

"GAS-PAINS."

BY

GORDON K. DICKINSON, M. D., F. A. C. S.,
Jersey City, N. J.

EVERY person upon whom an operation is to be performed dreads the anesthesia, the being reduced to insensibility, the taking away from him his ability to protect himself in a condition of danger. Anesthesia is abhorrent to us all, but to anyone who has had an operation, particularly an abdominal one, the recollection of "gas-pains," with its prolonged treatment and torture, is even more deterring than the anesthetic.

It is the duty of the surgeon to reduce his death rate, to save the hundredth man. It is not his only duty, however, to reduce mortality and morbidity, but to promote convalescence and render it as comfortable as possible.

The great improvement in surgical methods, the broad knowledge of the responsibilities of the profession, the intense study into post-operative conditions and their control, have greatly modified surgical procedures in the last thirty years. When abdominal conditions were first operated upon, the hemorrhage and handling of viscera, the uncertain attack and incomplete work with unnecessary drainage, led to a postoperative complication which was severe, dangerous and very distressing to the patient (and to the surgeon as well), namely: pseudo-ileus. How well we recollect when looking back into the past, sitting on the anxious seat and plugging away in Greig Smith over the chapter on tympanitis, pseudo-ileus and *peritonitis*; conditions for which we blamed the lesion, and now blame ourselves. As knowledge increased and methods became milder, pseudo-ileus ceased to be one of our fears; so that to-day rarely, if at all, does an intern meet such a condition in his hospital service.

Following pseudo-ileus came marked tympany, protracted, embarrassing, engendering fear as to its outcome, and receiving active, annoying treatment from doctor and nurse.

The surgeon of the present day, in place of these conditions, is disturbed by the complaints of the patients because of "gas-pains." These pains being more subjective than objective are, sometimes, passed by with the statement: "She is so nervous." Interns are up on night calls repeatedly, their efficiency thereby being diminished

by this condition, and would-be patients often postpone operation because of the stories told by those who have suffered.

It is interesting to study the history of this abdominal reaction as noted by the different lights of the past, correlating their methods of work, the knowledge of their day, and the treatment they felt was proper and sufficient:

Tait(1) in 1873 considered it a paresis of the intestine, leading to a kink or kinking in different portions of the gut. He was inclined to the opinion that it was one link in the chain leading to peritonitis. If peristalsis could be established the condition ceased and the dangers were passed. For this he administered Epsom salts. This impressed the surgical mind for a considerable period, so much so, that in the '90's, McCosh, while operating, would inject with a needle a solution of Epsom salts into the lumen of the gut.

In 1887 Malcom(2) noted the reaction of the intestine while exposed, and made exhaustive studies as best he could. He claimed there was a reflex arterial reaction, local and general, and that the phenomenon of pseudo-ileus (which is the grandparent, as it were, of "gas-pains") was a systemic reaction as well as a local condition; and that any procedure, which drew down the gases and facilitated their discharge, would by some mysterious method control this reflex condition immediately and lead to restitution and comfort.

In 1888 Olshausen,(3) writing on this topic, considered it a disturbance of circulation in the small intestine, whereas,

Verchere,(4) the same date, blamed the absorption of poisonous substances from the intestinal tract.

Crile,(5) 1903, after a series of remarkable and extensive psychological and physiological studies of the conditions pertaining to shock, local and general, studying and experimenting on the different tissues of the body (brain, adrenals, liver, etc.), determined that trauma of the intestine affected the vasomotor system in particular; that in a short time after the viscera were taken from their natural bed and exposed to the air, aberrant vessels would appear and the intestine change in color and in consistence; that it underwent a rapid lack of tonus, which was very soon followed by arterial hypotension, associated with exhaustion of the central vasomotor mechanism; and, if this continued for a time, there was chromatolysis in the Nissl substance with similar changes in the cells of the adrenals and liver.

In 1909 Yandel Henderson(6) was led from his observations to look upon the phenomenon exhibited from another viewpoint. With him, carbonic acid and its stimulating effect upon the vasomotor tissue

was the pathogenic factor most important in intestinal activity. He claimed that anesthesia alone, that is, without operation, may be followed by the syndrome known as "gas-pains;" that ether by the open method, stimulating the respiratory center, leads to an active discharge from the blood of carbonic acid, and a condition of acapnia in the tissues. He found that when the abdomen is opened there is exhaled from the viscera, when exposed to the air or moist gauze, an excessive amount of carbonic acid; the intestine failing to retain sufficient carbonic acid to maintain tonus, paresis, dilatation and subsequent conditions follow; that the diminution in the amount of carbonic acid in the system is preceded by exaggerated breathing; and that, when loss of carbonic acid in the lungs and exhalation by the viscera are prevented, normal activity of the intestinal tract is maintained, postoperative peristalsis quickly resumed, and "gas-pains" diminished or absent. His observations indicate that carbonic acid tension in the nerve centers, and in the tissues and fluids of the body, is the factor in the maintenance of tonus in the broad sense of the word, "of the same order of importance as temperature, oxygen supply, osmotic pressure, and equilibrium of the anions and kations." It, however, does not exist in the blood as a gas, but dissolved, largely combined with alkalies and in part ionized.(21)

Mall,(7) 1896, showed that the intestine has two contracting waves: a rapid one, of about twelve per minute, for propulsion of the contents; and another, of one or two per minute, which he considered the intestinal pulse; the appendix, even, taking on the same action. The submucous venous plexus, in totality, must be of considerable consequence as to the volume of blood and the contractions, undoubtedly, are a sufficient cause for sustained circulation through the liver.

Miller(8), 1911, states that the mesenteric plexus differs from the true nerve plexus both in structure and staining reaction.

Keith(9), 1915, as a result of a long series of investigations of the gastro-enteric tract of various animals and the colons, referred to him by Arbuthnot Lane and others, claims the discovery that there are just above the cardiac orifice, in the second portion of the duodenum, at the ileocecal collar and in the large intestine, elaborations of the plexus which prove to be pace-making nodes for the activation of peristalsis. In other words, that Auerbach's plexus resembles histologically and physiologically the auriculo-ventricular bundle; that peristalsis is very similar to cardiac contractions; that one of the functions of the intestinal tract is similar to that of the cardiovascular, that is, the circulation of the blood. Keith even goes so

far as to suggest that cardiac rhythm may be instigated in the abdomen.

Thus we see that this intra-abdominal pathology is varied according to clinical experience, acumen, and care; that the explanation of the phenomenon produced is varied according to our increase of knowledge of the different tissues, fluids, and gases of the body and their interdependence and importance; and, whereas, each observer is undoubtedly correct in part, the correlation of the factors must be studied in order to institute a rational and effective mode of treatment.

The susceptibility of the gastro-enteric tract to reflex effects has been known for centuries; as for instance, the mustard cloth to the pit of the stomach for the relief of pain, the scratching across the upper abdomen to activate a lazy upper colon, and similar irritation over the lumbar region to stimulate the rectum.

Metzler and Auer(10) found that dissection of the skin over the abdomen produced reflex inhibition of peristalsis.

Henderson's notions as to carbonic acid being the important factor in the tonus of the unstriated muscle are confirmed by several clinical observations. In the Nauheim(11) treatment of cardiac lesions carbonic acid in the bath stimulates the skin and its circulation so that it becomes pink. The arterioles and the terminal arteries dilate, thereby giving relief to the hypertension of the vascular system, reducing the blood pressure, and relieving the strained heart. If, instead of carbonic acid, oxygen be applied to the skin in a similar way, we have pallor and contracted blood-vessels. Effervescent purges are much more active, prompt, and efficient.

Decomposition of the carbohydrates in the intestinal tract leads to the formation of carbonic acid; and, according to the amount of this gas, do we have activation of the gut (18 and 23). Death by hanging, which through asphyxia leads to a surcharge of carbonic acid in the system, has a cathartic action(13). The woman in labor who holds her breath, carbonizes herself and, thereby, delivers herself more effectively than the woman who moans and cries and uses each inspiration for complaint(6).

Pieces of the intestinal tract placed in mildly effervescent carbonic solutions keep up a peristalsis which is lacking when other media are employed. So there is a physiological reason back of Henderson's discovery.

In all operations we have three factors that must be before our minds continually: the importance of the lesion, systemic conditions, and the co-equal danger of the surgeon and anesthetist. Anesthesia

as written in our books is largely a rattle of old bones, but from our journals and laboratory reports we are learning much which will tend, we hope, to bring about more sensible methods of narcosis in the immediate future.

So far as the abdomen is concerned, ether itself, so says Henderson,(6 and 21) but slightly disturbs the intestinal peristalsis in the laboratory animal, but, if the abdomen be opened and the anesthesia be administered by the open method, which means stimulation of the respiratory center, increased rapidity of breathing, a rapid discharge of carbonic acid and lowering of the carbonic acid tension in the tissues, we find that the intestines are not moving. The exhalation of carbonic acid gas in the exposed peritoneal surfaces is 0.2 c.c. per square centimeter in the first half hour, and the intestinal musculature through systemic and local loss is quickly deprived of its normal tonic agent.

Anesthesia by the closed method, and curiously enough, the profession is coming back to it unconsciously through the application of towels to the gauzes used, means less carbonic acid is being lost in respiration because of some rebreathing. So, under these conditions, visceral tonus is longer maintained. Rarely(7) do we obtain shock, local or systemic, except through abdominal operations, and even then not to a great extent if there be no loss of blood a minimum amount of manipulation and no exposure of the intestine. Moist gauze packing with wide retraction favors carbonic acid elimination. It has been well said that the responsibility of the surgeon and anesthetist is co-equal in mortality and morbidity.

A study of the physiology of the body, particularly under stress, leads one to believe nature demands that each tissue perform other functions than those ordinarily considered normal, thereby developing a greater efficiency.

As we study now the different hypotheses presented and the observations noted, it will be seen that the early investigators had only such knowledge as would lead them to note the contents of the intestinal tract, which is a septic fluid containing active germs, and their explanations were natural. Malcolm, with his mind set on the vasomotor system, very properly exploited certain phenomena the result of continued overstimulation. Crile goes further. He is the first to enunciate the broad principle that every tissue of the body allies itself when some other part becomes war-like. He investigated and found that certain cerebral cells, the adrenal cells and the liver cells, act together; and together they become exhausted in the effort to maintain body tonus. The one tissue that had not

been investigated was left to Keith; through his researches we have, seemingly, a harmonious development of the entire pathology of the syndrome under discussion.

When a surgeon opens an abdomen he sees the intestines pale, gray, flattened, no vessels, and apparently no content. If he waits a while and does not touch but simply gazes at them, he will see vessels appear on the intestines and mesentery. Slowly the intestines change to a dark red color, gases form in the interior, and they become distended. As this proceeds, the intestinal coils fill, round out at the end, kink, and produce numerous imitations of "Vella's loops."⁽¹³⁾ Laboratory studies lead us to believe that into each intestinal loop fluid is transuded, germs become active and multiply rapidly. It is this bowel distension and the accompanying inactivity of the organ which cause the pain suffered later. A stethoscope applied to the abdomen after such an operation, fails to hear any tinkle, or evidence of intestinal life.

After an operation where we have had, as a result of exposure, carbonic acid loss and myenteric arrhythmia or block, vasomotor reflex, as well as stress affecting the brain and glandular organs, plus enteric infection, a composite picture will be produced which demonstrates that each observer found a truth but not the whole truth.

The epigrammatic Byron Robinson⁽¹⁴⁾ says, "the chief duty of a physician is to cure functions. A physician comprehending pathological physiology becomes master of suggestions for the patient's benefit." Through a thorough comprehension of the many factors entering into postoperative intestinal stasis are we better enabled to apply, in all sanity, methods of treatment for the relief of pain and return of the proper peristaltic waves.

As preventive, clinicians have discovered, and the laboratory has confirmed, the immense value of a preoperative injection of morphine-atropin. According to Crile⁽⁵⁾, morphine interferes with the oxidation of the Nissl substance and, to a considerable degree, prevents the animal's susceptibility to shock. According to Henderson⁽⁶⁾, also Higgins and Means⁽²³⁾, it maintains a better carbonic acid content in the blood. Miller⁽⁸⁾ claims that "a patient comes into the operating room more composed and tranquil, the induction period is shortened, excitement lessened, more perfect anesthesia obtained, with better relaxation and lessened secretion of mucus, and cardio-inhibitory shock prevented, although the effect is not altogether ideal."

As the reflexes in the abdomen are so ready and rapid, and the distal effect so great and permanent, operative procedure should be

as free from manipulation as conditions will allow. As hemorrhage lowers blood tension, and the effect of lowered blood tension is the production of chromatolysis, it should compel a bloodless surgery.

As the omentum is the only efficient intestinal protector(6), it is well it be kept over the intestines as far as possible. Any necessary packing should have it between the pack and the gut, the abdomen being gently raised as the packs are applied.

If the link in the chain given us by Henderson be correct, anesthesia should be ether by the closed method, although gas-oxygen may be preferable if the patient be kept pink. Postoperative treatment is as uncertain and as ineffective as that of any diseased condition, prevention being far better and more certain than efforts at cure.

Of the pharmaceuticals we have belladonna, eserine, and physostigmine. Belladonna has long ceased to be used. Eserine was exploited for a number of years, but we hear little of it now because its action is local. Metzler and Auer(10) say that physostigmine salicylate produces a marked but temporary increase of peristalsis in cases of reflex inhibition. Forchheimer(15) considers it a powerful stimulant of intestinal paralysis and claims it should be employed with extreme caution as it is apt to produce enterospasm and congestion of the gut. He expresses the same fears as to eserine. I have had no experience with hormonal, nor can I find sufficient literature that will allow me to exploit its advantages or defects. Pituitrine(22), acting on unstriated muscle, is most efficient, provided there are no great changes in the gut. We meet with failure in advanced complicated conditions. Very probably in minor conditions any one of these preparations may be followed by active peristalsis, discharge of gases, easement, and recovery.

But in the marked condition of meteorism where the stethoscope fails to get a tinkle, where the patient is miserable as well as the abdomen, where we know that Crile's chromatolysis may be proceeding, something which will meet *all* the indications presented in this paper should be employed, something which is on nature's lines and will aid her, some method of treatment, not overdisturbing to the patient, but productive of prompt relief of mind and body.

In 1900, Kemp(16) issued a little book on enteroclysis. It was published by an unimportant firm and had no general sale. His investigations have not been greatly exploited, but, for over ten years, I have been using in Christ Hospital the double current rectal irrigation as advised by him: If a normal saline solution, or plain water, enter the rectum at a temperature of 120° not as it is poured into

the bag(13) be passed into the rectum and out again for twenty or thirty minutes, a marked physiological stimulation and betterment of function will occur through the entire anatomy. The water should be flowing constantly, with occasional compression of the exit tube to better allow the large gut.

Cannon(11) tells us that fluids thrown into the rectum induce antiperistaltic waves, and are thereby carried to the cecum. Dabarn(19), while performing a laparotomy and using the Kemp's tube, saw the water reach the cecum. The position of the large gut is such that the hot water it contains will warm up and stimulate the circulation of the large sympathetic plexuses; so not only is the intestine cleansed, but, through physiological stimulation of the sympathetic, we obtain a reflex effect upon the small gut. Through its effect upon the gastro-intestinal tract there is relief of congestion and improved circulation in the stomach and duodenum, as well as in the intestines(20), and all internal organs are disencumbered.

At the end of twenty minutes the cutaneous reflex is felt, the skin warms and normal perspiration occurs. If continued for more than twenty minutes, the circulation in the kidneys is enhanced, diuresis being instituted. It is a well-known fact(15) that a warm, mildly perspiring skin soothes mental jactitation and anxieties and promotes slumber. Various methods have been tried by me from time to time, but my interns and nurses, who judge my work impartially, invariably fall back to the Kemp's tube.

Now that we have, apparently, the entire pathology of this syndrome, physiological deviations of each of the different tissues of the intestines being diagnosticated, a true remedy can be instituted. The double-current high rectal irrigation with water at 120° F. seems to meet every indication in an advancing case of tympany. All other methods of treatment, so far as I am able to judge, seem to touch the condition but superficially. What is worth doing at all is worth doing well and thoroughly. What we do should be based on most competent knowledge and stand the test of criticism as well as experience, and in my practice the double-current high rectal irrigation has given the greatest success.

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