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THE HAZARDS OF GASTRO-INTESTINAL INTUBATION

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A variety of tubes have been employed for various gastro-intestinal problems, particularly in the fields of alimentation, decompression, diagnosis and esophageal tamponade. Originally the chief material used in the construction of these tubes was rubber. However in recent years the development in plastic, especially polyethylene, has made it possible to manufacture tubes which are less irritating to the patient. These various tubes have been the answer to some of the most difficult problems of the grastro-intestinal tract, not only in surgery, but also in medicine. Their judicious use, has been rewarded with the most gratifying results. However we cannot escape the fact that nearly every device which we employ, whether it be an instrument or a medication, is a two-edged sword. The excellent results achieved must be balanced against the occasional complication inherent in the use of such devices. Fortunately the majority of these complications are of minor consideration and are responsible for only minimal discomfort to the patient. However a certain number of these are associated with severe morbidity and even mortality. The purpose of this paper is not to discourage the use of gastro-intestinal intubation, but it is to point out some of the associated hazards, and to encourage the intelligent use of such devices for the management of complicated problems.

Over the past four years we have collected from the surgical services of the Henry Ford Hospital a large variety of complications arising from the insertion of tubes into the gastro-intestinal tract. It is our feeling that these are worthy of note and therefore they are being reported so that others may benefit from this experience. Each has been observed one or more times.

HISTORICAL

In 1790 John Hunter of London reported the use of a stomach tube for the purpose of feeding a patient with paralysis of the muscles of deglutition.[1,2] Throughout the nineteenth century only an occasional sporadic report appeared in the literature concerning the use of gastric tubes. The first four decades of the twentieth century saw the innovation of an entirely new armamentarium for our approach to gastro-intestinal problems. In 1921 Levin[3] described the smooth catheter-tipped tube which is in common usage today and now bears his name. In 1931 Wangensteen[4,5,6] showed the advantage of upper gastro-intestinal decompression in acute mechanical obstruction. Later, in 1933, Wangensteen and Paine demonstrated the advantage of constant suction, over siphonage, in decompressing the upper gastro-intestinal tract. Since that time there has been a tremendous increase in the trend toward the use of various types of tubes for the management of gastro-intestinal problems. This increased trend has resulted from a more thorough knowledge of the underlying patho-physiology of intestinal obstruction; from the performance of a greater volume and greater radicality of major surgery; from a more intelligent approach to the treatment of upper intestinal fistulae; and from increased use of tubular devices for alimentation with liquified foods, as developed and perfected by such investigators as Jones,[7] Snyder,[8] Barron,[9,10] Pareira,[11,12] and others.[13]

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Since 1934, Miller,[14] Abbott,[14] Cantor,[15] Harris, Honor, Smathers, and other men,[6,19] have developed various types of *long* tubes for small intestinal decompression. In 1941 Silvertsen advised the use of metallic mercury in the balloon of the Miller-Abbott tube to facilitate entry into the duodenum.[6] The Sengstaken-Blakemore tube, for tamponade of bleeding esophageal varices, has been used rather universally in recent years. At many institutions the small-bore, No. 240, polyethylene tube (P. E. Tube), has been used with increasing frequency, primarily for nutritional purposes, but also for small bowel decompression. The future will certainly bring forth different and more complex tubular devices and, of necessity, their associated hazards.

CLASSIFICATION

An anatomical classification of our complications is indicated since various types of tubes can inflict similar trauma as they traverse the gastro-intestinal tract. (Table I).

Table I

COMPLICATIONS OF GASTRO-INTESTINAL INTUBATION.

1. *Nasopharyngeal*
   - A. Pressure necrosis of tip of nose
   - B. Nasal Hemorrhage
   - C. Rhinitis
   - D. Conjunctivitis
   - E. Ear symptoms
   - F. Sinusitis
   - G. Pharyngitis
2. *Laryngotracheal*
   - A. Laryngitis
   - B. Laryngotracheitis—Traumatic
3. *Pulmonary*
   - A. Aspiration pneumonia
   - B. Aspiration asphyxia
   - C. Respiratory obstruction
4. *Esophageal*
   - A. Necrosis
   - B. Perforation
5. *Gastric*
   - A. Perforation (Miller-Abbott)
   - B. Perforation (Gastroscope)
6. *Duodenal—Perforation By Insertion of P. E. Tube At Surgery*
7. *Superior Mesentery Artery—Laceration*
8. *Small Intestine (Jejunum and Ileum)*
   - A. Obstruction
     1) Mercury bag
     2) Insusussception
     3) Secondary to silk suture (P. E. tube)
     4) Ulceration and stenosis
   - B. Perforations—Multiple
     1) Miller-Abbott tube
     2) Silk thread of P. E. feeding tube
9. *Extubation Complications*
   - A. Knotted tubes
   - B. Intestinal Laceration
   - C. Reversed intussussception and accordion effect
10. *Problem of Retained Tube (Unable to remove in usual fashion)*
    - A. Gaseous distention of balloon (Diffusion)
    - B. Liquid distention of balloon (Medication by nurse through incorrect lumen)
    - C. Mercury bag at ileocecal junction
    - D. Mercury bag and silk suture in small intestine (P. E. tube)
11. *Rectal*
    - A. Laceration (pain and hemorrhage)
    - B. Perforation (barium enema tube)
    - C. Perforation (Sigmoidoscope)
12. *Colostomy*
    - A. Perforation with irrigation tube.

NASOPHARYNGEAL

In the nasopharyngeal region a large variety of less serious complications have been experienced with the use of tubes of various types. For the most part these are not serious; however, they are quite distressing to the patient. Pressure necrosis of the tip of the nose should be prevented by avoiding the immobilization of a firm tube tightly against one side of the external nasal orifice. Nasal hemorrhage and irritative rhinitis and pharyngitis can usually be avoided by the gentle insertion of tubes

following adequate lubrication with a local anesthetic ointment. Conjunctivitis, sinusitis, otitis media should be treated symptomatically for the comfort of the patient. Nasal drops, oral drops, anesthetic lozenges and analgesic medication should be used rather freely in the treatment of these unpleasant but less serious complications.

LARNYNGOTRACHEAL

The larynx and trachea of an individual may easily be traumatized during the insertion of intestinal tubes, especially when an uncooperative patient is involved. One dramatic case which we have experienced illustrates this. A 66 year old white female, who was admitted for subtotal colectomy for multiple polyposis, withdrew her Miller-Abbott tube during the night preceding surgery. Attempts to re-insert the tube in this uncooperative patient resulted in such traumatization of the larynx and trachea that the patient barely escaped the necessity of a tracheostomy. This was avoided only through vigorous conservative measures which necessitated the delay of her surgery for two weeks. Although we have experienced numerous instances of laryngitis from prolonged use of tubes, we have not seen the severe stenosing reactions requiring tracheostomy as occurred in 10 cases reported by Iglaner and Molt.[16]

PULMONARY

Aspiration pneumonia and asphyxia is a catastrophe which should and must be avoided. This is one of the most severe hazards with which we are constantly confronted, especially in the field of forced alimentation with liquified foods through intestinal tubes. It is obvious that no forced feeding should be instituted through a tube which is proximal to a level of obstruction. However, it is probably not so apparent to the novice in forced tube feeding that this should never be instituted into the stomach in an unconscious patient, a highly medicated patient, or in anyone who is unable to manage the problem of emesis and regurgitation. Under these conditions the feeding tube must be inserted into the proximal jejunum or beyond a point of obstruction to assure against any significant regurgitation and aspiration.

ESOPHAGEAL

The esophagus is subject to a great deal of traumatization since most tubes employed traverse this segment of the alimentary tract. The complications of the Sengstaken-Blakemore tube[17] should be universally recognized. If prolonged or excessive pressure is maintained in the esophageal portion of the balloon, necrosis and perforation of the esophagus may develop. Aspiration into the tracheobronchial tree of overflow secretions above the esophageal balloon in an acutely ill and debilitated patient is a constant hazard. If the gastric portion of the balloon should deflate for one reason or another, traction externally, as is frequently applied, may cause mechanical obstruction of the larynx as the esophageal balloon is withdrawn.

Figure 1 illustrates an extremely interesting complication which we have encountered in the use of the esophageal tube. This patient developed esophageal varicosities secondary to cardiac cirrhosis which had developed from a chronic constrictive

pericarditis. Following insertion of the Sengstaken-Blakemore tube for hemorrhage the esophagus was pushed forward against a sharp horn of calcific pericarditis. This laceration of the esophagus resulted in fatal mediastinitis in addition to his already existing lethal disease processes.

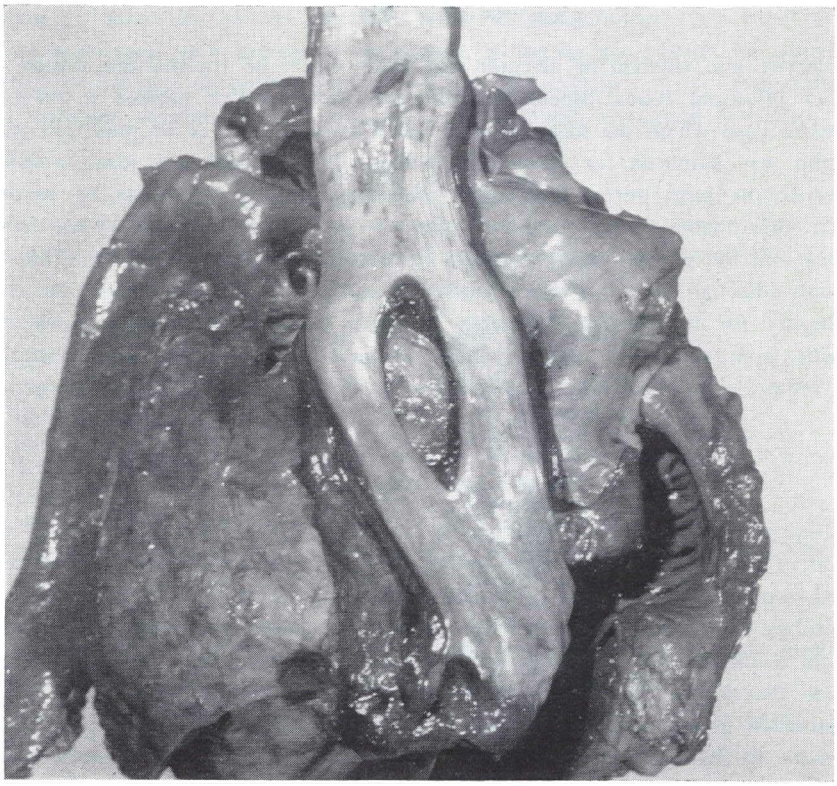

Figure 1

Esophageal laceration against pericardial calcific spur with use of Sengstaken-Blakemore tube.

Perforation of the esophagus is indeed a rare complication from the *ordinary* use of more common gastro-intestinal tubes. However, we have experienced one perforation of the lower esophagus near its junction with the stomach from the prolonged use of a Levin tube.

Diagnostic and therapeutic esophagoscopy has resulted in three perforations in our series and this represents a constant hazard when this procedure is undertaken. Several less serious mucosal lacerations have occurred with the use of the esophagoscope. The cricopharyngeus level presents the most difficult area to intubate, and therefore trauma with perforation is most likely to occur at that point.

GASTRIC

Perforation of the stomach is likewise rare in the ordinary use of gastro-intestinal tubes. However, we have had one patient who experienced a perforation of the stomach

nine months following the insertion of a Miller-Abbott tube. It was impossible to withdraw the Miller-Abbott tube at that time through the nasopharynx. It therefore, was transected with the expectations that this would pass through the intestinal tract and emerge at the rectum. Periodic x-rays, from time to time, encouraged optimism that the Miller-Abbott tube was progressing satisfactorily through the gastro-intestinal tract. Nine months later a portion of the tube was still present in the gastric pouch and was responsible for an acute perforation, requiring surgery for the extraction of the Miller-Abbott tube and closure of the perforation. This indicates that a foreign body of such magnitude which is maintained in the gastro-intestinal tract without good progress in a satisfactory period of time, constitutes an indication for surgical intervention in order to eliminate such severe sequelae as resulted in this case.

Gastroscopy is a more common method of gastric perforation and we have experienced three such cases in our series. Perforation by this method usually occurs high in the stomach near its junction with the esophagus. We believe that gastroscopic examination is by no means an innocuous procedure. It should be performed by an experienced operator under favorable circumstances and with careful manipulation.

DUODENAL

Perforation of the duodenum is indeed a rare complication from the use of Gastro-intestinal tubes. However, in one instance in our series we have experienced a perforation of the fourth portion of the duodenum. This was done at the time of a Billroth I gastrectomy when a polyethylene tube was being inserted beyond the anastomosis into the jejunum for postoperative feeding. A relatively rigid, rubber catheter tube with a fish-mouth slit at the tip is frequently used as an introducer for the insertion of the polyethylene tube into the distal intestinal tract at the time of surgery. Any such method of introduction must be done with extreme care since we believe that this is responsible for a fatal perforation of the fourth portion of the duodenum which was unrecognized at the time of surgery. Other less serious duodenal complications do occur in the form of superficial ulceration and laceration.

SUPERIOR MESENTERIC ARTERY

In one case in our series the superior mesenteric artery was lacerated, resulting in almost fatal hemorrhage. This represents one of our most fascinating and unique complications while using the No. 240 polyethylene feeding tube. The mechanism of trauma here demonstrates one of the most serious and feared complications of such a tube which employs a silk thread for the control of a weighted mercury bag at the end of the tube. This tube must be so constructed that there is no slack between the mercury bag and the end of the tube in order to prevent exposure of the bowel or other tissue to the sawing action of the silk thread. This can be, and is, a lethal weapon analogous to the action of a gigli saw. It should be pointed out here that these polyethylene tubes are so constructed in order to allow release of the mercury bag when peristalic action becomes so great as to cause cramping and obstruction. Following the release of the silk thread and mercury bag, a period of time must elapse before forced feeding is re-instituted. This is necessitated by the fact that the proximal portion of silk thread can be impacted somewhere along the

course of the tube due to the forced feeding, and thereby setting the stage of a potentially lethal circumstance in which a large portion of the taut silk thread is exposed to traumatize the intestinal wall. This has been a real hazard in the writer's experience, for this situation makes it hazardous even for the removal of the tube. In this particular case a bypass duodeno-jejunostomy had been performed in a 26 year old white female for the superior mesenteric artery syndrome. A polyethylene feeding tube inserted at the time of surgery was inadvertently withdrawn and a second tube was reinserted during the postoperative course.

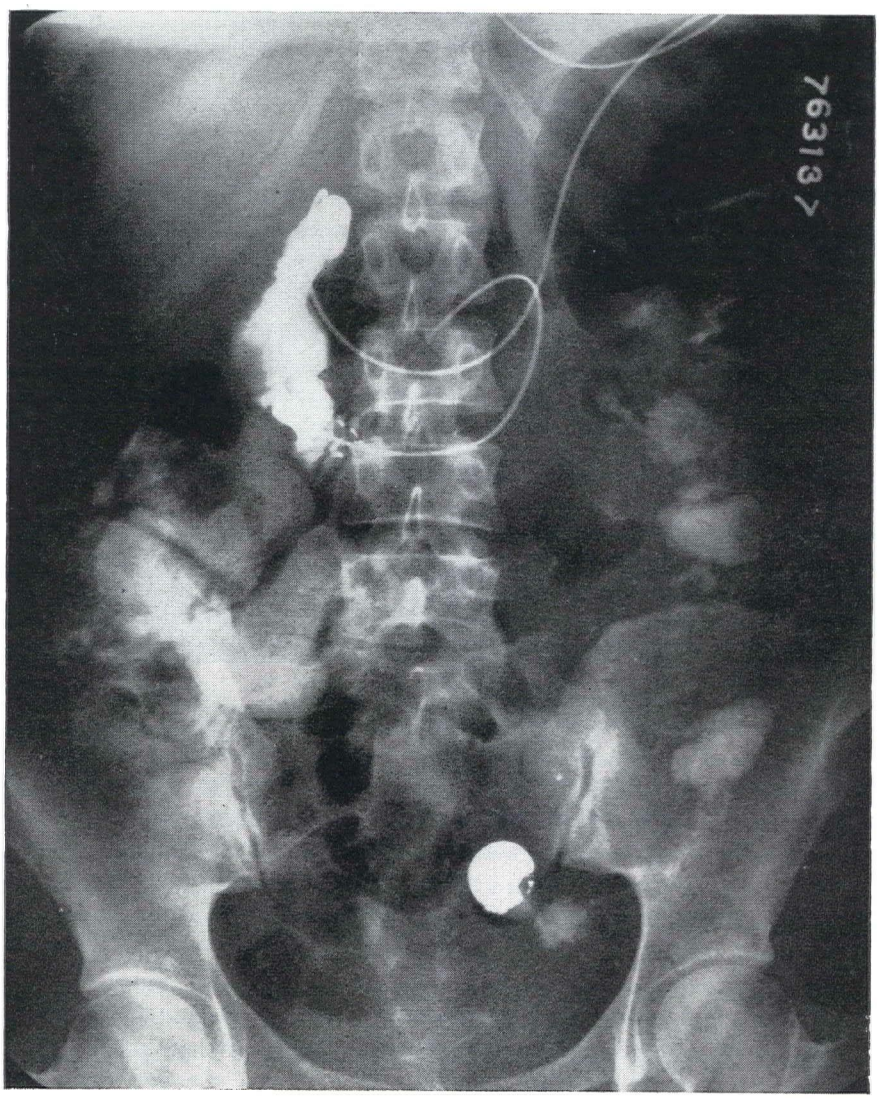

Figure 2

Feeding tube encircling duodenal loop after passing through duodeno-jejunostomy. Note also retained mercury balloon.

Figure No. 2 represents the course that this tube traveled. It traversed the duodenojejunostomy but returned in an anti-peristalic manner through the proximal limb of the jejunum and back through the fourth, third and finally second portion of the duodenum. A locking loop was thus formed around the altered intestinal tract by the polyethylene feeding tube. This resulted in laceration of the duodenum and superior mesenteric artery, and several operations with direct surgery on the artery were required to save the patient from this catastrophe. It should be pointed out at this time that any anatomical situation in which circular continuity of the gastro-intestinal tract has been established is an extremely dangerous one, no matter what type of tube is employed. Therefore, under this condition, precise insertion of

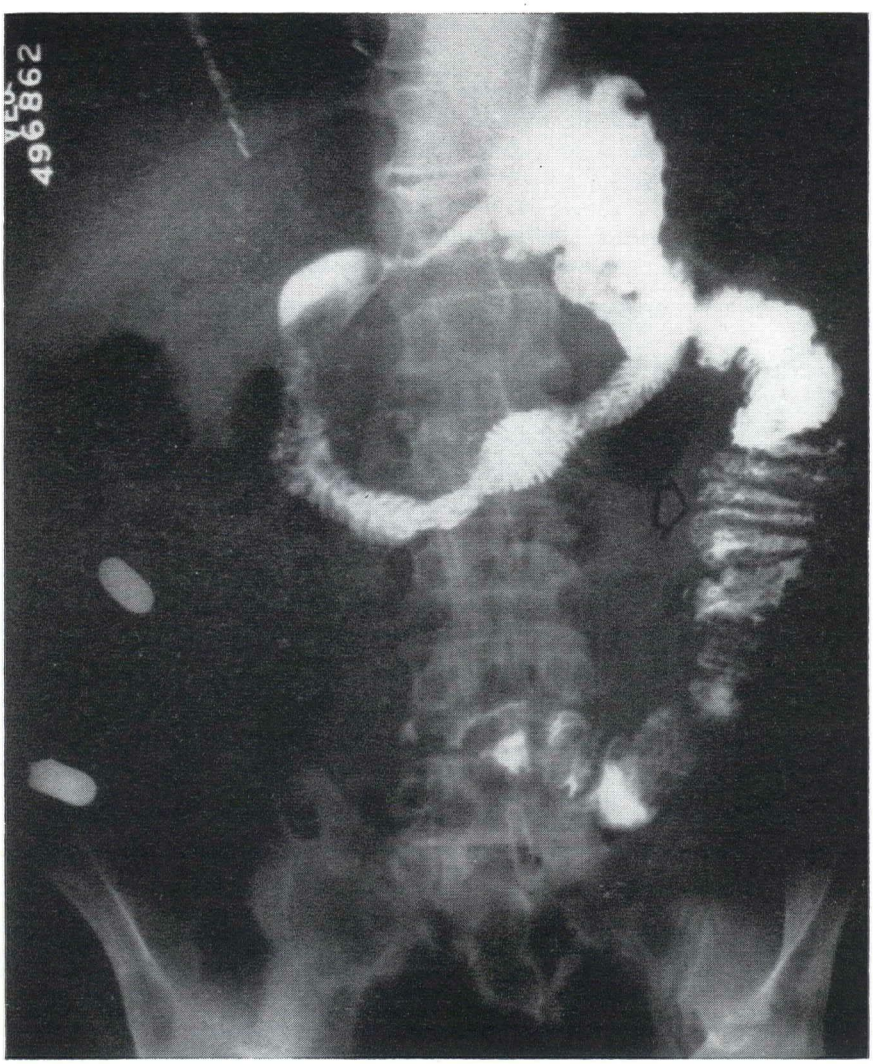

Figure 3

Accordion-like pleating of jejunum on feeding tube causing obstruction of intestine.

gastro-intestinal tubes under careful fluoroscopic visualization is mandatory.

Small intestinal obstruction is a phenomenon which we see with the use of any tube but especially more frequently with the small polyethylene feeding tube.

Figure 3 demonstrates the mechanism by which small intestinal obstruction can occur when peristalsis becomes active on the mercury bag attached to a long intestinal tube which is anchored externally to the patient's nose. Obstructive symptoms resulting from plication of the intestine and finally intussusception are frequently manifested by severe cramping abdominal pain and vomiting. This will occur with the use of any mercury bag intestinal tube which is anchored externally. Therefore we do not allow the Miller-Abbott tube to be anchored securely to the nose as this may result in severe intussusception and its sequelae. It should be pointed out here also that this is the reason for the construction of the polyethylene feeding tube in such a manner, that the mercury bag may be eliminated by the release of the intraluminal silk thread when cramping abdominal pain and other symptoms are first experienced by the patient.

Figure 4 illustrates a chronic intussusception firmly fixed by adhesions resulting in severe cramping pain and vomiting in a postgastrectomy patient.

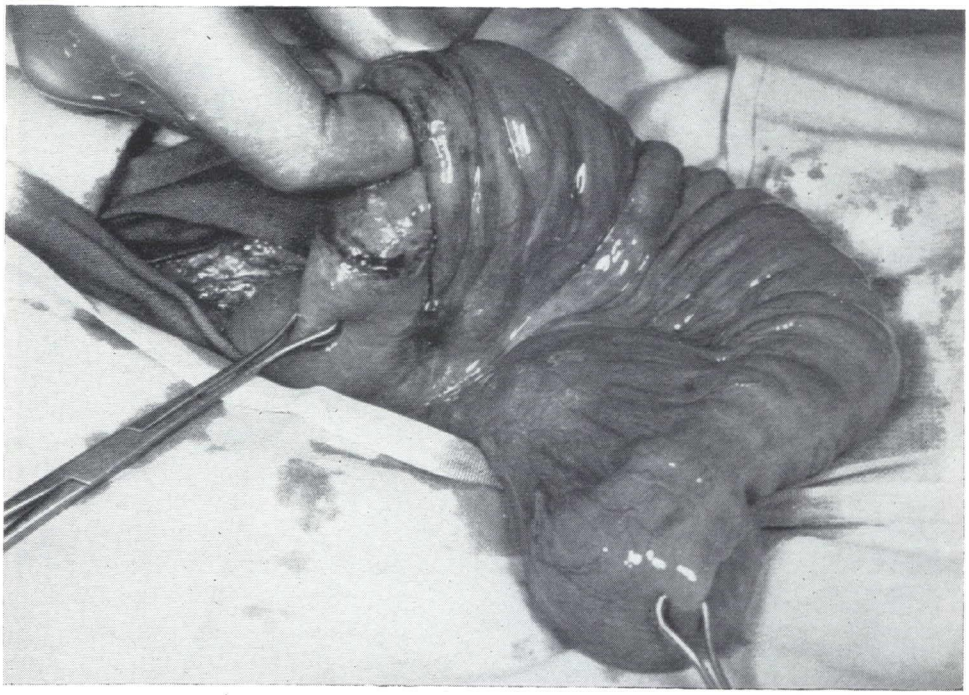

Figure 4

Chronic intussusception produced by feeding tube causing intestinal obstruction.

Several small intestinal obstructions have occurred secondary to retained silk strings after they had been released from polyethylene feeding tubes. It has been

the impression of this observer that the silk strings will pass rather readily through a normal intestinal tract. However, they tend to be retained in the small intestine when intraabdominal inflammatory disease and intestinal adhesions are present. These retained silk strings are frequently associated not only with obstruction but also with multiple perforations of the small bowel. The picture at the time of surgery is one of closely adherent kinked loops of small bowel with minute perforations at the angles of kinking; and, because of the close approximation of the bowel loops these perforations have been rather confined. At least two cases of jejunal ulceration with stenosis secondary to polyethylene feeding tubes have been observed. One case was found at autopsy and the second case required segmental resection of the involved area of jejunum.

We have had one very unique experience in which obstruction with gangrene and multiple perforations of the small intestine was inflicted by injury from a Miller-Abbott tube. The tube in this instance was unable to be withdrawn. Unfortunately, excessive tension was placed upon the tube during the attempts at extubation, and then the tube was anchored securely to the nose. The severe intussusception and accordion effect on the small bowel in this case resulted in gangrene and multiple perforations, requiring resection of a long segment of jejunum and ileum with closure of numerous other perforations in order to save the patient from this unusual injury.

EXTUBATION COMPLICATIONS AND RETAINED TUBES

Extubation complications, per se, that we have experienced have been quite distressing to the patient and are potentially dangerous, but have resulted in very few catastrophes to this writer's knowledge. Some of the more common examples of this condition in our experience have been the withdrawal of knotted tubes with extreme difficulty and discomfort to the patient, mild intestinal lacerations resulting in minimal gastro-intestinal bleeding, and intestinal plication with reversed intussusception which is usually corrected before serious damage has been inflicted. If one is unable to remove the gastro-intestinal tube without undue hazard or damage, one then gets into the problem of the *retained tube*. Some items relating to this category have been mentioned in the preceding paragraphs such as retained silk strings which do not pass, a retained Miller-Abbott tube which caused perforation of the stomach, and the specific instance in which a polyethylene tube encircled the duodenojejunostomy causing laceration to the superior mesenteric artery. However, certain *specific* problems relating to this category have been encountered in our experience. One problem is that of diffusion. Cantor, in 1949, studied the problem of diffusion of gases in and out of rubber ballons, and found this to be a serious one. This is mainly a consideration in tubes with a single lumen since pressure in the double-lumen tubes usually can be released easily. However, one case was reported in the literature in which gaseous distention of a Miller-Abbott balloon resulted from shrinkage of the thread used to secure the balloon.[17] This caused obstruction of both lumens and it was impossible to deflate the balloon. This problem of diffusion has been relatively infrequent, however, in our experience, since precaution is taken to perforate all air-tight mercury bags with a No. 24 gauge needle.

These small holes act as a gas vent as pointed out by Cantor. Another problem which we have experienced is that which is perpetrated by the unsuspecting nurse who injects medication through the incorrrect opening of a biluminal tube. Walker,[18] in 1940, pointed out this difficulty arising from the injection of barium through the channel of the double-lumen tube leading to the balloon. The injection of barium has not been a problem in our experience; however, we have frequently found that various medications have been injected by the nurse through the wrong lumen. This has accounted for some difficult extubations; and in one instance, it was impossible to extubate the tube and mercury bag intact. In this instance, the balloon was exploded by additional pressure and the Miller-Abbott tube was then easily withdrawn. This is a procedure which we do not recommend, since the explosive force of the bag might lead to perforation of the intestine.

Figure 5 illustrates a mercury bag which was retained at the ileo-cecal valve for three weeks, causing symptoms of cramping pain across the abdomen with some rectal bleeding and localized rectal pain especially at the time of bowel movements. In this instance, the silk thread still attached to the mercury bag traversed the entire colon and would emerge from the rectum with bowel movements. On any occasion in which a silk thread presents itself at the rectum we strongly condemn its manual withdrawal since laceration of the colon can easily result from this maneuver.

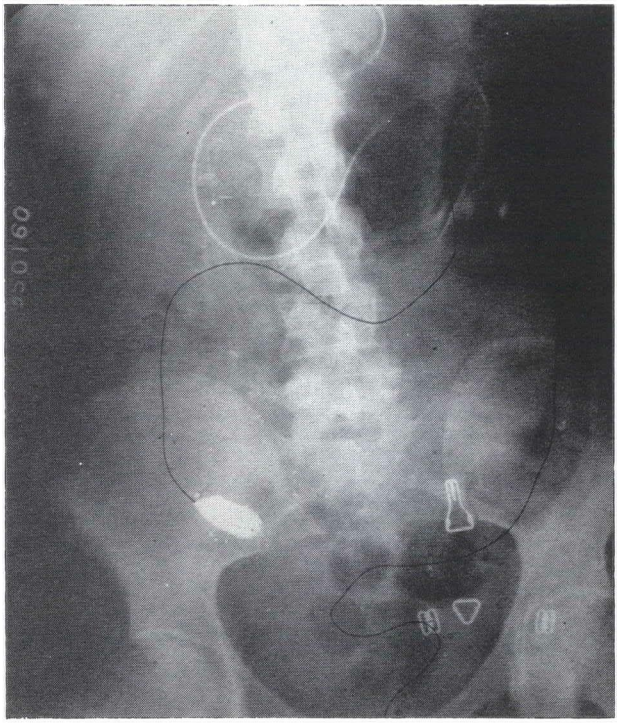

Figure 5

Retained mercury balloon and string after release from lumen of feeding tube. (Course of string superimposed on x-ray film).

The patient, nurses and resident staff should be thoroughly instructed to merely cut the excess protruding silk thread, and under no circumstance are they to place any tension upon this. In the patient with a retained mercury bag at the ileo-cecal junction, the bag finally ruptured and was passed without severe complications. This is the usual course of events.

RECTAL

Laceration of the rectum with pain and hemorrhage has occurred in our series, especially when tubes and silk sutures have been withdrawn by the patient or uninformed hospital personnel. We have seen one perforation of the rectosigmoid from a tube with an inflatable bulb inserted at the time of a barium enema x-ray. The ordinary straight blunt barium enema tube has caused very little or no difficulties. However, the rubber tube with an inflatable balloon used in children and in patients who are unable to retain enemas is always a potential hazard. This inflation bulb should never be inserted by a technician, but should always be inserted and inflated by a radiologist under direct fluoroscopic vision. We have experienced three perforations of the rectosigmoid region in our series during the use of the sigmoidoscope. This is a relatively infrequent complication; however, as with the use of the esophagoscope and gastroscope, this procedure must be done with care.

COLOSTOMY

One colon perforation occurred in our series when an irrigation catheter was inserted into a colostomy opening. It is indeed a wonder that this accident has not occurred with greater frequency since personnel with variable experience, including the patients, perform this procedure.

SUMMARY

Many of the complications arising through the use of gastro-intestinal intubation which we have experienced in the past four years have been presented. Although many of these appear to be common and trivial, they are, nevertheless, distressing to the patient. Others have been, fortunately, infrequent, but disastrous to the patient. It has been the purpose of this paper, by no means, to discourage the use of tubes in the management of complicated gastro-intestinal problems, but rather it has been the intention to demonstrate some of the hazardous pitfalls which are inherent in the employment of such devices. The indiscriminate use is to be avoided; the ignorant approach is to be condemned; and the intelligent application of gastro-intestinal tubes is to be encouraged.

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