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HISTORICAL SURVEY
OF THE
TREATMENT OF PERITONITIS.

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INTRODUCTION.

Modern surgery has known no greater problem than the successful management of acute inflammations of the peritoneum. No other disease that falls to the lot of the surgeon places so heavy a burden on his judgment nor is so dependant upon his management as this condition of the peritoneum. It was the fear of this dreaded condition that kept the surgeon out of the abdomen before the advent of bacteriology and its close associate--asepsis. Likewise, since the advent of aseptic technic, no tissue has been more maltreated or shown as little respect as the peritoneum.

The history of the literature bearing on the treatment of peritonitis is a long one, made up, as is the history of the treatment of most diseases, of a

vast number of irrelevant papers, many case reports of value in the final summation and a few path-forming papers. That there is no completely satisfactory treatment is evident by the fact that so many different methods have been propounded. It is the purpose of this paper to review the different procedures, to consider the underlying principles, and so far as is possible to show why they have remained or have been discarded from modern practices.

We define peritonitis as an inflammation of the peritoneum. This inflammation is the result of injury which may be bacterial, chemical, or mechanical. By far the largest number and most serious cases are those of bacterial origin. In the early literature we not infrequently see the term "idiopathic peritonitis". This term has long since disappeared from medical literature because it has been found that some definite cause for the condition is always present. The principles and mechanism underlying the etiology of peritonitis are well recognized and need not be considered here.

In this review I have attempted to deal only with general, suppurating peritonitis and not with the many special forms that are found. Likewise, I have not recounted in detail all the material covered since

many of the papers merely restated something that had already been said. Following the various procedures I have attempted to arrive at the most modern, and most widely accepted form of treatment in use at the present time.

ANATOMY AND PHYSIOLOGY.

Although a detailed discussion of the Anatomy and Physiology of the peritoneum is beyond the scope of this paper it seems adviseable to include a few gneral statements in this regard in order to form a background for the discussion of the treatment.

The peritoneum is the serous membrane which lines the abdominal cavity, and covers the organs contained in it. It also envelops the ligaments which project into the lumen of the abdomen and lines the depressions in which the organs lie. The peritoneum is divided into a parietal portion lining the wall of the abdomen, and a visceral portion covering the intraabdominal organs and their mesenteries. Roughly speaking the area covered by the peritoneum is approximately equal to that covered by the cutaneous surface. In tracing the peritoneum if we arbitrarily begin at the umbilicus and pass downward along the anterior abdominal wall the peritoneum is found to lie closely attached to the fascia of the transversalis and recti muscles. Near the pubis it is reflected over the bladder, passing

into the pouch of Douglas in the male but rising to cover the uterus in the female before descending into the cul-de-sac. From this point it ascends along the posterior wall of the pelvis, separated from the spinal column only by the great vessels and the areolar tissue surrounding them. Near the midline the peritoneum is reflected over the mesentery of the small intestine, passing upward over the transverse portion of the duodenum it is again reflected over the transverse mesocolon. From the transverse mesocolon it reflects over the stomach, having formed the great omentum, and reaches the under surface of the liver as far as the falciform ligaments. The stomach is further connected with the transverse colon by another reflection of peritoneum which then proceeds to the posterior body wall covering the duodenum and pancreas from which it is reflected onto the liver and back to the dorsal surface of the stomach. This forms the lesser peritoneal cavity which connects with the major peritoneal cavity through the Foramen of Winslow, bounded anteriorly by the right border of the hepato-duodenal ligament, posteriorly by the inferior vena cava, above by the caudate process of the liver and below by the duodenum. From the liver the peritoneum is reflected

onto the under surface of the diaphragm and thence down the anterior abdominal wall to the umbilicus. The peritoneum as it leaves the body wall to invest the various organs creates many folds and fossae, which although of importance to the Anatomist and to the Surgeon, and which may play a part in the walling off process in peritonitis, are not essential to a consideration of the treatment of peritonitis.

Histologically the peritoneum is generally conceded as being composed of a thin layer of connective tissue covered by a layer of simple squamous epithelium--the mesothelium. The mesothelial cells are continuous over the entire peritoneum and are connected by intercellular cement. The so-called "stomata" discovered by Von Recklinghausen (46) and which he considered to be openings into the lymphatic vessels were proven to be artifacts by MacCallum (46). The underlying connective tissue abounds with the free cells possessed by connective tissue in other parts of the body, namely the histiocytes, fibroblasts, polymorphonuclear leucocytes, lymphocytes, plasma cells, and mast cells.

In considering the physiology of the peritoneum one recalls how often the peritoneal cavity is referred to as a great "lymph sac". However, Sabin in her

classical study of the origin of the lymphatic system definitely concluded that it is a closed system and it is this concept that dominates the modern idea of the lymphatics (90). Hertzler (46) concluded that the main function of the peritoneum is to provide a surface which will permit the organs which it covers to move upon each other without friction. The prominent part the peritoneum plays in the protection of the organism against accidents to the intestinal tube is due to the facility with which it responds to injury due to its abundant circulation. With regard to the property of exudation there have been many theories. The most acceptable one is that of Starling (46) in which he considers the increased flow of fluid into the peritoneal cavity to be the result of increased permeability of the capillaries of the blood vascular system. How much the mesothelial cells contribute is problematical. As far as the absorption from the peritoneal cavity is concerned Poynter and Jefferson (52) concluded that two routes are mainly concerned. The lymphatic system which is that associated with the diaphragmatic lymph vessels draining into the anterior mediastinal lymph nodes and thence to the internal jugular or subclavian veins and which is

mainly concerned in the removal of particulate matter from the peritoneal cavity. The drainage through the thoracic duct is insignificant. The other route is the blood vascular channel through the omenta and mesogasters to the portal system via the superior and inferior mesenteric veins. This system is the one chiefly concerned in the removal of true solutions from the peritoneal cavity.

DISCUSSION.

The early writing along medical lines does not indicate that the ancients recognized peritonitis as a disease entity or as a complication of other abdominal conditions and consequently there is nothing to be found in the treatment of such conditions. It is certain, however, that peritonitis did exist in ancient Egypt since Prof E. Smith and Prof. W Jones in their "Archaeological Survey of Nubia" reported a case of adhesions due to old peritonitis (21). There is nothing in the Ebers papyrus on acute abdominal disorders, but in the fragmentary tablets of the library of Assur-Bani-Pal at Nineveh there are instructions for treating colic (21). In early mediaeval times there were no post-mortem examinations and symptoms were regarded as more important than signs, associated with this a great deal of mystery was attached to any sudden, severe, painful, and fatal illness, such as is seen in peritonitis, obstruction, appendicitis, or perforation. When such a victim was a person of importance rumors of foul play were usually current. This condition was spoken of as "iliac passion" which seems to be synonymous with our more modern term "acute abdomen". John of Gaddesden (21) in the Rosa Anglica, 1314

differentiates between iliac passion which is probably peritonitis, and colic passion which is probably intestinal obstruction. He speaks of the iliac passion as being accompanied by frequent vomiting, by hardness of the belly, and by extremely acute pain. The last mention of the iliac passion as such was made by Sydenham in 1788 (21). He says that the method of curing it has hitherto remained a secret and recommended that the salts of wormwood with a spoonful of lemon juice be taken morning and night and that in the intervals some spoonfuls of mint water by itself should be given twice every hour. "At the same time, I order a live puppy to be applied to the belly until the purgative is given two or three days afterwards".

Obviously the early treatment of peritonitis had to be medical since surgery had not progressed to the stage where the abdomen was entered intentionally. The generally accepted treatment for peritonitis at the beginning of the nineteenth century is well expressed by Benjamin Traves (21) who, writing in 1812 considered the best treatment to be absolute rest, purgatives--especially magnesium sulphate, abstention of food, cold applied to the abdomen, blood letting in acute cases, and opium very sparingly.

Peritonitis was first recognized as a disease entity in 1815 by the young French surgeon Bichat (92).

He insisted that in this condition the pathology was in the peritoneum itself in contradistinction to the commonly held view that all abdominal inflammations were infections of various organs. The possibility of an operative treatment now arose but progress was soon stopped by an unfortunate instance in which the surgeon Dupuytren was persuaded to operate upon an appendiceal abscess against his own judgment. The case died which confirmed Dupuytren in his opinion that an operation should not be done. Being the leading surgeon in France the operative treatment was set back at least 30 years because of his influence (21).

We see then that in the early part of the nineteenth century the treatment of peritonitis was for the most part supportive in nature. Smith (94) in reviewing the situation states that between 1840 and 1850 there were two main methods of treatment. One included the giving of saline cathartics, wet cups to the abdomen, and the use of small doses of opiates. The other treatment, the so-called Armstrong Method, was the commonly used venesection associated with the use of leeches applied to the abdomen. Needless to

say practically all patients died no matter which treatment was used.

It was at this time that Alonzo Clark introduced or rather popularized the opium treatment which was widely used for many years. S. Smith (94) was the resident physician at Bellevue in charge of Alonzo Clark's patients when this treatment was being instituted. Several outbreaks of Puerperal Sepsis had occurred at Bellevue in which the mortality had been practically 100%, the cause of death usually being a diffuse peritonitis. In 1851 when a similar outbreak occurred Smith was ordered to give tincture of opium until the respirations went down to twelve per minute. This time a large percentage of the victims recovered. The treatment was enthusiastically received and we find Smith in 1891 still strongly advocating its use. Enormous doses were used and we find that in the first case over one hundred grains of opium were used in the first twenty four hours. Haines (43), Meigs (71), and others reported beneficial results from the use of opium in large doses. Hertzler (46) in reviewing the use of opium states that probably very little of the opium was absorbed due to the associated ileus. It was maintained by the advocates of the opium treat-

ment that the beneficial results were due to the quieting effects caused by giving relief from pain, and the decreased intestinal movements preventing spread and absorption of the toxic material. Opposition soon grew up to this treatment and Price (85) stated, "The worst possible treatment for peritonitis is the use of opium." Likewise Baldy (50) and Burchard (18) condemn the use of opium. These men claimed that opium aggravates the ileus which is generally considered the main cause of death in peritonitis. Hertzler (46) made the interesting observation that in spite of enormous doses of opium these patients not infrequently continued to have regular bowel movements. This is interesting when compared with the more recent experimental work of Wilson (108) in which he showed that opium and morphine actually tend to increase peristalsis when associated with inflammation of the peritoneum. This would indicate that the second premise on which the use of opium was based is false and that the beneficial results were probably due to the prevention of exhaustion by relief of pain. In any case the present practice is to give morphine when needed for relief of pain post-operative in the treatment of peritonitis.

The use of cathartics in the treatment of peritonitis soon grew up as opposed to the opium treatment. Although calomel and magnesium sulphate had been used occasionally for sometime it remained for Lawson Tait to popularize the use of cathartics in 1873 (116). In delivering the Hastings Essay in that year he made the statement, "The administration of laxatives within a few hours after operation is becoming quite a common practice with me, this innovation in my opinion, being possibly conductive in some measure to my increased success." Tait held that the copious discharges that followed the use of cathartics created a flow of lymph into the intestines and thus eliminated a great deal of the toxic material in addition to counteracting the ileus. When first introduced the cathartic treatment was used without surgery however, as such it did not enjoy a long period of popularity but for many years continued to be widely used post-operatively to counteract the ileus. The statement has been made that the reason for Tait's early success with the cathartic treatment is to be explained by the fact that many of his cases were pelvic infections, particularly gonorrhoea which were relatively low in virulence. (116).

Shortly after the cathartic treatment was announced the operative treatment again became popular. Anesthetics it will be remembered were discovered in the 1840's but it was not until Pasteur and Lister had paved the way for asepsis that the surgeon again ventured to enter the abdomen. Mikulicz, an assistant of Billroth, in 1881 advocated opening the abdomen as soon as the condition was diagnosed. He also brought out the so-called toilette of the peritoneum using a 2% thymol solution in sponging the soiled intestines. He also favored the use of drainage tubes. In 1886 he remarked, "It has not yet the favour of the medical public accustomed to employ only medical means, but it has been followed by results so marvelous in the most desperate cases that one must consider it as the treatment of the future in peritonitis (21). Tait (104) likewise now advocated filling the abdomen with blood-warm water and washing all organs repeatedly until the water came off clear. However, in 1894 Schlange (11) stated, " I want to especially emphasize that laparotomy in the treatment of suppurative peritonitis should be rejected." Curtis (30), and Barwell (7) both advocated opening the abdomen, sponging, irrigating, and closing. Barwell emphasized the impossibility of draining the peritoneal cavity and reported a case which recovered

under the preceding regime. In 1886 J.E. Summers reported a case of peritonitis following herniotomy treated by irrigation of the abdominal cavity with 1-5000 bichloride of mercury solution through a ten inch metal tube passed up through the operative wound. After four days he changed to a 1% carbolic acid solution. Heat was used to the abdomen, and with morphine for pain and a milk diet the patient was able to go home on the fourteenth day. In 1892 McBurney presented a case to the Surgical Society of New York which recovered treated by incision, irrigation, and drainage. In the discussion following this paper there appeared considerable difference of opinion. Dr. Gerster recommended waiting in certain cases telling of two in which the abscess perforated through the rectum and the cases recovered. He considered this evidence that nature would take care of such conditions. Nicholas Senn (93) likewise advocated early operation even to the extent of evisceration in severe cases. As regards irrigation he took a neutral stand but did not believe in the use of antiseptic irrigants thinking that they were in part responsible for the toxic symptoms. He did not believe in the toilette of the peritoneum since he thought sponging was apt to injure the mesothelial cells.

Drainage he considered an unavoidable evil. Robson (87) reported a series of cases in which he got beneficial results by opening, sponging, applying iodoform and draining freely. Other surgeons went farther and advocated wide excision, complete evisceration, careful wiping of all the intestines that were contaminated with dry sponges and closure with drainage (31). With this latter treatment we marvel that any patients recovered.

The foregoing operative treatment in the best surgical hands still carried a mortality rate of 70%. In 1901 Ochsner reported a series of 565 cases which he had treated over a period of nine years with a mortality rate of only 50% using his famous "Ochsner Method." Ochsner (78) maintained that peristalsis was the chief means of spreading a localized peritonitis to other portions of the peritoneum. In cases of peritonitis that had been in progress over forty eight hours he recommended an expectant treatment, with the exception of a perforated peptic ulcer. He withheld all food and cathartics by mouth, practiced the use of frequent lavage for the fecal vomiting, gave predigested food per enema every four hours using four ounces at a time. He delayed operation until the patient was over the acute attack as evidenced by a lowering of pulse and

and temperature, or until a definite localized abscess could be detected. His main attempt was to prevent a local peritonitis from becoming generalized. This treatment was eagerly seized by the surgeons at this time but unfortunately others did not obtain the results that Ochsner had. There were two reasons for this; first Ochsner had a surgical judgment such as few other men of his day had and the decision as to the time to operate required more than the average surgeon possessed. Secondly general practitioners were misled into believing all cases of appendicitis should receive the expectant treatment. According to Powers (117) it was the misapplication of the Ochsner treatment that led many surgeons to reject it in the years to follow.

In 1904 Fowler (38) made a memorable contribution to the treatment of peritonitis. He advocated immediate operation, sponging with 1-3000 bichloride solution, flushing the peritoneal cavity with peroxide and bicarbonate of soda, drainage of the peritoneal cavity with a glass tube. Directly after the operation the patients head was elevated at least one foot, the knees were flexed and the patient held in such a position by a pillow tied under the buttocks. By this time

Fowler had realized that absorption from the peritoneal cavity was much less rapid from the pelvic portion and by his position hoped to cause a flow of the toxic material into the pelvis where it would be much better handled by the patient. Since his time there has been work to show that the position of the patient has nothing to do with the flow of the fluid in the peritoneal cavity (46), but nevertheless the patients were a great deal more comfortable in this position and it is still widely used today.

In the same year the famous John B. Murphy (74) reported two thousand cases of peritonitis. He advocated early operation, with no sponging or irrigation, closure with drainage, the "Fowler Position", and his own contribution, the use of the "Murphy Drip" method of giving fluid per rectum. He used normal salt solution and administered it by the drop method no faster than the patient could absorb it. Since dehydration was one of the most serious problems to consider in peritonitis we can see where the administration of fluids was a life saving procedure in many cases. Like the other procedures that have been able to stand the test of time it is still widely used today. Murphy likewise advocated the use of calomel and in 1906 (75)

added the use of antistreptococcus serum. Murphy had a great deal of influence and his method was widely used. In 1906 Le Conte(61) reported twenty nine cases treated by the Murphy method with one death, in general however, the results were not this good.

The work of Murphy practically ended the use of irrigation of the peritoneal cavity (46). Mikulicz (72) believed that mechanical cleansing of the peritoneum was useful and in addition thought that it tended to produce hyperleucocytosis. Blake (13) developed irrigation to the highest degree. He employed an irrigating tube through the abdominal incision coupled with a suction apparatus in the pelvis to remove the excess fluid. Reichel (46) was one of the first to oppose irrigation. He declared, "Spulerei ist eine Spielerei." It is quite obvious that irrigation tends to spread the infection into all parts of the peritoneal cavity. In removing the exudate from the peritoneal surface it probably does more harm than good. One has only to study a section of this exudate and note the large number of phagocytic cells with which are undoubtedly large numbers of antibodies to realize the protective possibilities of such an exudate. Hertzler (46)

sums the situation up by stating that there is only one condition in which irrigation seems rational. This is where large amounts of fluid containing foreign material such as might result from a perforated gastric ulcer has escaped into the general peritoneal cavity. Today most hospitals are equipped with efficient suction apparatus which removes the excessive fluid without injuring the peritoneum or spreading the infection. This method has largely replaced the irrigation process.

On the question of drainage of the peritoneal cavity volumes have been written both pro and con. Chassaignac (114) first used a rubber tube to drain the peritoneal cavity by the vaginal route in 1857. Primary drainage of the abdominal cavity was introduced by Koeberle in 1867 (114) using a glass drain tube. Capillary drainage was popularized in 1868 by Hegar. The attitude of the early surgeons in regard to drainage is well expressed by the words of Tait, "When in doubt drain." (46) It was soon evident that the gauze drain, which was used in the capillary drainage, became plugged with fibrin and acted as a plug rather than a drain. To overcome this Kehrer (46) introduced the cigarette drain which consisted of gauze enclosed in a rubber tube. This drain became exceedingly popular for

some time but according to Hertzler it is equal in efficiency to a sterilized corn cob, possessing all the disadvantages of both the rubber and gauze drains and the advantages of neither. In addition there is the tampon drain introduced by Mikulicz tending to encourage the formation of adhesions. It consists merely of a gauze pack. Penrose introduced the soft rubber tube drain which is probably the most widely used drain today in peritoneal surgery. (3).

Yates in 1905 reported his extensive studies on the use of drainage of the peritoneal cavity for which he was awarded the Senn Medal by the Surgical Section of the American Medical Association. He concluded that drainage of the peritoneal cavity was physically and physiologically impossible. Indeed he showed that it tended to produce a reverse flow of lymph from the local to the general peritoneal cavity. He showed that the drain tube became completely encapsulated by adhesions in a maximum time of six hours and that the secretion from the wound following this was merely wound secretion along the sinus and was caused by irritation due to the presence of the foreign body. He summarizes by stating, "Drainage must be local and unless there is something to be gained by rendering

an area extraperitoneal, or making a safe path of least resistance leading outside the body there is aside from hemostasis no justification for its use." (114)

Hertzler (46) brings out the dangers of drainage. By causing adhesions between coils of gut the drain may foster development of an intestinal obstruction. Drainage also tends to the formation of permanent adhesions and thus leave a permanent disability. Drains near a suture line excite a flow of serum away from the stitches and the healing is interfered with making the establishment of a fistula more liable. Solid drains near a vessel may erode through it causing secondary hemorrhage. Likewise erosion may cause the perforation of a hollow viscus. The loss of a drain tube by slipping into the peritoneal cavity is a serious danger but one that can be prevented by firmly attaching the portion outside the abdominal cavity to the dressings. Although advocated by such men as Fowler, Murphy, Crile, and Mayo a great deal against the use of drainage has appeared in the literature in the last twenty five years. In 1906 Hotchkiss (49) advocated drainage of only the extraperitoneal wound. In 1920 Carter (22) suggested that drainage be used only where urine, bile, or intestinal contents were

present; where there was a gangrenous area that could not be removed; where hemorrhage was apt to occur or where there was excessive bleeding. In 1931 Hall(44) was in favor of drainage only where there was a walled in abscess. The next year Grosshart (41) stated that drainage was definitely harmful and advocated closure without drains. On the other hand, as late as 1931 Ellars (37) stated that the most important instrument in the treatment of peritonitis was a glass drainage tube about 10 inches in length and $\frac{1}{2}$ inch in diameter and perforated in the lower three inches. This he introduced into the pelvis through a stab wound after operation and aspirated with suction every fifteen minutes for the first twenty four hours. This with the additions of the Fowler position, fluids intravenously and small frequent blood transfusions gave him good results.

What then is the present status of drainage in the treatment of peritonitis? In an attempt to ascertain this I consulted several members of the surgical staff of the University of Nebraska. In general I received four answers which I think is rather typical of the surgical profession as a whole. One surgeon said, "I always feel better if I have attempted to drain."

Another stated that he drained where there was an accumulation of frank pus, an area of necrotic tissue that could not be removed, or an oozing surface.

Others drain only the abdominal wound and there are those that do not believe in draining the peritoneal cavity at all in the management of acute, suppurative peritonitis believing that more harm than good is accomplished.

In 1912 Crile (29) reported 409 cases of appendicitis with or without peritonitis without a single death treated by his so-called "Associated Treatment." His treatment presents nothing new but is a combination of all the procedures that he has found best in the management of peritonitis. It includes early operation using nitrous oxide-oxygen anesthesia; accurate, clean cut operation to diminish infection and shock; adequate drainage; the Fowler Position; large hot packs over the entire abdomen; 5% saline with 5% glucose by rectum; primary lavage of the stomach repeated when indicated; 2500 cc. of saline subcutaneously every twenty four hours; morphine hypodermically to keep the respirations at about fourteen per minute. The term "Associated" means prevention of surgical shock and it is evident that this is what Crile is aiming at in his treatment.

We come now to a discussion of the introduction of so-called antiseptic drugs into the peritoneal cavity in the management of acute peritonitis. One of the first of these to be used was ether which was used by Waterhouse (46) as early as 1915. In 1923 Stieda reported twenty seven cases treated with 100 to 150 cc. of ether poured directly into the abdominal wound following operation with a mortality of 32%. (101). In the same year Caccini (19) reported favorable results from the use of ether and again in 1929 Wolfsohn advocated its use. The theory behind the use of ether was that in addition to being bacteriocidal it dissolved the lymph which with its toxic material was carried to the lungs where it was eliminated. Hertzler's studies (46) seemed to show that the only action of ether was to dissolve the cement between the mesothelial cells which in prolonged action became loosened with ecchymosis taking place. Likewise his clinical experience with the drug failed to show any beneficial results.

In 1927 the use of Mercurochrome 220 was advocated by R.T. Davis (34) introduced as a 5% solution. Of twenty one cases reported nineteen recovered. In the same year metaphen was reported by Spotts (96) to be

to be distinctly helpful, having used it only in one case however. The next year Rushmore (89) brought out the use of 25% glucose stating that it checked bacterial activity, prevented absorption by increasing exudation, and irrigated the tissues. Shortly Buchbinder and Heilman (17) reporting on the glucose treatment reported that in animals it produced a rapid spread of the infection usually resulting in a lethal outcome.

Trusler (105) in 1931 reported some experimental studies on the effect of amniotic fluid concentrate in the healing of the peritoneum. He thought that it accelerated the reaction of the peritoneum stimulating repair and minimized the formation of adhesions. He also concluded that it inhibited the development of fatal peritonitis but there was no evidence that it was of value in advanced cases. The amniotic fluid concentrate is widely used today in the prevention of adhesions in the peritoneal cavity but there is no evidence that it is of value in peritonitis.

In general with regard to the use of antiseptic solutions in the management of acute suppurative peritonitis it may be said that if there is ever a perfect antiseptic developed it will probably be distinctly

useful. However, the ordinary antiseptics are harmful to the mesothelial cells and the protective cells in the exudate and the retardation of their activity is more harmful than any good that might result from their bacteriocidal action. It is like the use of iodine on suppurating tissue--it merely adds insult to injury.

The management of the ileus in peritonitis is always one of the important considerations since it is generally conceded that it is one of the important factors in the cause of death. We have seen how Lawson Tait used saline cathartics in an attempt to get the bowels to move, likewise Murphy advocated calomel. Subsequently rectal tubes were used in an attempt to decrease the distention and bring back peristalsis. Another method of considerable prominence has been the use of the operation--enterostomy. It was first advocated by Heidenhain (51) in 1902. Lund in the next year advocated merely opening the intestines unburdening them and then closing them. (46) It was Bonney (47) who popularized the operation beginning in 1910. He advocated a jejunostomy in contradistinction to many others who advocated opening the intestine in a lower portion. Lane (60) was accustomed to bringin

out the first loop of intestine presenting itself and after opening it, he irrigated through the incision in the intestine. Caecostomy was advocated by Maer (108) and Hanley advocated attaching the ileum to the colon and placing a colon tube in the caecum thus producing a short cut through the intestines. This treatment was likewise advocated by Long (65) who added two successful cases to Hanley's five. It is obvious that this latter operation will entail a tremendous shock which a patient with peritonitis would find difficult to withstand. Macrae (69) strongly favored the use of an enterostomy tube stating, "I have long since discarded drainage of the peritoneal cavity substituting in its place drainage of the intestine itself thus reducing my mortality rate 50%". Summers (103) and Cantalamessa (20) also were in favor of the enterostomy. Clute (24) found that caesostomy and enterostomy were valueless but got good results from the use of jejunostomy. Orr and Haden found in a large number of experiments on dogs and in certain clinical cases that enterostomy was useless unless the peritonitis was low in the abdominal cavity. Hertzler (46) divides the ileus into two types: the first he calls the "dynamic type" in which

in which there is no peristalsis due to paralysis of the muscle by the toxic elements, in the other type, which he calls the "obstructive type" there is lack of peristalsis due to distention. He found that enterostomy failed to function unless peristalsis was present. Russel Best (10) likened the attempt to drain through an enterostomy tube to an attempt to drain a collapsed inner tube which was folded up in its box. He showed that the only area drained was the few inches on either side of the tube between the kinks in the bowel. Enterostomy has disappeared from the treatment of peritonitis although it is still used in obstruction.

Even Macrae, who was one of its strongest advocates, discontinued its use before his death. There are probably two reasons why enterostomy in peritonitis has disappeared: first the clinical results did not bear out the contention of its advocates, and second it contributed materially to the shock from which the patient was suffering.

Lately spinal anesthesia has been advocated by some in the treatment of paralytic ileus. Brown (115) reported three cases successfully treated by this method. The mechanism of action here is the paralysis of the sympathetic system which is the depressor

of the intestines. This leaves the parasympathetic system unbalanced and gives rise to an increase in intestinal movements. This is a method that gives promise and one which needs more trial before accepting or rejecting.

Strychnine, eserine, and pituitrin have all been tried but according to Babcock (3) these are all apt to be harmful. Parke, Davis and Co. have recently placed on the market a product called "Pitressin". This is an aqueous solution of the posterior lobe of the pituitary gland devoid of the oxytocic substance. (118) Given in $\frac{1}{2}$ to 1 c.c. doses every four hours it is supposed to have a remarkable effect in prevention and the treatment of paralytic ileus. The most successful treatment of the ileus at the present time seems to be the use of large, hot, wet packs applied to the entire abdomen, the use of a Levine tube with or without suction for fecal vomiting, restriction of everything by mouth, the use of a rectal tube, and the use of Pitressin as indicated.

In 1923 Costain (27) reported a case in which he had ligated the Thoracic duct in the neck in the presence of pneumococcal peritonitis with the patient

recovering. He believed that considerable of the drainage from the peritoneal cavity was through the Thoracic duct and likewise thought that the toxins from intestinal stasis was absorbed this way. Cooke (25) in 1925 reported four cases of peritonitis in which he had performed a lymphaticostomy, as the operation was now termed. Two recovered, one died on the seventeenth day, the other died of pulmonary embolism although he was apparently recovering from the peritonitis. Whiteford (107) thought that his patient was improved somewhat but suggested further trial before adding this operation to the treatment. Again in 1926 Costain reported twenty two cases of which he claimed to have saved 50% by lymphaticostomy. Lehman and Copher (63) did not observe that drainage of the thoracic duct exerted any favorable influence on the progress of the disease in dogs suffering from general peritonitis. McQuire (68) was unable to recover bacteria from the Thoracic duct following intraperitoneal injection of bacteria in dogs. Likewise the lymph collected from the duct did not seem toxic when injected into other animals. He was unable to notice any beneficial effect from the operation and further added that it probably did harm in robbing

the patient of valueable food material. The operation of lymphaticostomy did not enjoy wide acceptance for two reasons: first the drainage of the peritoneal cavity by the thoracic duct is insignificant as brought out in our discussion of the physiology of the peritoneum, therefore patients did not receive any relief from such an operation; in the second place the operation is a major procedure and one that not many surgeons would want to undertake in the face of a general peritonitis.

With the development of immunology the use of immune sera have come into prominence in the treatment of septic peritonitis. It is interesting to note that John B. Murphy added the use of anti-streptococcus serum to his method of treatment in 1906 apparently satisfied that it was of definite therapeutic value. Williams (110) came to the conclusion that a great deal of the intoxication in peritonitis was due to the development of B. Welchi in the stagnant contents of the small intestine. He reports a number of cases in which he has used the gas bacillus antitoxin with apparently very definite results. Bower and Clark (119) reported eleven cases of diffuse peritonitis. Five of these were operated upon and the gas bacillus serum used

post-operatively, of these two died. Six were placed upon the Ochsner treatment and the anti-toxin administered with no deaths. This series of cases is too small to draw any conclusions but there is apparently some benefit to be derived from such treatment in selected cases. Copher, Stone, and Hidreth (26) used the B. Welchi antitoxin in treating experimental peritonitis in animals and suggest that together with fluid therapy this treatment will be life saving in many cases.

Jern, Harvey, and Meloney (53) reported a large series of mice in which an experimental peritonitis had been produced of which they were able to save 50% by the use of B. Coli bacteriophage, in contradistinction to 100% mortality in the controls. There has been at least one case of chronic peritoneal infection in the University of Nebraska Hospital which has shown marked improvement after the administration of B. Coli bacteriophage. Steinbery and Goldblatt (99) have attempted to show a method of vaccinating for peritonitis. They inject thirty cubic centimeters of killed colon bacilli containing approximately 200,000,000 organisms twelve hours preceding any operation in which

there is apt to be contamination of the peritoneum from the bowel as in the case of gastro-enterostomy etc. They believe there are beneficial results to be derived from this treatment although they consider it contraindicated in already developed general peritonitis.

A great deal is appearing in the literature today, particularly from Italian sources, in regard to serum therapy. In general this work does not have the clinical background upon which to base any conclusions. There are two main difficulties in the use of immune sera: in the first place we are dealing with a multiple infection in peritonitis, and in the second place immune serum to be of any value must be given early in the progress of the disease and in this stage surgery has a great deal more to offer. Certain cases particularly of the virulent streptococcus type will be benefited particularly when used in conjunction with surgery. In any case it is a field that gives considerable promise at the present time.

Aside from the ileus the greatest problem that confronts the surgeon in peritonitis is the management of the intoxication. It was Murphy that first emphasize the value of giving fluids in this condition. He held that the dehydration associated with the septic condition

contributed to the acidosis and the intoxication. In peritonitis since frequently there is intestinal stasis it is all the more essential that elimination through the other routes be aided by the use of fluids. Murphy used the rectal route and administered normal saline. It has been held by some (12) that the administration of fluids per rectum adds to the intestinal unrest and tends to spread the infection. This is probably not the case when the drip method advocated by Murphy is used since the fluid is absorbed as rapidly as it is given.

Since the time of Murphy the subcutaneous route and the more rapid intravenous method of administering fluids have been developed. These methods have the advantage of more rapid absorption over the rectal route but care must be taken not to overload the heart by too rapid or too long continued administration, since it has been shown that edema of the lungs may result. With regard to the type of fluid given, Babcock recommends the use of either chlorides or glucose and suggests alternating the two. Glucose furnishes fuel for the body and saline provides the chlorides that are apt to be lost by vomiting. The important part in either case is to provide fluids that the

kidneys through increased activity may help eliminate the toxins.

With regard to anesthetics ether has for many years been the standby of the surgeon. Chloroform, because of the danger at the time of operation and particularly because of the possibility of late yellow atrophy of the liver, which is apt to follow its use in infected patients has long ago been discarded. Nitrous oxide does not give enough relaxation although it may be used in combination with ether. Local anesthesia followed by gas may be employed when a general anesthetic is contraindicated, however these patients are nervous and irritable and any attempt to infiltrate disturbs them. (46) Babcock is of the opinion that spinal anesthetic skilfully administered is the ideal anesthetic. It gives perfect relaxation, by causing contraction of the intestines necessitates minimal handling of them, and is not so apt to be followed by post-operative vomiting. Ether, he claims, causes parenchymatous changes in the organs and reduces their resistance to infection. However, he states that if ether gives better relaxation thus enabling the surgeon to do quicker and better work, with less traumatism of the tissues it should be preferred.

Hertzler (46) reviews the question of position of the patient post-operatively in a very complete manner. Originally the attempt was made to drain all cavities at the lowest point possible and with this in mind Kehrer proposed that the patients be placed in the ventral position. Likewise Coffey recommended the lateral position when the infection occupied the flanks. Fowler suggested elevating the head thinking that gravity would carry the toxic fluid away from the diaphragm where absorption took place most rapidly. Murphy advocated sitting the patient up in bed. Hertzler showed that gravity had nothing to do with the flow of fluid, this process being practically completely controlled by intra-abdominal pressure. He advocates the position of greatest comfort for the patient which is the logical conclusion. The Fowler position has remained with us mostly because the patients seem to be most comfortable in this position with less post-operative nausea and vomiting.

SUMMARY.

History has revealed some remarkable changes in the treatment of peritonitis. From no treatment at all we have seen how puppy dogs and leeches come to be used, venesection and other supportive measures marked the period before the recognition of peritonitis as a disease entity. With practically 100% mortality accompanying these procedures the medical profession seized with enthusiasm the opium treatment of Alonzo Clark. Then followed the cathartic treatment of Lawson Tait soon to be supplemented by operative procedures resulting from the development of anesthetics and the field of bacteriology and asepsis. Still the mortality rate remained at 70% and we see Ochsner introduce his waiting policy in cases that have progressed more than forty eight hours. The misapplication of his treatment by the general practitioners led to its rejection by the profession as a whole. From this time on refinements of the operative treatment hold a prominent place in the medical literature. The radical procedure of evisceration was developed soon to be dropped, irrigation of the general cavity was

advocated but the clinical results did not justify continuance of its use. Drainage was introduced, advocated by some, questioned by others, until today we find it occupying a questionable position. The introduction of Murphy's method of administering fluids and the Fowler position post-operatively were definite advances and for the most part remain today. The use of antiseptic fluids in the peritoneal cavity was soon rejected because more harm than good resulted. Comes the development and wide usage of the enterostomy operation in the management of the ileus with its rejection except in cases of obstruction. We see where the use of lymphaticostomy, based on a false conception and never widely used by the surgical profession, was soon discarded. Serum therapy has come into vogue and is still in the experimental use today. Of late years we see considerable in the literature in regard to the use of the modified Ochsner treatment in cases of peritonitis that have progressed over forty eight hours. It is possible that through the correct application of this treatment we are swinging back to the teachings of the great surgeon. In any case clinical results of this treatment in advanced cases of peritonitis justify its use.

What then have we left in the management of acute, suppurative lesions of the peritoneum? We may say that the treatment of peritonitis today represents the procedures that have proven themselves useful throughout the years of trial. We may summarize the most widely accepted treatment today under the following heads:

1. **PROPHYLACTIC TREATMENT:** By this I mean that conditions that may be complicated by peritonitis are so managed as to lead to their cure before the disaster develops. Gastric ulcers are so managed that they do not perforate, gall stones are removed in order to obviate a suppuration of the gall bladder, likewise appendices are removed before they rupture. Gonorrhoeal tubes are allowed to quiet down before being operated upon in order that infection shall not be spread by the manipulations of the surgeon. Even more important is the skilful removal of conditions which have already caused a local inflammatory process that the condition does not become generalized.

2. In cases where the generalized process has been in progress for forty eight hours or longer the modified Ochsner treatment is probably the method of choice.

Likewise it is the best treatment for the patient until the arrival of the surgeon.

3. ANESTHETIC: Ether or spinal anesthetic depending upon the patient and the preference of the individual surgeon.

4. Early operation removing the cause with the least possible manipulation. The words of Murphy are of value here. "Get in quickly, get out quicker."

5. No irrigation, depending upon suction to remove the exudate plus a minimal amount of sponging.

6. DRAINAGE: Drainage where there is frank pus, necrotic material that cannot be removed, or oozing surface. The Penrose drain is probably the best and should be gradually removed completing this process by the fifth or sixth day.

7. No antiseptic or irritating solution into the peritoneal cavity.

8. POST-OPERATIVE:

A. Following the operation the patient should be placed in the position of greatest comfort.

- B. Morphine when necessary to control the pain.
- C. The withholding of everything by mouth for a few hours, especially cathartics. After the first few hours, small, frequent sips of warm water, gradually increasing.
- D. The administration of glucose and saline, per rectum, subcutaneously, or intravenously. A minimum of 2000 c.c. per 24 hours.
- E. Large, hot, moist packs to the abdomen.
- F. The use of $\frac{1}{2}$ to 1 c.c. of "Pitressin" subcutaneously every four hours where distention develops or ileus is present at operation. The rectal tube may also be used.
- G. Gastric lavage in cases of persistent vomiting with the use of the Levine tube and intermittent suction.
- H. Low enema after the third or fourth day.
- I. Liquid diet as soon as the bowels begin to act, followed shortly by a soft diet.
- K. Small, frequent blood transfusions.

Under the foregoing treatment the mortality rate in peritonitis today remains at 30%.

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