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Etiological factors that predispose to cause constipation

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ETIOLOGICAL FACTORS
THAT PREDISPOSE TO CAUSE CONSTIPATION.

Senior Thesis.

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ETIOLOGICAL FACTORS THAT PREDISPOSE TO CAUSE CONSTIPATION

The etiological factors that predispose to cause constipation are protean. It is a symptom that is commonly met by all doctors. I chose this subject with the object of acquainting myself and perhaps a few readers with some of the causes of this common complaint.

The constipated individual is one that offers the man in medicine a most difficult task from the point of treatment. In order to do efficient and adequate treatment the causative factors must be determined as far as possible. In the chronically constipated, these factors are multiple.

After going through the literature of the past few years the most important etiological factors I find in the chronically constipated are systemic. The causes are due to weakened physical condition, slow metabolism and a general run down condition. We shall try and correlate this faulty metabolism and weakness with the symptom of constipation.

First, we shall give a brief description of the anatomy of the intestinal tract and then correlate derangements in this organ with that of constipation.

From the historical point there is very little that can be found. In early Biblical history there is no description of the condition. The scarcity of the condition is these people is probably due to their mode of living. These people were all active, did not lead sedentary lives, did not eat concentrated foods and had more of a variety and bulk in the diet. These conditions should be an important factor in limiting the symptom.

Constipation is defined as that condition in which there is infrequent or difficult evacuation of the feces from the bowel and rectum.

We have given considerable space to the anatomy of the stomach, intestines and associated structures which we shall review at this time.

The mouth and esophagus serve as the opening of the stomach to the exterior.

Stomach. The stomach is located immediately below the diaphragm. 14. It has a smaller and a greater curvature, the former looking upward and to the right and the latter downward and to the left. The entrance, esophageal opening, to the stomach is to the left, near the median line, while its outlet, pyloric opening, is lower down and a little to the right of this central line.

The stomach consists of four coats. The serous, which has no significance insofar as this work is concerned; a muscular, with its outer or longitudinal layer, its middle circular and its oblique internal layer, the submucous layer containing the vessels and nerves; the mucous membrane, with its many long irregular folds and its cardiac and pyloric glands.

Small Intestines . The small intestine extends from the stomach to the caput coli, from which it is separated by the ileo-cecal valve. It consists of numerous irregularly arranged convolutions, is about twenty feet in length, is considerably larger at its commencement than where it joins the colon, and holds about twelve pints or about six liters. It is divided into three parts, namely, the duodenum or first part is ten inches in length, and the jejunum and ileum make up the remainder.

The small intestine has three coats, the serous, the muscular

(longitudinal and circular), the submucous, containing the blood vessels, nerves and lymphatics, and the mucous layer with its goblet cells, Brunner's glands (in duodenum), crypts of Lubenkuhn, villi, valvulae conniventes, solitary glands and Peyers patches.

The blood supply of the small bowel is derived mainly from the superior mesenteric artery, and the nerve supply principally from the superior mesenteric plexus.

Large Intestine. The large intestine is that part of the alimentary canal extending from the ileocecal valve to the anus. It is so named because when distended it is considerably larger than the preceding portion of the bowel. It is further differentiated from the small intestine by its appendeces, epiploccae, its longitudinal bands and its greater degree of fixation. It varies from one and a half to two and half inches in caliber and it varies from five to six feet in length. It is widest at the caecum from which point it gradually diminishes in size as far as the rectum, here it again increases materially and so continues until the anal canal or narrowest part of the intestine is reached.

For convenience of study and to make plain to the reader its course and its peculiarities at different points, the large intestine is sub-divided into the colon, sigmoid colon, rectum and anus, and will be fully discussed under these anatomic headings.

Colon. The colon is the horseshoe or U-shaped portion of the large intestine surrounding the small intestine, having its beginning at the caecum in the right iliac fossa, and terminating at the sigmoid colon in the left iliac fossa at the outer border of the left

psoas muscle. It progressively diminishes in size from the caecum
down to the rectum. According to Gray the distended cecum has an
average diameter of three inches while the descending colon measures
about one and one-half inches.

Beginning at the ileocecal valve in a blind pouch (the cecum)
the colon passes upward to the liver (ascending colon) when it describes
a sharp turn (hepatic flexure) and extends across the abdomen to the
spleen (transverse colon) where it again turns sharply downward
(splenic flexure) and proceeds until it reaches the left iliac region,
where it becomes continuous with that irregular shaped part of the
bowel called the sigmoid flexure.

The cecum, the ascending, the transverse, and the descending
colon constitute the principle divisions of the part of the bowel, and
because of their importance in the study of constipation the anatomy
and peculiarities of each will be separately discussed.

Cecum. The cecum or blind pouch, the largest part of the colon,
measuring two and one-half inches in both its vertical and transverse
deameters is located in the right iliac and hypo-gastric regions, at
the middle of Poupart's ligament. The lower end is directed downward
and the other upward, and it is supported and held in position by the
peritoneal folds covering its lateral and anterior walls. The cecum
is separated from the small intestines (ileum) which joins it from below
by the ileo-cecol valve, an arrangement designed by Nature to prevent
fecal or other discharges from entering the small intestine after they
have once found their way into the large bowel.

The ileo-cecal valve is unique in its construction and effectively
prevents the regurgitation of solids, liquids and gases, which may have
accumulated naturally or have been introduced by artifical means. The

valve appears as a slit-like opening running at a right angle to the long axis of the bowel, its edges are thickened and form lips which are reinforced by strong muscular fibers.

As the cecum and large intestine become distended, these lip-like valvular folds are firmly pressed together, and are so arranged that the contents of the small intistine have free exit through it into the colon, but nothing from the latter can reenter the upper bowel except in rare instances and under great pressure. In this connection it is necessary to briefly refer to the vermiform appendix, a blind tube, leading off from the cecum, varying in length from three to four inches or longer and of the same general construction as the other parts of the large bowel. It is about the size of a lead pencil, is attached to the lower and inner surface of the cecum and is of importance because it frequently becomes inflammed as a result of constipation and fecal impaction, and conversely, when it becomes diseased itself it may induce costiveness.

Sigmoid Colon. The sigmoid colon begins at the termination of the descending colon in the left iliac fossa, at the outer border of the psoas muscle, on a level with the crest of the ileum, and joins the rectum at a point opposite the third sacral vertebrae.

The sigmoid is considered to be S-shaped. It passes downward to within a short distance of Poupart's ligament, then from the left to right until it drops into the pelvis. It passes to the opposite side, and then upward until it emerges from the right pelvic brim where it again makes a sudden turn and passes backward and down to become continuous with the rectum at the middle of the sacrum. The point of junctionis marked by a distinct increase in the circular fibers, producing a narrowing of the gut: this muscular ring is usually disignated as the sphincter of O'Beirne.

The sigmoid or pelvic colon is the narrowest part of the large intestine and varies greatly as regards its length and position. Its average length is seventeen and one-half inches.

The relation of the sigmoid colon is uncertain, both in health and disease. This depends on (a) abnormalities (b) its length (c) length of its right mesenteric attachments (d) distention (e) pressure of the abdominal expulsory muscles (f) tumors and distention of the adjacent organs and (g) sudden and violent injury.

In the empty state it remains in the left iliac fossa or drops down into the pelvis, but as it fills it extends, with a rotatory motion, upward or across the pelvis and well into the right iliac fossa where it usually remains until the beginning of defecation.

In abnormal states it has been encountered either loose or bound down by adhesions in nearly every part of the abdomen, sometimes as a straight tube and again twisted into irregular loops.

The serous, muscular, submucous and mucous layers constitute the coat completely envelops this part of the bowel and serves to form the meso-sigmoid which is variable in length, and serves to support and anchor the bowel. The mesenteric attachments of the sigmoid colon are very short above in the left iliac fossa and below at the recto-sigmoidal juncture, and is much longer between these points and because of their swing-like arrangement this section of the gut is capable of considerable motion and charge of position. The meso-sigmoid extends down to the third sacral vertebrae or beginning of the rectum.

The muscular layer has the circular and longitudinal fibers, but differs from other parts of the colon in that the three longitudinal bands spread out and lose their individuality as they reach the lower end of the sigmoid.

The Rectum (straight). The inferior portion of the colon and alimentary canal is called the rectum or straight intestine, a misnomer in the human species. It is tubular, devoid of longitudinal bands, and is narrower at its junctions with the sigmoid flexure (sphincter of O' Beirne) and at the anal extremity. The anterior and posterior rectal walls above the levatores ani-muscle remain in contact, forming a transverse slit, while the lateral walls below it, (anal canal) are in apposition, forming an antero-posterior slit.

The rectum varies in length from four to five and one-half inches, extending from the third sacral vertebrae to the anus. It descends obliquely forward and downward for about three inches, at which point it is found opposite the apex of the coccyx, from this point it turns upon itself and passes backward and downward for about one and one-half inches, there completing its course to the anus.

For clinical purposes the rectum may be subdivided into two parts: the movable and anal canal (fixed rectum).

The movable rectum is that portion of the lower bowel which begins on a level with the middle of the third sacral vertebrae and terminates about the crossing of the levatoris ani-muscle or at the upper margin of the internal sphincter. This is the largest part of the rectum and is known as the ampulla. It is capable of being moved laterally or vertically. It may be distended by inflation, and then appears to be divided into compartments of variable size, depending on the number of Houston valves present and the distance between them. Murgita (21) says that there are usually three in number but four or five or more have been reported. These valves were first described by John Houston of Dublin. They are arranged spirally at different levels about one-half inch apart, the end of one overlapping the beginning of

the other. The first or lower most is found about three inches above the anal border, the others from one-fourth to three-fourths inches apart and the uppermost just below and being a land mark for the intrance to the recto-sigmoidal junction. Each occupies about one third of the circumference of the wall, which normally is one-fourth to one-half inch in width from its attachment to the free border, and should present a good sized opening, between the free border of the valves.

The upper rectum is less sensitive than the lower, as is shown by the slight pain caused by surgical interference, extensive ulceration or malignant disease in this region.

The anal canal is that portion of the rectum lying between the levator ani above and the anus below, and it is surrounded by the hemorrhoidal plexus and is embraced by the external and internal sphincter muscles.

The rectum has four coats. Peritoneal, muscular, submucous and mucous.

At the commencement of the rectum it is surrounded by a peritoneal coat which binds it to the sacrum, lower down it covers the anterior surface only and is then reflected on to the bladder forming the recto-vesical pouch or to the uterus (Douglas cul-de-sac).

The muscular coat is thicker and stronger in the rectum than in other parts of the large intestine. It consists of two layers, circular and longitudinal. The circular fibers are neither numerous nor strong in the upper rectum, but become more numerous and stronger at the lower end of the rectum when they form a muscular band about one inch in width, called the internal sphincter. At certain points, particularly at the recto-sigmoid juncture (O'Beirnes Sphincter) and where the bowel dips in to form the rectal valves the circular fibers

are increased in numbers and have a fan-shaped distribution.

The longitudinal fibers are partly prolongations of those coming from the colon where the three longtudinal bands spread out, but some are peculiar to the rectum.

Submucous coat consists of a layer of more or less dense connective tissue in which the blood vessels, nerves and lymphatics ramify. It is sufficiently lax to permit of free gliding of the mucous membrane over it.

The mucous membrane of this region is much thicker and more generously supplied with blood vessels, and glides over the underlying structures more freely than in any other parts of the colon. When the rectum is empty the mucosa of the upper part is thrown into a multitude of superficial transverse velvety folds, which are obliterated by distention. The Houston Valves stand out more prominently when the bowel is distended and are of importance as a cause of constipation. This will be discussed more later.

The epithelium covering the mucosa has many mucous secreting cells.

Beginning just above the muco-cutaneous junction (Hilton's white line) and extending upward for a distance of one-third to three-fifths inch are several projecting longitudinal folds caused by sphincteric contractions and known as the columns of Morgagni. These plicae are broader above than below, contain some muscular fibers and are difficult to efface.

Suspended between the lower extremities of Morgagnis columns are transverse cup-shaped folds of the mucosa from one-twelfth to one-sixth inch in depth which are disignated as semilunar valves or crypts, the function of which is to collect mucous and hold it for the lubrication

of the feces during defecation.

Located at the lower end of Morgagni's columns are several minute elevations, composed of stratified epithelium and a slight amount of connective tissue, each containing an arteriole and a nerve filament.

The Houston's valves lie just above this area and have been previously described. They are always demonstratable in either the living or dead except in those instances in which they have been destroyed by disease or in which, because of pathologic changes in the gut wall, rectal inflation is impossible. They are directed obliquely to the long axis of the bowel and are slightly cup-shaped, their concavities looking upward.

Murrieta (21) states that the original theory that these valves were intended to support the fecal mass has been discarded, and their function to prevent the sudden deposit of the emptying sigmoid into the ampulla is accepted. Thus the physiological function may become pathological when hypertrophy prevents the passage of the fecal mass thru the rectum. The pathology that usually results is constipation. In the case reports of Murrieta in which over two hundred cases were reported the pathology of the valves was as follows. The usual interpretation of hypertrophy, and thickening was much less frequent than the thin wide valves, this increase in width obstructing the lumen or causing an over lapping of the free edges. No ulcers were seen but varying degrees of inflamation of the mucosa was observed in practically all cases.

The muscles of the rectum, which are of special interest in the study of constipation are the external sphincter, internal sphincter the transversus perinei, recto-coccygeus and the levator ani.

The external sphincter muscle is voluntary and is situated immediately

beneath the integument at the anal margin. It is about three inches in
length, one-half inch broad and is not thicker than the blade of a
knife. It arises from the tip of the coccyx, and after surrounding the
anus in the form of an *ellipse, is inserted into the central tendon of
the perineum. The function of this muscle is to close the anal orifice
and to assist in the expulsion of the feces, acting in conjunction with
the abdominal muscles and levator, *anæ muscles. Inferior* hemorrhoidal of the internal pubic
nerve. *and fourth sacral are its nerve supply.*

The transversus perinii muscle arises by a marrow tendon on the
anterior surface of the ischial tuberosities, and passes forward and
inward to be inserted into the center tendon of the perineum and in the
female with the posterior attachment of the vaginal sphincter. According
to Cruveilheur it aids in defecation by pressing the anterior and posterior
walls of the bowel together in conjunction withthe external sphincter.

The internal sphincter is a flat involuntary muscular band formed
by the collection of fibers of the circular coat and is located immediately
above the anal sphincter. It is about three-fourths to one inch in width
and one-sixth inch in thickness.

The recto-coccygeus embraces the lower end of the bowel in a fork-
like extension and draws the rectum upward toward the apex of the coccyx
after it has been forced down during stool.

The levator ani, arises from the pelvic fascia and from the inner
surface of the symphysis pubis, the fibers passing down-ward some to
be inserted into the perineum, others into the coccyx and still others
into the rectum on a level with the upper part of the anal canal.

The action of the levator ani, in so far as the rectum is concerned,
is to compress the sides of the bowel and the neck of the bladder, and
in the act of defecation, when the sphincter relaxes to open the anus,
it closes the urethra.

The levator ani forms a large part of the pelvic floor and helps to support the pelvic organs. It has a slight degree of voluntary action, which can be demonstrated by introducing the finger into the bowel and requesting the subject to draw up the anus.

The rectum obtains its support principally from the perineum above and from the external sphincter, recto-coccygeus and levator ani muscle below. Some of the fibers of the latter blend with the rectum, while others pass by it on their way to be inserted into the coccyx.

The anus is an oval orfice situated at the termination of the anal canal. It is located in the center of the pelvic outlet, one inch anterior to the tip of the coccyx, between the tuberosities, and like the anal canal has an anterio-posterior slit. It is lined above by mucous membrane and below by integument in which are found pigment, hairs, papillar suderiparious glands and sebaceons follicles. The skin about the anus is gathered into numerous radiating folds by the corrigator cutis ani muscle. The anus may be thoroughly stretched in every direction without permanently impairing its function.

Most of the nutritive material taken in by an individual comes thru the buccal cavity. Most of these foods are previously prepared in some way, by cooking, ripening, macerating etc. These food products are further broken up by the teeth and jaw muscles and the salivary enzymes.

Food is then thrown forcibly (Alvorez(1)) from the mouth through the pharynx and into the esophagus. Liquids are carried through this tube by the force of gravity, while solids are pushed by peristaltic waves through the cardia into the stomach. Normally the cardia should relax somewhat as food reaches the stomach. In rare cases it does not; the sufferer then has difficulty in swallowing and the sphincter at the

cardia has to be stretched by a special instrument.

The upper part of the stomach is a thin walled sac. According to Alvarez and others there is almost no peristaltic movement in this region, and the food drops very slowly and largely by the force of gravity into the muscular mill in the lower third of the stomach. The gastric-juice, which is secreted in the upper two-thirds of the stomach, flows down into the lower part and is here mixed with the food. The gastric juice is made to flow first by stimuli coming along the vagus nerves from the brain, and later by stimuli arising from the presence of food in the stomach and bowel.

There is practically no absorption of either food or water from the stomach. The stomach begins the process of digestion, but it is the small bowel that does most of the work. As long as the stomach contains material waves keep traveling over the parspylorica kneading the food and the gastric juice.

Alvorez(1) states that when liquids enter the stomach they tend to run rapidly thru the pylorus and on down the bowel. The factor of fliudity appears to be the most important one governing the rate of departure of foods from the stomach. As fast as foods are liquified they tend to move on through the pylorus and into the bowel. Those that stay solid or lumpy remain in the stomach for several hours.

Digestion in the stomach is dependent on the presure in the gastric juice of a certain ferment, namely pepsin and its activator, hydrochlorid acid.

As the partially digested food leaves the stomach it enters the duodenum. Then the products of gastric digestion are mixed with bile and with the powerful digestive juices of the pancreas. The duodenum in its first two inches is then walled, and poorly muscled, and perhaps

for this reason, food tends to stagnate in it. Because when filled with

barium, the shadow of this region in roentgen-ray films resembles a

bishops triangular-miter it is called the "cap." The particular importance

of this small area in medical diagnosis is due to the fact that it is

so often the site of ulceration.

The next two-fifths of the small bowel is called the jejunum,

from the Greek word meaning empty. It is so irritable that it quickly

pushes food on into the ileum, as a result it is always poorly outlined

in roentgenographs made after taking a barium meal.

There is the ferment erepsin, in the intestinal juice which

helps in the final splitting of the protein molicule.

Alvarez (1) states that there are two main types of activity in

the small bowel, the rhythmic segmenting or swaying movements which

churn the intestinal contents and rub them over the absorbing surface of

the mucous membrane, and the traveling waves which from time to time

rush down the bowel. According to his theory these waves always tend

to travel downward, because the upper part of the bowel is more active,

more irritable and more responsive to the stimulus of material in its

lumen than in the lower part. Since the activity and irritability decreases

gradually from the upper end of the bowel to the lower he says that the

food follows a gradient of muscular force.

This gradient can conceivably be reversed if one were to irritate

the lower end of the bowel until it becomes as active and powerful as

the upper end. This could induce constipation.

There is evidence to prove that there is a gradrent (Alvarez (2).

As far as the rhythmocity goes the evidence is overwhelming. It is a

simple thing to open an animal under salt solution and to demonstrate that

the rate of rhythmic contraction varies from about twenty per minute in

the duodenum to ten per minute in the lower ilium. It is easy also to
cut out short segments of the bowel and to show that their rate of
rhythmic contraction continues to vary inversely as the distance from
the pylorus. A similar gradient can be shown in strips of muscle
excised from the wall of the stomach. There the fastest rate is found
in the strip from the lesser curvature near the cardia. It is harder
to show the gradient in the colon, but that is to be expected when we
remember that the large bowel is more sluggish than the small, it lets
the contents lie in one place for long periods of time and it often
shows reverse peristalsis. Hence it is that the excised piece is slow
to contract down into a hard knot and stay that way, and the gradient
is poor and often reversed. In the small intestine of the rabbit and
white rat the rhythmic gradient is so fixed and so intimately built
into the structure of the intistines that one can determine the oral
and aboral ends of short excised segments by counting the rates of the
two ends.

Gerlach showed years ago, that the mesh of the plexus becomes
coarser and the ganglion cells fewer as one goes from the duodenum to
the ilium.

We may say, perhaps that the region on the lesser curvature
next to the cardia is the peacemaker for the stomach.

The small intestine empties its contents through the iliocecal
sphincter into the cecum or first portion of the colon. The muscle
around this opening serves, not only, to keep material from regurgitating
from the colon into the small bowel, but to keep the contents of the small
bowel from emptying too rapidly into the colon. The main function of
the colon appears to be the returning of water to the body; it is like
the condenser of a steam engine. Very little besides water passes through

the mucous membrane of this part of the bowel.

The colon is, normally, a sluggish, rather insensitive organ, which in man, shows very little peristaltic activity. Only occasionally, is there any sign of a traveling wave. At such times, usually after a meal, the fecal material runs together into a sausage-like mass which is pushed slowly, but steadily into the rectum. It is often this, so-called mass movement, which gives rise to the call to defecation. If the call is ignored the material in the rectum will sometimes be moved back again into the middle region of the colon.

The bile appears to be, largely, an excretion made up of pigments, formed during the destruction of worn out red blood cells. In addition to these pigments the bile contains certain salts and cholesterin, which help in the emulsification and digestion of fats.

One of the first things to remember about the digestive tract is that it is highly autonomous, that is, it contains within itself all the mechanisms necessary to carry on digestion and to maintain life. The vagus nerves and the splanchnic nerves may be cut, and still individuals will live, apparently in good health. Obviously, then, the digestive tract is somewhat like a factory which can go on with its work after all the wires between it and the manager's office have been cut. The nerves serve more as regulators, and the interruption of their continuity serves only for short periods of malfunction.

The vagus divides at the upper end of the stomach after passing through the thorax into many branches, some to the liver, stomach and to ganglia.

Stimulation of the vagi tend to produce contractions of the stomach and bowel, but this will vary from moment to moment and are different with different types of individuals. One of their main functions

is to keep the bowel from reacting too strongly to every stimulus. The main effect of stimulation of the splanchnic nerves is usually an inhibitory one.

There are two ganglionated nervous plexuses in the wall of the digestive tract, one the myenteric plexus or Auerbachs plexus is found between the two main coats of muscle and the other Meissner's plexus is found between the muscle and mucous membrane. The first has to do with the conduction of waves along the bowel. It seems to correlate the activity of one segment with another and it acts as a distributing net-work for those stimuli, which arrive by way of the splanchnic and vagus nerves.

Meissner's plexus probably serves to correlate the seretory activities of one part of the mucous membrane of the digestive tract with another, and it also is connected with Auerbach's plexus.

There is also evidence to show that there are long nervous paths in the mesentery which enable one part of the bowel to keep in touch with what is going on in another part.

Besides the nervous influence, there are the so-called harmonal or chemical ones which correlate the activities of different parts.

There is considerable physiologic and anatomic evidence to show that Auerbach's plexus consists of two types of nerve cells. (Alvarez 3). One group perhaps concerned with the maintenance of good conduction along the bowel, and the other group connected with the muscle fibers. Besides those two sets of neurones, with their axones and dendrites there are in Auerbach's plexus, innumerable fibers of vagal and splanchnic origin. Vagal fibers have little importance in conduction. Degenerative section of the splanchnic nerves interferred considerably with the conduction of electrically produced disturbances. Considerable evidence goes to show that conduction in the bowel takes place by way of neurons in Auerbach's

plexus. The synapses between these neurons are probably valve- like and favor conduction in the caudad direction.

Sprigg (25) states that digestion in the small intestine is continued in the caecum and ascending colon. Bacteria grow here in profusion and produce ferments which break up cellular hulls. This process apparently begins in the small intestine. It is assisted in the large intestine by a slow passage of food, which makes up to some extent for the shortness of the human bowel as compared with that of herbivora. Thus, Lovsch (quoted by McCane and Lawrence) found that 57% of the cellulose of the food disappeared from a normal intestine, but 81% from that of a case of chronic constipation. A second and main function of the large gut is the absorption of fluid from the chyme. To this end, the area of the mucous membrane is increased by the sacculations or haustra. Thus caecal contents contain 90% of water while normal feces contain 60% to 80%. A third function is the secretion of the mucous which mixes with the feces, and renders easy the fourth function, of the passage of waste matter along the bowel and its extrusion at intervals. It may be noted that most of the colon is, in health, not empty, but full.

The movements are: (1) Pendulum or mixing movements, which keep the contents moving, but not passing forward or back. These are slow like the changes in shape of an amoeba; (2) Transporting movements, involving various partial lengths of gut, and passing the contents usually forward. (3) Mass movements, which may involve nearly the whole of the large gut.

Sprigg states that these movements are dependent on the nervous plexus in the bowel and gut wall, but are influenced by extrinsic nerves in the proximal part of the colon, mainly, by the vagus, and in the distal,

mainly, by the sympathitics. There is evidence, according to Sprigg, that these stimuli are initiated from certain areas which are likened, by Kieth, to the nodal centers in the heart; the chief of these are described at the ileo-cecal junction, in the mid-transverse colon, and the sigmo-rectal junction. In the final act of defecation the abdominal, pelvic and large bowel muscles all take a part.

Sprigg, further states, that there is a general division of function between the proximal and distal parts of the colon, the cecum, ascending and transverse colon being chiefly concerned with digestion and absorption, while the rest of the colon, in which lymphatics are fewer, are mainly for the purpose of extrusion of feces. The pendulum movements are, accordingly, greater in the proximal colon than in the descending colon, where tonic contraction is more usual.

The terminal ilium is described by Sprigg, as contracting firmly at times forming an effecient valve to prevent chyme passing on, or back. It is doubtful whether the ileocecal valve can close itself when there is no muscular contraction above it; and the contents of the colon often pass into the ileum. When grateful food is taken into the stomach the terminal ileum relaxes, and chyme passes into the cecum, which then, with the ascending colon, contracts. This is the gastro-colic reflex.

The causes of functional disorders of the colon are numerous. Infections that lower the resistance of the bowel, septic infection from pyorrhea, or other mouth and throat disorders and with defecient chewing. Disorders associated with gall-bladder disease, appendex or other organs including those of the pelvis, or with general chronic infections, such as arthritis or fibrosites, may lead to intestinal stasis. Exposure to bad weather, too much smoking, bad water, ice water and bad foods are, likewise causes.

A person, who is coming down with a cold (Alvarez 21) or with

tuberculosis, loses appetite, and a dog, with distemper, refuses to
eat. Cannon showed, years ago, that if such a dog is forciably fed the
food will not leave the stomach altho there is no obsturction in the way,
and Alvarez showed, later, that the gradient in the small intestine is
reversed. Hysterical women and frail sickly girls often seem to have
such a poor gradient of forces in the bowel, that it is hard for them to
get any food thru the intestinal tract, in the normal direction.

An editorial, in the British Medical Journal (12) describes the
function of the colon as follows: "While the completion of digestion and
the absorption of the digestive products are some of the duties of the
colon, its principle function, in the proximal part, is the absorption
of water. The comparitively fluid chyme of the small intestine is
dried in the colon leaving only a pultaceous, or firm mass, by the time
the sigmoid and rectum are reached. It is, however, in the excretion of
waste products from the digestive tract, and their expulsion in defecation
that the lower part of the colon finds its essential function. The move-
ments of the colon are apparently different from those of the small
intestine. Both the small and large intestine show segmentation or
pendulum movements, which bring fresh absorption portions of mucous
membrane into contact with the digesting contents of the bowel. The
peristaltic wave of the small intestine, characterized by a relaxation
in front of a wave of contraction, is not so evident in the colon beyond
the splenic flexure through the proximal part of the colon tends to
fill by the slow onward passage of material from the small intestine.
In addition, the colon shows a new form of movement in which a mass of
contents is forced through a considerable length of the large bowel. The
longitudinal muscle of the colon appears to be mainly responsible for the
mass movement, and, in order that it may occur in normal manner, two

conditions must be satisfied; that the colon has been filled as far as the splenic flexure, and that having filled thus far, the transverse colon is so relaxed that maximal filling of this part of the bowel takes place. The mass movement then, starting in the neighborhood of the hepatic flexure, sweeps the contents of the transverse colon into the descending and sigmoid portions. Defecation may follow, or the ingesta may remain until the next mass movement propells it into the rectum. This mass movement is often set up when fresh food enters the stomach, and was described by Hurst as the result of a gastro-colic reflex. The details of the mass movement were observed by studying an opaque meal on the flourescent X-ray screen, and most of the observations on movements of the colon have been made by X-ray workers, in the course of routine examinations of patients suspected of gastro-intestianl disease. It is probable that both the segmentation movements and the peristaltic waves are initiated in the nerve muscle mechanism of the wall of the bowel, though external influences may exert control through the vagus and sympathetic nerves. The chemical constitution and reaction of the bowel contents, as well as the physical state as regards bulk and roughness, form the adequate stimulus for starting the segmenting and peristaltic movements.

"Although the physiology of the colon is thus somewhat obscure, a great deal of work has been done on the deranged colon. It is rare to see a colon so flaccid and atonic that segmentation movements are entirely absent. It is rather in the derangement of the mass movement that minor functional disorders of the colon occur. The hurried movements of diarrhea are less easily studied and the largest advance in knowledge has taken place in the conditions underlying delay in the colon and constipation. Several forms of disordered mass movement may occur. (1) a complete absence of the normal mass movements, so that the contents of the colon are slowly pushed on into the descending and sigmoidal portions,

giving rise to inspissation of the contents delay of several days duration, and evacuation, preceded by or accompanied by colicky pain. (2) Premature and insuffecient mass movement may take place, before the transverse colon has been filled, the contents of the ascending colon remains therefore insitu, and delay of the ascending colon type is seen. (3) In a condition of spasm of the colon, the mass movement may be unable to pass the spastic regions; in this way the contents are broken into pellits or cork-like portions and evacuation is delayed. (4) In elderly patients, a mass movement may be delayed for thirty to thirty-six hours, owing to the enfeeblement of the musculature of the bowel. (5) It is possible too, that a primary form of constipation may follow too complete absorption of the ingesta so that there is not sufficient stimulus to the bowel movement. Such conditions arise when people are on liquid and soft diets.

"The purely anatomical position of the bowel can no longer be considered of importance, nor can it be shown that disordered action of the colon is remedied by surgical procedures involving stitching up and fixing dropped portions. The living pathology of the bowel is much more concerned with its mobility, as expressed in its functional posture or tone and its various types of muscular movement. How the control takes place is not yet completely known, but it is dependent on the tread-bowel contents, mucous membrane and nerve muscle mechanism. Any one of these may be affected. In a recent paper or functional disorders of the colon. Spriggs (23) discussing the causation speaks of the importance of infections. Toxic sources may be present in the bowel contents as in dysentery, in the upper digestive tract as in pyorrhea and infected tonsils or in adenexa of the alimentary tract, as maxillary antra, or gall-bladder. Bad food, food deprived of vitamines in preparation, may have a deliterious effect.

Sprigg lays most emphasis, however, on the harmful effect of irritative

aperients which interfere with the rhythm of the bowel, setting up

inhibitions and spasms. Prolonged use of aperients must upset the normal

nerve muscle mechanism, fatiguing the postural tone and allowing dilatation

and relaxation of the colon.

Cummings (9) states that there are three types of movement in the

small intestine. (1) Rhythmic movements due to contractions of the

circular muscles. These occur more rapidly near the pylorous and diminish

in frequency the nearer they approach to the ileo-cecal valve. (2)

Pendulum movements due to contractions of longitudinal muscle. (3) Rush

movements due to contractions of both longitudinal and circular muscles.

The first two serve to mix the intestinal contents while the third

carries the mixture toward the cecum.

As has been stated previously, the colon also has rhythmic movements,

but they occur much less slowly than in the small intistine. In addition,

from time to time, the afore mentioned mass movements occur. These

will push a bolus of stool from the hepatic flexure clear into the rectum,

at which time, a desire to defecate is produced.

Constipation is an insidious trouble seldom descending upon the

individual with sufficient suddenness to permit one to set a definite

time of onset. In all probability improper evacuation has been present

a long time before sensations arise to the patient's consciousness,

resulting in symptoms.

Anything that interferes with rhythmic or mass movements of the

large intestine or with the sensitiveness of the anal canal will serve to

delay evacuation. Hence we must look to the nervous system for the onset

of constipation. Almost all have had the experience of passing from a

state of normal evacuations to one of acute constipation with no change

in their lives other than the excitement of a train ride. Todd has shown

the diminition of rhythmic movements of the colon in students during an

examination. It is reasonable that excitement of nervous tension would

produce a contraction of all the alimentary sphincters, except the

cardia, in as much as they are supplied by the sympathetic nervous system.

Thus undue excitement, by causing a contraction of therectal sphincter

could keep the bowels from moving regardless of the entrance of stool into

the rectum, causing the desire to defecate.

Reasoning from this, one can appreciate how the increased nervous

tension of our present civilization can cause a slight delay, in the beginning

to be followed after a few months or years, by chronic diminition of

rhythmic contractions and mass movements of the colon with a state of

continuous increased contraction of the rectal spincters, thus causing

the stool to be retained in the colon from twenty-four to forty-eight

hours longer than it should remain.

This delay and undue contraction of the sphincters could well

produce dilatation of the hemorrhoidal veins with irritated pockets about

the rectum.

Alvarez has pointed out a law that stimulation at any point tends

to hold back materials coming down from above. One can readily see

that because of the irritability of the rectum and colon there would

not only ba a delay in this region but it would extend to a greater or

less degree clear to the cardia. Again adhesive bands, congenital or

acquired, may act as irritating points delaying peristalsis, thus causing

stool retention and resulting mucous membrane pathology. Malformations

of the colon may cause the same results.

The physician who is interested in form and who recognizes that

form (stature) and function are different phases of the same vital process,

can appreciate the differences existing in persons of various body
types. The lack of appreciation of these differences in type, is the
cause of failure in many diagnosis.

In 1917, Mills (19) in submitting a classification of body types
described the sthenic and the asthenic as the dominent ones. The sthenic
group is characterized by a thick, broad, short thorax, a long abdomen
of great breadth in the upper portion and a relativily small pelvis,
padded with fat. The asthenic group is characterized by fraility of
build, a long narrow thin chest a short thin abdomen and relatively
wide and copious pelvis.

Seward (6) states that in the sthenic person if the lowest point of
the greater curvature of the stomach is below the interiliac line or
the transverse colon lies in the pelvis we consider the organs to be
below normal. In the asthenic, the stomach that has the greater curvature
lying well below the line between the iliac crest or the transverse colon
lying low in the pelvis, ptosis is permissable.

The causes of ptosis are due to mechanical deviations, which are
anatomical. These deviations create certain mechanical difficulties
under which the gastro- intestinal tract must work. The intestinal
tract is held in position by (1) Mesenteric attachments, (2) intra-
abdominal fat, (3) intra-abdominal pressure and (4) the shape of the
abdomen.

(1) Mesenteric attachments which become weakened and allow ptosis
cause their disturbance by impairing circulation, thereby, decreasing the
activity and efficiency of the bowel, due to circulatory inadequacy.

(2) Intra-abdominal fat aids in the support of the gastro-intestinal
tract by acting as a cushion for the viscera and by increasing intra-
abdominal pressure. The intra-abdominal pressure is of much greater

importance in the maintainance of normal peristaltic movements. In the depletion of fat pads this pressure may be decreased, markedly.

(3) Intra-abdominal pressure is a negative, pressure existing between the gastro-intestinal tract and the ossio-muscular walls. Wagoners (26) studies on this subject areof special interest, as they show the effect of intra-abdominal pressure on the function of the stomach and intistines. He measured the intra-abdominal pressure in animals and cadavars and found the pressure to vary from about minus four to minus two m.m. of water. When he placed the experimintal subjects in the upright position, the size of the abdominal cavity increased and the viscera gravitated to a lower level, in proportion to the degree of emacation and the relaxation of the abdominal muscles. As the cavity enlarged the pressure within the abdomen increased tenfold in some of the animals while it increased from minus twenty to minus one-hundred and six m.m. of water in the cadavars, the average increase being minus fifty-two. Wagoner found, also by experiment, that peristalsis is, in a large measure, dependent upon the relation between the pressure within the abdomen and the pressure within the intestines. For example, changes in intra-abdominal pressure to a greater negativity, resulted in gradual diminition of peristaltic contraction. As the pressure in the dog exceeded minus fifty m.m. of water, there was a gradual diminution in peristalsis, until there was obliteration of all movement. If the intra-abdominal pressure could be measured in visceroptotic patients, probably we would find that it often exceeds minus fifty m.m. of water and, in the light of Wagoner's experiment, we may expect peristalsis to be diminished in proportion to the increase in this negative pressure. A diminution in the rate of peristalsis promotes stasis of the intestinal contents and, sagging of the bowel with loss of tone of the involuntary muscles.

(4) The shape of the abdominal cavity largely determines the position of the viscera. It is markedly influenced by the tone of the voluntary muscles, and the tone of the muscles is influenced by posture. The athenic individual has an erect posture, the tone of the abdominal muscles is good and the viscera occupy mostly the upper abdomen. The asthenic person assumes a passive or stooped posture, the upper abdomen is often constricted, the distance from the umbilicus to the ensiform process is greater than the distance from the unbilicus to the side of the abdomen and the abdominal muscles are relaxed. The relaxation increases the size of the lower abdominal cavity, causing the viscera to descend to a lower level, when the individual stands.

There are two types of visceroptosis, according to Seward, the congenital and acquired. The majority of cases are congenital. An inherent structural weakness predisposes to ptosis which may be accentuated by a long, slender body, relaxed tissues, failure of the right meso-colon to fuse with the parietal peritoneum or of the right omental bursa to become obliterated, poor muscular development, flattening of the lumbo-sacral curve and faulty posture. As a result of faulty posture and deviations from the natural curves in the vertebral column, the weight bearing centers shift from the natural positions. Ptosis may also be found in patients with a more perfect body shape and posture. It may then, be due, either to relaxation of the abdominal wall ensuing upon a debilitating sickness, poor habits, childbirth, to any condition causing prolonged strain upon the abdominal muscles or to a developmental defect in the meso-colon.

Clausen (8) classifies as megalosplanchnics, those that are of medium stature or below medium, with excess body mass, horizontal diameters greater than longitudinal, large head, premature baldness, face broad, or

pentagonal, abdomen larger than trunk, upper abdomen larger than lower, with the umbilicus low, skin is tough and oily, stomach short, horizontal type, large bowel large and long caliber. The endo-crene system may show an atonic, flaccid type, such as a hypo-thyroid variety, characterized by vagotonia, in which there is a tendency to constipation.

Hunter (17) in an article on spastic colon very admirably explains the nervous mechanism related to this condition. The peristalsis of the colon is normally autonomic, regulated by Auerbachs plexuses, which lies between the muscular layers of the colon and is stimulated mechanically and chemically by the intestinal contents and by hormones derived from the bowel wall (Cholin) and else where.

The main effects, as previously stated, of stimulation of the sympathetics is inhibitory to the bowel.

Stimulation of the parasympathetic system thru Auerbach's plexus encreases the motility of the colon, but parasympathetic fibers pass also to the nerve plexus in the serous coat of the colon without passing through Auerbach's plexus, these fibers heighten the tone of the bowel and thus produce spasm or tonic hardening, interfering with, rather than promoting the ready passage of the feces.

Hunter further states that X-ray appearance supports the view that in spastic colon there is a tonic hardening, with rigidity and narrowing of the lumen of some portion of the colon, a condition which may last for hours or even days. Such an appearance has been seen repeatedly by surgeons in spastic ileus, associated sometimes with the passage of gall-stones or even with a round-worm in the colon, but usually without obvious explanation beyond possibly the nervous hypervagotonic state.

Spastic colon is met with more often in women and particularly in

the early years of life. There is usually a history of constipation and often of long duration. This condition has often been treated for long periods with irritating aperients. These aperients act, as has previously been alluded to, by interfering with the rhythm of the bowel setting up inhibitions and later, local stasis.

A condition of spasticity in low placed colons with disturbance of blood supply, pain and constipation was first suggested by Glenard, before the days of barium meals and X-ray was discovered. Bull (7). This visceroptosis, and low position of the viscera in some subjects probably does not of itself cause any symptoms, but because these subjects are rather poor stock and liable to minor ailments, their abdominal troubles are likely to be accounted for by the ptosed viscera.

Enterospasm, according to Bisset (5) may be described as a condition of the gut showing a contraction of the longitudinal and circular fibers simultaneously.

The causes of this spastic condition is attributed by Hurst to reflex irritation from within the intestines, poisons circulating in the blood, reflex causes, and as a result of tabes and chronic appendicitis. Morgan (20) incriminates a preponderance of vagal stimulation causing motor activity or to lessened irritability of the sympathetics.

Eggleston (13) says the principle etiological factor in nervous instability spasm and secretion of mucous is due to disturbance of the sympathetic and parasympathetics and that the mucous type of colitis is an end form of the spastic type. Another statement says that degenerative lesions in the cells of Auerbach's plexus may be the cause of enterospasm while Steindl found degenerative changes in the medulla and pons localized near the dorsal nucleus of the vagus in cases of intestinal spasm. Alessandrin attributes the spasm to the lowering of blood calcium.

Melli states that asthma may be produced by the inhalation of the substance and the ingesta of the same substance may cause gastric intestinal disturbances without asthma. Rowe (23) and Duke (11) have shown that gastro-intestinal symptoms may be due to food allergy. A. F. Hurst states that "If over activity of the motor fibers occurs alone entero-spasm results. This is analogous to the production of pure spasmodic asthma by irritation of the bronchial mucous membrane by some peculiar atmospheric condition in an individual with an abnormally irritable broncho-motor center. In other cases, the spasm is associated with increased secretion of mucous and mucous colitis results. This is analogous to the more common cases of asthma, in which bronchial spasm is accompanied by excessive secretion of mucous."

The explanation of the causes of the manifestation of food allergy is difficult (Bisset 5) but it may be primarly due to an inherited constitution which renders the individual hypersensitive to foreign proteins or it may conceivably be, that under certain disturbed conditions of the intestinal tract, proteins which are incompletely metabolized in the course of digestion may be absorbed in such a form or in such quantities as to sensitize the individual. In addition to the presence of the hyper-sensitive condition, mechanical factors also must be taken into account, as the mucous membrane of the bowel when in a sensitized state is also irritable and the bowel contents may mechanically sit up a response which is quite apart from the allergic response.

Gauss (16) gives a very good summary of the most possible predisposing causes of spastic colon. "Sex seems to have a significant influence. Spastic colon occurs three times as frequently in females as in males. Other predisposing factors are the chronic cathartic or enema habit, irregular habits of living especially that of ignoring the defecation reflex, faulty

diet, fatigue, insufficient exercise, faulty environment, emotional strain and allergy."

Constipation is frequently the result of pathology in the lower bowel (Sanders 24). Any condition which results in abnormal sphincter contraction at the anus will eventually produce constipation or fecal impaction. Error in habit, diet and sedentary living are productive of stasis in the colon. Hard dry fecal masses accumulating in the rectum produce an antony of the bowel wall and irritate the structures com pressing the anus. Small fecaliths entering the crypts of Morgagne cause chronic inflammation and subsequent abscess formation. Anal papillae become hypertrophied by irritation and the elongated papillae produce a contraction of the sphincters of the rectum. Engorgement of the hemor- rhididal plexus, frequently results in hemorrhoids. When the anal mucosa is irritated and injured by hard feces, fissures are formed. The acrid discharge from infections involving the papillae, crypts and fissures, pours over the skin around the anus, causing a pruritus, causing persons to delay defecation.

Inflammation and widening of the anal ring is basis for abdominal discomfort, constipation and flatulence, Alvarez (4).

In inflammatory diseases of the rectum, the submucosa often becomes thickened, indurated, rigid and adherent to the muscular layer, thereby interfering with the mobility of the mucous membrane.

In a great majority of cases of gall bladder disease, at some time or other, there is associated spasticity of the left side of the bowel, con- stipation is usually spastic in type (Rehfus 22). In individuals with hyper- acidity and hyperthyroidism, constipation often is found because of too rapid and complete metabolism of the food, giving inadequate stimulation of the gut and nerve-muscle mechanism.

Lentz (18) emphasises the importance of bad teeth in digestion and the production of gastro-intestinal pathology responsible for constipation. The harmful effects of bad teeth, in this condition is two-fold; namely, mechanical, resulting in faulty mastication and consequences, which follow this and metastatic dissemination of toxic absorption from the infected dental areas, giving rise to various pathology in the digestive tract, which in turn, leads to constipation.

Tumors, both benign and malignant, may cause a mechanical obstruction that will cause constipation. This same mechanical interference occurs following operations or peritoneal inflammation when adhesive bands bind the gut down. In pregnancy of due to uterine fibroids the enlarged tumor may produce a mechanical obstruction of the lower sigmoid, which results in constipation.

Intusseption and herniations will cause constipation of major or minor severity.

In summarizing the causes of constipation, we find that in very few instances, can it be accounted for by one single factor. The etiological factors are more probably systemic than local. We have divided the causes into nine headings.

1. Those due to nervous strain, or instability.

2. Those due to rectal stasis.

3. Those in which the disturbance is due, largely to neglect of the calls of nature or the cathartic habit.

4. Stagnation in the large cecum.

5. Those in which the food is insufficient in amount and residue.

6. Caused probably by cholecystitis, pyloric obstruction or chronic appendicitis.

7. Those in which there is disease about the anus and pelvis.

8. Those due to carcinoma of the bowel and to diverticulitis.

9. Those in which allergy is present.

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