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Robert S. Kinoshita
University of Nebraska Medical Center

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THE

ETIOLOGY OF CONSTIPATION

IN CHILDREN,

Especially Infants:

A REVIEW.

by

Robert S. Kinoshita

A THESIS PRESENTED TO THE FACULTY OF THE
UNIVERSITY OF NEBRASKA COLLEGE OF MEDICINE IN
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JULY, 1934.
INTRODUCTION

It has been the purpose of the writer to present a more or less thorough review of the common viewpoints of various medical men throughout the world on the possible etiology of constipation in children. In attempting to do so, the writer obtained materials and information from various medical periodicals, magazines, journals, textbooks, lecture notes, and from hospital records, and also from personal observations at the University Dispensary Clinics, The University Hospital Ward Clinics, and University Outcall Service. No attempt has been made by the writer to include the symptoms and treatments of this condition.

The writer believes that importance of recognizing the various etiology of constipation is most evident, since it is obvious that treatment cannot be instituted until the factor that is causing that certain condition is known. For instance, if we fail to recognize that constipation is caused often by allergy, ricketic condition, etc., we cannot treat the constipation adequately until we recognize and correct the original causative factor first. Therefore, the writer believes that the review of the various etiology of the condition will be of greater importance to all concerned.

The medical profession regards constipation as far less important than diarrhea. "This is true as pertains to mortality but not to morbidity", says Parker (1). In the words of Parker the importance is self-evident,- "It is a condition simple in itself but complex and far reaching in effects. To deal with constipation in early life is to deal with the
life long health of the individual." Nicholson (2) expresses the view - - "there is perhaps no ailment that we are more often called upon to treat than constipation." Although it is common belief among pediatricians that it is rarely directly dangerous to life, it is nevertheless, an important and common cause of lowered resistance and a contributing factor in many diseases. In the words of Pisek (3) "this minor malady in early life develops often into the habitual constipation of the adult." Thus it can be readily seen that a thorough knowledge of the subject in itself is of very great importance to the students and practitioners of medicine from the standpoint of recognition and treatment. This fact has influenced the writer to choose this subject for his thesis.
Definition....Cecil (4) defines constipation (costiveness) "as a disturbance of intestinal function, usually of the colon, which results in delayed or incomplete evacuation." Marriott (5) states that "constipation results when there is an insufficient stimulus to peristalsis or when the food residue is of such a nature as to form firm, hard masses, which are expelled with difficulty." Luzader (6) in her article quotes Metchnikoff and states, "it is an abnormal delay in the passage of the intestinal contents thru a portion or portions of the gastro-intestinal tract, which results in the absorption into the circulation of a great quantity of poisons or toxic material than can be treated effectually by the organs whose function it is to convert them into products as innocuous as possible to the tissues of the body." All in all, we see that constipation is not a disease but a symptom-complex, characterized by disturbance of the intestinal function, which results in delayed, incomplete or difficult evacuation and which in the final analysis, increases susceptibility to current diseases.

This condition was recognized by the ancient Greeks and Hippocrates revealed the ideas of his time by saying, "the excrement is best which is soft and consistent if passed at the hour which is customary, and in quantity proportionate to the food eaten; for when the passages are such the lower belly is in a healthy state." (quoted from(1)).

In his review of ancient literature concerning the subject of constipation, Longcope (65) states that only little is mentioned about constipation. He says in one of Horace's satires he found this line: - "Eggs roasted hard be costive." In the
Regimen Sanitatus, from the School of Salernum, written some time in the 13th century and translated into English by Sir John Harrington, there are only two notes upon the subject. The first verse of the poem ends with this warning:

"When moved you find your self to "Natures Needes,"
Forbear them not for that much danger breeds,
Use three Physicians still; First, Doctor Quiet,
Next Doctor Merry man and Doctor Dyet."

In another verse one finds this dietary advice:

"Cheese is a heavie meate, both grosse and cold
And breedeth Costiness both new and old."

and again:

"Eate medlers, if you have a looseness gotten,
They bind, and yet your urine they augment."

In the "Breviarie of Health" a complete compendium of symptoms written in the early part of the 16th century, there is no mention of constipation (quoted from 65.)

To recognize the symptom called constipation, it is obvious that one must be familiar with the normal number and consistency of the intestinal discharge in the various periods of early life, for constipation as I define it, is a condition in which the number of stools passed is less than the so-called normal or in which the consistency is greater than normal.

However, before doing so, I believe a brief review of the physiology of defecation at this point will be helpful.

PHYSIOLOGY OF DEFECAION-----It apparently appears that the whole act of "normal" defecation is, at bottom, an involuntary reflex. The physiological center for the movement probably lies
in the lumbar cord, and it has sensory and motor connections with the rectum and the muscles of defecation. The inhibitory fibers of the internal sphincter pass by way of the hypogastric nerve, the motor fibers thru the nervus erigens, and both of these nerves contain afferent fibers which may reflexly excite inhibition or contraction. It is of common opinion that this center is also provided with intraspinal connections with the centers of the cerebrum, thru which the act may be controlled by voluntary impulses and by various psychical states; the effect of emotions upon defecation being a matter of common knowledge.

According to the observations of Hertz (60) and Best (63), fecal material is normally absent from the rectum except just before defecation. The desire to defecate is probably felt only when the feces have actually entered the rectum and produced some distension. The fecal material is retained within the rectum by the action of the internal and external sphincter muscles which close the anal opening. When the rectum contains fecal material these muscles are thrown into a condition of tonic contraction until the act of defecation begins, when they are relaxed. No doubt the sensory stimuli arising from the accumulation of fecal material would eventually cause in this way a relaxation of the sphincters, but the act of defecation usually takes place before such a strong necessity arises. It is initiated usually by a voluntary act and it is possible that in such cases the relaxation of both sphincters may be effected by voluntary inhibition acting upon the spinal centers.
The voluntary factor in defecation consist mainly in the contraction of the abdominal muscles. When these contract and when at the same time the diaphragm is prevented from moving upward by the closure of the glottis, the increased abdominal pressure is made to bear upon the abdominal and pelvic viscera, and aids strongly in pressing the contents of the descending colon and sigmoid flexure into the rectum. If a deep inspiration is first made and then maintained during the contraction of the abdominal muscles then the pressure in the abdominal cavity is further greatly increased. Although the act is normally initiated by voluntary effort, it may also be carried out as a purely involuntary reflex when the stimulus is sufficiently strong. In infants the essentially involuntary character of the act is well known. (57 - 59)(61 - 62.)

The first stool of an infant consists of dark, brownish-green, semisolid meconium. This consists of partially dried intestinal secretions which have accumulated in the large intestine from the fourth fetal month on. The gradual passage of this meconium occurs during the first three or four days of life and accounts for much of the initial weight loss of the newly born. The meconium is usually passed from three to five times daily. Around the third or fourth day there occurs gradual transition to the usual type of infant stool. These are soft and golden yellow or greenish yellow in color, acid in reaction, have a slightly sour but not unpleasant odor and are of semi-liquid to salve-like consistency in a breast-fed; and small in number, more bulky and contain more solid
materials, of light yellow or grayish brown color, neutral or alkaline in reaction, and with a more unpleasant odor in a bottle-fed.

Statistics show, Hamilton (7), Eldredge (8), McClanahan (9), Marriott (5), that during the first year of life, the normal daily number of evacuations is two to three in the breast fed and one to three in the artificially fed. The consistency is usually greater in the artificially fed, but it should not be so great as to cause discomfort on passage. In the second year, the daily number of movement is one to two and in later childhood, one is the usual number per day. However, Clark (64), Hall (66) and others warned that a child may not have daily bowel movement and still be normal.

Since constipation is a symptom and not a disease, "its recognition, is already made " Hays (10.) However, the most important factor in the recognition of the etiology of the condition, and this depends upon a thorough knowledge of the various possible etiological factors, is the taking of a careful history which should include every detail concerning the child's diet, habits and daily life; a thorough physical examination which should include a rectal examination in every case and a X-ray examination where the cause cannot be immediately found otherwise.

After looking over various classifications in the text books and literature on constipation and the various physiological factors involved, I chose the following classification which is a modification of E. R. Hays' (10) and H. B. Hamilton's (7) classification of the etiology of constipation.

-7-
While not thorough in every respect, I believe it covers the subject very well and efficiently.

1. Constitutional......(Heredity

(Thyroid insufficiency-Mongolism, etc.
(Backward development

2. Mechanical............(Congenital deformity of gut
(as in Hirschsprung's disease)
(Fibrous adhesions, intestinal lesions etc.
(Obstructions - stenosis, stricture, imperforations, etc.

3. Reflex (spasmodic)...(Fissure of anus

(Spasm of sphincter - spasticity of colon; also of pylorus and cardia of stomach.
(Hemorrhoids, ulcers, polyps.

4. Partial Paralysis....(Opium

(Acute infections and metabolic diseases.

5. Dietary...............(Too little food or too little solids or too concentrated feedings.

(Insufficient carbohydrate or excessive slow fermenting carbohydrate.
(Insufficient or excess of fat
(Miscellaneous as heating of milk, excess of protein, lack of vitamins

6. Muscular Weakness....(Prolong indigestion

(Malnutrition and ricketic condition
(Lack of exercise
(Abuse of laxatives
(Lack of proper training
(Affections of nervous system as in Chronic hydrocephalus, intracranial hemorrhage, inflammation of brain and spinal cord.
7. Allergy.

Heredity As A Cause of Constipation.... In review of the literature (10) and lecture notes (7), it is interesting to note that in cases where the mother is habitually constipated, the child is also constipated without any apparent cause. These men and others seem to think that heredity plays some part in the causation of constipation in children. Morse (11) also claims that one of the causes of constipation is heredity. He goes on and says, "the large number of instances in which constipation occur in both parents and infants make it very probable that heredity does play some part in the etiology of constipation in infancy." Pisek (3) believes that the factor may be due to the habitual constipation of the mother—which, due to some mechanism cause constipation in the infant. Probably due to inhibitory substances in her milk. He explains that the.... "mother whose weight has increased rapidly after the birth of the child, now takes little or no exercise, or is taking a diet to which she has never been accustomed, believing that she is thereby augmenting her milk supply. I refer to the ingestion of large quantities of milk and the consequent lack of desire for other foods, resulting in constipation. The taking of a great deal of tea and coffee on the part of the mother is another dietetic error."

Therefore, this fact makes it very important for one to obtain a very thorough history of the familial traits and defects, before treatment can be efficiently given.

THYROID DEFICIENCY AS A CAUSE OF CONSTIPATION.... It has been noted that in a child with thyroid insufficiency, as for
instance in cretinism, constipation has been noted (10).
Pisek (3) in his article states that "infants who are mentally
deficient, such as cretins, or those suffering from Mongolism
or from birth injuries producing spastic paralysis, are apt to
be habitually constipated. In these children, the desire to
evacuate the bowel is prevented because of their deficient
intellect and imperfectly developed neuromuscular apparatus
and control of peristalsis." Brown (12) also emphasizes the
importance of thinking of hypothyroidism in those cases in which
no possible etiology is evident.

BACKWARD DEVELOPMENT AS A CAUSE OF CONSTIPATION..... Brown (12)
and Hays (10) are of the opinion that insufficient secretion
of the intestinal glands, and liver and thyroid; and the back­
ward development of digestive glands, liver and intestinal glands
are contributory causes of constipation in young children or
infants.

MECHANICAL CAUSES OF CONSTIPATION..... Hays (10) seems to think
that a "long colon, especially the sigmoid flexure which is rela­
tively larger in infancy than later life and has a proportionately
longer mesentery, allows more opportunity for kinks and breaks,
and may be a ...."contributory cause of constipation in children
especially infants."

We know that the function of the large intestine is chiefly
to absorb the liquid part of the food. Nature in the case of
infants has provided for them a form capable of rapid assimila­
tion, and to secure abundant absorption special provision is
made of the relatively large colon. At birth the large intestine
is relatively much longer than the body. At the end of the
second year (Snyderman (13) ) the differences become less
marked, and as it reaches the age of four or five years, the relationship is reversed. From this observation, it was thought very likely that due to its excessive length, some folding and kinking of this part of the bowels must be present in infancy. There is no question that this would offer considerable obstruction to the course of the feces. In the final analysis, the presence of feces will further accentuate the kinking.

It has been recognized since the 17th century that an apparently elongated and multilooped sigmoid was normal in infancy - (Jacobi (14)). McMurrich (15) in his manual on embryology, quoting Treves, explains the infantile peculiarities of the sigmoid also and their origin in the following manner. "The lower portion of the large intestine is thrown up into a loop which extends transversely across the lower part of the abdominal cavity, and represents the sigmoid flexure of the colon. At the time of birth, this portion of the large intestine is relatively much longer than in the adult amounting to nearly half the length of the colon, but after the fourth post-natal month, a readjustment of the parts of the colon occurs, the sigmoid flexure becoming shorter and the rest of the colon proportionately longer, whereby the cecum is pushed downward until it lies in the right iliac fossa, the ascending colon being then established." It can be readily seen from this that this physiologically elongated flexure with its immaturesly developed musculature lies cramped and coiled in the small pelvis of the infant. The elongated flexure may, when distended with meconium in the later prenatal or early post-natal growth, kink or compress an intestinal portion, with resulting acute obstruction.
Tobias (16) states "...we see megacolon for this reason in the fetus and often in the new born. Nature has provided in breast milk, a food which fulfills most accurately the metabolic requirements of the infant; it is liquid in composition and being most easily digested, absorbed and utilized, promotes normal intestinal function in the physiologically looped bowel. This fact implies that compatibility of the breast milk feces and the adequacy of peristaltic function in propelling the intestinal material without disturbance." As the child develops, the sigmoid assumes the adult S-shaped sigmoid. Therefore, the persistence of the infantile macro-sigmoid beyond this period is no longer physiological, and in consequence, its presence retards the evacuation of artificial foods. "With the institution of artificial foods and mixed feedings," he continues, "food more difficult to digest are retained in the intestinal tract a longer period, to insure the greatest possible utilization."

It is obvious therefore, that as this condition is made to continue, the vicious cycle formed aggravate the tortuous infantile flexure and, therefore, the associated constipation, and the smooth musculature of the sigmoid flexure is made to withstand a progressively increasing exertion. Then eventually, the musculature becomes weaker and in the final analysis, it is unable to propel the fecal material thru its tortuous channels. In Tobias' words...."the constant pressure of contained gas aids in forcing feces onward, yet exerts a distending effect towards its weakened wall, and habitual constipation results." (Case #2)
Hamilton (7), Hays (10), Morse (11), Moore et al (53), all feel that congenital lesions, such as pyloric stenosis, Jackson's membrane or some peritoneal adhesions by their mechanical factors cause prevention of passage of good stuffs beyond the stomach into the intestines. The baby may take sufficient and proper food for its requirement ordinarily, but as it cannot pass out of the stomach or duodenum on account of stoppage, and because it is very often vomited, constipation results. The writer reviewed cases of pyloric stenosis and spasm in children who entered the University Hospital here and found that in these cases constipation was a common finding.

Stenosis of the anal canal may also cause constipation. Kallett (18) in his article states that..."in reviewing the embryology of the gastro-intestinal tract, one notes that originally this is not a continuous canal. The primitive hindgut terminates as a blind sac called the cloaca, which is the anlage of certain genito-urinary as well as of the intestinal elements. A plug of tissue, termed the anal plate, separates the cloaca from the ectoderm. The latter in turn dips inward, forming what is called the proctodeum. As the embryo develops, this plug is gradually absorbed, so that by the eighth week or earlier there is a complete union of the hindgut with the proctodeum." He contends that if any arrest or distortion of this process occurs, malformation or anomaly results. He thinks that although these malformations are rather rare, we should bear in mind the fact that the line of fusion of the proctodeum with the entoderm in every new born infant represents a point of natural stenosis. He states that..."the sphincter muscles are as yet rudimentary
and the anal orifice is a narrow, more or less fibrous ring. In cases where the ring approaches the fetal type, the opening is exceptionally small and the elasticity minimal. In such cases, the stool reaches the rectum and is expelled with great difficulty. Therefore, it must be said that if there is no anal canal, which is rare, there cannot be any evacuation and also if there is only a slight opening, the spasm caused by the pain in defecation, tend to refrain the child from desiring to go thru the process and in the end it must cause what we call constipation - partly due to the constitutional mechanical anomaly and partly due to a protective reflex mechanism.

Congenital intestinal obstruction is given an important place as a cause of constipation in children by Bates (19). He writes ...."congenital intestinal obstruction is a deformity of the intestinal tract due to the mal-development in utero. It is characterized anatomically by a marked stenosis or complete atresia of the bowel lumen, and clinically by persistent vomiting, constipation, anuria, and progressive emaciation usually terminating fatally." It is noted that great dilatation of the bowel above the obstruction occur usually in these cases, and the wall become hypertrophied, especially when the obstruction is complete. The lower portion of the bowel is empty and collapsed, and firmly contracted and cordlike. Bates (19) quotes from Davis and Poynter's (1922) work in explaining the possible sites of these obstructions. He gives the common sites as near the ampulla of Vater, the duodeno-jejunal junction, and the ileo-caecal valve area. He quotes twenty nine cases of atresia of the colon from Heckel and Apfelback (20). In this series,
atresia occurred in the sigmoid flexure and rectum; in five in the ascending portions of the colon; in three, in the transverse portion; and in two each, in the ileo-caecal valve, splenic flexure and descending portion. In eight instances, many of these portions were continuously occluded.

The origin of congenital obstruction in the region of the digestive tract has not yet been fully explained. The following facts are suggested by Heckel and Apfelbach (20), as partially explanatory: 1. Mechanical factor; 2. Inflammatory process; 3. Embryonal disturbance of development. Jonas (17) believes that in cases of obstruction, the food passes out of the stomach into the duodenum, but due to the fact that it cannot pass, it is regurgitated and vomited. This after all, gives us the mechanism involved in the causation of this type of constipation. Jonas however, warns that...."this condition has to be differentiated from pyloric stenosis. In the latter condition, vomiting does not occur before the third or fifth week; whereas, in atresia of the duodenum, it begins soon after birth, and also in this condition bile is vomited. Bile is not vomited in pyloric stenosis."

Chittenden Hill and Hayden (21) write that...."in some cases stricture of the area just above the external sphincter and usually located about one inch from the anal orifice, is a cause of chronic constipation seldom thought of though fairly common and easily detected." He goes on and says....."Our clinical observations, and the teachings of embryology lead us to believe that the narrowing of the gut at this point is always due to a non-elastic internal sphincter, that has been present since
birth. Apparently these non-elastic and tight internal sphincters are due to some congenital defect which occur during fetal life." It is commonly believed by embryologists that mesoblast are not present at the junction of the hind gut and the proctodeum. One is thought of as belonging to the hypoblast, and the other to the epiblast. He emphasizes the fact that existence of fibrous tissues in this epithelial septum, when not absorbed, produces the imperforated anus. When fibrous tissue is not present, absorption takes place naturally and renders the junction of the rectum and anus complete, forming a normal anal canal. "Is it not reasonable to suppose," he says, "that the narrowed anal canal at the level of the internal sphincter occasionally encountered may be due to the presence of a small amount of fibrous tissue left behind, during the normal process of absorbing this septum?"

In other words, the embryonal development of the anus and rectum has been only partially arrested, resulting in a congenital anomaly of limited extent, but in origin identical with various malformations peculiar to this region.

Brennemann (22) reports six cases and David (23), three cases of anorectal stricture. In all the cases cited, there were apparently an identical anatomic condition, i.e., ...... "a sharp, short, firm constricting ring just above the sphincter ani; in all offering decided resistance to the examining finger, but in all yielding, reluctantly, but safely; in all, remaining dilated to a greater degree with the insertion of each larger finger, and in all, remaining
dilated as long as the infants were under observation, to a functionally normal degree." These men also seemed to believe that these anorectal strictures were embryonic arrest in development and caused constipation thru mechanical means.

David and Lauer (24) in their series of 104 cases found congenital stricture in 19 of their total cases. They claim that although it is common, it is occasionally seen. "as the result of failure of proper union of the infolding skin and the descending bowel in embryonic life." Ladd (25), Shattuck and Imboden (26) also assert that these types occur often in children and constipation is present in most of the cases. In his paper, which embodies eight years of study of intestinal obstruction cases involving 3000 patients, Kantor (27) points out that constipation occur in 54% of anomalies of the duodenum and colon.

REFLEX (or SPASMODIC) CAUSE OF CONSTIPATION. Reflex or spasmodic phenomena as the etiology of constipation have been observed by many men in pediatric practice. Hamilton (7) Hays (10), McClanahan (9), and Morse (11) believe that this condition is usually due to painful anal conditions as anal fissures, hemorrhoids (rare), ulcers and spasm of the intestinal tract. In explaining the mechanism of causation, Morse (11) states that constipation is "due to the pain which defecation causes." The pain, which the act causes, makes the baby put off having a movement as long as possible. In other words as a protective mechanism. Jonas (17) believes that rectal
polyps, which are occasionally found in babies, may cause constipation. "They do not usually remain long, but slough off and pass away," writes Jonas (17). He thinks that fissures are...."quite common in syphilitic babies."

Gauss (48) writes that spasticity of the colon is characterized by constipation and other symptoms. He claims that the essential mechanism of the condition is the hypertonicity. He explains that this hypertonicity may be due to an unstable nervous system. He claims that...."hypertonicity of the colon results when the normal rhythm of the intestine becomes disturbed and the contraction waves are accentuated. The tissues involved are the muscular layer of the colon and their innervations." Hunter (49) explains that this condition called spastic colon is a clinical description, and not a pathological entity; and that no evidence of inflammation of the colon is present in the stools on sigmoidoscopic examination, or in the post mortem findings.

PARTIAL PARALYSIS AS A CAUSE OF CONSTIPATION..... Under the heading of partial paralysis, the writer refers to those cases in which the condition is due to impaired innervation and not to weakness. As Hays (10) puts it...."this is the probable explanation to the symptomatic constipation as seen as the result of the administration of opium, usually in the form of paregoric or soothing syrup." The pediatricians on the faculty of the University of Nebraska School of Medicine have often stated,........"injudicious and prolonged use of opium derivatives have caused many cases of constipation in children." Morse (11) also states that obstinate constipation
in infancy is opium usage in various forms. He says that this is..."sometimes given by the mother, but more often by nurses or nursery maids without their knowledge, to keep the baby quiet and prevent it from crying. It is often given in the form of soothing syrup or paregoric." Whenever a baby that is constipated is unusually quiet and sleeps unusually well, it is a very good thing to consider this as a possible cause.

Lee (52) states that it is often found that in throat infections in children as a whole..."constipation is the rule." This he claims may be that temporarily, as a result of infection, all digestive activity is held in check. It may be that due to infection an unknown substance is liberated into the body which effects the sympathetic nervous system and thus inhibit peristalsis. Treves (34) reviewing 50 cases, observed constipation in 26 cases of appendicitis. Clore (28) Kelly (29), Osler (30), and Cecil (4) also noted constipation as a prominent symptom of appendicitis in children. In this case, it is undoubtedly the protective mechanism on the part of the body to inhibit peristalsis thus protecting itself from the diseased part or keeping that part quiet.

It is of common knowledge that great distress and fatality have been caused by not recognizing the fact, or knowing it, disregarding the fact that constipation usually occurs as a protective measure in appendicitis. Rupture of the inflamed appendix following the giving of carthartics in a patient giving the history of constipation and severe abdominal pain
following a supposed dietary irregularity, have been a great factor in the raising of mortality and morbidity of acute appendicitis. This fact alone, tends to emphasize the fact that the knowledge of the etiology of constipation is of benefit in general, as well as in specialized practice.

Dr. Hamilton on commenting on Hays work(10) states .."in contagious diseases, I think constipation is frequently due to a loss of water. The child has been vomiting, and has had a high fever, and there is not sufficient water in the intestinal tract or contents." It has been noticed by many writers that in cases of typhoid fever, constipation was the common associated symptom. Usher(31) in his study of 175 cases of typhoid in children, showed that constipation occurred in 35 or approximately 20% of the total cases. In the last two cases at the University Hospital, constipation was also noted. (See Case #6). The causative factor may be the same as explained by Dr. Hamilton above.

Passette (32) reports three cases of enterospasm secondary to upper respiratory infection in childhood. He defines enterospasm." as clonic or tonic contracture of the walls of the small or large bowel." He goes on and says..."it is a noteworthy fact that acute and often severe abdominal pain or colic, is an almost universal initial symptom in the acute infectious diseases of childhood. We see it commonly in tonsillitis, otitis media, pneumonia, etc. The child doubles up with pain, and points to the abdomen and though the symptom is transient, subsiding and recurring from one to twenty-four hours, it often throws one off guard as to the true site of infection."
Lentz (33) cites C. H. Mayo as saying... "75% of human ailments come from what goes into the mouth including food and drink, and the disease, and focal infections which may remain a cause of disease over a long period of time." From this statement, it is at once apparent how important is the study of the teeth in disease in general, and in digestive diseases in particular. He found from his study 15 patients of his group showed constipation. He believes from his study that... "harmful effects of bad teeth in this condition is two fold, namely mechanical resulting in faulty mastication and the consequences which follow this, and metastatic dissemination and toxic absorption from the infected dental areas giving rise to various pathology in the digestive tract which in turn leads to constipation."

Osler (30) and Cecil (4) and others point out that in children with diabetes, often constipation is noted. This may be due to the excessive excretion of water. If the skin may become dry, as it is usually the case, there is no reason why the intestinal tract and its glands may not also become rather dry. The writer, in looking over the series of cases at the University Hospital, between January 1, 1932 and July 1, 1933, noted that there were about 15 cases of diabetes in children and out of these approximately 67% showed definite constipation and 20% showed no history of constipation. The remaining 13% showed intermittent spells of constipation and regular movements (Case #7).

DIETARY CAUSES OF CONSTIPATION.... Hamilton (7), Marriott (5), McClanahan (9), Nicholson (2) and others stress the impor-
tance of improper as a cause of constipation. In fact most of the pediatricians today believe that most important causes of constipation are diet and habit - the diet especially in the infant and habit chiefly in the older children.

Hamilton (7) calls our attention to the fact that babies differ...."in their ability to handle foods and a formula which may agree with one infant may not in another, and produces constipation."

Too little food and too little solids are two of the dietary errors emphasized by these men. We all know, that the normal stimulus to peristalsis is food. Consequently, the taking of insufficient amount of food results in an insufficient amount of residue or waste for the bowel to act upon, and at the same time result in insufficient supply of nourishment to sustain the normal secretory and muscular functions of the gastro-intestinal tract, especially of infants. In older children too little food and lack of roughage in the food consumed, which the intestinal tract is normally equipped to handle and upon which it depends for its normal mechanical stimulus to peristalsis, cause laxity in the intestinal musculature due to insufficient stimulus to moderately vigorous peristalsis.

Nicholson (2) and Hamilton (7) write that a formula may provide for enough calories but may have in it a relatively insufficient amount of carbohydrate. This fact favors development of putrefactive types of organisms. Insufficient carbohydrate as a causative factor is obvious because we all know that the sugars or easily fermentable carbohydrates stimulate peristalsis and the acid formed by the fermentation prevent the forma-
tion of insoluble calcium and magnesium soaps, which are made up of fatty acids plus alkaline earths. This acid also overcomes the alkalinity produced by the calcium caseinate in cows milk. If on the other hand it is not sufficient, reaction in the intestinal tract becomes alkaline, in the presence of which the fatty acids combine with the calcium and magnesium salts to form large, dry, soapy stools which are difficult to pass. Hamilton (7) however, warns... "excessive quantity of slowly fermentable carbohydrates, such as starch, unless accompanied by sufficient sugar to cause more rapid peristalsis," is conducive to constipation. So it appears that we should know which type of carbohydrates are easily fermentable and which types are not so.

"Too concentrated feedings," according to Jonas (17), "may cause the trouble, unless water be given between feedings. For unless the baby gets sufficient amount of fluids, it cannot secrete digestive juices up to normal, and constipation may result."

An excess of fat in the diet often results in constipation especially when much casein and relatively little sugar are also present. Under these circumstances, the fatty acids of the fat combine with alkaline earths to form "soapy" stools in the intestines. These soapy stools have very little effect in stimulating peristalsis and may form hard firm masses. This type of stool... "are more often seen in the artificially fed infants and less frequently in the breast fed infants because of the high proportion of easily fermentable lactose present in human milk, the low proportion of casein and more complete digestibility of the breast milk." Nicholson (2).
Too little fat may also cause constipation. Hamilton (7) believes...."fat makes up a large share of the infant's stool and when these are low, there is not enough residue to stimulate the intestine, due to almost complete absorption of sugar and proteins." Jonas (17) writes that too little fat in the diet tends to cause constipation, since...."it normally seems to soften the stools and also to lubricate the mucous membrane of the intestines to a certain extent."

Jonas (17) also claims...."boiled milk is more likely to cause constipation than milk not boiled." He seems to think that in boiling, the bacteria which often cause diarrhea are killed and that in boiling, protein are broken down causing more complete digestion and absorption by the child. However, he points out, if the milk contains sufficient amount of sugar and not an excess of fat and protein, constipation does not often result in boiled milk.

Marriott (5) points out that much protein in the diet, especially casein, tends to neutralize any laxative effects of sugars due to fermentation and cause in infants who are receiving considerable protein and little carbohydrate, constipation.

Vitamin deficiency in the food consumed is said by some men like Marriott (5) as also instrumental in bringing about the condition called constipation. However, at this time this has not been proven. It may be that due to vitamin deficiency the tone of the musculature of the intestinal walls are weakened and in this way cause the condition in children.

MUSCULAR WEAKNESS AS THE CAUSE OF CONSTIPATION......
Synderman (13) states..."feeble musculature of the bowel has been held responsible for the frequency of this trouble in childhood, a view which gains support from the fact that feeble and premature infants are more prone to constipation than the normal ones."

It is pointed out by Hays (10) that prolonged indigestion, "when especially due to an excess of carbohydrates, is a common cause of this condition." It is believed to be due to excessive gas formation and intestinal distension which results in constipation. Morse (11) also is of the opinion that... "one of the most common causes of weakness of the intestinal muscles is prolonged indigestion, especially, if it is associated with fermentation."

Morse (11), Hamilton (7), Hays (10) Marriott (5), and Grulee (37) all agree that malnutrition and rickets involve the abdominal muscles in their general wasting and muscular atony, and cause constipation. The writer reviewed ten cases at the University Dispensary (Outcall Service), and it was interesting to note that nine out of ten cases of ricketic patients showed definite background of constipation, and the other showed a questionable degree of constipation. When we stop to consider that the general flabbiness so characteristic of this disease is not confined to the skeletal musculature, but includes, as well, the musculature of the intestinal tract, the etiologic relationship becomes quite evident.

Lack of exercise and postural deformities are conducive to weak abdominal musculature and pendulant abdomen. The
reason is obvious, and it is more often seen in a less active child.

In every teaching institution and in every medical periodical, we are warned against the too often and indiscriminate use of laxatives. We are told that laxatives and artificial means of causing bowel movement lead to habit formation and chronic constipation. In his comment on Hays' article (10), Hamilton emphasizes the fact..."one of the most pernicious habits that has come up in the medical profession is the unnecessary giving of laxatives." He believes that it would be good practice if we placed the same thought on whether we would give a laxative, as we do in the giving of a narcotic. He emphasizes the fact that we forget to investigate whether there is a necessity for it or not and give it merely as a matter of routine. Wagner (44) believes that the chief factors in etiology of constipation..."in its common and most prevalent form is medicine; or specifically that class of drugs known as laxatives, cathartics and purgatives." Pisek (3), Grulee (37), Spriggs (50), Adams (45), and Pritchard (46) also point out that daily use of suppositories and so-called rectal injections almost invariably..."result in the establishment of an insensitive condition, thus aggravating rather than curing constipation.

To explain the mechanism involved in this type of causation of constipation, I will quote Adam (45). He says,..."the liquid feces pass along the large intestine too easily, thus causing it to lose peristaltic tone, as it has not the normal work to do. In the sigmoid flexure and rectum, normal feces
form compact solid mass, which is expelled by a strong muscular effort. If an aperient is taken, this compact mass is largely broken up, and expulsion thereby made easier. Easy expulsion means less muscular efforts, less muscular effort is followed directly by deterioration of the quality and tone of the muscles concerned." Wagner (44) is of the opinion that in the case of infants, drug usage becomes "the first link in a chain of drugs that bind the patient to the cathartic habit." He asserts that drugs are administered regardless of the fact that in infant, we have a definite proof that meconium is a material stimulator of peristalsis. Often, it seems that, it is given before the milk flow has been established in the mother's breast and before the infant has had an opportunity of a normal bowel movement.

All in all, it appears that due to indiscriminate use of laxatives, enemas, and suppositories, nature simply attempts to adjust itself to the extra stimulation, and waits until the next dose is given. In other words, we teach the bowel to tolerate our medicines and to move only from an extra impulse. It is therefore no wonder that they will not act when we fail to give them the stimulant we have taught them to expect. It appears that enemas distend the bowel, weaken the musculature due to compelled overation, and ultimately produce atony. We must also remember that glycerine is hygroscopic in its nature and therefore extracts the normal secretion from the intestinal tissues and is sure, if used in suppositories, as it is often done, for any length of time, to produce a dry, weak, atonic, non-acting lower bowel and - constipation.
Lack of proper training is another cause of constipation. We all have had the experience of putting aside the natural urge to defecate, for something that happened to come up at that time, and which had to be attended to. We have also noticed that if we did so, the urge goes away and as time went on, we attain a "habitus," which could only be broken by laxative taking, or by purposeful retraining. Similarly, in infants, lack of training is conducive to constipation. Parker (1), Hamilton (7), Hays (10), Moore (42) Mores (11), McClanahan (9) and others place improper training as a great factor in the etiology of constipation. They all agree that proper training of the child to empty its bowels at a regular and proper time is often lacking, and postponement and no action are the ultimate results. In the words of Syndermann (13)...."there is a negative factor which may play an important role in the production of constipation - I mean the absence of voluntary effort to cultivate regularity." It is believed by Rotch (43), Marriott (5), and Nicholson (2) that retention of fecal material in the lower intestines leads to dilatation and atony of the bowel so that the condition is likely to progressively become worse. Drueck (35) seems to believe that when from any cause the fecal current is sluggish or from carelessness with reference to the art of defecation,..."the feces are retained abnormally, the fecal material may be arrested and dammed, forming a mass which cannot be voided by nature." In other words, impaction may occur. It is therefore a factor to bear in mind in the training or education of children, if this
condition is to be avoided.

Affections of the nervous system as in chronic hydrocephalus, cases that presented symptoms of intracranial hemorrhages, and inflammation of the brain and spinal cord very often cause constipation in children. The writer in looking over the University Hospital files noticed that in nearly every case, constipation in its various degrees was manifested by the patients. Hamilton (7), Jahr (54) and McClanahan (9) all expressed the idea that in children showing these affections, constipation was one of the chief symptoms present. Hassin (55) and Wechsler (56) also believe that constipation is often manifested in these conditions.

The mechanism of causation may be due to poor development and stimulation of the nervous system due to the toxic and mechanical effects caused by these conditions leading to inhibition of the stimulus of normal bowel movement.

ALLERGY AS THE CAUSE OF CONSTIPATION..... Although allergy as the cause of constipation in children appears rather far-fetched and sort of unreliable, many prominent men throughout the country doing actual work on allergy, claim that allergy has some basis as the cause of constipation. Rowe (38) has found constipation relieved by controlling the allergic reaction caused by foreign protein in a hyper-sensitized person. Presson and Wilson (39) in their article seem to notice chronic constipation in their cases of "allergic patients." They maintain that the musculature of the intestine loses its tones and that there "is probably a descending column of fecal material which had not been properly digested. Spasticity of the colon and irritation
at various places along the intestinal mucosa probably occur. Secretions are disturbed and there is possibly a super-absorption of water from the colon." They also think there may be a constant irritation in the rectum, with the resulting spasmatic closure of the sphincter and in consequence - constipation. Casparis (40) and Rinkel (41) in their reports mention the fact that gastro-intestinal allergy...."may be the possible cause of constipation in many of the cases in children."
Case #1 - Mongolism as a cause of constipation.

Case report from Pisek's article (3).

"E. W., three months old, was nursed to almost three months of age. A week ago he was put upon modified certified milk: 2 oz. of milk, 3 oz. of water, ½ dram of malt sugar; two such bottles to take the place of two nursings. The history is that of bowel trouble began seemingly soon after birth. His bowels have always been constipated, they had a greenish cast, and mechanical aid was always necessary to effect a movement. His doctor has been prescribing mineral oil. If the stool become dry, he goes off into a convolution. This has occurred six times to the present, each one of these convulsions lasting for five minutes. He is weak after these "spells" and refuses his bottle.

"On physical examination, this child was found to have all the characteristics of mongolism; the typical mongoloid cast of eyes, protruding, irregular shaped ears, flat occiput, and typical stigmata of his type. The lowered mentality is, in these cases, unresponsive to the ordinary stimulus of the full bowel, and little or no effort is made for expulsion."
Case #2 - Hirschsprung's Disease as a Cause of Constipation

From Pisek's Article (3).

"M. S., a girl aged 8½ years, has a history of constipation since early infancy. It was noted that even as a baby she had symptoms of intestinal indigestion, lost weight, and was in poor condition. At this time the clinical diagnosis of megacolon was made. When she was four years old, she had hemorrhages of the bowels, followed by prolapse of the colon, which proved to be a typical picture of Hirschsprung's Disease."
Case #3 - Congenital Anorectal Stricture as a Cause of Constipation

From Brennemann's report (22).

"Baby S. K., a breast fed boy, aged three months, was seen in private practice by Dr. Gerald Krost, to whom I am indebted for the following report and the courtesy of permitting me to include it in the present series. The birth weight was 7 lbs. 2 oz. (3.2 kg.). The baby had suffered from constipation from birth and had always cried a great deal, especially just before a bowel movement. With each movement, he would strain for a long time and then pass a thin soft stool with a large amount of gas. He passed very little gas at other times. The bowels moved about once in from 36 to 48 hours. After each movement the baby would quiet down for about 10 to 24 hours; and would then begin crying again. He never vomited.

"On examination, the baby seemed normal except for a marked drumlike distension of the abdomen. No visible peristalsis was detected. On rectal examination, the little finger encountered a very firm, constricting band in the region of the sphincter, which dilated only slowly after considerable pressure. The entire little finger was firmly admitted. When the finger was withdrawn the baby expelled a soft breast milk stool, and a large amount of gas with an almost explosive sound.

"The little finger and later, the index finger, were inserted daily for a week. After the first insertion, the baby passed gas more freely than it has since birth. After the second treatment, there were one or two normal stool a day. The abdominal distension was gone, and the baby seemed normal
in every way and remained so while under observation for several months."

Case #4 - Elongated Pelvic Colon as a Cause of Constipation

Case report from Goldberger's article (47).

"Z......, a boy seven years of age, with a history of constipation from birth. It has been necessary to use laxatives since birth, with increased frequency and strength, so that, at the time he came for treatment, it was impossible to bring on a bowel movement oftener than once a week, even with the use of drastic cathartics. The radiographic findings showed a markedly elongated pelvic colon."

This above article emphasizes the usefulness of X-ray in diagnosis and also tends to show how the habitual, indiscriminate use of cathartics may lead to weak muscular walls and therefore, aggravation of the condition.
Case #5 - Appendicitis as a Cause of Constipation.
From Kerley's Article (51).
"A girl, aged 7 years, had never had a normal evacuation, enemas and laxatives being required daily. Anorexia was a prominent symptom, and recurrent attacks of vomiting were frequent. Following a barium meal, the appendix showed retained barium at the end of 144 hours. Spasticity of the cecum was present for 96 hours and longer. There never had been localized signs suggesting appendiceal involvement, and its presence had never been suspected by previous professional attendants. This child passed from observation when operation was suggested for the removal of the appendix."

Case #6 - Typhoid Fever as a Cause of Constipation.
Case from University Hospital Files, University of Nebraska School of Medicine, Omaha, Nebraska
File No. 45315
G.B., age 11 years, entered University Hospital 10-12-33 complaining of fever and malaise since 9-30-33. Gave history of having had three doses of prophylactic typhoid vaccine in view of two others in family had typhoid fever at this time. A week after the third dose (Sept 23rd), on October 3rd, patient had an attack of nosebleed, fever and cough. Doctor was called who made a diagnosis of bronchitis. Fever of mild type continued and patient became constipated. She had headaches and abdominal tendernes almost since the onset and also loss of appetite (irregular type of fever, ranging from 102 - 105 ). Patient
was given water freely but mother had to give enema daily to cause evacuation of the bowel. She has had profused sweating for the last three nights. Water from the family drinking well was condemned by State Health Department. On entrance, physical examination revealed child to be apparently of normal appearance and development. She however appeared listless. Her skin was warm and moist; lips dry and tongue coated. There was a slight increase in breast sounds on lower right side and the abdomen was tender generally but with no rigidity. There were several small red spots over the ventral surface of the body - characteristic of "rose spots." The spleen was palpable. Widal agglutination test gave a positive reaction for B. typhosus. Blood count Hb. 63%. R. B. C. 4,500,000; W. B. C. 9540; Polys 80%, Lymphos 19%, Mono 1%. All throughout the treatment an enema had to be given to cause evacuation of the bowels.
Case #7 - Diabetes as a Cause of Constipation.
Case from University Hospital Files,
University of Nebraska School of Medicine
Omaha, Nebraska - (file No. 41121)

E. K. a girl aged 6 years, entered the University Hospital 10-30-32, in a semi-comatose state, complaining of headache and with the diagnosis of diabetes mellitus. Patient was well up to six weeks before entrance, when mother noted that she was weak, losing weight and quite irritable. She has always been troubled with constipation and the mother gave her salts. About three weeks ago she began drinking great amount of water, and since then she has been wetting the bed frequently. Three days ago, the home doctor diagnosed the case and sent her in to prevent coma.

On entrance, physical examination revealed a well developed rather poorly nourished girl of stated age. The left eye was swollen shut with pus discharging from it. Throat was moderately reddened. Heart rate was 120, with presence of a systolic murmur. The skin was dry, rough, loose with little subcutaneous fat. Blood sugar was found to be 364 mgm% on entrance. Otherwise examination was negative.

She was placed on routine diabetic treatment., and she made an uneventful recovery and was dismissed. All thru the treatment enema had to be given to cause evacuation of the bowels.
Case #8 - Hydrocephalus as a Cause of Constipation.

Case from University Hospital Files, School of Medicine, University of Nebraska, Omaha, Nebraska (File No. 45564)

P. T., 28 months old was admitted on 11/15/33 complaining of inability to walk, paralysis of leg and arm, and retardation in talking and responding. Child was of normal birth (9 lbs.), not difficult labor, and no birth injury received. Child had the usual childhood diseases and developed normally up to 7 months of age. She developed "kidney" trouble at 7 months. It was noticed at that time that her head was extended back and somewhat rigid; her mentality had not developed since that time. It has shown no inclination to walk and her left arm and leg have been in a state of spastic paralysis. Mother stated that child's left eye turned in at times, she had frequent colds and sore throat, was constipated (for which milk of magnesia 2x a week was given), and that she had no urinary control.

On entrance, physical examination revealed a child of normal physical growth and development with a rather "unintelligent" facies. She weighed 28 lbs. Her head was large (47 cm. circum. in largest diameter) with no exostoses, and some strabismus in the left eye. She also had large injected tonsils, anterior cervical adenopathy, and a slight nasal discharge. Left arm had jerking movements, the muscle tone was somewhat exaggerated, and her reflexes on the left exaggerated, but there were no atrophy of muscles. She was mentally retarded for her age. Encephalographic studies revealed an internal
hydrocephalus. The diagnosis of Hydrocephalus, Encephalopathy—post infectious was made.

Case #9. Constipation in Breast-fed Infants Caused by Anorectal Fissure...From Cathcart's Article(67).

M.S., aged seven months was brought in with a complaint of constipation and colic of four month's duration. She had been well until three months of age when the bowel movements became irregular. On one occasion she did not have a movement for three days. Suppositories and enemas were resorted to, and this seemed to give relief for a few days. The mother stated that she had noticed a slight excoriation near the anus, and that at times the baby cried as if in pain when enemas or suppositories were used. No blood was ever noticed in the stools.

Past History: Full term, normally delivered, breast fed infant, weighing 15.1 lbs and 14 oz. at six months of age. No history of any acute infection other than an occasional head cold, started on cod liver oil and orange juice at two months of age and on cereals at six months of age.

Examination revealed a well developed and nourished infant weighing 16.1 lbs and 5 oz. A mucoid discharge from the nose was present and the throat was slightly red. The neck and chest were normal. The abdomen was not distended and no fecal masses were palpable. Examination of the anus showed nothing externally. Digital examination of the rectum revealed a very tight sphincter. A small nasal speculum was inserted into the rectum and a rather deep fissure on the posterior surface of the rectal mucosa was observed. This fissure was about one and one half centimeters in
length and had a rather broad, grey base. No blood was seen. Lunar caustic was applied to the fissure on four occasions; increase of oil in small doses was given by mouth twice daily. Improvement in this case was gradual, and eight weeks after starting treatment, the stools were normal. At the end of this period, rectal examination with the speculum revealed a thin, grey ridge at the site of the fissure.
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