Bulletin of the University of Minnesota Hospitals and Minnesota Medical Foundation

Evaluation of Intestinal Intubation

Volume XX | Friday, May 13, 1949 | Number 27

BULLETIN OF THE
UNIVERSITY OF MINNESOTA HOSPITALS
and
MINNESOTA MEDICAL FOUNDATION

Volume XX | Friday, May 13, 1949 | Number 27

INDEX

Published weekly during the school year, October to June, inclusive.

Address Communications to: Staff Bulletin, 332M University of Minnesota Hospitals, Minneapolis 14, Minnesota.

I.

UNIVERSITY OF MINNESOTA MEDICAL SCHOOL
CALENDAR OF EVENTS

May 15 - 21, 1949

No. 248

Sunday, May 15

9:00 - 10:00 Surgery Grand Rounds; Station 22, U. H.

10:30 - 11:00 Arterial Transfusion; Claude Hitchcock; Rm. M-109, U. H.

Monday, May 16

8:00 - Fracture Rounds; A. A. Zierold and Staff; Ward A, Minneapolis General Hospital.

9:00 - 9:50 Roentgenology-Medicine Conference; L. G. Rigler, C. J. Watson and Staff; Todd Amphitheater, U. H.

9:00 - 10:50 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff; M-109, U. H.

10:00 - 12:00 Neurology Rounds; A. B. Baker and Staff; Station 50, U. H.

11:00 - 11:50 Physical Medicine Seminar; E-101, U. H.

11:00 - 11:50 Roentgenology-Medicine Conference; Veterans Hospital.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Eustis Amphitheater, U. H.

12:00 - 1:00 Physiology Seminar; Cardiac Output in Man Determined by the Direct and Indirect Fick Method; Carleton Chapman; 214 M. H.

12:15 - 1:20 Obstetrics and Gynecology Journal Club; Staff Dining Room, U. H.

12:30 - 1:20 Pathology Seminar; 104 I. A.

12:30 - 1:30 Surgery Problem Case Conference; A. A. Zierold, C. Dennis and Staff; Small Class Room, Minneapolis General Hospital.

1:30 - 2:30 Surgery Grand Rounds; A. A. Zierold, C. Dennis and Staff; Minneapolis General Hospital.

1:30 - 2:30 Pediatric-Neurological Rounds; R. Jensen, A. B. Baker and Staff; U. H.

4:00 - Public Health Seminar; 113 Medical Sciences.

5:00 - 5:50 Clinical Medical Pathologic Conference; Todd Amphitheater, U. H.

5:00 - 6:00 Urology-Roentgenology Conference; D. Creevy and H. M. Stauffer and Staffs; M-109, U. H.

4:00 - Pediatric Seminar; Reports of the Meetings at Atlantic City; Dr. McQuarrie and Staff; 6th Fl. W., Child Psychiatry, U. H.

Tuesday, May 17

8:00 - 9:00 Fracture Conference; Auditorium, Ancker Hospital.

8:30 - 10:20 Surgery Seminar; Physiology of the Stomach; R. J. Webber; Small Conference Room, Bldg. I, Veterans Hospital.

9:00 - 9:50 Roentgenology Pediatric Conference; L. G. Rigler, I. McQuarrie and Staff; Todd Amphitheater, U. H.

10:30 - 11:50 Surgical Pathological Conference; Lyle Hay and Robert Hebbel; Veterans Hospital.

12:30 - Pediatric-Surgery Rounds; Sta. I, Minneapolis General Hospital; Drs. Bosma, Wyatt, Chisholm, McNelson, and Dennis.

12:30 - 1:20 Pathology Conference; Autopsies; Pathology Staff; 102 I. A.

1:00 - 2:30 X-Ray Surgery Conference; Auditorium, Ancker Hospital.

2:00 - 2:50 Dermatology and Syphilology Conference; H. E. Michelson and Staff; Bldg. III, Veterans Hospital.

3:15 - 4:20 Gynecology Chart Conference; J. L. McKelvey and Staff; Station 54, U. H.

3:30 - 4:20 Clinical Pathological Conference; Staff; Veterans Hospital.

4:00 - 5:00 Pediatric Rounds on Wards; I. McQuarrie and Staff; U. H.

4:00 - 5:30 Physiology-Surgery Conference; Adrenolytics, Hypertension, and the Alarm Reaction; W. Kubicek, F. Kottke, B. Zimmerman; Eustis Amphitheater, U. H.

5:00 - 5:50 Urology-Pathological Conference; C. D. Creevy and Staff; Todd Amphitheater, U. H.

5:00 - 6:00 X-Ray Conference; Drs. Fink, O'Loughlin, and Staff; Veterans Hospital; Todd Amphitheater, U. H.

Wednesday, May 18

8:00 - 8:50 Surgery Journal Club; O. H. Wangensteen and Staff; M-515, U. H.

8:30 - 9:30 Clinico-Pathological Conference; Auditorium, Ancker Hospital.

8:30 - 10:00 Orthopedic-Roentgenologic Conference; Edward T. Evans, Room 1AW, Veterans Hospital.

8:30 - 12:00 Neurology Rehabilitation and Case Conference; A. B. Baker and Joe R. Brown; Veterans Hospital.

11:00 - 12:00 Pathology-Medicine-Surgery Conference; O. H. Wangensteen, C. J. Watson and Staff; Todd Amphitheater, U. H.

12:00 - 12:50 Radio-Isotope Seminar; Radio-Active Waste Disposal; Bernard Halper; Rm. 212, Hospital Court, Temp. Bldg.

3:30 - 4:30 Journal Club; Surgery Office, Ancker Hospital.

4:00 - 5:00 Infectious Disease Rounds; Main Lecture Room, Minneapolis General Hospital

Thursday, May 19

8:15 - 9:00 Roentgenology-Surgical-Pathology Conference; Craig Freeman and H. M. Stauffer; M-109, U. H.

8:30 - 10:20 Surgery Grand Rounds; Lyle Hay and Staff; Veterans Hospital.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; M-109, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:50 Surgery-Radiology Conference; Daniel Fink and Lyle Hay; Veterans Hospital

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Todd Amphitheater, U. H.

11:30 - 12:30 Clinical Pathology Conference; Steven Barron, C. Dennis, George Fahr, A. V. Stoesser and Staffs; Large Class Room, Minneapolis General Hospital.

12:00 - 1:00 Physiological Chemistry Seminar; Subject to be announced; Raquel Sussman; 214 M. H.

1:00 - 1:50 Fracture Conference; A. A. Zierold and Staff; Minneapolis General Hospital.

2:00 - 3:00 Errors Conference; A. A. Zierold, C. Dennis and Staff; Large Class Room, Minneapolis General Hospital.

4:00 - 5:00 Bacteriology and Immunology Seminar; A physiological Study of the Host Cell-Virus Interaction; Robert Siem; 214 M. H.

4:30 - 5:20 Ophthalmology Ward Rounds; Erling W. Hansen and Staff; E-534, U. H.

5:00 - 6:00 X-Ray Seminar; Review--Lung Fibrosis; Harvey Stone; Todd Amphitheater, U. H.

Friday, May 20

8:30 - 10:00 Neurology Grand Rounds; A. B. Baker and Staff; Station 50, U. H.

9:00 - 9:50 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U.H.

10:00 - 11:50	Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.
10:30 - 11:20	Medicine Grand Rounds; Staff; Veterans Hospital.
10:30 - 11:50	Otolaryngology Case Studies; L. R. Boies and Staff; Out-Patient Department, U. H.
11:00 - 12:00	Surgery-Pediatric Conference; C. Dennis, O. S. Wyatt, A. V. Stoesser and Staffs; Minneapolis General Hospital.
11:30 - 12:50	University of Minnesota Hospitals General Staff Meeting; Rehabilitation of the Amputee; Glenn Gullickson, Jr.; Powell Hall Amphitheater.
12:00 - 1:00	Surgery Clinical Pathological Conference; Clarence Dennis and Staff; Large Classroom, Minneapolis General Hospital.
1:00 - 1:50	Dermatology and Syphilology; Presentation of Selected Cases of the Week; H. E. Michelson and Staff; W-312, U. H.
1:00 - 3:00	Pathology-Surgery Conference; Auditorium, Ancker Hospital.
1:00 - 2:50	Neurosurgery-Roentgenology Conference; W. T. Peyton, Harold O. Peterson and Staff; Todd Amphitheater, U. H.
4:00 - 5:00	Electrocardiographic Conference; George N. Aagaard; 106 Temp. Bldg., Hospital Court, U. H.

Saturday, May 21

7:45 - 8:50	Orthopedics Conference; Wallace H. Cole and Staff; Station 20, U. H.
8:30 - 9:30	Surgery Conference; Auditorium, Ancker Hospital.
8:00 - 9:00	Pediatric Psychiatric Rounds; Reynold Jensen; 6th Floor, West Wing, U. H.
8:00 - 9:00	Surgery Literature Conference; Clarence Dennis and Staff; Minneapolis General Hospital, Small Classroom.
9:00 - 9:50	Medicine Case Presentation; C. J. Watson and Staff; E-101, U. H.
9:00 - 10:30	Pediatric Grand Rounds; I. McQuarrie and Staff; Eustis Amph. U. H.
9:00 - 11:30	Surgery-Roentgenology Conference; Review of Surgical Post-Mortems; Todd Amphitheater, U. H.
9:00 - 12:00	Neurology Conference; Powell Hall Amphitheater.
10:00 - 11:50	Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.
10:00 - 12:50	Obstetrics and Gynecology Grand Rounds; J. L. McKelvey and Staff; Station 44, U. H.
11:00 - 12:00	Anatomy Seminar; Further Studies on Ovarian Tumors in Mice, Louis C. Lick; Pigments of Normal Muscle, Richard H. Swigart; 226 I. A.

II. CLINICAL RESULTS OF THE USE OF A LONG INTESTINAL TUBE OF IMPROVED DESIGN

John Julian Wild
Jacob Strickler

Introduction

Since introduction to surgery of the migratory long intestinal tube by Abbott and Johnston[1] for the non-operative relief of intestinal distention following upon the use of continuous applied suction to static indwelling duodenal tubes by Wangensteen[2] much controversy in the light of subsequent clinical experience has arisen as to the value of intestinal intubation. The factors responsible are many. Perhaps the most important is the gradual realization of the inadequacies of the double-lumen Miller-Abbott tubes supplied through commercial sources. The faults of these tubes, which were originally designed for physiological studies, are many and have been dealt with elsewhere. The use of these tubes for the relief of intestinal distention is attended with much anxiety and time consumption. They rarely do what is expected of them, especially when urgently required to decompress a severely distended patient. Owing to the long periods of time which have to be allowed these tubes in which to try to bring about decompression, delays in treatment may occur with consequent deteriment to the patient.

In spite of these inherent drawbacks, decompression of prolonged post-operative bowel distention is still often advisable, since this type of treatment if successful is perhaps the safest and least drastic of possible methods of relief. While in the field of intestinal obstruction unassociated with recent operation the improvement in surgical management, including the antibiotic and anesthetic techniques, has tended to challenge the value of a long wait while decompression is attempted pre-operatively, the long intestinal tube nevertheless may still be needed post-operatively. The value of intestinal decompression, if it can be brought about rapidly, is undoubted in most quarters. The need for improvement is overdue.

The successful negotiation of the pylorus has occupied considerable attention as the main source of difficulty in accomplishing rapid decompression, but difficulties may be encountered long before the pylorus is reached, especially in severely distended patients, and even more often after it is successfully negotiated. We have been able in this series to demonstrate many of these difficulties by observation and, in some instances to overcome them, always with the thought in mind of rapidly accomplishing and maintaining decompression. The improvement in the condition of the patient with intestinal distention following successful decompression is often matched only by the relief evinced by the responsible medical attendant. This rapid improvement in the clinical condition of the patient which we often observe with our more efficient technique may again give rise to troubles stemming from the difficulty in assessing the part played by the tube.

The literature abounds with enthusiastic solutions or simplifications of various aspects of the problem, but the paucity of accurate and detailed statistics in the literature makes evaluation difficult. Only the realization of the need for strict standards on which to assess the value of various modifications of design of the long intestinal tube and technique will clarify the position. In this series, while concentrating mainly on the pyloric region, we have endeavored in our records to maintain a high standard of critical observation of all aspects of the problem.

The History of Gastroduodenal Intubation

The Cause of Distention:

The abnormal intralumenal volume found in intestinal distention is dependent upon a decrease of absorption and an increase in secretion by the bowel itself, coupled with an accumulation of gaseous content. Herrin and

Meek[3] have shown a considerable increase in secretion within obstructed loops. That swallowed air contributes the major proportion (68%) of the gaseous content in distention has been demonstrated by Hibbard and Wangensteen[4] in 1934 when they substantiated the observations made by McIver[5] in 1926. The swallowed air factor was later more conclusively proven by Wangensteen and Rea[6] when it was found that dogs with low ileac obstruction survived for a far greater period if a prior cervical esophagostomy was performed. In addition to the air that normally traverses the human intestinal tract, Alvarez[7] and Morris[8] believe that air may be pumped into the gastro-intestinal tract by a peculiar sighing type of respiration or by air swallowing that may be due to a reflex nervous mechanism.

Gastric Intubation:

Paine[9] and Thompson[10] credit Munro (1767) as the first to intubate the stomach. He removed gas and liquid from the stomachs of cattle by means of a flexible coiled wire tube. Paine[9] also credits John Hunter (1776) for the first tube feeding of a human, and Physick of Philadelphia (1812) as the first to utilize a gastric tube to lavage ingested poison from the stomach of a patient. Grimson[11] agrees with Paine in giving priority to John Hunter but places the date at 1793.

Paine[9] has described the many subsequent developments and uses for gastric tubes, but the distention problem was first approached by this tool when Kussmaul[12] in 1884 treated ileus by pumping the stomach. Continuous gastric drainage for the treatment of peritonitis ileus was described in 1910 by Westerman[13] who credited Tarnier with its invention in 1888. Kappis[14] described similar treatment by nasal tube in 1911. In 1916 Kanavel[15] described a modified stomach tube for the treatment of vomiting due to paralytic ileus and other causes. He proposed siphonage by hanging the end of the tube over the side of the bed into a pan of water. Matas[16] in 1924 suggested a similar procedure to drain the stomach in cases of obstruction or peritonitis. Kantor[17] (1929) recommended inserting a tube into the stomach to puncture the "bubble of post-operative flatulence" only after other means had failed.

Gastro-duodenal Intubation:

The employment of drainage of the intestine beyond the stomach in the treatment of intestinal distention was preceded by the work of men mainly interested in physiological studies and in the medical treatment of diseases not attended by distention. In 1896 Hemmeter[18] reported that during his kymographic studies on the human stomach balloons would often enter the duodenum. Gross[19] (1910), Jutte[20] (1913), Rehfus[21] (1914) and Max Einhorn[22] (1919) devised duodenal tubes. Buckstein[23] (1920), Levin[24] (1921) and Damade[25] (1932) also described tubes for duodenal intubation for purposes of physiologic study, diagnosis and treatment of various diseases of the intestinal tract.

The next advancement in the intubation treatment of distention was inaugurated by Bassler[26] in 1919 when he described the use of the Jutte tube as a means of trans-duodenal lavage in the treatment of post-operative adynamia. He was followed by Oden[27] (1923) who used a modified duodenal tube to treat post-opertive distention and vomiting. He employed syringe aspiration but suggested that siphonage could be used.

Ward[28] (1925) and[29] (1930) described a suction siphonage apparatus to remove the "toxins" of ileus, acute gastric dilatation, and intestinal obstruction from the stomach and duodenum. He used the Jutte tube with lead pellets on the end.

Suction siphonage treatment of intestinal distention became firmly established and was destined to universal acceptance after Wangensteen[2] (1931) reported its use for the first time as the sole definitive treatment of intestinal obstruction. In 1933 Wangensteen and Paine[30] added twenty cases to the original three, thereby impressively verifying the original work.

The Long Intestinal Tube:

The next stage in the natural course of development of this form of treatment appeared following the introduction of the long intestinal tube. As was the case with the shorter tubes, the intestinal tubes were first used to investigate the physiology of the lower reaches of the small intestine and to treat disease unassociated with distention. Scheltema[31] in 1908 permeated, with a tube, the entire intestinal tract of a frog. Later he applied the method clinically in an eleven-month-old child suffering from gastro-intestinal catarrh. The process of travel through the gut required a time of three weeks. McClendon[32] (1920) used a long tube, with a metal ring leader, for physiologic investigations. Dianelopolu[33] reported balloon studies of the small intestine in 1925. Miller[34] states that in 1932, while observing Abbott taking kymographic studies of the jejunum, Abbott remarked on how difficult it was to keep the balloon from slipping downward. From this remark Miller conceived the idea of using a balloon-tipped tube to study the lower intestine. He credits Chester Jones and Alvarez with also having noted the tendency of balloons to travel downward. Miller and Abbott[35] in 1934 reported physiologic studies obtained by use of the new balloon bolus double-lumen Miller-Abbott tube. It was, however, not until 1938 that Abbott and Johnston[1] reported its use in obstructive lesions of the bowel.

An examination of the communication of Abbott and Johnston[1] shows clearly that double-lumen tubes as used for physiological bowel studies, of sufficient diameter to insure efficient removel of bowel contents when applied to decompression of distended bowel, were found to be "too large and stiff to pass through the nose" and so separate tubes were used for suction and inflation of the balloon bolus. This paper also states: "The ideal tube should have two lumina, one large for aspiration and one small for inflation of the balloon. Such a tube has been designed and has proven satisfactory." However, this latter statement does not seem to have been born out in later writings, for in July of 1938[36] Johnston was still using separate tubes and has increased the lumen of his suction tube still more.

In 1949[37] Johnston reported the addition of a Twiss tip to his two-tube construction and showed holes closely approximated to the balloon bolus at both ends. In the meantime the physiological double-lumen tubes had been made available to the profession in spite of the demonstration of their inadequacies by Johnston when applied to the removal of the bowel accumulations of intestinal distention.

It was not until 1947 that Johnston's "ideal" double-lumen tube was reported by Honor-Smathers[38].

Because certain difficulties arose in the process of intubation of the small bowel and others involving travel and function while in the distended gut, several modifications and proposed improvements in design have been described. Johnston[36] (1938) described the tube with a separate small air tube and a Twiss tip to pass the pylorus. Willson[39] (1938) reported a similar tube made from three Sawyer tubes spliced by a cannula. In June 1944, Wild[40] described a mercury-weighted terminal gravity director head on a plastic balloon bolus tube of adequate bore. Harris[41] later in the same year described the use of mercury in the balloon of a Miller-Abbott tube. In 1945, Harris[42], feeling that a balloon-bolus was unnecessary, devised the first single-lumen mercury bolus long intestinal tube. Cantor[43] (1946) devised s single-lumen tube with a terminal mercury sack without the use of air. In 1948 both Cantor and Harris drew attention to the danger of auto-inflation of closed natural latex balloo balloons in the gut and suggested methods of avoiding this complication. The Honor-Smathers tube[38] (1947) is another commercially available tube with an inflatable gravity director head. Kaslow[44] (1948) described a plastic tube.

Earlier attempts to improve the speed of entrance of long intestingl tubes into the small bowel and their subsequent performance have not been primarily concerned with any improvement in design but with methods of obtaining more rapid results with the existing Miller-Abbott-

Piling tube. Many of the methods used harked back to various procedures employed in duodenal intubation by the shorter tubes.

Such devices as sinkers on a three to five inch length of string or a chain, as an aid to pylorus passage of duodenal tubes, have been described. Palefski[45] (1914) and Twiss[46] (1933) used gold-plated balls attached to a chain. Buckstein[23] (1920) fastened a bulb by means of No. 4 chromic gut. Kunsztler[47] also found such sinkers to be an aid to pylorus passage. In 1928 Wilkins[48] used mercury to weight the tip of a duodenal tube. Rousselot and Bauman[49] (1933) first described the stylette technique and applied its use for insertion of a standard duodenal tube. Morgenstern[50] (1931) reported excellent results, with short tube intubation of the duodenum, from the fluoroscopic technique of massaging and pushing on the greater curvature of the stomach. Korbsch[51] used a cherry-sized sponge on a leader string to bring a duodenal tube through the pylorus. He thought that peristalsis passed the sponge easily through the Pylorus with less irritation than with other types of leader devices. Damade[25] found that 40 gm. of bismuth in 100 cc. of water would force pylorospasm and permit passage of his olive tip end.

Similar methods have been adapted to long intestinal intubation. The mechanical advantage of the stylette was first employed by Abbott[52] in 1941 as adapted from the original technique of Rousselot and Bauman[49]. Dennis and Brown[53], Devine[54], and McKittrick[55] have also described its use. B.A. Smith[56] discarded the method as having too many difficulties and dangers to make it worth while. In brief, the technique consists of insertion of a wire stylette to within 5-6 inches of the tip of the tube, inflating the stomach with 300 - 500 cc. of air, placing the tube along the greater curvature and the tip at the pylorus, then deflating the stomach, thereby causing the rising greater curvature to shove the stiffened tube toward and into the pylorus.

A variety of physical forces have been utilized in attempts to solve the problem of the phlorus. Electromagnets, such as those used to remove metallic foreign bodies from eyes, have been tried as a means of guiding the tube through the pylorus. Mayer[57] places such a magnet at the right flank posteriorly when the tube with steel or Alnico alloy tip is at the pylorus and by using the magnet and feeding the tube in from above, reports passage of the pylorus in one or two minutes.

Scott[58] reports good results in overcoming an arrest at the pylorus by having the patient drink very hot water as rapidly as possible.

The gravity devices have been the most consistently used and most frequently modified since the earliest attempts to intubate the human intestine.

In earlier modifications of the Miller-Abbott tube, comparatively rigid types of tips were used. Johnston[36] used a Twiss tip and Matheny[59] a Wangensteen lead tip, to facilitate pylorus passage.

The more flexible type of gravity tips followed as modifications of the leader devices used on duodenal tubes. McClendon[32] (1920) used an iron ring tied by a gut leader. B.A. Smith[56] (1941) found that a metal ball tied to a leader string aided pylorus passage of the Miller-Abbott tube, and attached five inches of lead shot for the same purpose. Morton[60] (1943) also reported the use of lead shot.

The use of mercury as a flexible loaded tip for the long intestinal tube was preceded by its use in shorter tubes such as described by Wilkins[48] in 1928. Although no reference can be found in the literature, the Hurst esophageal dilators should be mentioned, since, like the Wilkins tube, they also contain mercury. The lead impregnated tip of the Wangensteen duodenal tube has somewhat similar properties. Water was commonly used in the balloon of the Miller-Abbott tube before mercury. Wangensteen[61] credits Ivar Sivertson with having been the first to suggest the use of mercury in the balloon of the Miller-Abbott tube. Harris[41] (1944) reported improved results from the use of mercury in the balloon of the Miller-Abbott tube.

The senior author had, a few months earlier, published a description of his plastic balloon bolus tube with terminal gravity director head containing mercury. Harris[42] (1945) and Cantor[43] (1946) subsequently discarded the bolus balloon and used mercury as the sole bolus.

More direct solutions to the obstinate pylorus have been suggested. Devine[62] has performed jujunostomies to by-pass the pylorus in two cases of serious distention of adynamic nature. McIntyre[63] performs a gastrotomy when he desires to pass an intestinal tube during surgery. The tube, which is already in the stomach, is grasped with a forceps and inserted through the pylorus. Uriburu[64] has carried out right-sided paravertebral blocks to aid pylorus passage of Miller-Abbott tubes.

The effect of drugs employed to aid in pylorus passage of long tubes is largely in the realm of casual observation and impressions, since there are no adequate series or studies reported. However, Kaplan[65], Blalock[66], Harris[67] and Cantor[43] recommend atropine; Krook[68] and Folley[69] suggest the use of nitrites to open the pylorus.

Although we are convinced that x-ray evidence is the only reliable means of determining the position of the tip of the tube in the duodenum, many other tests have been suggested, and these may be used as supportive information where an x-ray may not be at once available. The standard tests to determine the presence of the tip of the tube in the duodenum were outlined by Abbott[70] and Miller[71] and reviewed by Leigh[72] and Beverley C. Smith[73]. Such tests involve inspection of the aspirate. Clear yellow bile is considered to be of duodenal origin, whereas a cloudy, turbid green is likely to be duodenal content that has regurgitated into the stomach. Water given orally is expected to return, by suction, at once if the tip is in the stomach, but if several minutes delay is noted it is likely to be in the duodenum. Another test propsed by these authors is the use of a glass syringe attached to the airway tube of the balloon. A few cc. of air are inserted into the balloon, and if the balloon is in the small bowel a characteristic back thrust is noted due to the pressure of peristalsis in the bowel. The syringe test has also been advocated by Baird, Campbell and Hern[74], Blalock[66], Devine[54], Hamrick[75], B.C. Smith[73] and Thompson[10]. Kaplan[65], however, feels that it is not reliable.

Moses Einhorn[76] had the patients tke congo red orally and observed the time it took to appear in the aspirate. Jutte[20] put water down the tube and then tapped on the abdomen over the stomach. If no splashing was heard he assumed that the water had been injected into the duodenum. Palefski[45] injected air down the tube. If the epigastrium distended, became tympanitic, and if gurgles could be auscultated over that area, he believed the tube tip was in the stomach. He also stated that if the tube were beyond the third duodenaum the lower quadrants would become distended.

Many intubators suggest the use of fluoroscopic manipulation as an aid to passage of the long intestinal tube, but most of them propose a four to six or even twelve hours preliminary trial without fluoroscopic technique. Fluoroscopy is recommended by Bockus[77], Boehme[78], Devine[54], Glenn[79], Leigh[72], Noer[80], B.A. Smith[56], and McKittrick[55]. Herrera[81] states that if the tube fails to pass in the first twelve hours, fluoroscopy is of no help. Guthrie[82] takes even the very ill patients to fluoroscopy and uses a harness to facilitate manipulation on the fluoroscopy table. Since this technique was instituted, his failures are reported as negligible.

History of Technique:

The technique of intubating the small bowel generally in use at the present time has been a gradual development from the time when intestinal tubes were first devised as tools for the study of gastro-intestinal physiology. Since failures or undue delays still interfere with satisfactory operation and use of the intubation method of non-operative decompression of bowel distention, the technique will continue to require modification until certain and speedy caheterization of the small bowel can be accomplished by means of a standardized procedure.

The technique now in general use is that described by Miller and Abbott[35] in 1934. The same method is recommended by Duncan[85] and in the textbooks of Bockus[77] and of Mason and Zintel[83]. Cantor [43,84] and Harris[42,67] also advocate this method. The procedure consists mainly of intranasal passage of the tube, passage through the esophagus by swallowing sips of liquid while the patient is in a sitting position. The patient is then placed on the right side and the tube gradually advanced while sipping water.

The problem of traversing the stomach from fundus to pylorus has been approached in many ways. Abbott and Johnston[1] in 1938 described the "floating" and "sinking" methods of traversing the stomach. In both instances the stomach was not emptied, and as the names imply, the "sinking" method employs the force of gravity to bring the tip to the pylorus, and the "floating" method involves having the patient on the left side, inflating the balloon with air so that the tip is floated, through the fluid in the stomach, to the pylorus. Devine[54] suggests passage along the lesser curvature or "magenstrasse" when the stomach is empty, since it is the only open portion in a deflated stomach. Whereas Abbott, Miller and others estimated the distance to the pylorus by calibrated markings on the tube, Leigh[72] (1940), B.A. Smith[56] (1941), and Hamrick[75] (1943), suggest pulling the tube back to the cardia with the balloon inflated and proceeding from that point as a landmark. Willson[39] (1938) proposed a similar method but did not mention inflation of the balloon.

Most authors agree that the stomach should be emptied so that the decompensation of distention can be corrected to permit return of motility of the gastric musculature. Blodgett[86], Boehme[78], Finney[87], Folley[69], Hamrick[75], Harris[42], B.A. Smith[56], Wangensteen[88], and Willson[39] recommend in addition lavage of the stomach. Matheny[59] advises a lavage of sodium bicarbonate. Thompson[10] on the other hand believes that a tube will pass better across a full stomach.

It is apparently true that the walls of the stomach should not be in direct apposition for easiest passage from fundus to pylorus. After emptying has permitted re-establishment of tone in the gastric musculature, most authors advise sips of water. The injection of a slight amount of air into the stomach was suggested by Gross[19] (1910) to aid passage of a duodenal tube. Abbott[52] employed the injection of 300 cc. of air as part of his stylette technique. Abbott[89], Devine[54], and Folley[69] used a like amount to "force antral spasm." Hamrick[75] suggested the routine use of 250 cc. of air and Wild[91] (1948) reported the use of much large quantities (600 - 1000 cc.). Krook[68] (1948) suggested the use of 200 cc. for the more difficult cases.

Wyndham[90] observed that the more the stomach is compressed against the diaphragm by the pressure of distended bowel, the more difficult it is to make the Miller-Abbott tube point toward the pylorus. Wild[91] employed a large 1-1½ liter balloon tied near the tip of his tube to solve the problem of forcing a passage from the fundus to the pylorus where massive air injection failed to dilate the stomach.

As early as 1896, while taking kymographic recordings from a gastric balloon Hemmeter[18] observed passage into the duodenum in two instances, and suggested that, since the duodenal tubes tend to kink and turn in the stomach, a gastric bag with a groove in it might make it possible to slip a tube along the groove into the pylorus.

<u>Description of the Tube Used in this Series</u>

- - - - -

DESIGN OF TUBE

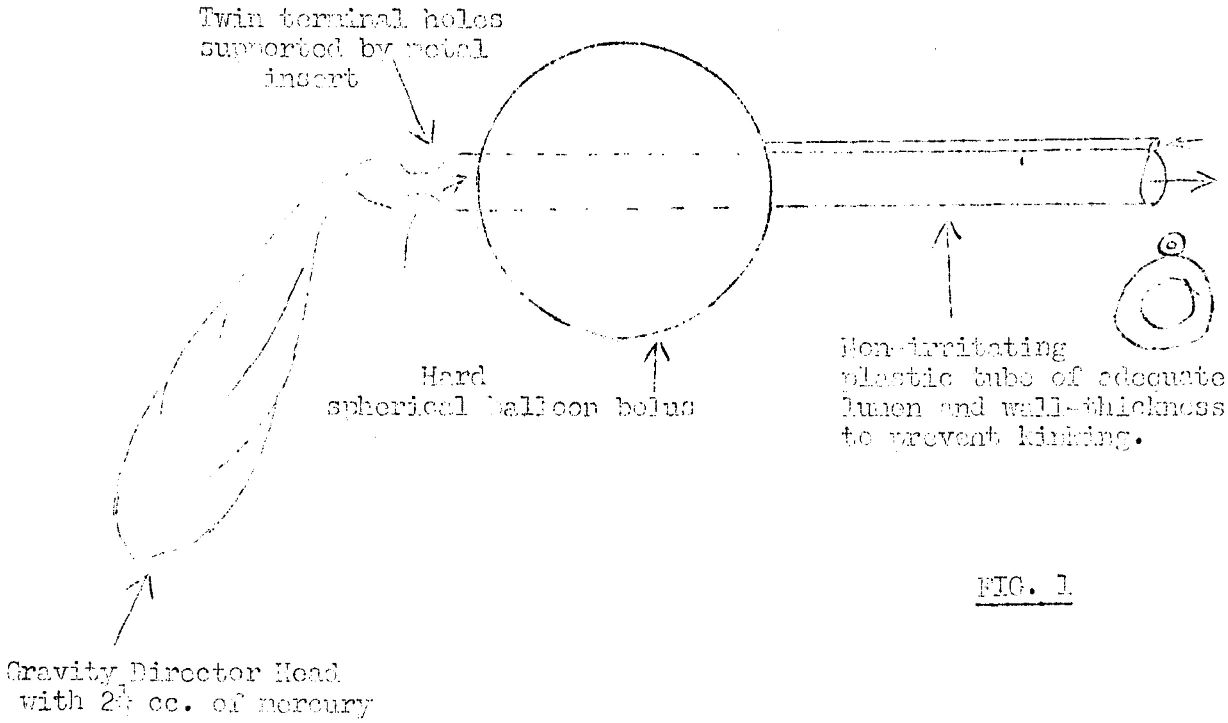

FIG. 1

The details of construction of the tube used in this series may be followed from Figure 1. The reasons for this design of tube have been dealt with elsewhere[92]. It may be of help to summarize them here.

The gravity director head[40] has been carefully tested clinically and the possible dangers removed. Unlike those used by Cantor[43] and Honor-Smathers[38] it is considerably smaller and somewhat pointed.

Maximum efficient suction is maintained in front of the balloon bolus which holds the bowel lining membrane away from the holes. Efficient removal of bowel contents is further aided by the silicone oil coating, adequate size of the suction lumen, and assurance from kinking of the tube by the provision of an adequate wall thickness.

There are no holes proximal to the balloon to reduce the power of the tube to remove intestinal contents through the more distal holes which are the most important holes insofar as migration is concerned. In addition, multiple holes not held away from the gut wall tend with continually applied suction to adhere to the mucosa in a limpet-like manner. Thus considerable resistance to migration of the tube may occur. This resistance is probably the cause of the arrest of such tubes in the duodenum at the ligament of Treitz and the failure to migrate in cases where gut propulsive ability is impaired. Moreover, the absence of proximal holes makes possible the rapid delivery of the gravity director head to the pylorus in practically all cases by means of the technique described. (See Analysis of Cases)

Also, for local x-ray bowel study with opaque media or where it is desired to inject air into the bowel in order to unkink bowel kinked by adhesions, it is possible to seal the bowel proximal to the holes and thus inject fluid distally.

The capacity of the balloon is such that 5 cc. of air will fill it to a diameter of 5/8-inch for the purposes of observing duodenal contractions and for travel through the pylorus and around the duodenum, past the ligament of

Treitz and into the jejunum. When distended under pressure to 20 cc, it forms a hard spherical bolus of 1-$\frac{1}{4}$ inches in diameter which does not move relative to the tube to which it is attached and thus may form a more efficient balloon bolus than the relatively nonrigid balloon bolus used with the Miller-Abbott tube. This hard, spherical balloon bolus is also far more easy to handle through the bowel wall at operation. The bowel can be easily threaded on to the tube and decompressed in a matter of minutes in cases where time for decompression pre-operatively cannot be allowed. Thus the necessity for aseptic decompression[93] may be avoided.

Distention of the balloon under pressure to 50 cc. or more effectively seals the small bowel by stretching the walls. This procedure is tolerated usually for ten to fifteen minutes before the onset of colicky pain. If a longer time is desired, temporary deflation followed by re-distention can be carried out.

Technique

An attempt has been made to reduce the technique to an empyrical basis in order to lessen the time and worry which has hitherto been the lot of a would-be intubator. In our opinion there is no longer any place for "wait and see if it goes in" intubation, where a tube is dropped into the stomach and then left to find its way into the intestine.

The technique used in this series was standardized on the basis of previous experience of difficulties and was not varied. Our aim has been to place the tip of the tube rapidly in a matter of minutes at the pylorus and thus sidetrack many of the pit-falls which may catch the unwary intubator on the way to the pylorus. The technique to be described is essentially active. There is no waiting about for things to happen. They are made to happen. Therefore, our figures for the first time recorded represent the true pylorus pass rate.

As a result of our experience, we, like some other workers in this field, have no hesitation in taking our patient to Fluoroscopy without delay. It is a good plan to leave the patient on the mattress. It must be understood that we use Fluoroscopy merely as a means of obtaining a quick glance at the situation in order to save the time occupied by developing films. The temptation to "look around" is repressed rigidly. Normally sedation is neither desirable nor necessary. Anaesthetization of the Nostril:

Two per cent tetracaine is applied with a cotton applicator.

Marking off the Tube:

The gravity director head and balloon assembly is laid at the xiphod along the sternum to the angle of the jaw and up to the external nares. A small piece of tape is stuck on to the tube at this point. The tube is then swallowed into the fundus of the stomach.

Inflation of the Stomach with Air:

This step is carried out with the patient vertical as before but not leaning to the left. A 50 tr 100 cc. syringe is employed and air is measured as it is injected into the stomach through the suction lumen. Care should be taken that the air is not injected down the inflation lumen in error. After a varying amount of air, usually over 800 cc., has been injected, the patient will complain of fullness and another 200 cc. should be put in and the suction tube clamped. The tape is now removed from the tube and replaced about eight inches from the previous mark. The tube is passed down to this second mark or as far as it will go without forcing. The patient is then placed on the right side.

The object of the technique so far has been to deliver the tune to the distal border of the inflated stomach. This is checked with a quick fluoroscopic glance. If the tip of the tube is held up in the fundus under the left diaphragm and the stomach is visualized fully inflated down to the pylorus, the gravity director head is held up either by a stomach shelf or even, more rarely, by a diverticulum such as a hiatus hernia. Suitable positioning of the patient and manipulation of the tube back and forth from the nostril with gravity aiding will usually succeed in overcoming these obstacles. A very successful position is that of prone lying with the feet down at an angle of 45 degrees.

If the stomach cannot be inflated due to continual eructation, it is useless in our experience to persist with the apparatus described. Special apparatus is in the process of development to overcome this situation which may be due to compression of the stomach against the liver to such a degree that air cannot be forced in[91]. Carcinomatous infiltration of the stomach wall, i.e. "leather-bottle" stomach, and an incompetent lower esophageal sphincter have emerged as rarer causes so far in our experience.

Normally little trouble will be experienced in inflating the stomach, even in distention of long standing. Before giving up, an attempt to "blast" the gravity director head to the pylorus should be made. The patient is placed on the right side and while pumping air rapidly into the stomach through the suction lumen, the tube should be advanced down to the pylorus. The temptation to ravel the tube into the fundus and to await developments should be avoided, as knots are almost certain to develop.

It should be realized that in severely distended cases only tubes with terminal holes can be used for stomach inflation. This feature of design is responsible for our almost constant success in reaching the pylorus rapidly. Having lowered the tube to the bottom of the fully inflated stomach, the patient is rocked over on his right side and not permitted to roll on to his back.

The Pylorus:

If the technique has been followed out correctly, the gravity director head will be found in the pyloric antrum.

Immediate Passage into the Duodenum:

If conditions are satisfactory, it will be passed into the duodenum almost at once in 43 per cent of all cases, according to our records. This can be observed by quick fluoroscopic flashes in the right-side-lying position. A loop of tube should be visualized in the stomach. The gravity director head will be found to pass away from the observer as it enters the second part of the duodenum.

At the end of ten minutes the patient is rolled onto his back and the feet depressed to an angle of 45 degrees with the horizontal. If success has been obtained, the gravity director head should be hanging down on the right of the vertebral column like a dead duck suspended by the neck. The patient is now placed as nearly vertical as possible, more tube is swallowed, and the balloon cautiously inflated to 5 cc. (5/8-inch in diameter). After a few minutes, if nor sooner, the tube will travel down the second part of the duodenum.

It is our practice always to attempt to get the tube around the duodenum to the ligament of Treitz in immediate pyloric passages. More tube is passed into the patient with the balloon still inflated. The table is returned to the horizontal position and the patient is laid on his left side for ten minutes, with suction if possible. After this he is returned to the ward.

Delay at the Pylorus:

If an immediate pass is not obtained after placing the gravity director head at the pylorus, the following procedures should be tried where possible:

a. Place the patient on his stomach for a few minutes, with or without the foot of the table depressed. The head end of the table may also be depressed in cases of "high" outlet of the stomach.

b. If the tube cannot be identified positively in the stomach, some watery-thin barium sulphate suspension may be run down in order to check that sufficient slack has been placed in the stomach.

c. If any doubt arises as to the anatomy of the patient, we have found no harm in injecting a small quantity of watery-thin barium sulphate suspension into the pyloric region. The tube is thoroughly flushed afterwards. A complete obstruction may be revealed and thus save time. Also in cases where the tube has been missed in its passage around the duodenum and comes to lie under the stomach on the left side, a little barium suspension will reveal the valvulae conniventes of the small bowel.

d. Empty the stomach and refill with air. Frequent success has been observed during the second injection of air.

If these measures are unsuccessful the case should be reviewed at this point to determine whether or not further delay can be permitted. Table VI will show that the average time to reach the lower part of the second duodenum was 4.64 hours.

If further delay is permissible, 5 cc. of air (5/8-inch in diameter) are placed in the balloon and the patient is returned to the ward, with adequate slack in the stomach. The long intestinal tube is attached to the nose until the gravity director head is found to be in the duodenum. A stomach tube of the Wangensteen type, preferably made of non-irritating plastic, with suction, is passed through the other nostril and is so positioned that one or two holes are in the lower esophagus and the others in the stomach. This tube will keep the stomach empty during the few hours necessary for passage into the duodenum and will prevent swallowed air from entering the stomach. It may be removed as soon as duodenal suction has been established, providing bowel activity of sufficient degree to cause sounds is present. If bowel sounds are weak or absent, gastro-esophageal suction should be continued or instituted at once as soon as the duodenum has been reached by the long intestinal tube. This effectively prevents re-distention proximal to the migrating tube.

Further Management:

The procedure upon returning to the ward will vary according to whether or not the second part of the duodenum or further has been reached.

If delay at the pylorus has occurred, the patient is laid well over on his right side and suction is applied to any suction tubes which may be protruding from the nostrils. The long intestinal tube is left taped to the nostril with 5 cc. of air in the balloon. Check x-rays are taken at intervals depending on the urgency of the case.

If an immediate pass has been accomplished, careful instructions are given to the nurse if she is unfamiliar with the management of long intestinal tubes. Great stress should be laid on the necessity for maintaining the suction, since there can be no advance without removal of intestinal contents ahead of the tube. The nurse is instructed to inject forcibly 25 cc. of 5 per cent glucose in distilled water as necessary when drainage ceases. Hypotonic solutions such as water or inaccurately mixed sodium bi-carbonate should never be used because of the damage caused to the intestinal mucosa[94]. No attempt should be made to suck back into the syringe.

<u>Wrapping the Hands</u>:

In children, all old people and very uncooperative patients no hesitation should be entertained in binding the hands and restraining one arm.

<u>Maintenance of Reserve Amount of Slack in the Stomach</u>:

The nurse is instructed to pass four inches of the long intestinal tube, well lubricated with non-oily lubricant, into the nose every hour, and to check that the patient swallows the tube. This is done by looking into the open mouth for evidence of coiling. If coiling in the mouth occurs, the loop should be pulled out and the tube re-swallowed

Taping the Tube to the Nose:

The tube should always be taped to the nose during transport at any time. It is an advantage in cases of depressed post-decompressive caudad motor bowel function (bowel sounds weak or absent) to tape the tube to the nose, since the stomach is being kept empty by the gastro-esophageal tube and slack in the compressed stomach is not easy to maintain. It is in these cases that much more nursing care with regard to feeding the tube and maintenance of suction on both tubes is necessary. On the other hand, in a patient with active peristalsis, the tube should never be taped to the nose when the balloon is inflated, for the sawing motion caused by the peristalsis tugging on an anchored tube may cause esophageal erosions at the level of the cricoid cartilage, and consequently a laryngeal inflammation and stenosis.

Feeding the Patient once the Tube is in the Gut:

The practice of giving hypotonic liquids by mouth when the upper gut is decompressed in the hope that they will be absorbed may lead to further dehydration of the patient, since the liquids are rendered iso-tonic in the bowel even in the presence of distention[95] with consequent electrolytic loss from the body. If liquids are given they should be iso-tonic, and little harm will be done, providing they reach the aspirating portion of the tube which is there to be removed. Unfortunately, there are conditions where they may not reach the aspirating portion of the long intestinal tube. This occurs when the caudad motor function of the bowel is impaired after decompression. It is, therefore, our practice in the absence of information on the recovery of both the absorptive and motor functions of the gut after decompression in the various clinical conditions giving rise to distention, to prohibit all liquids by mouth until the intestinal aspirate diminishes markedly (Table XVI) and to give supportive parenteral fluids and oral hygiene, including ice chips.

Management while Decompression is in Progress:

The rapid clinical improvement which attends partial relief of distention may give a false sense of security. This is particularly so with our more rapid technique, and we have noticed a distinct tendency to underestimate the part played by the tube in bringing about this improvement. With the older and slower methods, the period between decompression of the distended bowel and the recovery of normal tonus and absorptive capacity of the bowel was not so evident. Often with the older methods only partial decompression was achieved as the tube traveled down,so that by the time the bowel had recovered the tube was about ready to be removed. With our design of tube, decompression may be achieved long before bowel recovery necessary to prevent re-distention has occurred. This is especially noticeable in cases of adynamia.

Periodic films of the abdomen should be taken according to the clinical urgency of the case until decompression is accomplished. The case should be constantly reviewed in the light of the radiographic and clinical findings. The radiographs must be of the highest technical quality and no hesitation should be entertained in taking the patient to the X-ray Department if necessary.

Daily Checking of the Balloon Bolus:

All air is sucked out of the balloon bolus and the required amount of air is re-injected. This should be carried out daily, preferably after a radiograph.

Arrest of the Tube in the Gut:

If the position of the tube has not changed in two consecutive comparable radiographs with a 24-hour interval, in spite of maintenance of inflation of the balloon bolus and of efficient suction, the question of arrest of the tube must be considered. Much valuable information can be obtained from the radiologist and after examination of the radiograph. The question of the presence of incarcerated loops of bowel requiring enterolysis may be decided upon reduction of distention. A local radioopaque bowel enema should next be considered. This will often indicate whether or not surgical relief of an obstruction will be necessary. Air injection into the bowel may be carried out to break down postoperative fibrinous adhesions causing kinking if this cause is suspected. If no obstruction is revealed by such a study, suitable positioning of the patient with the degree of inflation of the balloon reduced to 5 cc. (5/8-inch diameter) may be tried.

Deflation of the Balloon:

If during decompression the tube should become arrested at one point with 20 cc. ($1\frac{1}{4}$-inches diameter) inflation of the balloon, the patient will complain of crampy pain. This can be relieved by deflating the balloon to 5 cc. (5/8-inch diameter) permitting continued efficient aspiration without endangering the bowel wall. It is important not to deflate the balloon completely if continued aspiration is desired, since bowel lining membrane will occlude the aspiration holes.

In the absence of arrest of the tube, the bolus balloon may be reduced to the minimal inflation of 5 cc. when all of the tube has passed into the nostril. The tube should be taped securely to the nose. In such a case it may safely be assumed that no obstruction of the bowel is present and aspiration should be continued until bowel absorption recommences.

Indications for Removal of the Tube:

In view of our absence of serious complications associated with the plastic tube which we use, we advise against removal of the tube until the cessation of continuous suction and toleration of a low residue diet by the patient without redistention. The indication for this test is the reduction of aspirate as mentioned above. Should re-distention occur, resumption of continuous suction will decompress obstructive cases but in the adynamia types the tube may have to be pulled up under fluoroscopic guidance, with 5 cc. in the balloon and suction maintained, and then allowed to migrate again.

The passage of gas as an indication of returning bowel activity is a good sign in our experience, providing decompression has been achieved and providing stimulant drugs have not been used.

Clearly there are two factors involved in recovery of distended bowel, namely recovery of absorption and recovery of caudad motor function. Their relationship not only to recovery of bowel function but also to the cause of bowel distention needs further investigation of a fundamental nature.

The use of mineral oil as an aid to recovery of bowel function has, we feel, little to recommend it. However, if used, the dangers relative to the tube should be appreciated.

Removal of the Tube:

The dangers of leaks in the gravity director head should be appreciated in connection with removal of the tube. For this reason we do not use metallic instruments for introduction into the nose, and the gravity director head is securely tied to the tip of the tube. In the absence of mineral oil usage, which rapidly rots natural rubber, we deflate the balloon fully and pull steadily on the tube until removed. The patient may be sedated for the procedure, even to the point of light anesthesia, if necessary. The gravity director head never distends in the gut sufficiently to cause difficulty in removal. We used intravenous sodium amytal in three cases of difficult withdrawal.

However, where mineral oil has been used and where considerable resistance is felt to removal from the nose, it is wise to get the patient to expectorate the gravity director head and to remove the mercury before withdrawing through the nose. This procedure eliminates all possibility of aspiration of metallic mercury into the lungs. In addition, should the tube be knotted as occasionally may happen due to faulty technique, the knot will be detected and can be untied. There were no complications in this series attributable to withdrawal of the tube.

Criteria for Clinical Evaluation of a Long Intestinal Tube

Degree of Distention Present:

Operator A in this series has attempted roughly to classify 67 cases of intestinal distention on the basis of severity of these cases. Sixty-four percent were of moderate degree. By moderate we mean clinical evidence of a full abdomen with visible loops of bowel and radiographic evidence of distention of bowel throughout the abdcmen.

In severe distention, which comprised 34 per cent of the group, a tight abdomen was found which offered considerable resistance to the palpating fingers. Visualization of loops of bowel is not possible, due to the distention.

Extreme distention is characterized usually by a history of unrelieved distention of ten days or over. The anus and umbilicus are everted and the skin of the abdomen stretched taut and shiny. These cases are rare and amounted to four per cent of the 67 cases.

The air injection technique described in this communication has been found satisfactory for rapidly reaching the pylorus in the first group and in most of the second group, but it is useless in the third group where a gastric balloon[91] is necessary. An accurate method of assessing degree of distention and correlating this with success in reaching the pylorus would greatly assist evaluating of intubation results.

The Pylorus:

Since it is difficult to be sure of the position of the tube in the region of the pylorus in cases of distention, we feel that the only true indication of successful intubation of the bowel is when the tip of the tube has reached the lower portion of the second duodenum. In our series this has been what we call a pass, and the time to reach this point is recorded.

The Rate of Removal of Intestinal Contents:

This is a critical method of evaluation of a long intestinal tube providing no oral liquids are given.

Available Statistics:

The only carefully recorded series, that of Beverley Smith[73], of 1000 cases of Miller-Abbott intubations, reports a 25 per cent failure to pass the pylorus. Boehme[78] reports 50 per cent success. Eliason and Welty[96] record an 18 per cent failure in an earlier and 10 per cent in a later group. Guthrie[82] states that without fluoroscopy a 50 per cent failure could be expected. Johnston[37] reports only six failures of 300 small bowel intubations over a three-year period. Leigh and Diefendorf[97] record 400 intubations with less than 10 per cent failure to pass the pylorus when x-ray guidance was employed. Penberthy, Johnston and Noer[98] found that the jejunum was reached in only 54 per cent of cases of adynamic ileus. Schliche, Borgan and Dixon[99] encountered difficulty in passing the pylorus with the Sawyer-Willson tube, in over 1/3 of distended cases. Wyndham[90] notes the same ratio. Cantor[84] has reported 200 cases with only eight failures. It is noteworthy that none of the authors established a very definite criterion of pylorus passage. Since it is difficult to be certain of the exact position of the pylorus and because a tube thought to be in the first duodenum may later be found in the stomach, we feel that success can be certain only when the tube tip is low in the second duodenum. A review of the literature fails to present a classification of the type of cases intubated or an analysis of the failures to pass the pylorus.

The average time required to achieve

catheterization of the small bowel has been set at six to 24 hours by Bockus[77], one to two hours by Cantor[43], and six to 12 hours by Folley[69]. Glenn[79] has found that when fluoroscopic manipulation is used to place the tip of the tube at the pylorus half of the cases will enter the duodenum in four hours, one-third more by lw hours, and one-sixth will take over 12 hours. Harris[42] reporting on his tube found that most cases where in the duodenum within six hours. Herrera, Millet and Lawson[81] employed the Harris tube in 30 cases. They found that five cases took over 13 hours to pass the pylorus. Leigh, Nelson, and Swenson[72] found that one-half of their cases of Miller-Abbott tubes passed the pylorus in four to six hours. From an analysis of B.C.Smith's 1000 cases [73], it is noted that nine per cent were through the pylorus in three hours, 25 per cent in 12 hours, and 47 per cent within 24 hours. In an early series of 20 cases the senior author achieved an average pass rate of 57.2 minutes for x-ray evidence of the tip of his tube in the low second duodenum. In an analysis of adynamic ileus distention, Green[100] has found that in peritonitis, 24-48 hours and often 72 hours are required to pass the pylorus; and Wyndham[90] expects a 12 to 18 hour waiting period.

TABLE I

CLINICAL USES OF WILD TUBE (248 CASES)

Primary Obstruction on Admission to Hospital	98
Small Bowel	78
Large Bowel	20
Postoperative Distention	91
Adynamic Ileus	41
Mainly Mechanical	20
Mixed or unknown	30
Adynamic Ileus Not Related to Prior Surgery	18
Total Intubated for Distention	207
Non-Distended Cases	41
Physiologic Study	1
Prophylactic Pre-Op.	34
Diagnostic or Therapeutic	6

It will be seen that the causes of distention have been based as far as possible on accurate observations, such as presence or absence of bowel sounds, cramping pain, the distribution of gas in the x-ray films, and, in some cases, at autopsy.

TABLE II

SECONDARY USES OF WILD TUBE

Local Barium Diagnostic Study	16 cases
Heavy Gravity Head (150 gm.Hg.) to Pass an Edematous Gastric Stoma	6 cases
Gastric Balloon to Traverse Stomach	8 cases
Air Injection to Open a Kink in Bowel	1 case

The special heavy gravity director head was used more as a bougie in some cases of obstruction at the anastomosis after a gastric resection. Having passed the stoma, however, the tube was used in our usual manner described for relief of the bowel distention demanding intubation.

The gastric balloon is described elsewhere[91] and is still in the process of development.

Air injection into the bowel was used successfully in one case of postoperative distention in which, on the basis of cramping pain and high-pitched bowel sounds, a mechanical cause was suspected. At fluoroscopy barium was found to pass the site of arrest of the balloon bolus. Positioning of the patient did not bring about any advance, so the bowel was inflated locally with the gut sealed proximally. After this, advance occurred, after reducing the inflation of the bolus balloon to 20 cc.

Postoperative fibrinous adhesions

will sometimes arrest the balloon bolus inflated to 20 cc. causing kinking of bowel. This has been verified both at post-mortem and at operation. These adhesions can be broken down easily with the fingers but will nevertheless bring about arrest of boluses in the bowel lumen.

TABLE III

MISCELLANEOUS DATA (248 CASES)

Prior stomach suction	22%
(14%, 8 cases, were of previous failure of other types of long intestinal tube)	
Fluoroscopic Guidance.............	60%
Repeat Passage	10%
Mismanagement	10%
Gastro-Esophageal Suction in Addition	8%
Died	13%
Failures of Intubation that Died .	29% of failures
Died of Unrelieved Distention	0%
Prior Failures of Other Types of Long Tubes	4.8%
Knotting of Tube	1.2%
Average Days of Intubation	
Primary Obstruction	7.3 days
Post-operative Distention	5.4 days
Longest Case .... (terminal carcinomatosis distention unrelieved by operation)	35 days

In this series stomach suction prior to long intestinal intubation was the rule in post-operative cases.

The value of gastric suction prior to long intestinal intubation has been stressed by Blodgett[86] and Thompson[10]. We have been unable to draw any conclusion as to its value, but we do use it where delay in intubation occurs.

Cases were deemed to be mismanaged when the tubes were removed against our advice. They were recorded as far as was possible under the circumstances.

Gastro-esophageal suction in addition to bowel intubation was found to be the best method of preventing re-distention and was used in all cases of suspected adynamia as soon as duodenal suction had been established.

It should be appreciated when considering the total deaths in this series that no case was refused intubation. Some cases were moribund when intubation was attempted. An analysis of the deaths, together with the corrected mortality, is given below. No cases died of unrelieved distention.

Knotting occurred in one case early in the series due to ravelling of the tube in the stomach without fluoroscopic control. This knot tightened and traveled into the bowel. In another case a boy of 14 years seemed to have a stomach that would tie the tube in knots, since the tube appeared to travel round and round in his stomach. At fluoroscopy he was found to have a high outlet and was successfully intubated. This shows the need for fluoroscopic control. Knotting occurring in the intestine was not observed in this series.

TABLE IV

PASS RATES INTO INTESTINE IN 30 MINUTES OR LESS

	Operator A (113 cases)	Operator B (135 cases)	Total Series (248 cases)
Primary Obstruction	57%	44%	49%
Post-operative Distention	55%	33%	42%
Gastro-enteric Stoma	83%	46%	58%
All Cases	51%	36%	43%

Average time all cases..4.64 hours

The tube described and shown in Fig. 1 was used throughout this series. In the first part of the series considerably more time and enthusiasm was spent in some of the patients than in the second part of the series, which were carried out by a less experienced operator. Nevertheless the latter's results were considerably better than any previously recorded. Operator A was an enthusiast. Operator B was a busy surgeon with a genuine critical interest in intubation.

Post-operative cases were not usually followed as rapidly as cases of obstruction since the clinical urgency was less. less.

Our standard of pass was based on x-ray evidence of the tube in the second part of the duodenum in all cases.

It should be noted that nearly 50 per cent of cases of primary obstruction were intubated according to our standards in less than 30 minutes.

TABLE V

PASS RATES INTO SECOND PART OF THE DUODENUM OR ONE FOOT INTO EFFERENT LOOP (248 CASES)

	Up to ½ hr.	½ to 1 hr.	1 to 12 hrs.	12-24 hrs.	over 24 hrs.	Failures
All Cases (248)	106	30	55	13	6	38
Primary Obstruction on Adm. to Hosp.(98)	48	11	18	4	3	14
Small Bowel (78)	35	10	13	3	3	14
Large Bowel (20)	13	1	5	1	0	0
Post-operative Distention (91)	38	11	22	6	0	14
Adynamic Ileus (41)	15	5	11	3	0	7
Mainly Mechanical (20)	10	2	6	1	0	1
Mixed or Unknown (30)	13	4	5	2	0	6
Adynamic Ileus not related to prior surgery (18)	6	1	3	1	2	5
Non-Distended Cases (41)	14	7	12	2	1	5
Physiologic Study (1)	1	0	0	0	0	0
Prophylactic Pre-op. (34)	10	6	12	2	1	3
Diagnosis or Therapy (6)	3	1	0	0	0	2
All cases with Gastro-Enteric Stoma (Incl. above) (38)	22	4	3	0	2	7
Primary Obstruction with Stoma (9)	4	1	0	0	1	3
Post-op. Gastric Resection (27)	18	2	3	0	1	3
Adynamia, no recent Op., Stoma present (2)	0	1	0	0	0	1

This table shows an analysis of the time required to reach the second part of the duodenum in specific types of case. Important data are repeated in subsequent tables.

TABLE VI

AVERAGE TIME REQUIRED FROM NOSE TO SECOND PART OF THE DUODENUM

Operator A (113 cases) .... 3.65 hrs.
Operator B (135 cases) .... 5.54 hrs.
Entire Group (248 cases) .... 4.64 hrs.

Shortest Case ....8 minutes
Longest Case ....72 hrs.

These times represent times from the passage into the nose to x-ray evidence of the tube in the duodenum. Delays occurring in any part of the gastro-intestinal tract down to the second part of the duodenum are included. With experience gradually acquired these delays have been largely eliminated.

TABLE VII

FAILURES TO ENTER SECOND DUODENUM OR EFFERENT LOOP

Failure to pass pylorus	14.8%
Failure to pass gastro-enteric stoma	18.4%
Total Failures	15.0%

TABLE VIII

ANALYSIS OF CASES WITH FAILURE TO PASS INTO THE SECOND PART OF THE DUODENUM (38)

Carcinomatous Obstruction at Pylorus or stoma (Proven at autopsy or operation)	3
Mechanically Obstructed Duodenum due to Post-operative Edema (Proven at autopsy)	1
Duodenal Ulcer with Pyloric Obstruction (Proven by barium x-ray study)	3
Dense Adhesions at Pylorus and First Duodenum (Peritoneal Lavage Case)	1
Immediate Post-operative Vagotomy with Decompensated Stomach and Ileus	2
Mesenteric Thrombosis and Infarction	1
Severe Biochemical Imbalance (not a consistent cause of failure) (Including one case of bile peritonitis)	3
Unrecognized Knot in Tube (avoidable)	1
Unmanageable, Violent Patient	2
Early Discontinuance of Intubation (Treatment by surgeon or taken to operating room after $\frac{1}{4}$, $\frac{1}{2}$, 1, 3 or 4 hour trial)	5
Marked Compression of the Stomach by Greatly Distended Small Bowel (This case occurred before introduction of gastric balloon)	1
Patient pulled tube out after Successful Intubation of Duodenum	1
Pre-terminal (patient could not swallow)	2
Inability to Manipulate or Position due to Fractured Hip, Fractured Pelvis	2
Inserted Immediately Post-operatively with no Attempt to Position Patient	1
Recurrent Carcinoma at Esophago-jejunal Anastomosis	1
UNEXPLAINED	8 (3.2%)

TABLE IX

TIME OF OPERATION AFTER INTUBATION

Primary Obstruction on Admission to Hospital - 98 cases

No Operation	34 cases	35%
Less than 4 hours	9 cases	
4 - 24 hours	14 cases	
24 - 48 hours	10 cases)	-42%
over 48 hours	31 cases)	

Therefore, 77% either had no operation or were operated upon after hydration and at least partial if not complete decompression.

Post-operative Distention - 91 cases

Treated by Suction and Intubation only	80 cases	88%
Treated by Intubation followed by Operation	11 cases	12%

(An obstructing mechanism was found in five cases. Four cases were explored for reasons other than distention, viz. sub-phrenic abscess, etc.)

In some cases of primary obstruction where time could not be allowed for complete decompression the bowel was decompressed as a preliminary to exploration after opening the abdomen. This was done easily, since the hard, spherical balloon bolus was easy to handle while the bowel was threaded on the tube. The tube can be manipulated easily from the second part of the duodenum but is considerably harder to manipulate from the stomach. Thus a short trial of intubation under fluoroscopic control is, in our opinion, still a worthwhile procedure even in cases of primary obstruction in which early operation is contemplated. (See Table IV)

TABLE X - TIME UNTIL DECOMPRESSED by X-Ray or Clinical Impression (See section on Management of the Tube)

Primary Obstruction	26.3 hours
Small bowel	27 hours
Colon	25 hours
Decompressed in less than 12 hours	43%
Post-operative Distention	40 hours
Adynamic Ileus (none less than 30 hr.)	53hr.
Mechanical	28 hours
Mixed of Unknown	36 hours
Decompressed in less than 12 hrs	18%

No attempt was made to separate the cases in which decompression may have occurred partially without the aid of suction.

In the obstruction group, the rapid decompression of the colon is explained on the basis of selectivity, since intubation was employed only on cases of incomplete or very early obstruction. The remainder were treated by emergency colostomy.

TABLE XI

COMPARISON TO BEVERLEY SMITH'S SERIES PYLORUS PASS RATES

	Smith (1000 Cases)	This Series (248 Cases)
Failures	25% *	15%
Up to 3 hours	9%	58%
Up to 12 hours	25%	77%
Up to 24 hours	47%	82%
Over 24 hours	74%	85%

* 22% failure, 3.3% incomplete records

It should be noted that no analysis of failures was given by Beverley Smith.

TABLE XII

COMPARISON TO BEVERLEY SMITH'S SERIES Additional Data

	Smith	This Series
Use of Mercury	6%	100%
More than One Intubation	10%	10%
Gastric Distention after Intubation*	13%	1.7%
Fluoroscopic Guidance	54%	61%
Strangulation with Gangrene	2%	2%
Series Complications	1.1%	.8%
Died	10%	13%

(see Table XIII)

*In most instances of adynamic ileus, re-distention above was anticipated and an additional tube was placed in the stomach as prevention.

TABLE XIII

MORTALITY IN CASES INTUBATED

	Number of Deaths	Total Cases	Percent Mortality	Corrected Mortality
Total Deaths	32	248	13	6%
Obstruction	10	98	10	5%
Adynamia not related to Operation	4	18	22	17%
Post-operative Distention	17	91	19	11%
Non-Distended (Proph., Preop., etc.)	1	41	2	0%
Died of Unrelieved Distention				0%

Some idea of our type of practice can be gained from the Analysis of Mortality below.

ANALYSIS OF MORTALITY BY CASES

Asterisk Indicated Rejections

Cases of Mechanical Obstruction 10

*4 cases of terminal carcinomatosis with multiple intra-abdominal metastises. Obstruction was only a part of the clinical picture, and intubation was done as an adjunct to pre-terminal palliation.

*1 case of carcinomatosis intubated for feeding purposes. No distention. Obstruction had been relieved by colostomy.

1 case admitted with pelvic peritonitis due to perforated bowel.

1 case died of air embolism following a tracheotomy.

1 case died of cardiac decompensation. An undiagnosed, partially obstructing, carcinoma of the cecum was present.

1 case died at operation due to hyoscine reaction after having been successfully decompressed and prepared for operation.

1 case died of cerebro-vascular accident one day after tube had been removed. Decompression has been complete for five days.

Postoperative Distention 17

*1 case died of liver failure following a Whipple operation for carcinoma of the head of the pancreas. Death occurred two weeks after decompression of adynamic ileus.

*1 case had carcinomatosis and multiple intra-abdominal abscesses from a ruptured carcinoma of the cecum. Decompression of post-operative distention had been accomplished 4 weeks prior to death.

*1 case died of saddle embolus and sepsis. This patient was fully decompressed before death.

*1 case had ascites. Intubation of erroneous diagnosis of distention.

*1 case of multiple lung abscess died four days after decompression.

*1 case developed an adynamic ileus after resection of chest wall for extensive mammary cancer. The bowel was fully decompressed at autopsy.

*1 case died of cerebrovascular accident three days after the tube had been removed.

1 case died due to thrombosis of mesenteric vein.

1 case died in post-operative shock and cardiac failure after operation to release a loop of bowel strangulated in a disrupted wound near the colostomy, made in a combined abdominoperineal resection done six days previously.

1 case was intubated for post-operative distention the fifth day after a total gastrectomy. There was x-ray evidence suggesting an incarcerated loop of small bowel.

1 case with ileitis was intubated

pre-operatively to prevent perforation. After resection and discontinuance of suction, re-distention occurred. Subsequent decompression by the long intestinal tube was observed to be complete at autopsy.

1 case died of generalized peritonitis after a total hysterectomy. Intubation failed. Moribund at time of intubation.

1 case died of volvulus of small bowel occurring post-operatively. Intubation failed because patient was pre-terminal.

1 case developed adynamic ileus after internal fixation of hip fracture. Death due to CVA.

1 case of peritoneal lavage had persistent distention. Intubation failed due to dense adhesions about pylorus and duodenum though the jejunum had successfully been reached one week before death and the tube had been removed.

2 cases expired from cardiac decompensation.

Dynamic Ileus not related to Operation[4]

*1 case died of hepatic failure due to chronic ulcerative colitis. Bowel distention had been only minimal.

1 case died of ruptured gall bladder operated upon before decompression had been accomplished.

1 case died of peritonitis, carcinomatosis and adynamic distention.

1 case died of pneumonia pulmonary edema, and spesis, six days after decompression had been accomplished. Initial disease was ruptured appendix.

Prophylactic Pre-Operative Intubation[1]

*1 case was intubated prior to colonic surgery for carcinoma. No distention was present. Death wassdue to retroperitoneal hemorrhage following a para vertebral sympathetic procaine block performed in the treatment of thrombophlebitis.

In the obstruction group, the five cases of terminal carcinomatosis with minimal or no distention have been eliminated.

In the post-operative distention group, since distention was, in many cases, only an attending feature of profound physiologic imbalance, it appears reasonable to eliminate those cases of adynamia which had been fully decompressed by intubation some time prior to death.

The cases of adynamic ileus unrelated to prior surgery are reduced to three by elimination of the case of chronic ulcerative colitis in hepatic failure. Distention had never been more than very minimal.

The non-distended group contains only one death entirely unrelated to intubation or distention.

- - - - -

TABLE XIV

GENERALIZED PERITONITIS

Cause of Peritonitis	Time into 2nd Duod.	Time for Decompression
Extravasated Urine	35 min.	18 hrs.
*Bile, ruptured gall bladder	failure	-
Sigmoid Perforated at Op. Developed Post-op. Ileus	15 min.	-
Bile, mild	45 min.	complete but time unknown

*These cases are proven, definite and severe generalized peritonitis. The others listed may possibly have been somewhat localized.

TABLE XIV (Continued)

E Coli Peritonitis following perforation of uterus during D & C	$19\frac{1}{2}$ hrs.	72 hrs.
*Ruptured appendix. Generalized fibrinopurulent peritonitis	20 min.	taken at once to Op. room
H emoperitoneum (colic present)	1 hr.	12 hrs.
*Ruptured appendix. Fibrinopurulent peritonitis	20 min.	48 hrs.
Carcinomatosis with perforation of Bowel	12 hrs.	- (died)
*Ruptured appendix with generalized fibrinopurulent peritonitis	30 min.	6 days
*Perforated Duodenal Ulcer	15 min.	48 hrs.
Peritoneal Lavage	15 min.	Tube removed in error - died
Peritonitis following Gyn Op.	failure	-
*Pelvic abscess ruptured into main peritoneal cavity	failure	Operated upon 8 hrs, after intubation; tube passed thru pylorus and down by surgeon.

*These cases are proven, definite and severe generalized peritonitis. The others listed may possibly have been somewhat localized.

TABLE XV

STRANGULATION OBSTRUCTIONS

Cause	Time into 2nd Duod.	Time of Operation after Intubation
Exteenal Hernia	10 Min.	1 Hr.
External Hernia	Failure (unmanageable pt.)	24 hr. diagnosis of Obstr. was in doubt.
Adhesive Band	Failure	To Op. Room after $\frac{1}{2}$-hour trial
Small Bowel wrapped about Ileostomy	15 Min.	12 Hrs.
Richter's Hernia	8 Hrs.	Taken to Op. Room after 1 hr. initial attempt to intubate.
Adhesive Band	15 Hrs.	24 Hrs.

When even a question of strangulation obstruction existed, no more time was given to the intubation than was required to prepare the patient and the operating room.

In three of the cases of strangulation the diagnosis was not made pre-operatively. The others were intubated on the way to the operating room. All other cases of strangulation at this hospital were operated upon without prior intubation.

- - -

TABLE XVI

SAMPLE LIQUID ASPIRATE TABLES

24-Hour Intervals -- in Cubic Centimeters

Large Bowel Obstruction	Small Bowel Obstruction	Post-operative Distention of Adynamia Type
4100	1200	2100
2800	1225	1900
2900	1400	2000
3200	1400	1500
2200	800	800
2850	500	400
1900	160	
600		
400		

Boehme[78] has drawn attention to the importance of charting the aspirate from the long intestinal tube as a guide to the recovery of the bowel. Table XVI shows three sample charts, and the sudden drop in aspirated material may be noted. This drop, in our experience, is an invaluable guide to bowel recovery, and it is our practice to cease suction 24 hours after it occurs and to feed the patient with liquids followed by a low-residue diet, while observing for re-distention.

Complications of Intubation

Recorded Complications:

One of the objectives of improvement in tube design and the development of a better technique is that of a reduction in the incidence and severity of clinical complications resulting from intestinal intubation.

Knotting of the tube, providing the size and consistency of material are correct, occurs only when one has carelessly inserted the tube or has been lax in observing its progress. If the tip of the advancing tube becomes arrested at any one point and excess tube is permitted to travel to or beyond the tip, then the end has only to drop through a loop of tube and a knot is formed. The stomach is the most common location for this to occur. Blodgett[86] and McKittrick[55] note knotting in the stomach, and Devine[54] suggests that advancing more tube will undo the knot. Brenizer[101] has recorded a case of knotting at the site of obstruction.

Cantor[102] states that intestinal gases, principally carbon dioxide and hydrogen sulphide, will diffuse into and distend a balloon containing mercury after the tube has been in the bowel five days or more. Harris[67] cited three cases of difficult removal of the tube due to such distention. One case required operation to remove the tube. In each of his cases the tube has been in the bowel over ten days.

It has been frequently noted that the bowel will pleat itself or become reefed upon the intestinal tube. Various a authors have commented upon the occurence of intussusception when the tube is removed. This is most likely to occur if the balloon is partially inflated during withdrawal of the tube. Most such intussusceptions are of a reverse type and normal motility will undo them. Devine[54] and Eliason and Welty[96] note such retrograde intussusception but cite no specific cases. Warren and Cattell[103] report a fatal case of perforation of jejunum in an area of intussusception but do not state whether the proximal segment of bowel was found to be outside of or within the distal segment. Harris[42] has recorded a case of ileo-ileac intussusception due to the air bag acting like a polyp.

Neglecting carefully to observe the

position of the balloon so that prolonged arrest, while inflated, does not occur, or to leave the balloon partially inflated while withdrawing the tube, may cause necrosis of the bowel wall or laceration and perforation. Devine[54] and Folley[69] state that laceration may result from pulling back on a partially inflated balloon, but they cite no cases. Harris[67] reports one case in which the tube, apparently deflated, was pulled back through the ileocecal valve. A tear in the bowel resulted, with consequent abscess. Kaplan and Michel[65] record a case in whom 70 cc. of air in the balloon located in the terminal ileum caused necrosis of the bowel wall. Schlicke, Bargan and Dixon[99] have reported one case of collapse and generalized peritonitis developing shortly after partial withdrawal of a tube with inflated balloon. Although references seem lacking in the literature, most surgeons are aware of cases in which the nurse and attendant have injected feeding material or irrigation liquid into the balloon of Miller-Abbott tubes. The consequence is naturally very troublesome if not of extremely serious nature. McKittrick[55] and Mason's and Zintel's text[83] state that such difficulties do arise.

Holinger and Loeb[104] have published the most extensive review of the literature and offer a very plausible explanation for the development of laryngeal stenosis following intubation of the gastro-intestinal tract. They reported 24 cases from the literature and four of their own. They believe that constant tugging on the tube by the duodenum and the friction caused by swallowing and talking cause an erosion of the esophagus at the level of the cricoid cartilage where the superior laryngeal constrictors exert pressure against the hard cartilage. Due to the inflammation about the erosion, a perichondritis develops which results in subsequent stenosis of the larynx. Most of these cases developed after the tube had been removed and required a tracheotomy for relief of airway obstruction. Iglauer and Molt[105] reported ten of these cases and had one specimen with a deep esophagoal ulcer. In their cases the tube had been in place from 6 to 20 days with an average of $8\frac{1}{2}$ days. Kaufman, Serpico and Mersheimer[106] reported one case and reviewed eight from the literature of severe laryngeal edema requiring tracheotomies. They postulated that the esophageal erosions were due to a combination of trauma from the tube and regurgitated gastric acids. B. C. Smith[73] reported two cases of ulceration of the aryepiglottic folds, and van Beuren and Smith[107] observed ulceration of the esophagus in some cases at autopsy.

Herrera, Millet and Lawrence[81] recorded two cases from whom the tube could not be pulled out. In one case it could not even be withdrawn at post mortem. We have had three cases of difficult withdrawal but adequate sedation, such as amytal, and a steady firm even pull have solved the problem without ill effect.

Schlicke, Bargon and Dixon[99] reported a case of lower ileac, obstruction due to coiling of a tube.

B. C. Smith[73] reported one case of hemorrhage after passage of a tube in a patient who had esophageal varices and two other cases of melena following intubation of patients having a history of an old duodenal ulcer.

Complications in This Series of Serious Nature Directly Attributable to Intubation:

Death from air embolism following a tracheotomy for relief of laryngeal edema occurred in one instance. This patient also had a rubber gastric tube in the other nostril.

One patient developed severe cerebral edema due to the use of the Trendelenberg position as an aid to passing a difficult pylorus.

Unusual Cases

On attempting to intubate a heavily morphinized 86-year old man, the gravity director head was found to be directed into the left mainbbronchus. The patient developed mild dyspnoea after intubation, but did not cough. No complications ensued.

A general anesthetic was required to remove a heavy gravity director head (150 gm. Hg) from a strictured area of bowel. Recovery occurred uneventfully.

In one case the gravity director head repeatedly dropped into a para-esophageal hernia, but was finally directed beyond that area.

One case of arrest of the tube in the third duodenum was due to the gravity director head's being caught in a diverticulum.

During intubation of a patient with only moderate small bowel distention, it was noted that the patient could retain only 150 cc. of air injected to aid traversing the stomach. In view of no evident cause of low gastric capacity, a presumptive diagnosis of infiltrating carcinoma of the stomach was made. This impression was subsequently substantiated at operation.

There were no cases of arrest at the ligament of Treitz. This, in our opinion, was due to the design of the tube and to our practice of limiting the inflation of the bolus balloon to 5/8 inch diameter until the ligament of Treitz has been passed. The absence of holes proximal to the balloon bolus eliminates the limpet-like attachment to the mucosa and insures suction ahead of the tube.

Discussion

We have made a detailed clinical study of an improved technique for rapid intubation of the human small bowel in cases of distention of all degrees of severity. As a result we feel that the value of efficient long intestinal intubation for the relief of intestinal distention, made possible by improvement in technique and design of tube, is undoubted. The tendency in the past with unsatisfactory techniques has been to reduce to the minimum the indications for intubation and to attempt to avoid its use if possible, so that the patient must often tolerate unrelieved bowel distention of some degree or other. Post-operative abdominal discomfort is often regarded as a necessary concomitant of bowel surgery and only after failure to relent is the question of relief considered at all.

On the basis of our experience, we would suggest the following management to serve as a "firm bottom" on which to anchor future developments.

The indication for intubation with our long intestinal tube is bowel distention. The exact management will depend upon the urgency of operation, which should be decided at once. Wangensteen[88] warns, "The practice and employment of suction as a test procedure to indicate whether operation will be necessary leads only to a deferment of appropriate treatment." Where immediate operation is required, the tube is placed in the stomach as a minimal procedure before operation. If possible, 10 minutes in the fluoroscopic room will deliver the tube to the pylorus in practically all cases and into the duodenum in about 50% of the cases. This can be done at the same time as any further radiographic procedures as may help in the diagnosis.

At operation the tube is manipulated through the pylorus or picked up in the bowel. The hard, spherical balloon, inflated under pressure to a diameter of $1\frac{1}{4}$ inches, and attached to the tip of the tube, may then be passed throughout the length of the small intestine in a matter of a few minutes with applied suction. With the distended bowel empty the operation is greatly facilitated.

The tube is left near an anastomosis, if made, with the balloon bolus inflated to 5/8-inch diameter. Routine gastro-esophageal suction is applied after operation and the question of post-operative bowel distention forgotten, providing suction is efficiently maintained on both tubes and the tubes are not prematurely removed.

Where no immediate indication for operation exists, the case is evaluated in the light of the clinical condition of the patient as time passes. (see section on Technique). The precision technique described has greatly reduced the hard work associated with previous methods.

We have been able to indicate accurately the results which may be expected. Instead of reducing the indications for decompressive treatment to meet the inadequacies of design and technique, we have modified the design and technique in order to overcome the difficulties as they arise. This has resulted in a reversal of the trend towards compromise which occurred through deficiency of earlier techniques.

The use of the tense balloon, which makes rapid and comparatively non-traumatic passage of the tube through the bowel possible, should encourage the pre-operative installation of this "post-operative bowel distention insurance" by the surgeon, even though immediate operation is envisaged.

We realize that time must elapse before the importance of the terminal holes supported by a metal insert, placed just distal to the tense balloon bolus, will be appreciated. We would urge most strongly that this arrangement be more widely evaluated.

The gravity director head has apparently proven its worth, as evidenced by two other workers in the field who have utilized the principle subsequently to the senior author. However, we feel that only when used in conjunction with the other features of design described, will any great advance be made in the management of intestinal distention by intubation.

Intubation should be considered as a vital supportive measure whenever bowel distention is discovered. Its benefits, if used in the manner outlined, may often save life, not only directly but also indirectly. The benefits of early ambulation and the much needed reduction of hospitalization time and bed space should in themselves recommend the adoption of our more efficient and positive approach to the distention problem. Unrelieved small intestinal distention often passes almost unnoticed as a contributory cause of death. "Bi-lateral basal broncho-pneumonia" has hidden many an post-operative death in which distention was unrelieved. For this reason, any method which shows promise of expediting relief of bowel distention should at once be evaluated and previous inefficient and slow methods discontinued. There is no longer any place in clinical surgery for the complacent approach. Bowel distention though insidious is an emergency once recognized.

Further Development

In the light of our experience we feel that further improvement in design of the tube towards achievement of even more rapid intubation is possible without sacrifice of any of the features so far proven effective. It is our impression that the pyloric sphincter is a comparatively rare cause of arrest and delay, and that the chief cause of delay in reaching the bowel is the inability of the tube to conform quickly to the multiple acute angles sometimes present in the upper duodenum, especially where the propulsive function of this region is weak. For this reason, we are evaluating tubes with extremely flexible terminal design. A device designed to force the tip of the tube rapidly to the pylorus without air injection is in the process of development[108].

Summary

1. A long intestinal tube of plastic material with attached mercury-containing gravity director head and separate high pressure bolus balloon is introduced by the senior author.

2. A critical evaluation of the clinical results in 248 consecutive cases is presented.

3. Certain rigid criteria are set forth as the basis for classifying successful intubation.

4. A simplified standard technique is outlined for insertion of this tube into the small bowel. Massive air injection into the stomach and fluoroscopic guidance are emphasized.

5. Secondary uses, such as local barium diagnostic studies, are described.

\- - -

6. In the group of primary obstructions, the aspirating portion of the tube was introduced into the lower part of the second duodenum in thirty minutes or less in 49% of the cases.

7. In this series the most consistent causes of failure to pass the pylorus were mechanical obstruction of the pylorus and the vagotomy decompensated stomach.

8. Seventy-seven per cent of the primary obstruction group either needed no operation or were operated upon after hydration and decompression.

9. A comparison is made of this series to that of Beverley Smith, the only other carefully classified series in the literature.

10. A six per cent overall mortality was observed. In the obstruction group the mortality was five per cent.

11. Although intestinal travel and decompression is slower in the case of adynamic ileus, such cases are presented in this series which demonstrate decompression.

12. Since, with the use of this tube and technique, decompression at operation can be easily carried out, it is proposed that intubation be employed even in those cases going shortly to the operating room.

References

1. Abbott, W. O.; Johnston, C. G.
Intubation Studies of the Human Small Intestine X.
A Non-Surgical Method of Treating, Localizing and Diagnosing the Nature of Obstructive Lesions.
Surg., Gynec. & Obst. 66:691-697; '38 April.

2. Wangensteen, O. H.
The Early Diagnosis of Acute Intestinal Obstruction with Comments on Pathology and Treatment. With a Report of Successful Decompression of Three Cases of Mechanical Bowel Obstruction by Nasal Catheter Suction Syphonage.
West. J. Surg. Obs. & Gyn. 40:1- '32.
Also Trans. West. Surg. Assn. '31.

3. Herrin, R.C.; Meek, W.J.
Distention as a Factor in Intestinal Obstruction.
Arch. Int. Med. 51:152-168; '33.

4. Hibbard, J.S.; Wangensteen, O.H.
Character of Gaseous Distention in Mechanical Obstruction of the Small Intestine.
Proc. Soc. Exper. Biol. & Med. 31:1063-1066, '34.

5. McIver, M.A.; Benedict, E.B.; Cline, J.W.
Post-operative Gaseous Distention of the Intestine.
Arch. Surg. 13:588- '26.

6. Wangensteen, O.H.; Rea, C.E.
The Distention Factor in Simple Intestinal Obstruction:
An Experimental Study with Exclusion of Swallowed Air by Cervical Esophagostomy.
Surg. 5:327-339; '39.

7. Alvarez, W.C.
An Introduction to Gastroenterology.
Paul Hoeber Inc. N.Y., '40.

8. Morris, C.R.; Ivy, A.C.; Maddock, W.G.
Mechanism of Acute Abdominal Distention.
Arch. Surg. 55:101-124; '47.

9. Paine, J.R.
The History of the Invention and Development of the Stomach and Duodenal Tubes.
Ann. Int. Med. 8:752-763; '34.

10. Thompson, M.
Intestinal Intubation.
South Surg. 10:88-92; '41.

11. Grimson, K.S.; Hodge, G.B.
Prolonged Intubation Suction and Deferred or Delayed Surgery in Treatment of Multiple Adhesive Obstructions of the Small Intestine.
Surg., Gynec. & Obst. 78:316-326; '44.

12. Kussmaul; Cahn, A.
Heilung von Ileus durch Magenausspülung. Berl. Klin. Wchnschr.
21: 669-672; 685-687; 1884.

13. Westerman, C.W.J.
Über die Anwendung des Dauer Magenhebers bei derNachbehandlung Schwerer Peritonitisfälle.
Zentralb. f. Chir.
37:356-357; '10.

- - -

14. Kappis, M.
Einige Praktische Wirke zur Behandlung des Peritonitischen Ileus.
Munchen Med. Wchnschr.
58:15-17; '11.

15. Kanavel, A. B.
Continual Stomach Lavage and Continuous Hypodermoclysis in Peritonitis, Persistent Vomiting with Dehydration and Dilated Stomach. With a Description of a Modified Stomach Tube.
Surg., Gynec. & Obst. 23:483-485; '16.

16. Matas, R.
The Continued Intravenous Drip with Remarks on the Value of Continued Gastric Drainage and Irrigation by Nasal Intubation with a Gastroduodenal Tube (Jutte) in Surgical Practice.
Ann. Surg. 79:643-661; '24.

17. Kantor, J.L.; Marks, J.A.
A Study of Intestinal Flatulence.
Ann. Int. Med, 3:403-422; '29.

18. Hemmeter, J.C.
Intubation of the Duodenum.
Johns Hopkins Hosp. Bull. 7:79-80; 1896.

19. Gross, M.
A Duodenal Tube.
N.Y. Med. J. 91:77-78; '10.

20. Jutte, E.M.
Transduodenal Lavage. Treatment and Report of Some Cases of Chronic Diseases.
JAMA 60:586-587; '13.

21. Rehfuss, M.E.
A New Method of Gastric Testing with a Description of a Method for the Fractional Testing of the Gastric Juice.
Am. J. Med. Sc. 147:848-855; '14.

22. Einhorn, Max.
An Intestinal Tube.
N.Y. Med. J. 110:456-459; '19.

23. Buckstein, J.
The Intestinal Tube.
Its Significance and Applications.
JAMA 74:664-667; '20.

24. Levin, A.L.
A New Gastroduodenal Catheter.
JAMA 76:1007; '21.

25. Damade, R.
Le Tubage Duodénal.
Gaz. des Hopit. 95:1061-1066; '22.

26. Bassler, A.
The Use of the Duodenal Tube in Extreme Cases of Ulcerative Colitis. Some Forms of Parasitic Infection of the Colon, and Post-Operative Ileus.
South Med. J. 12:4-7' '19.

27. Oden, C. L. A.
The Treatment of Post-operative Nausea, Vomiting and Distention in Certain Abdominal Sections by the Use of a Modified Duodenal Tube.
Surg., Gynec. & Obst. 36:572-573; '23.

28. Ward, R.
An Apparatus for Continuous Gastric or Duodenal Lavage.
JAMA 84:114; '25.

29. Ward, R.
Acute Dilatation of the Stomach.
Am. J. Surg. 8:1194-1195; '30.

30. Wangensteen, O. H.; Paine J. R.
Treatment of Acute Intestinal Obstruction by Suction with the Duodenal Tube.
JAMA 101:1532-1539; '33.

31. Scheltema, G.
Die Permeation und die Anwendung xx ihrer Prinzipien zur Untersuchung und Behandlung des Magen-Darmkanals.
Zeitschr. f. Klin. Med. 65:505-518; '08.

32. McClendon, J. F.; Bissell, F. S.; Lowe, E. R.; Meyer, P. F.
Hydrogen-Ion Concentration of the Contents of the Small Intestine.
JAMA 75:1638-1641; '20.

33. Dianélopolu, D.; Simici, D.; Dimitriu, C.
Inscription Graphique de L'Intestin Grele Chez L'Homme. Reflexe Oculo-Intestinal.
Compt. Rend. Soc. de Biol. 92:1143-1146; '25.

34. Miller, T. G.
Intubation Studies of the Human Small Intestine IX. Factors in the Maintenance of Physiological Conditions.
Rev. Gastroenterol. 4:115-120; '37.

35. Miller, T. G.; Abbott, W. O.
Intestinal Intubation: A Practical Technique.
Am. J. Med. Sc. 187:595-599; '34.

36. Johnston, C. G.
Decompression of the Small Bowel by Intestinal Tube Drainage at Site of Obstruction.
Mich.State Med. Soc. J. 37:623-628; '38 July.

37. Johnston, C. G.
Decompression in the Treatment of Intestinal Obstruction.
Surg., Gynec. & Obst. 70:365-369; '40

38. Honor, W. H.; Smathers, H. M.
Double-Lumened Plastic Tube for Intestinal Intubation.
Arch. Surg. 55:498-504; '47.

39. Willson, D. M.
Intestinal Intubation I. Studies in Acute and Subacute Obstruction of the Small Intestine.
Proc. Staff Meet. Mayo Clin. 13:666-671; '38.

40. Wild, J. J.
Apparatus for Intestinal Intubation.
Brit. Med. J. 1:815; '44 June.

41. Harris, F. I.
A New Rapid Method of Intubation with the Miller-Abbott Tube.
JAMA 125:784-785; '44 July.

42. Harris, F. I.
Intestinal Intubation in Bowel Obstruction. Technique with a New Single Lumen Mercury Weighted Tube.
Surg., Gynec. & Obst. 81:671-678; '45.

43. Cantor, M. O.
New Simplified Intestinal Decompression Tube.
Am. J. Surg. 72:137-142; '46.

44. Kaslow, A. L.
A New Material and Tube Design in Gastrointestinal Intubation.
Surg. 23:293-297; '48.

45. Palefski, I. O.
The Examination of the Gastroduodenal Tract.
Interstate Med. J. 21:977-1002; '14.

46. Twiss, J. R.
A New Type of Duodenal Tube Tip.
Am. J. Med. Sc. 185:109-114; '33.

47. Kunsztler, M.
Eine neue Duodenalsonde.
Zentralb. f. Chir. 59:2812-2814; '32.

48. Wilkins, J.A.
Mercury Weighted Stomach Tube.
JAMA 91:395-396; '28.

49. Rousselot, L. M. and Bauman, L.
Cholesterol Crystals and Calcium Bilirubinate Granules. Their Significance in Bile Obtained through the Duodenal Tube.
JAMA 100:175-176; '31.

50. Morgenstern, M.
A Simplified Procedure for the Introduction of a Tube into the Duodenum.
JAMA 97:175-176; '31.

51. Korbsch, R.
Zur Jejunalsondenbehandlung des Uleus Vertriculi and Duodeni.
Med. Klin. 28:1069-1070; '32.

52. Abbott, W. O.
Indications for the Use of the Miller-Abbott Tube.
New Eng. J. Med. 225:641-646; '41.

53. Dennis, C.; Brown, S.P.
Treatment of Small Bowel Obstruction.
Surg. 13:94-105; '43.

54. Devine, J.
Intestinal Intubation.
Med. J. Australia 1:213-219; '45. March.

55. McKittrick, L. S.
The Diagnosis and Management of Acute Obstruction of the Small Intestine.
New Eng. J. Med. 225:647-652; '41.

56. Smith, B. A. Jr.
Gastro-Intestinal Suction Tubes; Their Efficacy in Decompression of Stomach and Bowel.
M.S. Thesis, U. of M. '41.

57. Mayer, H. Jr.
Passage of Miller-Abbott tube through Pylorus with Aid of Electromagnet.
U. S. Naval Med. Bul. 43:463-466; '44.

58. Scott, H. G.
Personal Communication. '49.

59. Matheny, D.; Hutchine, L. R.
The Use of Gravity and Wangensteen Tip in Miller-Abbott Intubation.
West. J. Surg. 50:618-619; '42.

60. Morton, H. B.
Improved Tip for Miller-Abbott Tube.
Ann. Surg. 117:159-160; '43.

61. Wangensteen, O. H.
Intestinal Obstruction.
C. C. Thomas, Springfield, '42.

62. Devine, J.
A Concept of Paralytic Ileus. A Clinical Study.
Brit, J. Surg. 34:158-179; '46.

63. McIntyre, C. H.
A New Method for Operative Small Bowel Intubation Using the Miller-Abbott Tube. Forum on Fundamental Surgical Problems--
Clinical Congress Am. College of Surgeons; '48.

64. Uriburu, J.
Occlusion Intestinal: A Prosito de dos Nuevos Accidentes Observados el Manejo de la Intubacion.
El Dia Med. 14:1256-1258; '42.

65. Kaplan, I. W.; Michel, M. L.
Treatment of Post-operative Adynamic Ileus and Obstruction of the Small Bowel with the Miller-Abbott Tube.
New Orleans Med. & Surg. J. 93:558-565; '41.

66. Blalock, T. T.
The Importance of the Miller-Abbott Tube in Intestinal Obstruction.
U.S. Nav. Med. Bul. 40:376-378; '42.

67. Harris, F. I.; Gordon, M.
Intestinal Intubation in Small Bowel Distention and Obstruction. Further Experiences with the Single Lumen Mercury Weighted Tube and Analysis of Complications.
Surg., Gynec. & Obst. 86:647-658; '48.

68. Krook, S. S.
Intestinal Suction Treatment. (With the Miller-Abbott Tube)
Acta Chir. Scand. 96:562-576; '48.

69. Folley, J. H.
The Medical Management of Intestinal Obstruction. With Special Reference to the Use of the Miller-Abbott Tube.
New Eng. J. Med. 228:606-612; '43.

70. Abbott, W. O.; Pendergrass, E. P.
Intubation Studies of the Human Small Intestine. V. The Motor Effects of Single Clinical Doses of Morphine Sulfate in Normal Subjects.
Am. J. Roent. & Rad. Therap. 35:289-299; '36.

71. Miller, T. G.; Abbott, W. O.
Small Intestinal Intubation. Experiences with a Double-Lumened Tube.
Ann. Int. Med. 8:85-92; '34.

72. Leigh, O. C. Jr.; Nelson, J. A.; Swenson, P. C.
The Miller-Abbott Tube as an Adjunct to Surgery of Small Intestinal Obstruction.
Ann. Surg. 111:186-212; '40.

73. Smith, B. C.
Experiences with the Miller-Abbott Tube.
Ann. Surg. 122:253-259; '45.

74. Baird, M. Mc; Campbell, J. M. H.; Hern, J. R. B.
The Importance of Estimating Chlorides in the Fractional Test Meal Samples and Some Experiments with the Duodenal Tube.
Guy's Hosp. Rep. 74:23-54; '24.

75. Hamrick, W. H.
A Technique for Introducing the Miller-Abbott Tube.
U.S. Nav. Med. Bul. 41:1737-1742; '43.

76. Einhorn, Moses.
Nasal Simultaneous Gastroduodenal Aspirator. Its Use in Post-operative Gastro-Intestinal and Abdominal Surgery.
Surg., Gynec. & Obst. 72:48-57; '41.

77. Bockus, H. L.
Gastro-Enterology.
W. B. Saunders Co., Philadelphia, '44.

78. Boehme, E. J.
Management of Intestinal Distention (Adynamic Ileus), with Special Reference to Post-operative Distention. Surg. Cl. No. Am. 24:560-577; '44.

79. Glenn, P. M.
Intestinal Obstruction: Results of Treatment with the Use of Intestinal Intubation.
Am. J. Digest Dis. 8:35-39; '41.

80. Noer, R. J.; Johnston, C. G.
Decompression of the Small Bowel in Intestinal Obstruction.
Am. J. Digest Dis. 6:46-49; '39.

81. Herrera, R. E.; Millet, J. B.; Lawrence, G. H.
A Report on the Use of the Harris Tube.
Surg., Gynec. & Obst. 85:604-606; '47.

82. Guthrie, D.; Gagnon, G.
Value of the Miller-Abbott Tube in Surgery: Technique of Introduction.
Guthrie Clin. Bul. 15:111-117; '46.

83. Mason, R. L.; Zintel, H.A.
Preoperative and Postoperative Treatment.
W. B. Saunders, Philadelphia, '47.

84. Cantor, M. O.; Kennedy, C. S.; Reynolds, R. P.
Use and Abuse of Intestinal Decompression Tube.
Am. J. Surg. 73:437-449; '47.

85. Duncan, J.
Miller-Abbott Intestinal Intubation. Evaluation in Treatment of Obstruction. N.W. Med. 39:177-179; '40.

86. Blodgett, J. B.
A Technic for the Satisfactory Use of the Miller-Abbott Tube.
Am. J. Surg. 53:271-279; '41.

87. Finney, G. O.
The Importance of Nonsurgical Measures in the Treatment of Intestinal Obstruction.
Surg. 21:270-279; '47.

88. Wangensteen, O. H.; Rea, C. E.; Smith, B. A.; Schwyzer, H. C.
Experiences with Employment of Suction in the Treatment of Acute Intestinal Obstruction.
Surg., Gynec. & Obst. 68:851-868; '39.

89. Abbott, W. O.
Digestive Tract: Decompression.
pp. 308-310, Med. Physics, Year Book Pub. Chicago '44.

90. Wyndham, N. R.
The Miller-Abbott Tube in the Treatment of Ileus.
Australian and N.Z. J. Surg. 16:62-67; '46.

91. Wild, J. J.
The Stomach as a Cause of Difficulty in Intubating the Human Duodenum. With Introduction of the Use of the Gastric Balloon.
Surg. 24:70-78; '48.

92. Wild, J. J.
The Design and Management of Long Intestinal Tubes.
Surg. '49 (In press)

93. Wangensteen, O. H.
New Operative Techniques in the Management of Bowel Obstruction.
Surg., Gynec. & Obst. 75:675-692; '42.

94. Dennis, C.
Injury to the Ileac Mocosa by Contact with Distilled Water.
Am. J. Phys. Vol. 129, 1:171-175; '40.

95. Peters, J. P.
Problems of Intestinal Obstruction.
Univ. Pennsylvania Press; '41.

96. Eliason, E. L.; Welty, R. F.
A Ten-Year Survey of Intestinal Obstruction.
Ann. Surg. 125:57-65; '47.

97. Leigh, O. C. Jr.; Diefendorf, R. O.
The Miller-Abbott Tube in Surgery.
JAMA 118:210-214; '42.

98. Penberthy, G. C.; Johnston, C. G.; Noer, R. J.
The Treatment of Adynamic by Gastrointestinal Intubation.
South Surg. 8:416-425; '39.

99. Schlicke, C.P.; Hargen, J.A.; Dixon, C. F.
The Management of Intestinal Obstrution. An Evaluation of Conservative Therapy.
JAMA 115:1411-1416; '40.

100. Green, J. C.
The Value of the Miller-Abbott Tube in Surgery and Case Reports.
Miss. Dr. 24:186-194; '46.

101. Brenizer, A. G. Jr.
An Unusual Complication of Intestinal Intubation.
New Eng. J. Med. 238:291-292; '48.

102. Cantor, M.O.; Phelps, E.R.; Esling, R.H.
Effects of Intestinal Gases Upon Balloons of Intestinal Decompression Tubes.
Am. J. Surg. 75:441-452; '48.

103. Warren,K.W.; Cattell, R.B.
Stenosis of the Intestine after Strangulated Hernia. With Fatal Complication Following intestinal Intubation.
Am. J. Surg. 75:729-732; '48.

104. Holinger, P. H.; Loeb. W. J.
Feeding Tube Stenosis of the Larynx.
Surg., Gynec. & Obst. 83:253-258;'46

105. Ivlauer, S., and Molt, W. F.
Severe Injury to the Larynx Resulting from the Indwelling Duodenal Tube.
Ann.Otol.Rhin.Laryng. 48:886-904;'39.

106. Kaufman, L.R.; Serpico, S.; Mersheimer,W
A Rare Complication of the Miller-Abbott Tube.
Am. J. Surg. 57:173-176; '42.

107. Van Beuren, F.T.,Jr.;Smith, B. C.
Acute Ileus. Analysis of 130 Cases Operated upon at the Presby. Hosp. N.Y. City from '32 to '33, Inclusive.
Ann. Surg. 107:321-339;'38.

108. Wild, J. J. Further Development of the Gastric Balloon to be published.

III. MEDICAL SCHOOL NEWS

The news pages of this number of the Bulletin are written in honor of Dr. E. T. Bell, Professor and Head of the Department of Pathology. Dr. Bell will become Professor Emeritus in June of this year when he reaches the time of automatic retirement from the University faculty. It is a pleasure to use these pages to announce the beginning of the campaign of the Greater University Fund and the Minnesota Medical Foundation to appropriately honor Dr. Bell.

The Minnesota Medical Association honored Dr. Bell at its 96th annual meeting which was held in St. Paul on May 9, 10, and 11. Dr. Bell was presented with the Distinguished Service Award of the Minnesota Medical Association at the annual banquet on May 10. Dr. Bell was cited by the Association for "his contribution, not only to teaching and research in Pathology, but to the practice of medicine in this state as a whole." Dr. Bell's many friends within the medical profession will be happy to learn that they can personally participate in honoring him by their contributions to the E. T. Bell fund as explained on the following page.

* * *

Biographical Briefs -- Dr. Elexious T. Bell

Dr. Elexious T. Bell was born in Ralls County, Missouri, in 1880. His father was a country doctor and was active for many years in the general practice of medicine in Ralls County. In 1897 Tommy Bell, as he is still affectionately known by his colleages, entered the University of Missouri as a premedical student. He received his Bachelor of Science degree from that University in 1901 and his Doctor of Medicine degree in 1903.

Dr. Bell taught in the Department of Anatomy of the University of Missoure Medical School until 1905 when he traveled to Europe for a year of study. This work was done at the University of Bonn in Germany under Dr. M. Nussbaum. Dr. Bell returned to the University of Missouri to resume his teaching in anatomy. He remained there until 1910 when he came to the University of Minnesota Medical School as Assistant Professor in the Department of Anatomy. In 1911 he became a member of the staff of the Department of Pathology. Dr. Bell was made Director of the Department of Pathology in 1921 and has served in that capacity up to the present. Dr. Bell has published numerous articles on various phases of medicine and has made a particular study of renal diseases and hypertension. His publications include two books, his "Textbook of Pathology" and Renal Diseases."

Throughout the years, Dr. Bell has been the guiding spirit and stimulus behind the Minnesota Pathological Society. He served as secretary-treasurer of that organization for 29 years. Graduates of Minnesota will long remember Dr. Bell's Tuesday noon Pathology Conferences. His stimulating and friendly way of presiding, the ever-present cigar, and his frequent chuckles of amusement have always highlighted the scientific material of the conferences.

All of Dr. Bell's former students and colleagues will join in the hope that our beloved professor will long continue to grace the campus of our Medical School with his prescence.

The Minnesota Medical Foundation
182 Medical Sciences Building
University of Minnesota
Minneapolis 14, Minnesota

Dr. E. T. Bell To Be Honored

On June 15, 1949, Dr. E. T. Bell, Professor of Pathology, reaches the age of retirement and will relinquish the chair. He has served the University since 1910, first teaching in Anatomy, and from 1911 until the present time in the Department of Pathology. He was appointed head of the department in 1921 and in this capacity has directed its activities in the intervening years. Everyone who has had any contact with medicine in the Northwest knows how profound his influence has been, not alone on teaching and research in pathology, but on the practice of medicine, as a whole.

Many physicians and former students have brought to the Minnesota Medical Foundation the request that a fund be established in Dr. Bell's honor, to perpetuate in some measure his influence as a teacher, investigator, and consultant.

As a result of these requests, an advisory committee was appointed and has recommended the establishment of a fund of $100,000 to create and maintain for teaching and research a Museum of Pathology in the Medical School, which will bear his name.

The Sponsoring Committee feels confident that there will be a gratifying response to requests to his many friends and admirers for subscriptions to this fund. It has been suggested that contributions might range from $100 to $1,000 or higher in individual instances.

This is a splendid opportunity to promote teaching and research in Pathology and to honor a great leader in medicine.

It should be added that as a special project of the Greater University Fund any donor to the E. T. Bell Fund of the Minnesota Medical Foundation will also be listed and recognized as a donor to the Greater University Fund, even though his gift is entirely to the Bell Fund.

E. Platou.

E. S. Platou, President
Minnesota Medical Foundation