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## Intestinal obstruction : with special reference to its occurrence in pregnancy

Adolphe J. Kerbel  
*University of Nebraska Medical Center*

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Intestinal Obstruction With Special Reference  
To Its Occurrence in Pregnancy

By

Adolphe J. Kerbel

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It is my purpose in this paper to present the subject of intestinal obstruction complicating pregnancy by giving first, a brief review of the anatomy and physiology of the intestinal tract, so that what is to follow might be more easily correlated. Secondly, it will be seen that much experimental work has been done on the subject of intestinal obstruction in an attempt to give some explanation for the great toxicity and death produced by this condition. Many theories are advanced and conclusions drawn so that the subject is yet high controversial; controversy acting as a spark to light the fire of enthusiasm in other experimenters to continue the efforts of attempting to solve the problem. Lastly, it is desirous to show that this problem is encountered quite frequently during normal pregnancy, and to discuss it from the view point of difficulty in diagnosis and treatment.

The small intestine is the portion of the digestive tract which is placed between the stomach and the beginning of the large intestine. It is divided into three parts namely, the duodenum, jejunum and ileum. The average length of the small intestine is about twenty four feet. The duodenum constitutes the first eleven inches, possessing a peculiarity of fixation and the absence of a mesentery. The jejunum comprises about eight feet of the small intestine, the succeeding twelve feet of intestine constitute the ileum. These two parts are irregularly disposed in the form of crowded loops or coils which are connected to the posterior abdominal wall by a great fan-shaped fold of peritoneum containing their vessels, and nerves,

and known as the mesentery. This posterior connection is of such length that the coils are able to move about freely in the abdominal cavity.

The large intestine is made up of the following parts: The caecum, ascending colon, transverse colon, descending colon, ileac colon, pelvic colon and rectum which ends at the anal arifice. It succeeds the ileum, beginning on the right side some two and one-half inches below the ileo-caecal junction. The great bowel usually measures between five and five and one-half feet in length. The ascending colon is usually devoid of mesentery being attached posteriorly by areolar tissue. The transverse colon is comparatively fixed in its first few inches but beyond this a long mesentery is developed at its left extremity, it bends sharply downward in the region of the spleen, forming the splenic flexure, and runs downward into the descending colon. This latter structure is covered by peritoneum only its anterior and lateral sides, its posterior surface being destitute of a serous coat and connected to the posterior wall of the abdomen by areolar tissue. In some cases this part of the colon is furnished with a short mesentery. The iliac portion of the colon is also without a mesenteric attachment, but the succeeding portion, the pelvic colon, has a well developed mesentery and forms a large variously shaped coil, which usually lies in the cavity of the pelvis. The large bowel terminates with the rectum and is unlike the portion immediately preceding it being entirely destitute of mesentery. (1)

Physiologically, the function of the intestines is for the

purpose of digestion during which process complex colloidal substances of high molecular weights are changed into the simpler diffusible substances of lower molecular weight. This is brought about by the production of enzymes which act on complex organic substances, by the creation of favorable physicochemical environments for the action of enzymes. These products are furnished by innumerable gland cells in the form of tubules, crypts and coils distributed from the mouth to the rectum.

Since this paper has to do more specifically with the pathology of the small and large intestine, it seems adequate to discuss the physiology of only that portion of the alimentary tract.

Given then, food in the first portion of the digestive tract upon entering the small intestine is attacked by the pancreatic juice, secreted by the pancreas through a large duct, which enters the duodenum with the common bile duct. It contains three chief enzymes; lipase, a fat-splitting ferment; amylase, an amylolytic ferment, and trypsin, a proteolytic fermenting substance. This gland is stimulated partly through nerves and partly through humoral pathways. Stimulation of sectioned vagi causes secretion of pancreatic juice. Stimulation of certain thoracic branches of the sympathetic, however, leads to an inhibition of secretion. The humoral theory of excitation is that acid chyme comes into contact with the mucosal cells and changes the inactive substance yielded by the intestinal cells to an active form called secretin. This substance is absorbed, reaches the pancreas and causes it to secrete.

The intestinal secretions proper are formed by the crypts of Lieberkuhns which are deep simple glands, distributed throughout the small intestine, and the glands of Brunner, convoluted, branching glands limited to the upper region of the duodenum. Florey and Harding (2) have shown by experimental investigation, that the secretion from these glands is alkaline, mucin containing and serves to protect the duodenal mucosa from the action of acid of the gastric contents. Their results suggest that the stimulating factor involved in its secretion is blood borne and occurs independently of extrinsic innervation and also in duodenal transplants.

The enteric juice contains a number of special enzymes among which is enterokinase which increases the activity of all ferments in the pancreatic juice, it also activates the secretion of trypsin in inactive form. The succus entericus contains considerable mucin and debris of broken down cells, contributing to considerable extent to the formation of feces.

According to Alvarez (3) and others, there are three types of activity in propelling the bolus through the small intestine the rhythmic segmenting movements, the swaying or pendular movements, and the peristaltic rushes.

The segmenting movements are brought about by localized rhythmic contractions of the circular muscle. The contractions knead the food, mix it with the digestive juices, and spread them again and again over the absorbing surfaces.

The pendular movements, are a local mixing to and fro motion. Sometimes appears as if the bowel were being drawn over its contents

like a stocking over a foot.

Most of downward progression of the intestinal content is accomplished by means of the peristaltic rushes. They are large waves, which from time to time run down the bowel. According to Alvarez (3) true peristalsis consists of a series of rushes traversing the whole length of the small intestine, travelling much more rapidly, and in which the constriction is less intense and not preceded by a wave of relaxation. By this means the bolus travels slowly down the whole length of the gut until it passes through the ileocaecal opening into the large intestine.

The large intestine is remarkable in that it is here that micro-organisms flourish. These are constantly present in the mouth; they are restricted in the flora of the stomach because of the strong acid reaction of its contents. Organisms are relatively few in the small intestine but the bacterial content rapidly increases as the ileo-caecal valve is approached. In the large intestine itself, enormous and rapid growth of bacteria of various species occurs; among them: Staphylococci, *B. pyocyanus*, *B. coli*, *B. perfringens*, *putrificus*, *sporogenes* and many others.

In the mucous membrane of the large intestine are a number of simple tubular glands, the secretion of which is wholly made up of mucus. Due to results obtained in investigating the secretion in the colon, Florey (4) concludes that the secretion by the large intestine is independent of nervous control and is brought about apparently by local irritation. The function of this secretion is probably two fold in that it aids the passage of the feces along

the gut, and probably impedes the propagation of bacteria.

The chief function of the large intestine, is not one of absorption but rather of excretion since it plays an important part in the excretion of calcium, magnesia, iron and phosphates. The large intestine is also the main channel of excretion for certain substances, such as bismuth and mercury. Its chief absorptive function is for water.

By means of peristaltic waves, accompanied by relaxation of the ileocecal valve, the contents of the small intestines are transferred into the colon, occurring from three and one-half to four hours after food has been taken. By means of contractions within the wall of the large bowel the contents are moved onward to fill the proximal, transverse and descending parts. There is some question as to whether there are two peristaltic waves or whether they should be considered as local contraction. The innervation of the large intestine is derived from both sympathetic and parasympathetic sources.

When the pelvic colon gradually fills with feces, some of the material descends into the rectum whenever the pressure due to such an accumulation reaches a certain point, a nervous reflex is set up between the sympathetic, parasympathetic nerves and the motor fibers supplying external sphincter. The impulses originate in the rectal mucosa, are carried to the cortex where sensations of fullness are interpreted as a desire to defecate. (5)

The earliest work done in the field of Intestinal Obstruction was undertaken in Germany, dating back to the latter part of the nineteenth century. This work, of course, is written in German



the translation of which is not available to me.

However, reviewing the literature of work done in this country, we find early interest taken by Nesbitt (6) of Johns Hopkins University who obstructed the lower end of the small intestine of a dog and found choline and neurin occurred in the bowel content providing the food fed was rich in lechithin. He concluded that choline would have to be absorbed in large quantities to exert a marked toxic action in human beings, but that neurin is an exceedingly active poison and is very intense in its action. It is formed from choline by bacteria.

It is claimed by Draper Maury (7) (1909), that simple abstraction just below the papilla of Vater causes death with maximum rapidity and that if the pancreatic juice is drained into the intestine distal to the obstruction, life may be prolonged. Sweet, Peet and Hendrix (8) agree with this having proven experimentally that animals would die four or five days sooner with the pancreas intact with a high obstruction than they would with a high obstruction and the pancreas removed.

In his experimental work Maury (9) concluded that the bile had nothing to do with the cause of death in obstruction and in 1910 (9) he stated that death in intestinal obstruction and kindred conditions was due to a physiologic disturbance brought about by certain substances being removed from the body and by the normal current of the intestine being blocked. He maintained that blocking interfered with the normal exchange of jejunal secretions.

It was found by Murphy and Vincent (10) that animals died much more rapidly with intestinal obstruction, with the veins occluded and the arteries left intact than visa versa. They concluded, however, that along with the factor of circulation was the factor of toxin formation, more likely bacterial in origin secretory, that produced toxic symptoms.

In experiments carried out by Whipple, Stone and Bernheim (11) they established facts which proved a toxic substance present in closed intestinal loops in dogs. When injected into normal dogs, only one dose was necessary to bring about a reaction which consists of fall in blood pressure, fall in temperature, vomiting and profuse diarrhea. They claim that this substance with which they are dealing is elaborated in the mucosa of the closed loop, yet they state there is no demonstrable change from the normal in the epithelial cells. They disagree with Maury's (9) contention that it is a normal mucosal secretion which is poisonous unless neutralized by fluids from other parts of the intestinal tract.

Sweet, Peet and Hendrix (8) question the results of Whipple, Stone and Bernheim (11) stating they believed there is a functional obstruction of the duodenum the same as in the closed loops. They were unable to get sufficient drainage from the duodenum by means of the posterior interostomy above the obstruction. They hold to the theory that the toxin is elaborated in the duodenum, which is functionally obstructed, and is then excreted into the closed loop. They disagree also with the theory of the above mentioned group that there is no toxin in the closed loop the mucosa of which having been

first destroyed with sodium fluoride. They believe this would destroy the possibility of the mucosa either secreting or excreting any substance. They show in their experiments the close relationship between acute pancreatitis and intestinal obstruction and feel that the secretion of the pancreas plays a vital role in the production of the toxic substance in obstructed loops.

Davis and Stone (12) in working with fluid from closed loops, showed that when removed by repeated washing from the loops, this material became toxic to other animals when allowed to incubate for eighteen hours. They produced symptoms the same as in the original animals. Fluid which had been boiled did not cause the appearance of symptoms and therefore was non-toxic. They conclude from this that there is not a perverted mucosal secretion and disagree with the views held by Whipple, Stone and Bernheim, (11)

Hartwell and Hoguet (13) kept dogs alive with intestinal obstruction by administering normal saline. They believed at first that there was a toxin liberated and that by the administration of normal saline, it was diluted and its toxicity reduced, by its diuretic action on the kidneys. They were of the opinion that during obstruction the mucosa of the intestine absorbed the toxic material. They believed that a bacteremia was not present. After publishing their results, they continued their experimentation from which they concluded, that the symptoms were due to dehydration, that by means of injecting normal saline subcutaneously they would replace the fluids lost by the animal in vomiting and

thus prolong its life. (14)

In disagreement with Hartwell and Hoquet (13) Draper (15) administered pilocarpin to dogs and dehydrated them to the same extent as animals with high intestinal obstruction, but found that they would rapidly recover if fluids were given. He was of the opinion as was Whipple and his co-workers, that the benefit derived from normal saline injections was due to dilution and elimination of the toxic material by this means. In other words, they believed in the toxin theory produced by the mucosa of the obstructed intestine and absorption taking place there.

It is interesting to note that most observers insist there is a toxin absorbed by the intestine yet Davis (16) has shown that phenosulphonephthalien is taken up much more slowly in an obstructed intestine than in the normal intestine. This was done to determine the absorptive power of the obstructed gut, which was half the amount absorbed by the normal intestine, measuring the amount in the urine. This seems quite conclusive evidence that the absorptive power of the pathological intestine is reduced, yet far the majority of men cling to the absorption theory.

A new reason for death in intestinal obstruction was advanced by McLean and Andries (17) who believed not in the theory of absorption of toxins and bacteria, but held that there was a depletion of the vascular and lymph system. A disturbance in the circulatory system, especially in the cerebral circulation the latter being a prime factor in the cause of death.

In his experimental work, McKenna (18) concluded in agreement with Whipple, Stone and Bernheim (11) that there is an upset in the physiological balance of the duodenal mucosa which is responsible for the production of a toxin. He made no distinction between paralytic ileus and ileus produced mechanically, he considered the results the same probably due to the secretion of the duodenum. He felt that bacteria played no part in the cause of death, it was due purely to a secreted toxin.

Tileston and Comfort (19) cite three cases of post-operative ileus, two of these were paralytic. According to the results of their observations, all three showed a marked increase in the blood non-protein nitrogen. Upon recovery in two of the cases the blood non-protein nitrogen directly returned to normal. They made no explanation for this rise, but we find that in 1921 Bacon, Anslow and Eppler (20) verified this work and obtained the same results. They found, however, in the course of the experiments, that they could keep the blood non-protein nitrogen within normal limits by the administration of saline in adequate amounts subcutaneously. They arrived at the conclusion, that the fluid above the obstruction is derived from the blood, analysis having shown that the fluid contained non-protein nitrogen bodies. They furthered their experimentation by withholding all fluid from a number of animals, and observed there was a marked rise in the non-protein nitrogen of the blood and the animals promptly died as did those with intestinal obstruction. They then produced diuresis in other animals by injecting hypertonic salt solution bringing about a dehydration, resulting in a rapid rise in the

non-proteic nitrogen and ensuing sooner than in the obstructed cases. They do not consider the absorption of a toxin the cause of death, they do believe that one is present and that it is produced from the blood. From their results, they maintain that due to lack of fluids the body proteins are disintegrated causing the rise in the blood non-proteic nitrogen. They state that due to the decreased amount of fluid these products cannot be carried off and an intoxication results which causes the death of the organism.

Murphy and Brooks (21) in describing the results of their work on intestinal obstruction state that a bacterial toxin enters the organism by way of the lymphatics. They say that it will not pass through normal mucosa but believe interference with the blood supply is the factor that permits this absorption to occur. They are of the opinion that this toxin produced by bacterial action can be formed anywhere in the digestive tract. Early involvement of the circulatory system is their reason for early death.

Dragstedt, Moorhead and Bureky (22) asserted that death was brought about in cases of simple closed intestinal loops by bacterial activity plus necrotic tissue or the absorption of toxic products resulting from the action of these organisms on necrotic tissue. They also showed that death did not occur if the duodenal or jejunal loops deprived of their blood supply were sterile, only anaemic necrosis resulting.

In support of the bacterial or infection theory as the cause

of death, Cammon, Dragstedt and Dragstedt (23) in some further experimentation along bacteriological lines, state that the acid type of flora is replaced by proteolytic bacteria, during obstruction. They contend these organisms play an important part in the formation of a toxin. It must be admitted in view of the evidence given in favor of this theory, that bacteria invade the animals from the obstructed gut, and hence may be a factor in the cause of death. McKenna (18) has demonstrated, however, that bacterial invasion is not necessary for death to occur in the obstructed cases and rules out infection as a principal cause of death.

In dogs with high intestinal obstruction Haden and Orr (24) claimed that the fundamental change was a marked fall in the blood chlorides which was coincident with a rise in blood non-protein nitrogen. They also found there was a rise in the carbon dioxide combining power assuming that it combined with the sodium ion left free by the loss of the chlorine ion. They succeeded in keeping their animals alive by administering ample quantities of salt solution subcutaneously. They conclude that this is due to a neutralization of a formed toxin by the chlorine. That the toxin and chlorine ion combine and become stored in the tissues and used by the cells as a means of defense. They did not believe the benefit derived was due to the replacement of fluid lost by vomiting and diarrhea.

In experimenting further with blood findings in dogs with pyloric obstruction Haden and Orr (25) gave up their original theory that sodium chloride neutralized the bodies responsible for

the toxemia, and was stored in the body tissues. They found that these last chloride were excreted in the urine and gastric and intestinal secretions. They concluded that the administration of sodium chloride caused a rapid return of the blood to normal and that when the normal chloride content of the blood was reached increased protien destruction would cease resulting in a drop of the increased non-protien nitrogen of the blood.

Gamble and Ross (26) state that the loss of ions from the blood is the important factor, from what they observed in dogs with pyloric obstruction. They claim that the chloride ions lost from the blood were replaced by  $\text{HCO}_3$  ions and in this way the ionic concentration of the blood remains normal. With the loss of sodium ions there is a corresponding loss of  $\text{HCO}_3$  ions. For this reason they conclude that neither glucose, saline nor sodium chloride would produce satisfactory effects desired.

Raine and Perry (27) working with intestinal obstruction in rabbits found that they would recover readily in a comparatively short time if the obstruction was relieved. The obstruction was relieved. They observed that the recovery was very slow, if the content of the obstructed bowel was aspirated, until sodium chloride was administered in food or water. They also found that recovery was no more rapid if they replaced the intestinal content with water. They concluded therefore, that the intestinal content was not toxic to the animal but to the contrary was directly beneficial in its recovery.

It was found to be true by Wangenstien and Chunn (28) that



the intestinal content of normal animals was fully as toxic as the intestinal content taken from obstructed loops. They proved this by injecting this material from normal and obstructed dogs into healthy dogs and rats and producing intoxication. They also showed that the intestinal content below the obstruction was likewise toxic to healthy animals.

Dragstedt and Ellis (29) produced a drop in the blood chlorides an increase in the carbon dioxide combining power, and a rise in the non-protein nitrogen as did Tileston and Comfort (19) Hayden and Orr (24 and 25) but used a different method. They constructed a gastric fistula, allowing the animals to eat and drink at will. Their results showed that the dogs died in from five to eight days. Their reason for death was on a basis of loss of gastric secretion. They believe the blood chemistry is changed due to this loss of gastric juice. They claim the blood ionic concentration is brought to normal by administering Ringers solution.

In favour of the theory that death is due to a loss of essential secretion from the upper part of the intestinal tract, is Pearse (30) who produced intestinal obstruction in dogs constructing it in such a way that the pancreatic juice and bile entered the bowel below the obstruction. He found that the animals lived and showed no changes in the blood chemistry.

Scott and Wangenstien carried out a series of experiments to confirm the work of Murphy and Vincent (10) in 1911. They divided their experiments into four groups. In group one they passed a tape about the mesenteric vessels and then carried around the

bowel wall and tied. In group two all the arteries and veins to the obstructed loop were ligated and severed. In group III, all the arteries were ligated, the veins left intact. In group four, the arteries were left intact, the veins ligated. They found that the dogs in group III lived the longest, the length of life shortening in the groups in the following order II, I and IV. They concluded that the type of destruction is of greater significance than the length of bowel involved. They varied the length of bowel strangulated between one and five feet. (31)

Jenkins and Beswick (32) were able to keep dogs alive seventy days with intestinal obstruction by instilling into the intestine, below the site of obstruction, about a liter per day of 1% sodium chloride and from five to seven per cent dextrose solution. They state that none of the dogs surviving the longer periods showed any toxic signs. There was a steady loss in weight and vomiting occurred about every other day. In their chemical studies of the blood they found little change from normal, except in a few cases, the chlorides of the blood increased. The carbon dioxide and non-protein nitrogen showed relatively little change, the latter showed an occasional slight rise. They concluded that an important factor in death was the loss of digestive secretions. The sodium chloride that was administered daily replaced water, sodium and chloride ions, which were lost from failure of resorption and vomiting.

Intestinal obstruction is a condition which bears resemblance to adrenal insufficiency according to Wahl, Burns and Pfeifer (33) They describe the histological changes of the adrenal glands in the

dog with high intestinal obstruction as that of lipoid exhaustion of extreme degeneration of the adrenal cortex. They studied the combined effect of cortical extract and salt solution in dogs in which they had previously produced high obstructions. Some of the animals received salt solution plus cortin; others neither cortin nor physiological salt solution; and others received only cortical extract. There was produced in all the animals the routine rise in non-protein nitrogen, decreased blood chlorides, increased carbon dioxide combining power, but not as marked in the dogs receiving salt solution and cortical extract. Those receiving no therapy died in five days - those getting cortin only lived seven days. They are satisfied that further work must be done in the problem, but feel justified in emphasizing the apparent benefit from the combined administration of salt solution and adrenal cortex in combating the toxemia of high intestinal obstruction.

Scudder, Zwemer, and Truszkowski (34) caused intestinal obstruction in cats and noted a rise in the blood potassium but also noted that the potassium content of the obstructed loops, peritoneal fluid and vomitus was many times that of the blood. They theorize that the rise is due to a combination of dehydration, tissue breakdown and action of bacterial toxin with consequent adrenal and renal dysfunction, resulting in inadequate potassium elimination. This gives somewhat of an explanation for the benefit derived from the administration of adrenal extract by Wahl, Burns and Pfeifer (33).

In conclusion, it seems favorable to believe that auto-intoxication is the predominating cause of death in intestinal obstruction, there is, however, as we have seen in the preceeding pages, much conflicting evidence which prevents us from being able to definitely state the problem is solved on this theory. Evidence for this theory can be outlined thus:

1. Absorption of a toxin produced by the intestinal mucosa.
2. Toxin produced by bacteria and their action on the intestinal content and absorbed.
3. Toxin absorbed through the intestinal mucosa the toxin being produced elsewhere.
4. Toxin due to proteolytic action or to the fermenting substance, itself.
5. Interference with normal exchange of the duodenal and jejunal secretions by blocking of the intestinal currents.

Other facts speaking against antointoxication as the only cause of death can be given as:

1. Dehydration and chemical changes.
  - (a) Loss of chloride ions.
  - (b) Loss of sodium ions.
  - (c) Loss of gastric, pancreatic and bile secretions.
  - (d) Increase in blood pottasium.
2. The resemblance of the condition of intestinal obstruction to Adrenal insufficiency.

## INTESTINAL OBSTRUCTION DURING PREGNANCY

Having shown that a great problem in intestinal obstruction still remains to be solved, truly as great is the problem of intestinal obstruction complicating normal pregnancy. Ileus occurring during pregnancy, labor or the puerperium, was formerly considered to be a very infrequent affection, if it occurred at all. Blair (35) quotes Pinard, 1902, as having said, "there is no need to begin another chapter in puerperal pathology entitled, 'Intestinal Occlusion of Pregnancy' I have never seen intestinal obstruction complicate a normal pregnancy." Yet only thirty years have passed since that statement was made; and although there is no reference, in any standard textbook on obstetrics or surgery, to pregnancy itself being a cause or a factor in ileus, Slemons and Williams (36) state that there may be found in the medical literature approximately one thousand references to cases in which intestinal occlusion was a complication of a normal pregnancy. Very little is written on the subject as far as discussion is concerned, each author being satisfied with merely presenting a case that has come under his observation and allow conclusions to be drawn by his readers. So that this discussion will consist largely of a consensus of views held by writers who have presented cases and discussed this condition from a clinical aspect.

It is found that the frequency of intestinal obstruction in pregnancy is greatest between the fourth and fifth month, then it diminishes and again increases during the eighth and ninth months.

These points of maximum frequency correspond to distinct stages in the evolution of pregnancy. Before the fourth month the gravid uterus occupies the pelvic cavity, after which time the uterus rises out of the pelvis and comes to occupy the greater portion of the abdominal cavity. It can be readily understood that in this ascension the position of the intestinal coils is changed, thus causing traction on any existing adhesion, so that symptoms of occlusion are produced. During the latter part of pregnancy the uterus still increases in size in all dimensions so that the organ with its contained fetus almost completely fills both the abdominal and pelvic cavities. To explain the frequency of occurrence of symptoms during the post-partum it seems logical to assume it to be due to the relatively sudden displacement the intestines undergo after the uterus has been emptied.

Slemmons and William (36) challenge the first two views, being of the opinion that overeating and coarse food during the fourth and fifth month contribute greatly to the production of ileus rather than the height of the fundus at this period. They feel that during the latter part of pregnancy, the irritability of the uterine musculature, attested by stronger and more frequent Braxton-Hicks contractions, is then pronounced, and consequently more influential in disturbing the relationships of the intra-abdominal organs.

The various types of intestinal obstruction that may arise during pregnancy and the post-partum are: strangulation due to adhesions, volvulus, intussusception, strangulation due to gravid

uterus alone, hernia and miscellaneous types due to tumors, cysts and abdominal pregnancies. Of these the incidence is greatest in the type due to adhesive fibrous bands binding and strangulating the intestine, which in the majority of instances were produced by old peritoneal adhesions following previous abdominal surgery. These bands can, however, be congenital, neoplastic or inflammatory. A good example of intestinal obstruction in pregnancy caused by a neoplasm is that case presented by Priest (37), 1936, of a patient  $7\frac{1}{2}$  months pregnant who developed pain in the abdomen, followed by vomiting and abdominal distention. She promptly went into labor and spontaneously delivered twin infants six weeks premature that lived. Following delivery the condition of the patient did not improve and she died. Autopsy revealed a carcinoma of the Sigmoid colon, with generalized peritonitis and metastases to the cortical lymph nodes.

Operative procedures in the pelvis that are responsible for offending adhesions are those for appendicitis, ovarian cysts, and pyosalpinx. Other operations, that might leave adhesions to complicate a later pregnancy, outside the pelvis are those for gall bladder disease, stomach, or upper reaches of the intestine.

From the cases reviewed in Table #1, one is able to divide adhesions into uterine or utero-intestinal and non-uterine adhesions that act as constricting bands on the coils of the intestines. The non uterine adhesions have a tendency to follow former operations. In one case presented by Bemis (38) there was a history of appendectomy 15 years previously, during her

Table #1. Cases Reviewed due to Adhesions:

	Author	Year	Stage of Gestation	Bowel Affected	Uterine Adhesions	Non-uterine Adhesions	Operated	Results
42	Corner	1888	4 months	Ileum	No	Yes	No	Died
43	Williams	1908	?	?	No	Yes	Yes	Died
44	Doane	1910	5 Months	Ileum	No	Yes	Yes	Lived - aborted
45	Pinkham	1915	7 Months	Caecum	No	Yes	No	Died
46	Greeley	1916	Post Partum	Ileum	No	Yes	Yes	Recovered
47	Jefferson	1924	7 Months	Ileum	Yes	No	Yes	Recovered delivered
48	Johnstone	1926	Term	Ileum	Yes	No	Yes	Recovered Delivered
49	Burke - Gaffney	1927	8 Months	Ileum	No	Yes	Yes	Recovered Caesarian
50	Beasley	1928	5 Months	Ileum	Yes	Yes	No	Aborted
51	Bettman-Immerman	1928	Term	Jejunum	Yes	Yes	Yes	Recovered Delivered
38	Bemis	1932	9 Months	Ileo - cecal	No	Yes	Yes	Recovered Delivered
39	Cornell	1932	8 Months	Small	No	Yes	Yes	Recovered Caesarian
41	Charbonnet	1935	6 Months	Ileum	Yes	No	Yes	Recovered Delivered
52	Bourland	1936	9 Months	Small	No	Yes	Yes	Recovered Caesarian
53	Sage	1938	4 Months	Ileum	No	Yes	Yes	Recovered Delivered
40	McGoogan	1938	5 days Post Partum	Ileum	Yes	No	Yes	Recovered
40	McGoogan	1938	2½ Months	Sigmoid	Yes	No	Yes	Recovered
54	Hoffman	1938	4 Months	Ileum	No	Yes	Yes	Recovered Delivered
55	Taylor	1938	Post Partum	Small	Yes	No	Yes	Died
55	Taylor	1938	8 Months	Small	No	Yes	Yes	Recovered Delivered



last month of pregnancy she developed symptoms of obstruction and at operation fine bands of adhesions formed a constricting band across the caecum, just above the ileo-cecal junction obstructing the bowel. In another case Cornell (39) appendectomy was performed three years previously and at operations during height of obstructive symptoms the small intestine was found to be obstructed by bands of fibrous tissue constricting its lumen. In McGoogan's (40) patient, the sigmoid was adhered to the left corner of the uterus following salpingo- oophorectomy done six years before. In another case presented by Charbonnet (41) the terminal ileum was densely adherent to the uterus at a point formerly occupied by the right tube, the latter having been removed some years previously.

In table #2 are listed twelve cases of volvulus during pregnancy. The enlarging uterus of itself may produce dislocation and twisting of a loop of bowel. In Brettaner's (56) case the sigmoid flexure and descending colon with its mesocolon was twisted through  $360^{\circ}$  while in Donald's (57) case at operation the caecum was found in the region of the spleen and the appendix was blown out like the finger of a rubber glove. The small gut, caecum and ascending colon formed a free loop **which** had still to be rotated in an anti-clockwise fashion for two full turns before the relationships could be normal. The loop, in other words, had undergone a torsion of  $2\frac{1}{2}$  turns clockwise.

Sudden wrenching of the body may also be an accessory factor in the development of this variety of obstruction as brought out

by the case of Donaldson, 1919, (58) of a woman eight months pregnant who slipped in the street but did not fall, recovering herself. She began to have pain in her side and three days later, consulted a doctor, having had no bowel movement and abdominal distention developing during that time. She was operated, caesarian section was performed, volvulus of the sigmoid flexure involving also a large loop of small intestine was found which was untwisted and replaced without anchoring. Mother and baby recovered.

Table #2. Cases Reviewed due to Volvulus:

Author	Year	Stage of Gestation	Bowel Affected	Operated	Results
59 Smith	1890	Post Partum	Small	Yes	Recovered
60 Glendon	1901	9 Months	Sigmoid	Yes	Recovered delivered
56 Brettauer	1903	7 Months	Sigmoid	Yes	Aborted - Recovered
61 Flower	1912	7 $\frac{1}{2}$ Months	Ileum	No	Died
57 Donald	1915	5 Months	Caecum Asc. Colon	Yes	Died
62 Bonney - Bridges	1919	5 Months	Pelvic Colon	Yes	Vag. Caesarian Mother Recovered
58 Donaldson	1919	8 Months	Sigmoid	Yes	Caesarian - Recovered
63 Grant	1925	7 Months	Ileum	Yes	Aborted - Recovered
64 Basden	1934	Labor	Caecum	Yes	Recovered
65 Karnfeld - Daichman	1934	8 Months	Sigmoid	Yes	Mother died - Child recovered
66 Ridler	1935	8 Months	Pelvic Colon	yes	Delivered - Recovered
67 Massey	1936	7 Months	Caecum Asc. Transverse	Yes	Mother died - Child recovered

Table #3. Cases Reviewed due to Intussusception:

Author	Year	Stage of Gestation		Operated	Results
70 Robson	1885	3 Months		Yes	Died
71 Wylie	1888	6 Months	Passed Slough	No	Recovered
69 Ayer	1890	4 Months	" "	No	Mother died child recovered
43 Williams	1908	5 Months		Yes	Died of Miliary T.B.
72 Allen	1919	Post Partum		Yes	Recovered
68 Chaffin-Mason - Slemons	1937	5 Months	Uterus Amputated	Yes	Recovered

In Table #3 are six cases of intussusception complicating pregnancy. Chaffin, Mason and Slemons (68) state that it has been encountered 20 times in the practice of obstetrics. In this case, a tumor was present within the lumen of the bowel which proved to be an adenoma after removal. In those cases in which sloughs of bowel were passed, tuberculosis was a vital factor. Williams (43) cites a case of intussusception at the site of a tuberculosis ulcer, that was operated and died two weeks later of miliary T.B. Chaffin, Mason and Slemons (68) are of the opinion that the majority of intussusceptions are due to benign intraluminal tumors. Yet in this series of collected cases, benign tumors were detected only in two instances. They concluded that those cases whose etiology was undetermined were probably due to neoplasms that were overlooked.

Ayer's (69) patient was 4 months pregnant and presented symptoms of subacute occlusion for seventy-five days before going into

labor delivering a six weeks premature male child. Fifty-three days before this, however, she passed a large portion of small intestine by rectum. She finally died 122 days after the birth of her child and 100 days after the discharge of the intestine per rectum. Autopsy revealed intussusception of the small intestine and tuberculosis ulceration of the bowel.

Early in the twentieth century controversy was high in France as to whether pregnancy of itself could cause an occlusion of the intestines. Brindeau expressed himself as being of the opinion that such a condition could exist. This brought about a wild discussion of the subject and elicited two factions, for and against, the theory. (36)

According to Blair (35) Ludwig, a German, collected ninety-six cases in 1913, ten of which were considered due to the gravid uterus. He mentioned that in 1918 Fleischauer (75) reported a case four months pregnant that died of intestinal obstruction and at autopsy, obstruction was determined to be due to compression of the gut between the pregnant uterus and pelvic brim. This case is to have confirmed the opinion of Vauder, Haeven, that occlusion is more apt to occur between the fourth and fifth month of pregnancy. Blair (35) states that Der Verf during this period, theorized that the cause of ileus was in the bowel itself owing to muscle weakness and loss of muscle tone. The present concept of the condition is the same as that held some years ago. According to Eliason and Erb (75) it is easy to conceive that pressure of the pregnant uterus upon a toneless bowel, the latter manifesting

itself by increased constipation, is all that is necessary to bring about complete strangulation. They believe that pressure of the gravid uterus would be unable to produce obstruction in a normal individual. They bring out the fact also that mechanical pressure such as hydrocephalus must be taken into consideration.

Table #4. Cases Reviewed due to Adhesions:

Author	Year	Stage of Gestation	Medical Treatment	Surgical Treatment	Results
75 Fleischauer	1918	4 Months	No	Yes	Mother-child died
74 Drew Smythe	1926	8 Months	Yes	Yes	Recovered - Delivered
76 Pridham	1927	4 Months	No	Yes	Recovered - Delivered
77 Lazard	1933	Term	Yes	Yes	Recovered - Delivered
73 Eliason and Erb	1937	5 Months	Yes	Yes	Recovered - Died
73 Eliason and Erb	1937	4 Months	Yes	No	Recovered - Delivered
73 Eliason and Erb	1937	6 Months	Yes	No	Recovered - Progress

This is illustrated in the patient of Drew Smythe, who was eight months pregnant and was presenting symptoms of obstruction which was considered due to the pressure of the presenting part. She was induced into labor and examination revealed a hydrocephalic fetus. The head was perforated and baby delivered, which was followed by a great deal of hemorrhage. Attempt was made to manually retrieve the placenta, but the examining hand encountered a perforation of the uterus, in communication with the abdomen. The perforation occurred at the site of an old scar left by a previously performed

caesarian. The placenta was found floating free in the abdomen. A hysterectomy was accomplished and the patient recovered.

It must be admitted that normal pregnancy may become responsible for ileus; the differences of opinion that might arise will probably be based upon the causative mechanism. Stoeckel explains the theory of atonia on the basis of a pre-existing pyelitis which affects the negative nervous system. He considers inhibitory impulses pass through the perineal sympathetic plexus to the vagus nerve that inhibit peristalsis. (36)

Abdominal and pelvic tumors can and do produce intestinal occlusion during pregnancy. In the cases I reviewed, tumors or cysts during pregnancy were not once encountered. However, the foreign literature contains several such cases. Slemons and Williams (36) state, ovarian cysts associated with ileus nearly always present a twisted pedicle, and this is considered to be the initial phenomenon in the order of events.

The above complications occur during intrauterine gestation, but more impressive is the association of obstruction with ectopic pregnancy. Massey (77) (Table #5) presents a case of abdominal pregnancy, where the descending colon was obstructed by the mass and adhesive bands which were attached to the uterus in the posterior cul-de-sac. Smith's (78) case is the most interesting because of its rarity, being a case of retained lithopedion for fifteen years. In 1892, the patient consulted a Doctor complaining of amenorrhea for three months with gradual increase in size of the abdomen. However, sometime later menses returned and abdomen resumed its normal contour. She enjoyed fairly good health

1907 when she presented symptoms of obstruction and was operated. A boney fetus was encountered with intestines and omentum everywhere adhered to it which were peeled off quite easily. The bowel was constricted in the ileum two inches from the ileocecal valve, by the right lower limb of the fetus. The fetus was removed as was the calcified placenta. A drain was put in through the vagina, through the cul-de-sac of Douglas into the abdomen and the abdominal wound was closed. Four hours later, the patient had a copious evacuation of bowel suddenly deluging the bed with feces, followed by collapse and death of the patient. The explanation given was that impregnation occurred in 1892, which was tubal and ruptured. The amniotic sac must have escaped damage in being set free into the peritoneal cavity and continued to develop until the six - seven months. Its death was not accompanied by any of the phenomena of false labor.

From a point of interest rather than importance is the case cited by Tormey and Tormey (79) of a widow with amenorrhea for three months who tried to abort herself by using a length of clothesline wire. She made a loop on the end of the wire and after inserting it could not remove it. A Doctor was summoned after pain and abdominal distention warranted. On examination, the wire was found to have passed through the fundus of the uterus and the patient was operated. The loop of wire had become hooked over a segment of ileum and was compressed against the fundus of the uterus. The obstruction was relieved and the patient recovered. The amusing thing about the case is that the patient was not pregnant.

Table #5. Cases Reviewed due to Miscellaneous Causes:

Author	Year	Stage of Gestation	Condition	Treatment	Results
85 Sprigg	1896	5 Months	Fecal Obstruction	Medical	Aborted - Recovered
78 Smith	1908	8 Months	Retained Lithopoeidian	Surgical	Died
85 Jackson	1920	2½ Months	Bicornuate Uterus	Surgical	Fetus - Removed Rec.
79 Tormey & Tormey	1931	No Menses	Attempted abortion	Surgical	Recovered
84 Massey	1936	6 Months	Foreign body	Del. Spon.	Died
37 Priest	1936	7½ Months	Ca. Rectum	Del. Spon.	Died
77 Massey	1936	3 Months	Abd. Preg.	Surgical	Died

According to Slemons and Williams (36) strangulation of inguinal and femoral hernias have occurred in twenty-four cases during pregnancy. In 1882, Jones (80) treated a patient, seven months pregnant with an umbilical hernia, surgically, with success.

Table #6. Cases Reviewed due to Hernias:

Author	Year	Stage of Gestation	Type	Operated	Results
80 Jones	1882	7 Months	Umbilical	Yes	Recovered
82 Casagrande	1936	Term	Peritoneal	Yes	Recovered - Delivered
81 Bischoff Pinkerton	1937	7 Months	Opening in Mesentary	Yes	Recovered - Delivered

Table #6 shows three cases of hernia two of these are of a type quite different than the usual type of hernia. The one presented by Bischoff (81) occurred in a young primipara seven



months pregnant. A loop of bowel became strangulated in a congenital opening of the mesentery. She was operated, the loop of intestine freed and the opening in the mesentery sutured. The next day the patient delivered prematurely, both mother and child recovered. In Casagrande's (82) case, the patient had had a laparotomy ten years previously. She was now with child at full term presenting symptoms of bowel obstruction. After some delay she was operated and six or eight inches of ileum had passed through a rent in the peritoneum just beneath the previous operative attachment of the left round ligament. Thirty six hours later delivered a baby by forceps with an uneventful convalescence. The infant also survived.

Occlusion of the intestine by a foreign body caused the death of Massey's (84) patient. She was eight months pregnant and was presenting symptoms of pain, temp and acute distention of the abdomen. She spontaneously delivered a still born child and began to run a very stormy course, she died the next day. Autopsy revealed general peritonitis from rupture of the descending and sigmoid colon. A mass was found in the colon which weighed 165 grams and consisted of strips of cloth numbering in total about 200.

Symptoms of intestinal occlusion are the same during pregnancy as they are in non-pregnant individuals. The important difference is the fact that pregnancy itself is a mask, so to speak, that covers their importance from the eyes of the examining physician. In other words, symptoms of obstruction during pregnancy are misinterpreted as being signs

of pathology in the progress of child bearing.

Enumerated, these symptoms are pain, abdominal distention, constipation, diarrhea, vomiting, shock and dehydration. Several or all of these signs were present in the cases reviewed. The sequence of events may not necessarily be the same in each case but present nevertheless.

There seem to be two types during pregnancy as in the non-pregnant state. Namely, acute and chronic. The difference being in its progress of onset. In the former, the onset is sudden with severe pain, early vomiting with subsequent development of shock. In the latter type, the condition is slowly developing with constipation being an early complaint. This was brought out in the histories of many of the cases presented, especially in Brettauer's (56) patient who complained of constipation, having great difficulty in moving the bowels for two weeks and having passed no gas for two days previous to entry.

The symptoms in many cases, remain obscure or masked by the uterus so that diagnosis is rendered impossible. In the later months of pregnancy, where the symptoms suddenly appeared, the physicians were led to believe labor had commenced and allowed the patient to remain in such a condition until symptoms of shock, fecal vomiting and extreme abdominal distention finally convinced them they were dealing with an obstructed intestine. It has been seen that these accidents occur early in pregnancy as soon as labor has commenced, or some days after delivery. In other words, the appearance of intestinal obstruction is

quite as variable during pregnancy and the post partum as it is where no pregnancy exists.

Pain as might be expected is quite variable, it may be severe sharp and sudden in its appearance, while in other cases, it may be crampy and dull, disappearing for a time only to return with greater intensity. It may be localized at the site of obstruction but in most instances, rapidly spreads over the abdomen. As for the relief of pain, in many instances, enemata, purgatives and sedatives were administered with only temporary relief.

Vomiting was also a constant symptom being present in practically every case, although in some few cases nausea, alone may be present. Vomiting usually begins soon after the onset of pain and as soon as the stomach has been emptied of its previous meal only bile-stained gastric juice may be expelled or is supplanted by unproductive retching, and finally the vomitus become fecal in a lapse of time varying from hours to days. The time element as to the occurrence of vomiting depends on the point of obstruction the lower the obstruction, the longer time before vomiting appears. In two cases continued vomiting was the initial complaint.

Diagnosis of intestinal obstruction was made on the basis of abdominal distention in several cases, because of the fact that there are other reasons why pain and vomiting can be present during pregnancy; but not so with distention, especially with other signs to cooperate with it. In Sage's (53) case at operation, the small bowel was dilated from five to six inches in diameter. In a few cases, examiners were led to believe the patient was farther ad-

vanced in pregnancy than she really was and because there were some contractions of the uterus, believed she was going into labor. In other instances, when distention was marked, especially in those cases due to intussusception, a tumor mass was palpated as were also the dilated loops of bowel. In Sprigg's (85) patient rectal examination revealed a mass the size of a lemon well up in the large intestine.

Constipation as a symptom of intestinal obstruction is an important one because of its frequency and because of the problem it presents. The problem is in the fact that it is rather the rule that pregnant women consult their physician about constipation of several days duration, and as usually is the case, purgations are ordered, which as a rule, promptly relieve the condition. From this it can be readily understood that the value of this symptom is greatly diminished. In most instances, this very thing was done enemas and purgatives were given and when no results were obtained, or as soon as there was a complete arrest of gas and fecal matter, intestinal obstruction was suspected or the diagnosis was made with the appearance of other symptoms. I believe it is the most constant symptom, because when the occlusion is complete constipation is never wanting. In Sprigg's (85) case, the patient had failed for several days to empty the bowel. By bimanual manipulation, with one finger in the rectum a large fecal mass with a consistency of dry putty, was broken up and subsequent enemas produced good results.

We have, in the early pages of this paper, seen that dehydration has been proven by animal experimentation to be due to a dis-

turbance of the acid-base regulating mechanism which causes a loss for at least a reduction in the sodium chloride ions in the blood. (25) That loss of fluids by vomiting and sweating have some affect on dehydration cannot be denied.

In close relationship with the sign of dehydration is the condition of shock. Some degree of each is present in practically all cases of ileus. The latter symptom depends upon vasomotor imbalance due to severe splanchnic irritation which is the result of the toxemia. It is evidenced by the ashen color, small, rapid pulse, normal or just below normal temperature, drawn facial expression and sweating. These all make evident the gravity of the affection by their presence.

Diagnosis is important because treatment of intestinal obstruction demands it early. It is made, of course, by signs and symptoms already given and their presence should determine the diagnosis. However, it can be readily understood as stated by Slemons and Williams (36) that these symptoms of obstruction in a pregnant woman can easily be taken to mean something else. Also that the enlarged uterus makes diagnosis difficult the same as acute sudden pain may point to abortion as definitely as it does to intestinal pathology. They point out that positive roentgenological findings which indicate the location and extent of pathology establishes the diagnosis beyond doubt. They are by no means necessary judging by the fact that diagnosis was made in many of the accumulated cases without X-ray examination, purely made on observation, physical findings and informa-

tion, as to the sequence of events, from the history.

Judging from the majority of cases studied, one is prompted to feel that the treatment of intestinal obstruction complicating pregnancy is surgical. The gravid uterus of itself has been the etiologic factor of intestinal obstruction so that in some instances it seemed that by emptying it of its contents, the symptoms arising from the occlusion would disappear. Lazard (77) had a patient at full term who developed symptoms of obstruction and upon whom he performed a low cervical caesarian. He states that as soon as the fetus was delivered, flatus passed via rectum and that by the time suturing was complete the distention had completely disappeared. It must be admitted that the case just mentioned was ideal because the patient was at term there was no deliberation necessary as to the viability of the fetus and had it not been the exciting factors, the removal of the advanced pregnancy would facilitate the exposure at operation.

In other cases, the pregnancy had not advanced to the time of viability of the fetus, and consequently, some hesitated in advising surgery, in fear of inducing premature labor. The majority used medical means first such as purgatives, enemata, stomach irrigation, turpentine stools and the like, and these will probably be used in the future because of the difficulty of diagnosis. But it would seem from the results seen in Table #1 (adhesions) that the possibility of premature labor is not great. All but one patient in this group recovered, and she died of military T. B. One aborted, three were delivered by section at time of operation; and the rest went on to deliver

spontaneously at term. The only two that were not operated died.

Eliason and Erb (73) present three cases in which the obstruction was due solely to the pregnant uterus putting pressure on the intestine, verified by roentgenological examination following barium meal. They recommend what they please to call "Change of Position," as a conservative method of treatment. They cured all three cases by putting the patient in the knee-chest position and employing soap suds enemata. This course of treatment would not hold in those instances where the pressure was due to adhesive bands, mesenteric torsion, or invagination. But they state that if the obstruction is not relieved by high enema and change of position, laporatomy is indicated.

We can conclude from this review that although not extremely common, intestinal obstruction complicates pregnancy often enough to warrant more serious study centered upon it, and should be kept in mind by the practicing obstetrician. Secondly, that diagnosis is not easy, yet scrutinizing observation over a relatively short period of time, plus the aid of the X-ray is sufficient for the purpose. Thirdly it can be concluded the condition in most instances is surgical and not be too long deferred.

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