THE PRESENT STATUS OF THE TREATMENT OF INTESTINAL OBSTRUCTION

by

DONALD STANFORD BOLSTAD

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Intestinal obstruction has long been a thorn in the side of the medical profession. Numerous long and bitter disputes have been waged over the causes, direct and indirect, the diagnosis, pathogenesis, but above all, the treatment. The latter two particularly since the opening of the century have been the object of numerous investigations and countless contradictory researches.

The evils of many of the acute abdominal conditions were overcome with the advent of abdominal surgery through the momentous discovery of antisepsis and the development of aseptic tecnique. Appendicitis and perforated gastric ulcer are no longer regarded with such terror by the physician and surgeon. Today, early surgery in both of these conditions, once regarded as sure death, is attended by a remarkably low mortality rate. It would seem reasonable to expect, from the advances made in the above mentioned conditions, that the surgical treatment of intestinal obstruction would follow along the same general lines of improvement.

In spite of this, the mortality rate as reported in many recent publications of large series of cases is almost as high as those reported at the turn of the century. Statistics show

that forty to sixty percent of patients operated upon for intestinal obstruction, die. This may be due to late diagnosis and consequent late surgery as is claimed by many, still recently instituted methods of non-surgical treatment even when not begun so early, have been quite effective in reducing the mortality rate in at least one series of cases. Have we, then, in our zeal for reducing the appalling mortality rate of intestinal obstruction, missed the keynote of successful treatment? We must all agree in view of persistently high mortality rates reported in late years that we have not been very successful in reducing the mortality rate of intestinal obstruction since the advent of the twentieth century.

TABLE I

Mortality Rates as Reported by Various Authors

Author (Year of Report)	No. of cases	Mortality rate
Haven - 1855 (from literature)	258	84.8%
Gibson - 1900	1000	40.3%
Finney - 1921	317	36.0%
Tuttle - 1925	128	41.3%
Holden - 1926	135	19.2%
Deaver & Ross - 1926	---	42.0%
Miller - 1927	171	70.9%
Van Buren & Smith - 1927	1089	41.8%
Brill - 1929	124	36.3%
Seelaus - 1931	---	53.0%
Koslin - 1932	185	38.38%
Vidgoff - 1932	266	45.9%
Cornell - 1932	235	51.48%
Mc Iver - 1932	---	31.0%
Robbins - 1932	65	49.2%
Wangensteen & Paine - 1933	51	21.5%
Meyer & Spivack - 1934	505	38.8%
Rentschler - 1934	100	41.0%
Moss & Mc Fetridge - 1934	340	31.7%

TABLE II

Relation of Time Elapsed Before Surgery is Done and Mortality Rate

Author	1-12 hrs.	12-24 hrs.	After 24 hrs.
Finney	5%	11%	31%
Tuttle	4%	15.4	50%
Brill	0	12.5	54.7
Miller	29.4	52.9	50-84
Bower	13.0	8.9	28

We see in the above chart that the mortality rate varies tremendously with the various authors. Whether or not this can be blamed to the type of cases treated and the length of time elapsed before treatment was instituted is a subject for closer scrutiny. Let us probe more deeply into the types of cases treated by various authors and the duration of symptoms.

As a whole the etiology of the cases as seen in the publications, does not vary a great deal. At least there is not enough variation to account for the great differences in the reported mortality rates. There are minor differences noted in the causative mechanism to be sure, but we must look farther to find an apparent reason.

From Chart two it is quite evident that the time elapsed between the onset of symptoms and the operation, affects profoundly the mortality rate. Of the 217 cases reported by Finney, with a total mortality of 36%, only 5% of those operated upon within the first twelve hours, died, while 11% of those operated upon within twelve to twenty-four hours, 11% died. Tuttle, with a total mortality of 41.3%, reported that those operated upon within six hours of the onset of symptoms, all lived, and only 4% of those operated within twelve hours died. In Brill's series of 124 cases, with a general mortality rate of 36.3%, those operated upon within twelve hours, all survived, while of those operated upon within twelve to twenty-four hours, 12.5% died. Moreover, of the 135 cases treated by Holden, fifty-one came directly to him and were operated upon with a mortality of only six

percent.

Here is one point at which we must aim our future efforts if we are to lower appreciably our present mortality rate. The nature of intestinal obstruction is such that if we wish to do any surgery we must do it before any marked degree of distention has occurred or after the distention has been at least fairly well reduced. There are some types of obstruction which do not lend themselves to the latter, hence those types must be operated upon early if we expect any further reduction in mortality. The earlier the operation is performed the greater the chance for the patient to survive.

Etiology

In those series in which the age incidence was recorded, the results are very interesting. The greatest age incidence was between the ages of twenty and fifty, although in Gibson's series the highest incidence was in the first decade of life. In Meyer and Spivack's series the highest incidence was in the fourth decade, and in Rentschler's series in the fifth and sixth decades. In Vidgoff's series 60% of the cases were between the ages of twenty and fifty.

Sex in most series is about equally divided, with a slightly higher incidence reported in males than in females. This may be due to the larger proportion of hernia in males than in females, hernia in some series making up a high percentage of the cases seen.

TABLE III

Incidence of Intestinal Obstruction by Sex

Author	Male	Female
Rentschler	47%	53%
Meyer and Spivack	51.3	48.7
Gibson	65.0	35.0
Koslin	60.5	39.5
Vidgoff	47.0	53.0
Cornell	50.0	50.0
Haven	56.9	43.1
Average -	54.0	46.0

Previous abdominal operation is an important predisposing factor to the production of an intestinal obstruction. Thus Meyer and Spivack report that adhesions were the cause of the obstruction in 72% of their cases, 64% of whom had had previous abdominal surgery, and Vidgoff reports previous operations in 68% of his cases. In most of the series adhesions of one sort or another, and very frequently post operative adhesions are among the most common etiological agents.

Wangensteen classifies intestinal obstruction by dividing the causes into three main groupings, namely, mechanical, vascular, and nervous. He further classifies the cause as producing either simple obstruction in which the blood supply is intact, or strangulation obstruction in which there is serious interference with either the venous or arterial cir-

culation or both. His classification is given.

As to the relative frequency of the various etiological factors, most authors agree quite closely in naming hernia and post operative adhesions as the most common offenders. Intussusception, tumors, either malignant or benign, and valvulus follow in irregular order.

Wangensteen's Classification of Intestinal Obstruction

A - Mechanical.

I. - Narrowing of lumen.

a. - Strictures of bowel wall.

1. - Congenital { atresia, imperforate anus } } simple

2. - Acquired { Inflammatory, Traumatic, Vascular, Neoplastic } } simple

b. - Obturation

c. - Compression from without (Especially pelvis and retroperitoneal duodenum

II. - Adhesive bands { Congenital, Inflammatory, Traumatic, Neoplastic } } simple or strangulation

III. - Hernia
- a. - External - strangulation
- b. - Internal - strangulation

IV. - Volvulus - strangulation

V. - Intussusception - strangulation

B - Nervous

I. - Inhibition ileus (paralytic) adynamic } simple

II. - Spastic ileus - dynamic } simple

C - Vascular

I. - Thrombosis & embolism of mesenteric vessels } strangulation

II. - Severance or injury of mesenteric vessels (Operative or blunt trauma } strangulation

Symptoms

The time honored pathognomonic triad are the well known and often waited-for pain, vomiting and obstipation. These symptoms are by far the most commonly mentioned in all series reviewed.

1. Pain - Pain is the most common symptom complained of, and in most cases it is the first symptom to be complained of. It is present in almost 100% of the cases of intestinal obstruction, and continues until some method of relief is used. Characteristically the pain is of a crampy, intermittent nature and is accompanied at its height by loud gurgling borborygmi. When the small bowel is obstructed, the pain tends to be localized above and to the left of the umbilicus; when the large bowel is obstructed, the pain tends to be localized below and to the left of the umbilicus. This, however, is not to be relied upon too strongly, for many cases have only a generalized abdominal pain.

2. Nausea and Vomiting - Next to pain, nausea and vomiting are the most common symptoms, in fact Meyer and Spivack report twelve cases in which vomiting actually preceeded the onset of pain. However, this is rare. At the onset, the vomiting consists of the food taken immediately before the attack occurred, but as the condition progresses, bile appears, followed by partially decomposed intestinal contents. Late in the course the vomitus becomes of a feculent odor, but only very rarely, contrary to a not uncommon belief, is there ever actual fecal material present.

3. Obstipation - From the very nature of the condition being dealt with, one would expect this symptom to be prominent. However, because the portion of the bowel distal to the point of obstruction, as shown by Wangensteen is anatomically and physiologically normal, it is possible to have a small amount of feces and flatus passed. This is especially true following the administration of an enema. It is not uncommon that an enema may cause return of gas and feces, although no relief from pain is to be had. Catharsis also may be relied upon too much in ruling out constipation as a symptom of intestinal obstruction. Wangensteen cites several instances in which cathartics administered to cases with a simple obstruction caused a bowel movement, with the result that the patient was allowed to wait too long before treatment was instituted. Vidgoff reports twenty cases in which diarrhea was present. As a rule, however, constipation is absolute, there being neither gas nor feces passed.

Physical signs, early, are conspicuous by their absence. Intestinal obstruction is the only acute abdominal condition in which physical signs are absent early. Wangensteen says, "When a patient complains of intermittent, crampy pains, nausea, and vomiting, but local signs are absent, the presence of an intestinal obstruction should immediately be considered."

In cases of simple obstruction the temperature is subnormal and the leukocyte count is normal or only slightly elevated. As soon as there is any serious infraction upon

the circulation of the bowel, however, the temperature rises and the leukocyte count increases, although it seldom goes over 25,000 per cubic millimeter.

There are no early changes in blood chemistry. It is only after several days of persistence of the obstruction with no relief that there is noticed a fall in the blood chlorides, elevation in blood urea and alkalosis.

Diagnostic Aids

1. Stethoscope Borborygmi are a valuable sign, and when heard are very significant. A metallic tinkle heard over the abdomen indicates the presence of a bowel that is dilated and already under tension. When a sound much like that caused by the dripping of water into a half empty rain-barrel or by inverting a bottle filled with water and allowing the water to run out, is heard over the abdomen in a patient complaining of intermittent crampy pain, especially when these signs are most prominent at the height of pain, it is likely that an obstruction is present.

2. X-Ray Although the presence of gas in the small bowel was recognized many years ago as being a common finding in cases of intestinal obstruction, it has not been until comparatively recent years that much emphasis has been placed upon X-ray demonstration of this gas in relation to the early diagnosis and success of decompression of intestinal obstruction.

As early as 1911, Schwarz of Vienna, described the

presence of gaseous shadows in the small bowel and indicated their significance in the diagnosis of intestinal obstruction, but he was unwilling to commit himself to a diagnosis without the corroborative evidence of an opaque medium. Kleiber, in 1919, was the first to indicate that the presence of gaseous shadows in the small intestine was alone sufficient to warrant a diagnosis of intestinal obstruction, and stated that the administration of barium was unnecessary. Visible collections of gas in the small bowel in the adult are synonymous with intestinal stasis, and it should not be necessary to wait for the step-ladder appearance described by Case in order to make a diagnosis.

Wangensteen and Lynch showed experimentally that definite evidence by the single plate method may be obtained within four to five hours after the onset of an obstruction in the small bowel. In large bowel obstructions the gas is slower in appearing than in the small bowel, and cannot be visualized much before eight to ten hours after the onset of the obstruction. They advise taking an exposure with the patient in the upright position, or, if this is not possible, with the patient on his side in bed. This establishes the presence of fluid levels which cannot be seen with the patient lying on his back or abdomen, and thus further proves the presence and nature of distention of the bowel.

Gas in the small bowel is characterized by its central location; the long axis of the shadow is transverse, and when the loops are considerably dilated, the intestinal walls separating the adjacent loops are seen as very thin and

narrow walls. Gas in the large intestine is at the borders of the abdomen; the long axis is vertical, and the intestinal walls are thicker. The haustral markings are also occasionally present.

In any case when the diagnosis is in any way uncertain and the possibility of an intestinal obstruction cannot be ruled out, a single plate roentgenogram of the abdomen should be taken. Craig recommends the use of thin suspensions of barium by mouth so as to localize the point of obstruction, but most authors feel that the risk of further obstructing the intestine is too great, and therefore do not use it.

Vidgoff reported X-rays taken in 104 of his 266 cases, with a positive diagnosis in 71% of these cases, and numerous workers feel that herein lies the hope of reducing the mortality rate from intestinal obstruction in the future.

Cause of Death

The results of a large number of experimental investigations have indicated that the absorption of a toxin produced in the obstructed bowel and effecting a profound and overwhelming toxemia, is largely responsible for the high mortality. Clinicians were quick to seize upon this theory, finding in this refuge some solace for their misgivings and a satisfactory explanation for their poor results. This is not surprising in view of the fact that there is an accumulation of gas and fluid in the bowel above the point of obstruction.

In fact, Elman devoted an article to the danger of sudden deflation of the acutely distended bowel in late low intestinal obstruction and stated that the results were largely due to an increased absorption of the toxic products in the previously distended and hence more permeable bowel, or that the toxic products of decomposition were allowed access to the normal bowel below, and that here absorption could take place.

Since the discovery of Hartwell, Hoguet and Beckman that the subcutaneous administration of saline solution may permit a dog with complete obstruction of the upper intestine to survive as long as three weeks, the ideas concerning the mode of death in intestinal obstruction have undergone considerable change. It was at first, thought that the saline solution had a detoxifying action, but when physiological saline solution had the same effect, this idea was discarded.

Jenkins, White and Fender also showed by reinjection of the vomited secretions and by relieving the obstruction and leaving the contents in the distended bowel that the presence of a toxin was unlikely. In the recent work published by Herrin and Meek, they produced definite evidence which indicates that a toxin is of no importance. They showed that drainage of the fluid from the distended bowel, the distention itself remaining, did not relieve the symptoms of intestinal obstruction. On the contrary, reinjection of this drained fluid into the intestine below the point of obstruction prevented the symptoms from developing. They also showed very conclusively that distention of denervated loops of small intestine produces no symptoms,

even when no attempt was made to remove the contained fluid. This work is a further blow to the toxin theory.

Since we can no longer, in view of the proof to the contrary, lay the blame to the production of a toxin, we must look farther for the cause of symptoms and death. Herrin and Meek demonstrated in dogs by distention of isolated loops of bowel by pressures of 75-80 mm. of mercury, that symptoms of depression of activity, in some cases retching and vomiting, and on the fourth day, on the average, the entire dissappearance of appetite. As the distention continues the dog shows loss of weight, signs of emaciation, and gradually passes into coma, followed by death. The average length of life was eight days. When the loops of bowel were previously denervated, the distention produced no symptoms within a period of twenty-one days in three dogs and no symptoms for a week in four other dogs. They also found that dechlorination of the blood and tissues does not depend so much upon the loss of chlorides by vomiting as upon hypersecretion of the digestive fluids in the distended bowel. When chlorides were supplied to the normal bowel below the distended loop, the animals endured periods of fourteen days with no symptoms of any kind. Thus, they contend that dechlorination is the important factor in causing death from intestinal obstruction.

Although Herrin and Meek account for the fluid accumulated during distention, and point out the results of the distention, they make no attempt to explain why there should be so much gas formed in the distended loop.

McIver, like many others, feels that the gas is formed largely by decomposition of the intestinal contents directly above the point of obstruction. Wangensteen and Rea, however, by excluding the swallowing of air by transecting the oesophagus in dogs with an intestinal obstruction, have indicated that swallowed air is probably the chief source of gaseous distention in mechanical obstruction of the small bowel. They found that the average amount of air in closed loops of bowel was only 76 c.c. as compared to 234 c.c. present in open loops of comparable length. By analysis of the gas present in obstructed loops, Hibbard and Wangensteen show further that gases formed from decomposition of intestinal contents play a very minimal role in the distention produced in intestinal obstruction, and that the greater percentage of the gas present was nitrogen.

Treatment

It is interesting to note the various methods of treatment advised by various authors, particularly in regard to the advisability of surgery and the employment of the various surgical procedures. There are almost as many types of treatment advocated as there are reports on the subject, and yet one may follow definite trends in the treatment.

Haven, in 1855, collected 258 cases from the literature and tabulated the results of the various methods of treatment used at that time. Of the 258 cases, only thirty-nine were operated on with a mortality of 38.5%. Of the 219 not operated

on, only fifteen recovered, a mortality of 90.7% ! Even with the limited surgery practised at that time (there were only two types of operation done, enterostomy and gastrostomy) the mortality rate with surgery was markedly less than that with medical treatment. He states, "If a diagnosis could be made out in cases of simple twist, or of simple strangulation of knuckles of intestine through loops, rings, openings, or under bands, how far should we be justified in performing abdominal section? Evidently, in cases of twists the answer would depend much upon the frequency of peritonitis; and in those of knuckles, it would depend upon the frequency of peritonitis, adhesions, thickening, disorganization, etc. preventing a withdrawal of the incarcerated portion." He goes on to state, "It is surprising, however, what inroads upon the abdominal cavity may sometimes be made without causing death....."

Bristowe, in 1879, writing of intestinal obstruction, advised immediate surgery for obstructions due to volvulus, impaction of foreign bodies, and cases of strangulation, and recommends surgery for stricture, compression and intussusception. He recognized the importance of avoiding purgatives, but says that easily digestible food may be given. He also states that enemata and inflation of the bowel with air may be attempted in cases of intussusception with a chance of reducing the intussusception.

Einhorn, in 1904, realized the importance of withholding everything by mouth and the administration of fluids by salt

solution enemata, or if these were not retained, salt solution intravenously or subcutaneously. In addition, he advised the use of opium, only, however, after the diagnosis has been made if possible. As further aids in treatment, he recommended gastric lavage, lavage of the bowel and inflation of the bowel with air, the latter two measures being of special benefit in cases of intussusception. He also mentions the practice of puncturing the distended bowel through the abdominal wall and cites several instances of cures, although he does not favor its general use because of the danger of peritonitis. He suggested the use of mercury and electricity both faradic and galvanic as being of value in the treatment of paralytic ileus, but stated that electricity was contraindicated in cases of incarceration.

Einhorn devoted very little space in his discussion of intestinal obstruction to the subject of surgical treatment. he stated that if possible, the cause of the obstruction should be removed, but if this were not possible, then an enterostomy should be done in the most distended coil of the intestine.

Gibson, in 1900, reported a series of 1000 operations for acute intestinal obstruction in which the surgery done was mostly of two types, resection or artificial anus (enterorrhaphy). Of the cases thus treated hé reported a mortality rate of 40.3%.

In recent years an ever increasing emphasis has been laid on the need for early diagnosis and the institution of treatment. We have only to refer back to Chart 2, to

to see why this has come about, and how really dependent the mortality rate following surgery is upon the time element, and it becomes quite evident that earlier diagnosis is going to influence the future mortality rate from a surgical standpoint.

From recent advances made, there are two methods of treatment which, at least theoretically, should be ideal in coping with the various types of obstruction of the intestines. Surgery is immediately indicated in those cases with a strangulation obstruction. This may commonly be due to any of three causes, namely volvulus, strangulated hernia, and irreducible intussusception. In any of these conditions we see the symptoms described for strangulation. In obstruction due to strictures of the intestine, whether they are of a simple or malignant nature, it is obvious that the obstructing mechanism must be removed before any hope may be offered for recovery. Acute obstructions of the descending colon with enormous dilatation of the proximal colon and the ileo-cecal valve functioning properly is also essentially a strangulation obstruction, since there can be no regurgitation into the small intestine and the distention is limited to the colon producing necrosis, gangrene and perforation in the cecum.

Most authors, until Wangensteen's report of the successful decompression by suction-siphonage, advocated immediate surgery for all types of intestinal obstruction. Although we know this is no longer necessary, those types of obstruction mentioned above must be treated surgically if any hope is to be had of their ultimate recovery.

Various methods of preoperative treatment have been proposed as being necessary to get the patient into condition to withstand the ordeal of the surgeon's knife. Rentschler prepares his patient by stomach lavage and by the administration of fluids subcutaneously and intravenously. For this purpose he employs dextrose and normal saline solution. Meyer and Spivack agree, stating that gastric lavage should always be used when a general anesthesia is administered for the operation. Cornell, in addition to the above procedures advocates the administration of enemata.

Moss and Mc Fetridge favor, instead of normal saline, the use of Hartman's buffer solution except in those cases in which the chlorides are badly depleted, where hypertonic saline solution is given. They favor the use of Hartman's solution because of its tendency to correct either alkalosis or accidosis.

Wangensteen feels that one is not justified in delaying the operation to attempt to restore the body fluids and chlorides to a normal level unless the roentgenogram shows the distention to be slight, because of the danger of peritonitis and severe hemorrhage. He prepares his patient, during the hour that preparations are being made in the operating room, by gastric lavage and the administration of 1-3 liters of 5% glucose in normal saline intravenously and subcutaneously. In cases of strangulation obstruction, transfusions are often of distinct benefit, because there is not infrequently hemorrhage into the strangulated bowel. He states that any patient with a strangulation obstruction

presenting a high pulse and a low blood pressure, should have a transfusion before the operation.

The actual surgery done varies somewhat with the problem met with upon opening the abdomen. It is fairly well agreed that the simpler the procedure, the more likely is the possibility of recovery. Simple release of the bowel from the obstructing mechanism should therefore be the first procedure to be attempted, providing the involved portion of the bowel is still viable. In many cases this will be sufficient to effect a cure. However, in those cases in which the bowel is decided to be non-viable, that portion of the bowel must be excised. Owings and Smith showed by animal experimentation that massive resections are accompanied by a remarkably low mortality and with only a slight reaction when they are done quickly. They removed pieces of gut varying in length from eight to forty-six inches.

Wangensteen feels that secondary anastomosis with exteriorization carries a far less mortality rate than resection and primary anastomosis, because of the danger in the latter method of peritonitis.

In late cases, enterostomy is the operation of choice, and should be done at a point as near to the level of the obstruction as is possible. A deliberate attempt to make a high enterostomy is to be avoided, the greater percentage of good results being obtained when the enterostomy is near the level of the obstruction. The technique of enterostomy varies with the training and experience of the individual and will not be discussed here. Occasionally decom-

pression of the distended bowel by enterostomy may fail. This may be due to a mechanical obstruction of the bowel such as kinking at the side of the enterostomy, to a residual paralysis of the bowel from over-distention or from a complicating peritonitis, to multiple gas traps in the bowel, or to an obstruction distal to but close to the enterostomy.

Intussusception, in which there has been no strangulation, frequently lends itself to conservative treatment. As early as 1879, Bristowe recognized the possibilities of reducing intussusception by enemata and inflation of the bowel with air. Hirschsprung, in 1905, advised a method for non-operative reduction and practised it with good results. In 1926, Hipsley, of Australia, reported one hundred cases with good results on non-operative treatment. He allowed water to run into the colon under the influence of 3½ feet of gravity pressure, and stated that he would be loath to submit any patient to operation until this method has been tried.

Wangensteen recommends the use of barium in the same way. This has the further advantage in localizing the exact site of the defect and a visual test, by means of the fluoroscope, of whether or not the reduction has been effected. The procedure must be used before adhesions have had a chance to form between the layers of the bowel, and is of no value in enteric types of intussusception and only of slight value in ileo-colic types.

Robbins, on the other hand, favors immediate surgery for all cases of intussusception, and treats them all by one of three methods. Those which are easily reducible require

no further surgery. Those which are irreducible but in which no evidence of gangrene exists can be reduced by incising through the constricting ring but not through the mucosa. Those which are irreducible and gangrenous should have resection and immediate anastomosis. He believes that successful resection is not so rare as is generally believed and probably should be done more frequently before the bowel is subjected to too much trauma.

The anesthesia of choice is spinal anesthesia. Most authors agree that this is the ideal anesthesia in cases of intestinal obstruction, largely because of the danger of aspiration pneumonia from vomitus where an inhalation anesthesia is used. The fall in blood pressure sometimes occurring along with spinal anesthesia, may be counteracted by the use of epinephrine or infusion of normal saline solution, the latter of which is also doubly valuable in replenishing the fluids and chlorides.

The post-operative care of the patient is another link in the treatment of intestinal obstruction. Here again, the general condition of the patient must be taken into consideration. Fluids should be given subcutaneously and intravenously and the intake and output must be closely watched. One must bear in mind that a patient with intestinal obstruction, due to the dehydration of the body tissues, requires several times more fluid than the patient with ordinary abdominal surgery. Thus, for the first few days, 3,000 - 4,000 c.c. of fluid daily may well be utilized, and when a liberal output of urine occurs, the intake may

may be decreased. Both glucose and normal saline solution should be given in these cases, the former intravenously to relieve the starvation symptoms, and the latter to balance the chlorides and the fluids both of which are often depleted.

In addition to the administration of fluids, both Cornell and Rentschler recommend gastric lavage. Suction-siphonage for several days, however, will accomplish the same end, and is to be preferred to gastric lavage.

Wangensteen, in 1932, reported the successful decompression of three cases of intestinal obstruction by means of nasal catheter suction-siphonage. He was led to try this method because of the success of enterostomy in effecting a permanent cure in certain cases of intestinal obstruction, and indeed, it is surprising that this procedure was for so long overlooked. However, one distinct advantage of simple enterostomy over suction-siphonage is that the intestinal canal above the obstruction may be utilized as a nutritive tube during the interval in which the continuity of the intestinal canal is being reestablished, while attempts at feeding before the obstructive mechanism has been corrected, when decompression is effected by the duodenal tube, usually results in recurrence of the obstruction.

His first attempts at suction-siphonage were carried out with the tube in the stomach. However, because the activity of the pyloric sphincter interrupts the continuity of the stomach and small intestine as a single tube, he decided that it was wiser to have the tube in the duodenum

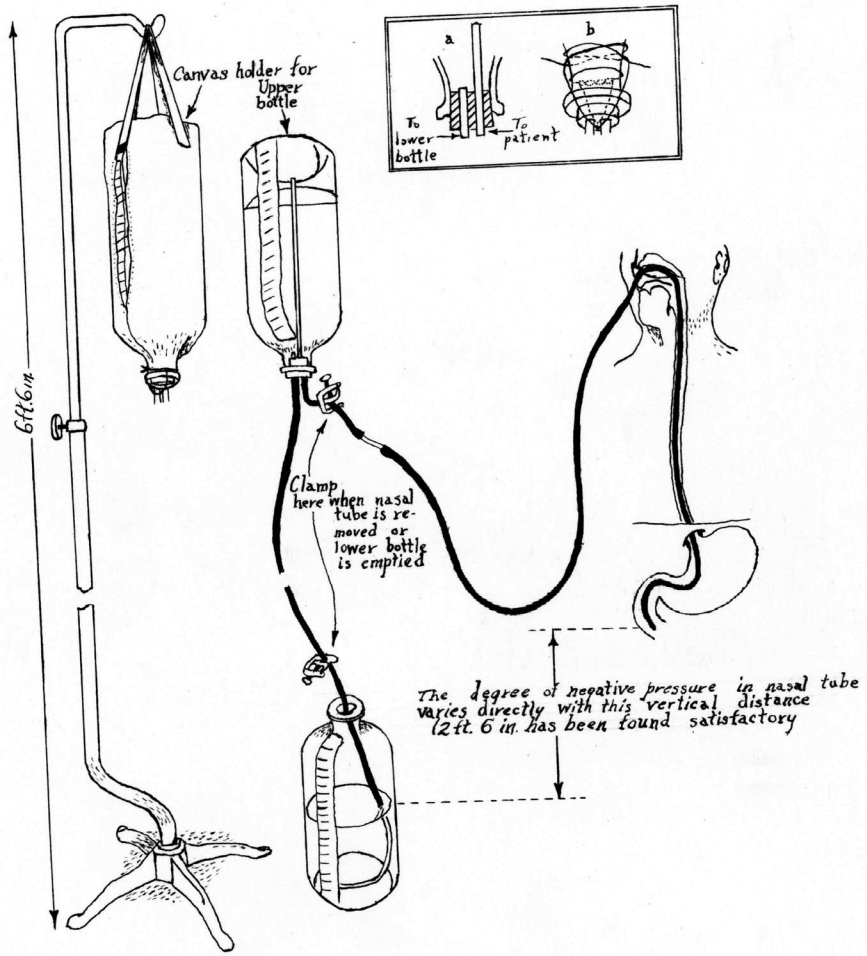
to assure a more successful decompression of the intestine above the obstruction, although not infrequently the pylorus fails to act as a physiological block when the tube remains in the stomach.

Wangensteen uses a modified Levine tube, with extra holes as far back as ten inches proximal to the tip of the catheter, and when the tip is in the duodenum, continuous suction can be exerted in the stomach and duodenum simultaneously. Moreover, he uses a tube with rubber of a heavier specific gravity at the tip, and he states that not infrequently after emptying the stomach by suction, he is able to intubate the duodenum directly with this catheter. The pyloric sphincter may, at times, be relaxed by having the patient inhale the fumes of a broken pearl of amyl nitrite.

Because of the nature of the distention, where segments are alternately filled with gas and fluid, decompression tends to be only slowly effected. This may be corrected to a fair degree by frequent changes in posture and massage of the abdominal wall, which dissarranges the existing collections of fluid and gas within the intestine and thus facilitates decompression. It is important to follow the decompression by means of roentgenograms taken at the bedside until it is obvious, from the degree of intestinal distention present on successive films, whether or not the method is going to be successful.

Occasionally duodenal suction-siphonage fails to deflate the small bowel, and when this occurs, several things must be looked for. The tube may be plugged by food

or mucus, although this possibility is largely overcome by (the use of a tube with multiple perforations. The tube may be



Wangensteen's Suction Siphonage Apparatus

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curled in the stomach with the pylorus very active. There may be multiple gas traps present in the small bowel above the obstruction. There may be paralysis of the bowel from marked distention, particularly in peritontis cases.

Enough fluid must be administered parenterally to provide a liberal daily output of urine. Wangensteen feels that a liberal amount of urine varies from 800 to 1000 c.c. in twenty-four hours. During the time that suction is in force no fluids are permitted by mouth, although ice chips, lemon, or gum may be used to stimulate the secretion of saliva. From 3000 to 4000 c.c. of 5% glucose in normal saline solution given intravenously by the continuous drip method usually suffices to maintain an adequate output of urine.

Measures to relieve the pain are usually unnecessary. With the establishment of suction the pain ceases almost miraculously, although an occasional lesser cramp is complained of. Frequently several hours elapse before the patient is entirely free from distress, but the intermittent crampy pain soon ceases. Hot packs to the abdomen tend to hasten the disappearance of the pain. One danger of the cessation of pain should be mentioned. There being no accretion of the distention and the patient having accomodated himself to a certain amount of intestinal distention, the crampy pain frequently ceases. Herein lies one of the main indications for the use of the X-ray in determining the success of the decompression.

After the suction has been operating successfully for a long enough time to decompress the distended bowel, it may be clamped off for short periods of time. When this can be done without complaint of recurrence of pain and with no x-ray evidence of return of the distention, the tube may be removed.

When the tube has been in place for a day or two the patient may complain of its making his nose or throat sore. The application of argyrol or nasal oil locally two or three times a day will overcome this difficulty. Wagensteen cites several examples in whom the tube was in place for more than a week at a time with no complaints, and in one of his cases, the tube was left in situ for six weeks.

Continuous negative suction may be used in cases that have nausea and vomiting following abdominal surgery for the relief of some other condition. This keeps the stomach empty, makes the patient more comfortable, and serves to supply fluids by mouth during the time the patients are nauseated and are vomiting.

There are, of course, cases which will not respond satisfactorily to the suction-siphonage method of treatment. Even a fairly successful decompression will at times fail to effect the establishment of continuity of the obstructed bowel. These cases require operation for the removal of the cause of the obstruction. This is by no means an excuse to condemn the procedure, for the patient has most likely been put into better condition than when he was first seen. The distention has been largely corrected, the lost body fluids have been restored, and the chlorides, if they were lowered, have been restored to normal. The patient is now in better condition than if he had been rushed madly into the operating room on his admission to the hospital or had been given the routine pre-operative care for several hours.

By the suction siphonage method of treatment, Wangensteen

reported, in 1933, twenty cases treated solely by suction, eleven cases in whom suction-siphonage was successful in producing decompression but in whom surgery was necessary to relieve the obstructing mechanism, and seven cases on whom suction was begun but operation was necessary to effect complete decompression. The mortality in the first group was 5.0%, in the second group 9.0% and in the third group 42.8%.

The average mortality rate for all those in whom suction-siphonage was used as the primary mode of treatment, was 15.6%.

However, the true value of duodenal suction siphonage in the treatment of acute intestinal obstruction will become apparent only when the method has been given a wide clinical trial. It is to be hoped that when its use is more fully appreciated by a wider group of the medical profession that the mortality rate can be even more drastically lowered.

Summary and Conclusions:-

The etiology, symptoms and diagnosis of intestinal obstruction are noted. It is seen that a host of abdominal conditions may be instrumental in causing obstruction of the bowel. The most important symptoms of early intestinal obstruction are pain, nausea and vomiting, constipation, and an absence of physical findings. The presence of a leukocytosis, fever, and rigidity of the abdominal wall should indicate the presence of a strangulation. Early diagnosis is essential in the successful treatment of intestinal

obstruction, and is aided by the stethoscope and the roentgenogram.

A brief summary of the present conceptions of the cause of death is given, the most likely of which is the dechlorination theory of Herrin and Meek.

A brief history of the treatment of intestinal obstruction is recorded and indicates that surgery was an early means of reducing the mortality rate, but after once established, reached a standstill.

Surgery is indicated in cases of strangulation obstruction, in cases with a permanent constricting mechanism such as carcinoma, and in those cases of simple mechanical obstruction in which duodenal suction-siphonage fails to effect complete decompression or automatic reestablishment of continuity of the bowel.

Duodenal suction-siphonage in the hands of an experienced surgeon is an effective means of treating simple adhesive intestinal obstruction. It is effective in most of those cases in which enterostomy will relieve the obstruction. There are some cases of simple mechanical intestinal obstruction which will not respond successfully to suction-siphonage alone, and in these cases, operation is necessary to complete the decompression or relieve the obstructing mechanism.

Further work, and a wider clinical trial is necessary before a true evaluation of suction-siphonage as a means of treating intestinal obstruction can be made.

BIBLIOGRAPHY

BOOKS

1. Bristowe - Diseases of the Intestine & Peritoneum W. Wood & Co. 1879 - Woods Library of Standard Medical Authors pp. 19-49.

2. Einhorn - Diseases of the Intestines 2nd Rev. ed. W. Wood & Co. 1904 pp. 264-274.

PERIODICALS

3. Bower - The Cause & Prevention of the Increasingly High Mortality in the Acute Surgical Abdomen. Am. J. of Med. Science 174: 225-231 1927.

4. Brill - Mortality of Intestinal Obstruction. Ann. Surg. 89: 541-548 April 1929.

5. Case - Roentgen Studies after Gastric and Intestinal Operations. J.A.M.A. 45: 1628. Nov. 6, 1918.

6. Case - Roentgenological Aid in the Diagnosis of Ileus. Am. J. of Radiology 19: 413 1928.

7. Cornell - Acute Intestinal Obstruction at N.Y. Hospital. A Report of 235 Cases. Ann. Surg. 95: 810-820 June 1932.

8. Craig - Special Methods in Diagnosis of Subacute Obstruction of the Small Intestine. Med. J. of Australia 21: 545-546 Oct. 27, 1934.

9. Elman - The Danger of Sudden Deflation of the Acutely Distended Bowel in Late Low Intestional Obstruction. Am. J. of Surg. 26: 438-446 1934.

10. Finney - Acute Intestinal Obstruction. Surg. Gyne & Obst. 32: 402 May 1921.

11. Gibson - A Study of 1,000 Operations for Acute Intestinal Obstruction & Gangrenous Hernia. Ann. Surg. 32: 486 1900.

12. Hartwell, Hoguet & Beekman - An Experimental Study of Intestinal Obstruction.
Arch. Int. Med. 13: 701 May, 1914.

13. Haven - Statistics of 258 Cases of Intestinal Obstruction, with Remarks.
Am. J. of Med. Sciences 30: 351 1855.

14. Herrin, R.C. - Chemical Changes of the Blood and Intestinal Juice Produced by Loss of Intestinal Juice.
J. Biol. Chem. Vol. 108: p. 547-562. Feb. 1935.

15. Herrin and Meek - Distension as a Factor in Intestinal Obstruction.
Arch. Int. Med. Vol. 51: p. 152-168. Jan. 1933.

16. Hibbard & Wangensteen - Character of the Gaseous Distention in Mechanical Obstruction of the Small Intestine.
Proc. Soc. Exper. Biol. & Med. 31: 1063-1066. 1934.

17. Hirschsprung - 107 Falle von Darm Invogination bei Kindern Behandelt im Konigen-Louisen Kinderhospital in Copenhagen, Wahrend der Jahre 1871-1904.
Mitt aus d. grenzgeb. der Med. in Chir. 1905. 14:555.

18. Hipsley - Intussusception.
Med. Jour. of Australia Nov. 9, 1918, p. 201.

19. Hipsley - Intussusception - Its Treatment by Hydrostatic Pressure.
Med. Jour. of Australia. 1926 2: 201.

20. Holden - Intestinal Obstruction in 135 Cases.
Arch. Surg. 13: 882-886 Dec. 1926.

21. Koslin - Acute Intestinal Obstruction - A Report of 185 Cases Treated at Lebanon Hospital of N.Y.City.
Ann. Surg. 95: 821-828 June 1932.

22. Mensing - Intestinal Obstruction and Peritonitis.
Am. J. of Nursing. 34: 971-979 1934.

23. Meyer & Spivack - Intestinal Obstruction - Analysis of 505 Cases from the Records of Cook Co. Hospital.
Ann. Surg. 100: 148-158 July 1934.

24. Moss & McFetridge - Acute Obstruction. A Comparative Study of 511 Cases, With Special Reference to the Lowend Mortality Achieved by Modern Methods of Therapy.
Ann. Surg. 100: 158-166 July 1934.

25. Owings & Smith - Massive Resections in Acute Mechanical Intestinal Obstruction.
Ann. Surg. 95: 840-849 June 1932.

26. Rentschler - Acute Intestinal Obstruction - Immediate & Late Results in 100 Consecutive Cases.
Arch. Surg. 29: 828-836 Nov. 1934.

27. Robbins - Acute Intussusception.
Ann. Surg. 95: 830-838 June 1932.

28. Schwartz - Die Erkennung der tiefen Dunndarnstenose mittels des Rontgenverfahrens.
Wien. Klin, Wchnschr. 1911. 24 Nr. 40 p. 1386.

29. Tuttle - Mortality of Intestinal Obstruction.
Boston Med. & Surg. Jour. 192: 791-795 Apr.23,1925.

30. Van Buren & Smith - Status of Enterostomy in the Treatment of Acute Ileus.
Arch. Surg. 15: 288 Aug. 1927.

31. Vidgoff - Acute Intestinal Obstruction, - Analysis of 266 Cases Treated in the Los Angeles Co. General Hospital.
Ann. Surg. 95: 801-809 June 1932.

32. Wangensteen - Elaboration of Criteria Upon Which the Early Diagnosis of Acute Intestinal Obstruction May be Made, with Special Consideration of the Value of X-ray Evidence.
Rodiology 17: 44-62 July 1931.

33. Wangensteen - The Diagnosis and Treatment of Acute Intestinal Obstruction.
Northwest Md. 30: 389-407 Sept. 1931.

34. Wangensteen - The Early Diagnosis of Acute Intestinal Obstruction with Comments on Pathology & Treatment, with a Report of Successful Decompression of Three Cases of Mechanical Bowel Obstruction by Nasal Catheter Suction-Siphonage.
West. J. of Surg., Gyn., & Obst. 4: 1-17. Jan,1933.

35. Wangensteen - Therapeutic Considerations in the Management of Acute Intestinal Obstruction.
Arch. Surg. 26: 933-961 June 1933.

36. Wangensteen - The Management of Acute Intestinal Obstruction: With Special Mention of the Character of the Vomiting and Distention.
Journal Lancet 54: 640-645 Oct. 15, 1934.

37. Wangensteen - Diagnostic & Therapeutic Considerations in Management of Acute Intestinal Obstruction.
Wis. Med. Jour. 34: 24-32 Jan. 1935.

38. Wangensteen & Gaehl - Evaluation of the Expulsion of Enemata as a Criterion for Intestinal Obstruction.
Arch. Int. Med. 46: 669-679 Oct. 1930.

39. Wangensteen & Lynch - Evaluation of X-ray Evidence as a Criteria of Intestinal Obstruction.
Proc. Soc. Exper. Biol. & Med. 27: 674-676 April, 1930.

40. Wangensteen & Paine - Nasal Catheter Suction-Siphonage: Its Uses and the Technique of Its Employment.
Minn. Med. 16: 96-101 Feb. 1933.

41. Wangensteen & Paine - Treatment of Acute Intestinal Obstruction by Suction with the Duodenal Tube.
J.A.M.A. 101: 1533-1539.

42. White and Fender - Cause of Death in Uncomplicated High Intestinal Obstruction.
Arch. Surg. 20: 897 June 1930.

APPROVED:

Kenneth E Lemmer

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