic afferent loop obstruction where apparent preferential gastric emptying into the afferent loop occurs. These patients may present with intermittent bilious vomiting, weight loss, anemia, malabsorption, and steatorrhea. The symptoms are felt to result from



14A



B



15

Fig. 14. A Gaseous distention of the stomach and a mass in the cardia are seen in this patient who has undergone Belsey type fundoplication and complained of bloating and inability to belch. **B** The narrowing of the newly created intraabdominal esophagus is desirable for preventing reflux but also produces 'gas bloat' type symptoms

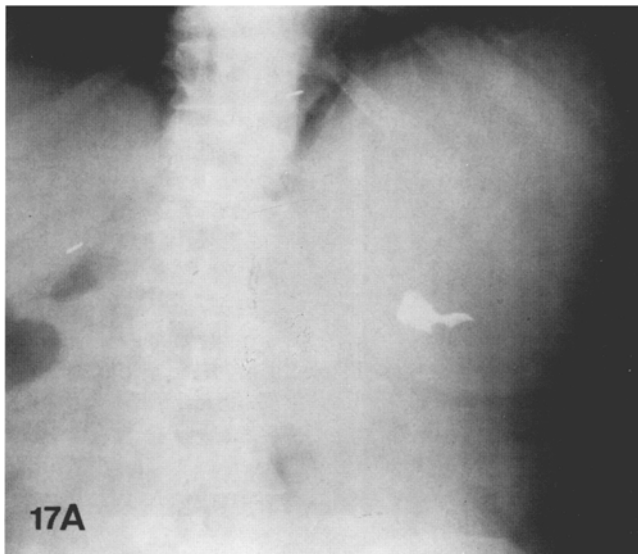
Fig. 15. This patient developed marked diarrhea within 2 weeks following surgery. Upper GI series reveals short circuiting of most of small bowel secondary to inadvertent gastroileostomy. (Case courtesy of R. Shapiro, M.D., Connecticut)

Fig. 16. Retained sponge in gallbladder fossa with surrounding abscess (*arrows*). This subsequently perforated into bowel and was passed per rectum

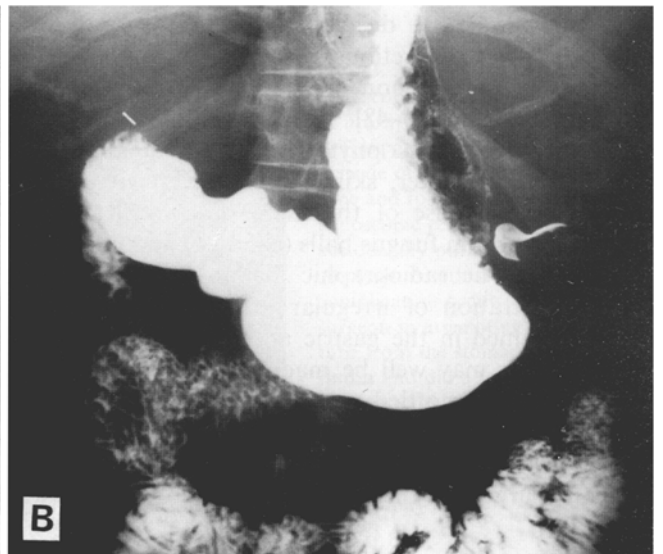
Fig. 17A and B. Following splenectomy a large left upper quadrant abscess surrounds a sponge in the area of the pancreatic bed and is seen distorting and displacing the stomach. (Case courtesy of M. Keohane, M.D., Connecticut)



16



17A



B

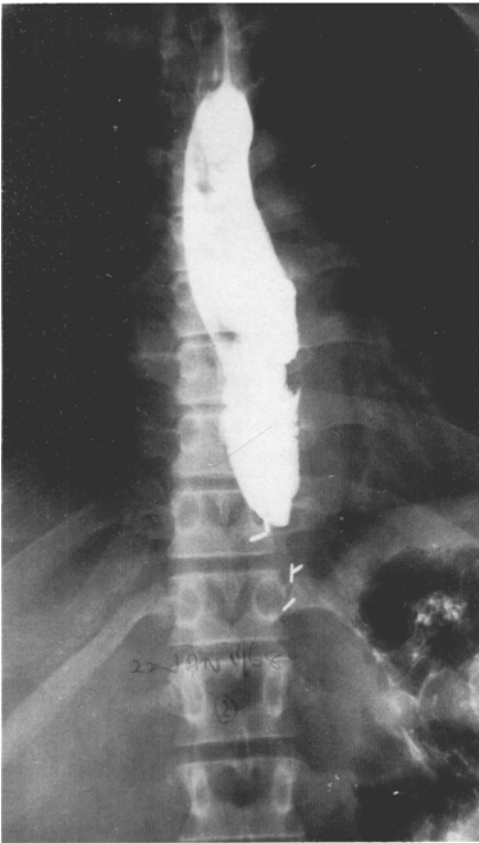


Fig. 18. This patient experienced food sticking in lower chest following vagotomy and X-ray studies revealed long smooth narrowing of lower esophagus with partial obstruction. Symptoms abated in several months and the appearance of the lower esophagus returned to normal

stasis in the afferent limb with accumulation of biliary and pancreatic secretions. This is an incomplete obstruction.

Radiographic findings include preferential filling of the afferent limb, retention of barium on delayed films, and regurgitation of contrast into the stomach from the afferent limb (Fig. 20). These findings are sometimes more obvious on upright examination where there is prompt filling of this limb with barium [54]. During the surgical procedure to correct this abnormality, the surgeon may face an unremarkable anastomotic site. The reasons for this appearance may be due to the anesthesia (relaxed abdominal muscles) and the supine position. Revision of the anastomotic site generally resolves the problem.

Efferent Loop Dysfunction

Conservative therapy of efferent loop dysfunction is the appropriate mode of therapy. The iatrogenic problem here is one of premature surgical intervention for what appears to be obstruction. Efferent loop

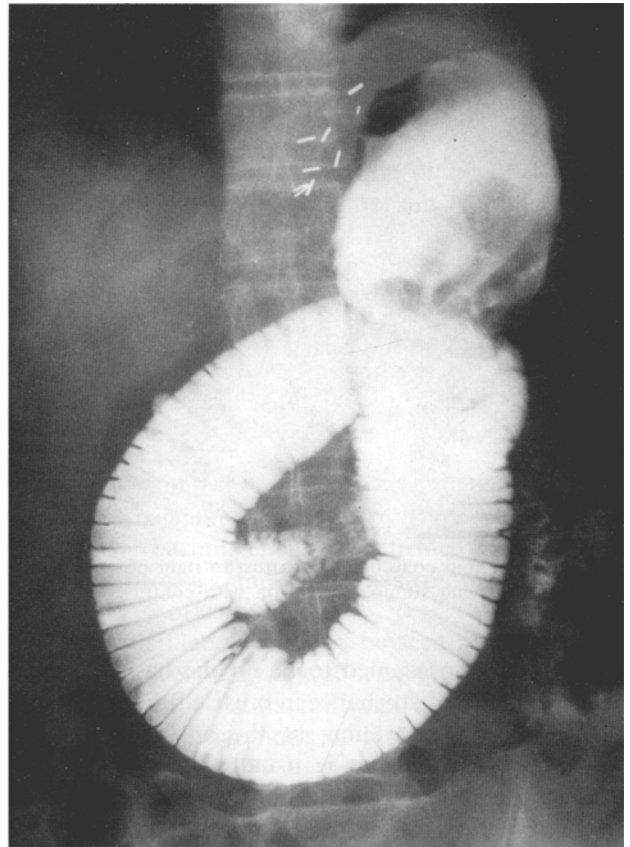


Fig. 19. Acute abdominal pain was associated with marked distention of the efferent loop and a localized defect at the gastric stoma near the anastomosis. The defect was secondary to incarceration of a loop of bowel in this area

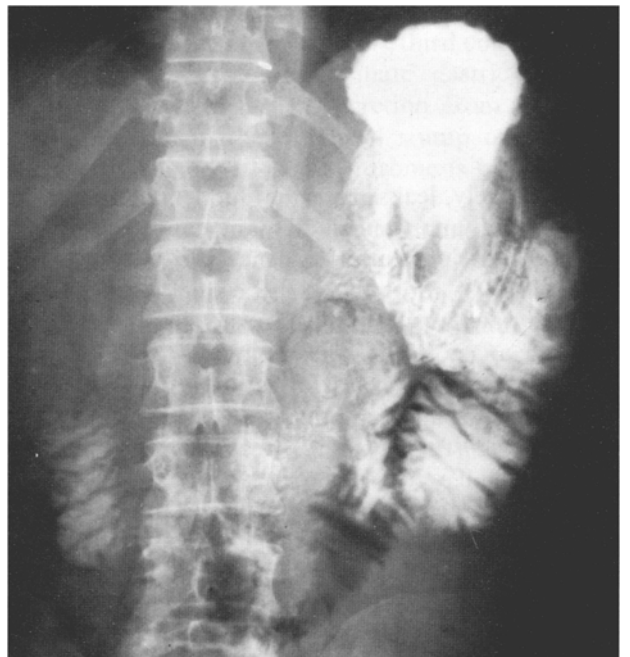


Fig. 20. The distended loop of bowel is the efferent loop which is anastomosed in a left-to-right fashion with obstruction secondary to knuckling of the efferent limb just distal to the anastomotic margin

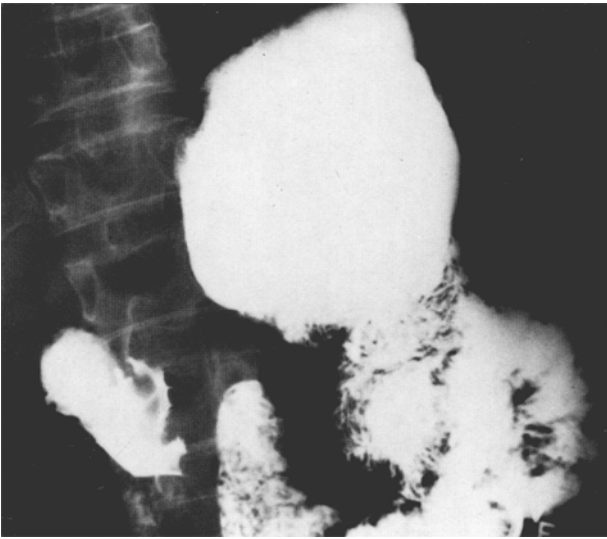


Fig. 21. Amorphous collection of contrast to right of spine is secondary to duodenal stump perforation with contrast pooling in abscess cavity

dysfunction is presumed to be on the basis of localized, temporary disturbance in muscle function resulting from surgical trauma at the anastomosis. The onset of this condition is usually characterized by a lag period of eight to ten days postoperatively. It may last from a few days to several weeks and often remits spontaneously. The characteristic clinical feature is bilious vomiting [55, 56]. Radiographs reveal poor filling of the efferent loop for two to ten centimeters below the site of the surgery. The mucosal pattern remains normal, but the emptying is markedly delayed.

Leakage

Postoperatively, leaks from the duodenal stump and gastroenteric anastomosis remain the single most common cause of death. Incidence varies from 1–5% with a 40–50% mortality [57]. Leakage occurs more frequently at the stump closure site than at the gastroenteric anastomosis. The etiology of leakage is felt to be secondary to devascularization around the duodenal stump or anastomotic site.

Duodenal stump leakage occurs within the first two and a half weeks postoperatively. The most frequent time of occurrence is during the three to seven day postoperative period. Clinically, the patient presents with sudden onset of fever, abdominal pain, and tachycardia. Without surgery the mortality is 100% [58]. Peterson et al. describes a group of patients presenting with ileus, retention, and fever. In this group spontaneous closure of the tract has occurred [57].

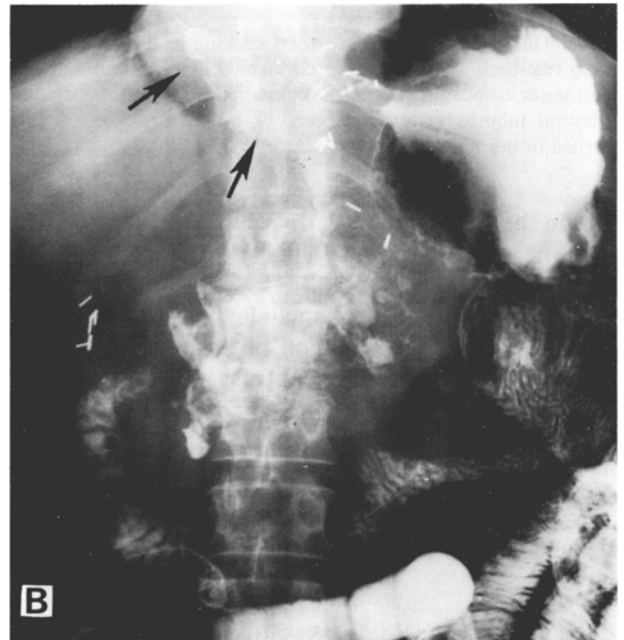


Fig. 22A and B. Massive central collection of contrast and air is in large abscess related to leakage at gastroenteric suture line. The defect in the area of gastric fundus and contrast alongside esophagus (arrows) are related to subdiaphragmatic abscess tracking into mediastinum respectively. This patient's iatrogenic problems started with perforation of the bladder following manometrics at that time of prostatic surgery. He subsequently developed a stress ulcer which bled profusely and then underwent the gastric surgery seen above

Radiographic findings include plain film demonstration of abscesses, peritonitis, and obstruction. Contrast studies may reveal the site of extravasation (Fig. 21). An anastomotic leak (Figs. 22 and 23) may be generalized or localized to the left upper quadrant. With stump leakage, fixed lucencies in the subhepatic space and deformity in the lesser curvature of the stomach may be seen [59].

Obstruction

Failure of gastric emptying after gastric surgery is most commonly caused by stomal edema [60]. Other causes may be more related to iatrogenic problems. These consists of: gastric atony as a result of vagal denervation, minor suture leak resulting in an abscess with surrounding edema, postischemic fibrosis of the duodenum, internal herniation (Fig. 24), and retrograde jejuno gastric intussusception [61, 62]. Less frequently related causes are volvulus about the gastrojejunostomy perhaps due to excessive mobilization and defective suturing of the transverse mesocolon allowing slippage of both limbs of the anastomosis superiorly. They become entrapped within the opening of the transverse mesocolon. This has been termed the 'pantaloon syndrome'. Stomal or efferent loop obstruction occurring postoperatively is best managed conservatively.

Antral Narrowing Post-Gastroenterostomy

The gastric antrum may become atrophic and contracted long after surgery. The radiologic appearance may be confused with infiltrating carcinoma. Knowledge of this may prevent unnecessary surgery [63].

Hajdu et al. [64] reviewed one hundred thirty-two patients with a gastroenterostomy. He found thirteen patients with hypertrophy of the pylorus and antrum. The radiographic diagnosis rests on the demonstration of the relatively smooth, concentric narrowing of the pyloric antrum. The incidence in this group of patients was higher than in a random group of upper gastrointestinal studies (21 out of 6456 patients; 0.32%).

Another type of stricture is that which occurs in the proximal efferent loop, presumed secondary to ulcer scarring.

Fistula

Stomal ulcers, if unrecognized or inadequately treated, may pursue an aggressive course with a well

known tendency to perforate into the peritoneal cavity or transverse colon with a resulting gastrojejuno-colic fistula (Fig. 25). This occurs rarely after a gastrojejunostomy. The most common site for fistulization is at the suture line of anastomosis (gastroenteric), or in the Hofmeister suture line of the gastric remnant. Diarrhea and weight loss are present in 80% of cases. Fecal vomiting and fecal breath are found in less than 30% of cases. The interval of occurrence may be immediately postoperatively or up to twenty-five years after surgery [65].

The malabsorption which may occur with fistulae is caused by bacterial overgrowth of regurgitated fecal material into the small bowel. The result of this is severe diarrhea [66].

Radiographically, the best way to demonstrate fistulae (gastrojejuno-colic) is with a barium enema. In one study, barium enemas confirmed the diagnosis in 100% of cases and upper gastrointestinal studies in only 11% of cases [67].

Other fistulae which may be seen are enterocutaneous ones secondary to duodenal stump leakage and enterocutaneous fistula following the leak from the gastroenteric anastomosis or Hofmeister suture line.

Marginal Ulcer (Anastomotic Ulcer, Stomal Ulcer)

The two most common causes of marginal ulcers are inadequate vagotomy and simple gastroenterostomy without vagotomy. This latter procedure diverts secretions from the ulcer bed but does not shut off the gastrin producing mechanism. A third common surgical deficiency is an inadequate gastric resection. Lastly, increased gastrin secretion from a retained distal antrum in the duodenal stump or an unrecognized Zollinger-Ellison syndrome is highly ulcerogenic [68].

It is estimated that a marginal ulcer will subsequently develop in 3–10% of patients operated on for duodenal ulcer. It is much more common in men than women (6:1). Of the current operative procedures, vagotomy and partial gastric resection consistently has the lowest reported ulcer recurrence rate of 0–2% [69].

The radiographic appearance of marginal ulcers is sometimes very difficult to appreciate. Many authors relate a 50% positive diagnostic rate for these ulcers and a suspicion rate of approximately 80%. The site of ulceration is generally within the first two centimeters of the anastomosis on the jejunal side. Secondary findings to assist in making the diagnosis consist of rigidity and lack of peristalsis in the proximal jejunum and spasm of the transverse colon adjacent to the anastomosis [70].

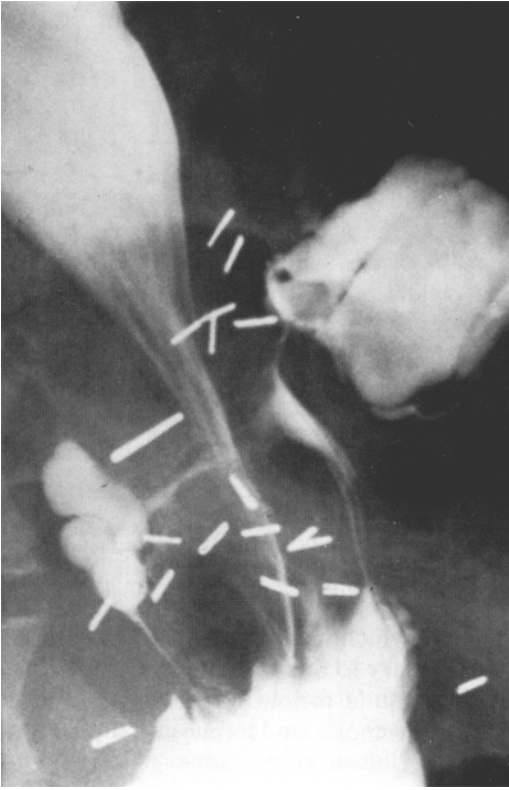


Fig. 23. Extravasation of contrast following fundoplication leading to mediastinal abscess. (Case courtesy of M. Keohane, M.D., Connecticut)

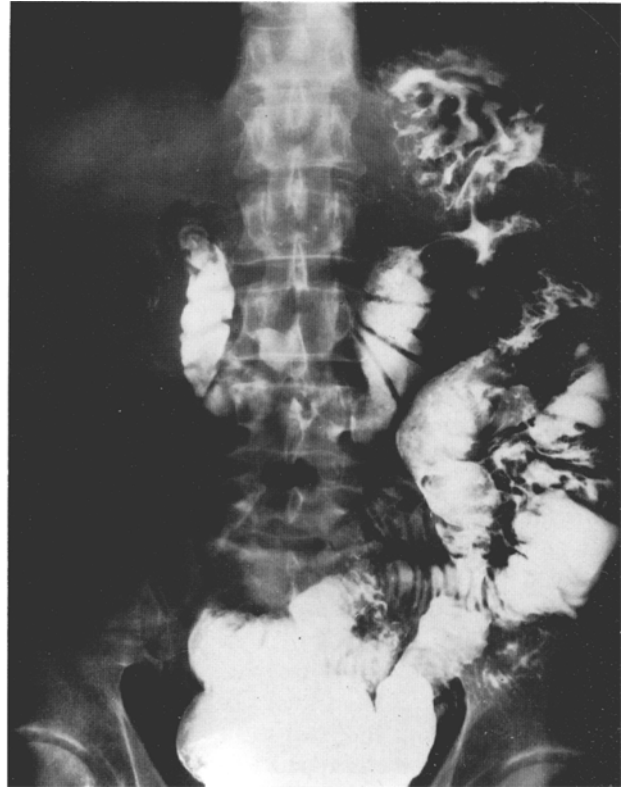


Fig. 25. Barium enema reveals reflux of contrast material into stomach and efferent loop. The marginal ulcer seen opposite the anastomosis is responsible for the gastrojejunal fistula. (See acknowledgement on page 255)

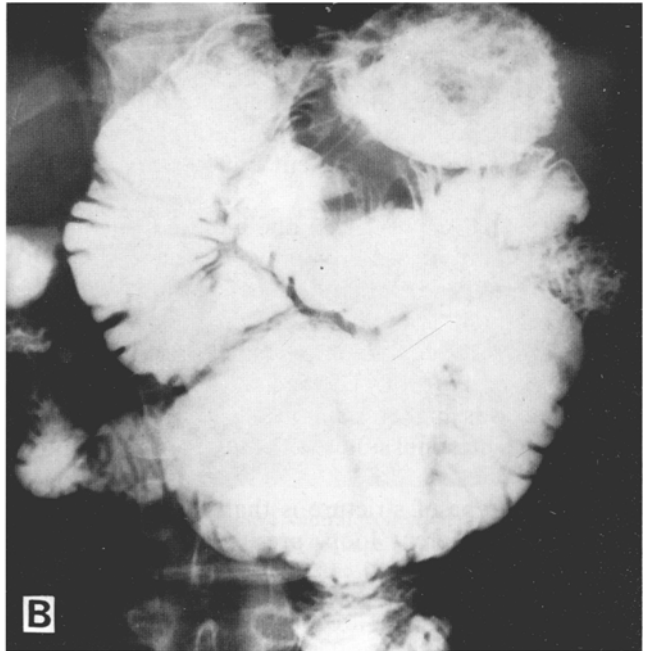
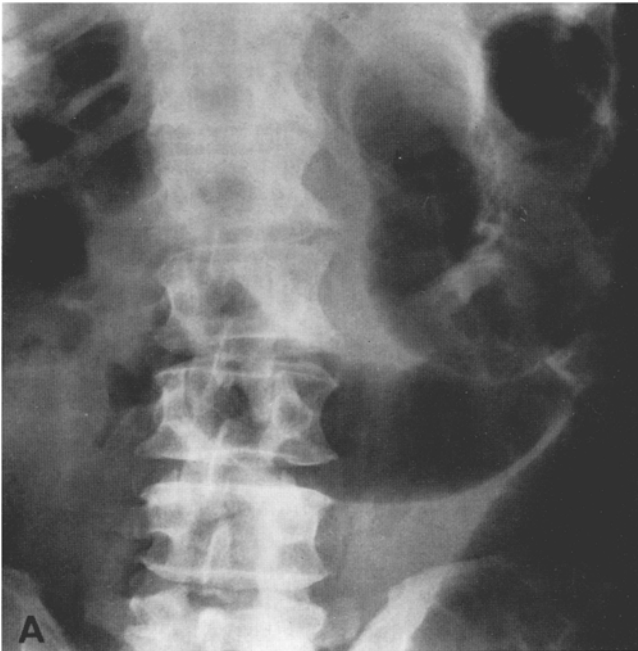


Fig. 24. **A** Following Billroth II procedure plain film demonstrates multiple dilated loops of small bowel in left upper abdomen. **B** Barium study reveals these loops to be contained in a sac-like enclosure in the upper abdomen. At surgery these loops were entrapped in a large retroanastomotic hernia

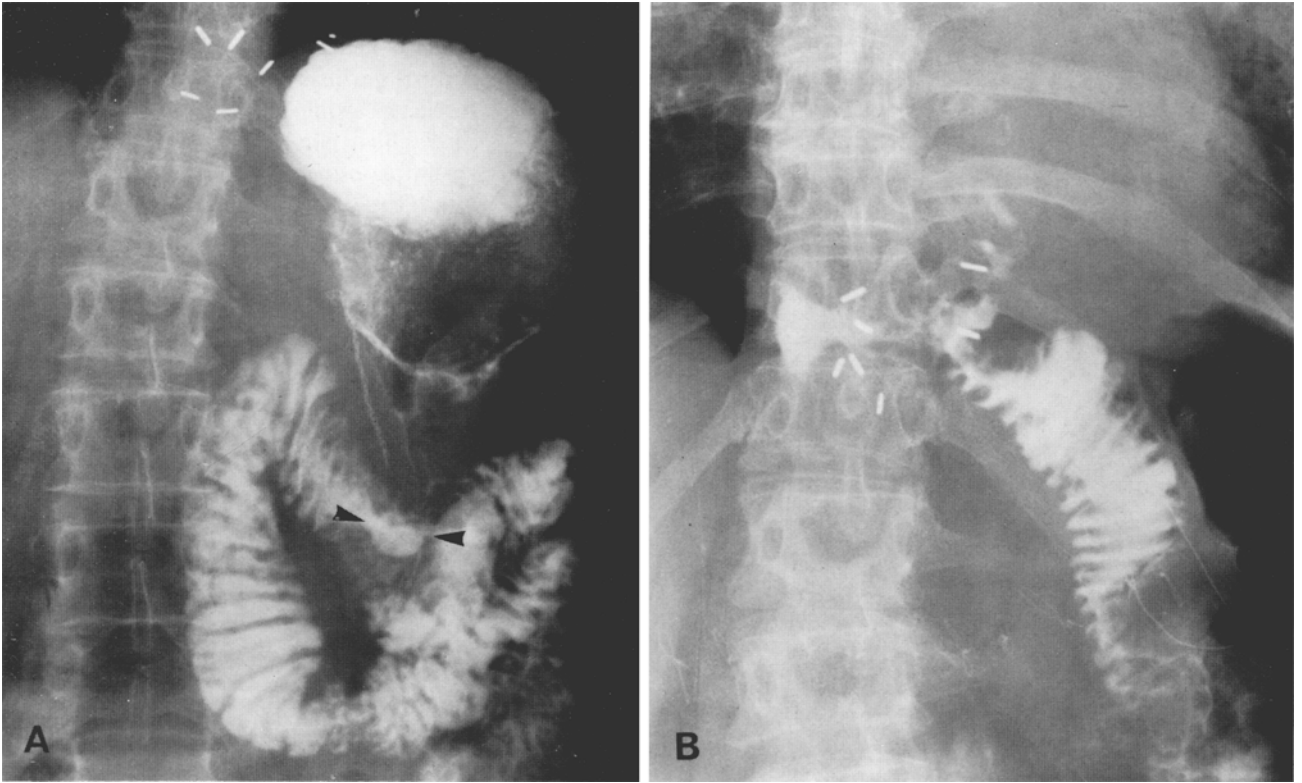


Fig. 26. **A** Marginal ulcer is seen here in classical location in this patient with very high gastrin level proved to be secondary to Zollinger-Ellison syndrome that was not recognized preoperatively. **B** An attempt was made to manage this patient with Cimetidine and although the ulcer decreased in size at first the lack of any further resolution lead to complete gastrectomy and the additional complication of anastomotic leak and mediastinal abscess



Zollinger-Ellison Syndrome

The presence of a gastrin secreting tumor, although rare, is an important cause of recurrent ulcers. This can be ruled out with gastric acid secretory tests and gastrin levels. The radiographic picture consists of evidence of hypersecretion on the upper gastrointestinal series associated with multiple ulcers occurring in unusual locations [69, 71, 72]. If this diagnosis is not recognized, the usual partial gastrectomy for ulcer disease will invariably lead to problems, i.e., recurrent ulceration (Fig. 26).

Once the diagnosis is confirmed, the surgery of choice is total gastrectomy with reconstitution of a gastric pouch from the remaining small bowel (Hunt-Lawrence pouch).

Fig. 27. Marginal ulceration and edema of bowel loops adjacent to anastomosis are secondary to excessive gastrin secretion from retained antral tissue which is not in continuity and thus cannot be inhibited by acid or distention. (Case courtesy of A. Clemett, M.D., New York; see acknowledgment on page 255)



Fig. 28. Contrast is already in the colon on this film taken 15 min following barium meal in a patient with clinical symptoms of dumping. In general, we have not found a good correlation between the radiographic transit time of contrast and clinical symptoms

Retained Gastric Antrum

Although this is a rare occurrence, retained gastric antrum produces similar symptoms as found in the Zollinger-Ellison syndrome. The normal inhibitory factors of acid and distension cannot act upon the antrum. Thus gastrin production proceeds continuously, acting on the fundus and parietal cells to cause hypersecretion and hyperacidity and thus ulcer predisposition [73].

The radiographic demonstration is extremely difficult. The efferent loop must be seen, as well as the duodenum and duodenal stump. A search is then made for residual antrum and pylorus [74, 75] (Fig. 27).

⁹⁹Tcchnetium may be helpful in locating residual antral tissue [76]. Its visualization is time related and its accuracy is limited by varying blood concentrations and time of maximum concentration of the isotope within the retained antral tissue.

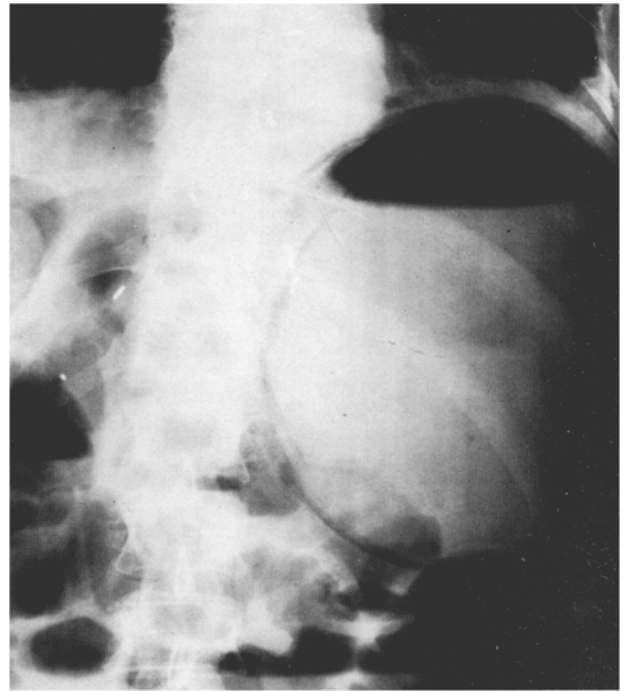


Fig. 29. A benign linear gas collection is seen in the wall of the stomach in this post-gastric surgery patient who had received respiratory assistance. The patient was managed conservatively and this resolved without consequence

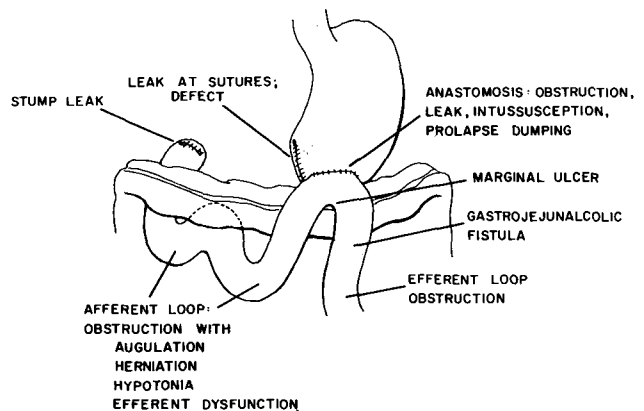


Fig. 30. Schematic diagram of several of the potential complications in the postoperative stomach. (See acknowledgment on page 255)

Prolapse

Gastric prolapse may be iatrogenic in the sense that the predisposition for this problem is thought by some to be related to the type of surgical closure [77]. It may be related to mucosal redundancy about a Hofmeister closure [78]. It also has been described with the Polya repairs.

Patients with this condition may present with bleeding, however, it is difficult to relate the radiologic picture to the clinical problem.

X-rays are characteristic [77, 78]. A smooth, sharply demarcated filling defect is seen in the post-anastomotic small bowel resulting from the prolapsed mucosa. The size of the prolapse varies and may originate symmetrically or asymmetrically from either anterior or posterior margin of the stoma producing the appearance of two separate masses.

Treatment is generally symptomatic. Prolapse is usually self-reducing.

Dumping Syndrome

The dumping syndrome is due to disruption or bypass of the pyloric sphincter mechanism. It occurs after any type of gastric surgery. The stomal size may also be directly related to the development of the dumping syndrome. This has not been definitely proven, however, as a major cause of this syndrome. The symptoms are both vasomotor (flushing, sweating, tachycardia) and intestinal (cramps, diarrhea) [79]. Because of the great fluctuation in blood glucose levels, some patients may faint or actually have hypoglycemic seizures. Generally, the symptoms start fifteen to thirty minutes after eating, and may last for thirty to ninety minutes. Fortunately, in the majority, symptoms tend to decrease in severity with the passage of time. Statistics as to the frequency of occurrence of this syndrome vary; however, in a study by Hardy of six hundred and four patients, twenty-nine (5.8%) developed the dumping syndrome [80].

Radiographic correlation is not very accurate when compared with the physiologic problems associated with this syndrome. An upper gastrointestinal study may reveal extremely rapid transit time with simultaneous visualization of both the stomach and distal colon after a barium meal (Fig. 28).

Treatment is generally symptomatic and aimed at control of the diet. For severe cases, surgical intervention is needed [81].

Miscellaneous

Gastric stump carcinoma is a very rare form of gastric carcinoma. It accounts for approximately 1% of all forms of gastric carcinoma. There is a definite increase in the frequency of this entity in patients post-gastrectomy when compared with the general population [82]. The radiographic picture reveals an irregular polypoid mass at the anastomotic margin or within the stomach. There may also be diffuse shrinkage of the stomach and possibly findings of gastric outlet obstruction [83].

Esophagitis, gastritis, and jejunitis occur postoperatively. Esophagitis may occur secondary to a nasogastric tube, bile reflux, or post-vagotomy with esophageal vestibular spasm [84–86]. Strictures may occur secondary to the nasogastric tube and associated

reflux. Reflux gastritis is recognized as a complication following surgery either removing, altering, or bypassing the pyloric sphincter mechanism [87]. The radiographic findings with esophagitis, gastritis, and jejunitis are nonspecific.

Unusual cases of stomach rupture have been reported associated with oxygen therapy by nasal catheter [88]. Other related items include air within the wall of the stomach (Fig. 29) related to respiratory therapy, intermittent positive pressure breathing therapy, and nasal oxygen.

Cryosurgery is frequently used via endoscopy for routine polypectomies. In a case which we recently observed, a gastric polyp was removed uneventfully with endoscopy and cryosurgery. Follow-up endoscopic pictures of the polypectomy site showed an area of ulceration. A follow-up barium study of the stomach revealed this area. It was completely indistinguishable from a routine gastric ulcer. Knowledge of this occurrence may be extremely helpful in routine follow-up of these patients.

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