THE TREATMENT OF GENERAL PERITONITIS FOLLOWING ACUTE APPENDICITIS.

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Acute appendicitis continues to cause too many deaths. Grey Turner, in a series of 2,391 cases, gives a total mortality of over 3 per cent. For cases complicated with flank or pelvic peritonitis, he gives a mortality of 8·9 per cent, while with diffuse peritonitis the figure rises to over 29 per cent. These figures are from his own practice; in less skilful hands they are undoubtedly much higher. Every effort should therefore be made to find some means of reducing this waste of life, so often in its prime. I propose to devote this paper to the treatment of the gravest complication of acute appendicitis, general peritonitis.

General peritonitis, the main cause of death in acute appendicitis, may kill either directly or by its sequelae, paralytic ileus and intestinal obstruction. Particularly in the very young and the old general peritonitis is apt to be a deadly complication.

Peritonitis results when the bacterial flora of the appendix pass through its devitalized wall to enter and proliferate in the peritoneal cavity. This may happen before the appendix perforates, in which case the peritonitis is early of onset and often generalized from the beginning. Fluid is poured out by the peritoneal cells and soon becomes purulent. Case 1 (see later) was an example of this type. More often, however, the gangrenous appendix becomes surrounded by omentum, the peritonitis remaining localized until perforation occurs, when it either becomes generalized or may be still partly localized to a flank or pelvic peritonitis. If the omentum manages to keep the infection localized to the vicinity of the appendix, an appendical abscess results. Although careful packing off of the abdomen will minimize it, spread of infection is inevitable at operation, after which the case must be regarded and treated as one of general peritonitis. An exception is the late appendical abscess already walled off and pointing, and opened only to admit a drain tube so that the infection does not spread. The point made though is important enough to be repeated: all cases of localized peritonitis with pus formation have become generalized as far as the spread of the organism is concerned by the end of the operation for appendicectomy, and must be treated accordingly.

The time after which general peritonitis follows appendicitis is very variable. In many mild cases resolution will occur without it ever following; others will remain localized until the abscess formed points. Then on the other hand there are those fulminating cases where general peritonitis comes
on very early. These, often very deceptive, constitute the danger of any delayed treatment in appendicitis. Usually, however, there is a respite of some hours during which the surgeon, if he sees the cases in time, can operate before the appendix has perforated.

The most important factor then in the prevention of peritonitis is immediate operation in all cases of appendicitis. Let the surgeon remember that it is highly probable that any abdominal pain persisting unabated for over four hours is surgical, and of itself an indication for exploratory laparotomy unless there is another very obvious cause. Let the non-surgeon remember that any pain in the mid or lower abdomen should be suspected as appendicitis until proved otherwise and referred for surgical opinion. If these rules are remembered, that repeated question, "Do you think it has burst, Doctor?" could be more reassuringly answered. Personally, I only consider one treatment for acute appendicitis, and that is operation as soon as the patient can be got to the theatre. The Ochsner-Sherren treatment, carried out in a ward next to the theatre by an experienced surgical team, may have minor advantages in carefully selected cases, but under ordinary circumstances it is asking for trouble.

And beware of the soft abdomen! Occasionally with well-advanced general peritonitis the rigidity may be surprisingly little. I am not likely to forget the first time I was caught over this. As a Resident Medical Officer at the Melbourne Hospital, I was once called up at 2.30 a.m. to see a man admitted as acute appendicitis. His pain had begun about four hours previously, but half an hour before had eased off considerably. His pulse and temperature were only slightly raised, and his abdomen, though tender over the appendix, was quite soft. I decided he could wait until the morning and put him down for 8.30 a.m. At operation his abdomen was full of pus he had had for hours. The easing-off of his pain was, of course, the result of gangrene and not improvement. He died of paralytic ileus about the sixth day. This lesson made all the difference to a case soon after I arrived in India. The surgical specialist asked me to look at a doubtful abdomen which he proposed to watch for a while. The case was almost identical, with just the slightest abdominal rigidity. I said I thought he had general peritonitis, and at operation half an hour later, his abdomen was full of yellow pus. He made an uneventful recovery. The "soft abdomen" case is very much of a snare for the unwary.

Now let us consider the problem of general peritonitis from the point of view of formulating a rational line of treatment. We have a small gangrenous hollow viscus lying within the peritoneal cavity, its lumen continuous with the bacteria-laden cæcum. Various organisms are liberated, coliforms, anaerobes, and streptococci being the commonest. On the defensive side we have the omentum trying to wrap itself round and localize the lesion and the defensive powers of the peritoneal cavity itself, than which no structure in the body is better capable of dealing with infection.
It was J. B. Murphy (of "Murphy's button" fame) who, at a British Medical Association meeting in Toronto some thirty-odd years ago, first described a rational treatment of general peritonitis, which was to change completely the prognosis in these cases. Briefly, his method was the adoption of Fowler's position, drainage of the pelvis and the continuous slow administration of normal saline per rectum (the "Murphy's drip" method). The point about drainage will be discussed later, but his results spoke for the great value of this revolution in treatment.

The rational sequence, then, for attacking the problem of general peritonitis may be summarized as follows: (1) Remove the source of infection, and do it in the minimum time possible; (2) remove as far as possible the debris of the fight (pus, etc.) found at operation; (3) then give the peritoneum its optimum chance of fighting the invading organism by putting the patient into Fowler's position and ensuring complete and absolute rest; (4) directly attack the invading organism by any specific means possible; (5) keep the patient supplied with the fluid and chlorides he badly needs, and carefully watch the general condition so as to be able to meet any special need which may arise. Remember circulatory failure is not necessarily fatal if treated promptly.

The Operation.—In every sense this must be an immediate operation. Every minute delayed increases the risk to the patient. I usually give an adult patient morphia ½ grain as soon as I have made the diagnosis. If the patient has to be moved any distance to hospital, or if there is likely to be any delay, it should be increased to 1 grain. Complete removal of the gangrenous appendix is essential, and offers the patient his best chance by far. It is much better to take a little longer and get the whole appendix out than to put in a drain tube and trust to luck. Luck is usually out in these cases and it is a confession of surgical failure. The time factor is most important, and not a minute should be wasted during the operation. As the removal of a deeply buried gangrenous appendix, surrounded by thickened omentum and adhesions, can be anything but easy, and must be performed very gently and carefully, this means that opening and closing the abdomen must be done with all possible speed so as to save the limited time for the actual handling of the appendix. Murphy's golden rule in these cases was "quick in and quicker out." It makes all the difference to the patient. I prefer the muscle-splitting incision except in odd cases where the diagnosis is doubtful. There is usually no point in trying to bury the appendical stump unless it can be easily done. It is often difficult to perform as the sutures cut out from the oedematous caecal wall and the attempt, which wastes a lot of valuable time, may do more harm than good. If tied off it can be safely left, and in the presence of general peritonitis is a mere drop in the ocean.

The peritoneal cavity should be sucked or mopped dry, not forgetting to swab down into the pelvis where the last of the fluid collects. Flushing out the peritoneal cavity has fallen into disfavour. It rarely does much
good, and in any case should never be done with anything stronger than normal saline.

The appendicectomy completed and the abdomen mopped dry, the peritoneum is then closed without drainage. The rest of the wound is washed, first with saline, then with flavine, and closed as quickly as possible with the minimum of sutures. I put a small glove drain down to the rectus sheath, as wound infection with such cases is the rule rather than the exception. An anchor dressing stops any tendency for the skin vessels to bleed and means that any but large vessels can be twisted off without tying.

Drainage of the peritoneal cavity is to be condemned. Although a minority of surgeons still favour it, it is an obsolescent form of treatment and usually serves no useful purpose. Once the focus of infection has been removed, the issue is now a battle between the pathogenic organisms free in the peritoneal cavity and the peritoneum. The striking ability of the peritoneum to deal with infection is well known. If the virulence of the organism is so overwhelming that the resistance of the peritoneum is overcome, no number of drain tubes will save the patient. If, on the other hand, the peritoneum is capable of dealing with the infection once the focus is removed, a drain tube is unnecessary and only does harm. In any case the tube, itself an irritant, tends to be quickly shut off with omentum so as to become ineffective. It then only serves as a path for more infection from outside.

Without drainage the peritoneum can usually manage to overcome the infection and the purulent peritoneal fluid is absorbed. Less often a localized abscess is formed which, with the patient in Fowler's position, collects in the pelvis, where it can be later opened through the rectum or vagina.

Drainage, therefore, is indicated only in two circumstances:

(1) If for some reason the surgeon is unable to remove the appendix or the patient is too desperately ill to stand anything but the most rapid operation, a tube to the appendix through a stab in the loin offers the only hope.

(2) In the cases of appendical abscess seen late, where the abscess has already started to point through the abdominal wall, a drain tube, introduced through a small slit incision with the minimum interference, is the best treatment. The appendix can be removed six months later.

The abdominal wall, however, should always be drained. It helps to prevent wound infection.

The patient is returned to bed with the usual hot bottles, etc. He should be laid flat and not put into Fowler's position until well out of his anaesthetic. At least two pints of saline should be given immediately while he is still unconscious, either rectally or better subpectorally. When consciousness returns, the patient should be put into high Fowler's position, given continuous rectal saline by the drip method, and the morphia treatment begun.
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The Morphia Treatment.—Morphia is a life-saving drug in general peritonitis. The object of the treatment is to morphinize completely the patient and keep him so until his peritonitis has subsided. As previously stated the issue, once the gangrenous focus has been removed, is that of a battle between pathogenic organisms in the peritoneal cavity and the lining cells of the peritoneum. In order to give the peritoneum its maximum advantage in this fight, complete rest, both of the bowel and the body generally is essential. Morphia alone can do this. With it, pain is almost absent and the patient dozes most of the time. The restless tossing of a pain-wracked patient, unable to sleep, which does so much to exhaust and kill, is thus eliminated to the benefit both of the patient and his attendants. In Case 6 morphia was stopped against my orders. He collapsed after a very restless night. The properly morphinized patient has contracted pupils and respirations reduced to 10 to 14 per minute. The dose should be arranged so that he is never in pain but dozes all day, though answers questions readily when roused.

I have found an amazing prejudice against giving morphia like this. After the first day the nursing staff usually weaken and want it stopped. If matron does not attempt to, the night sister is sure to try. The usual excuse is “He seemed so comfortable that I did not give it,” or “He was asleep at the time for his injection.” I think they suspect me of attempting euthanasia.

The best way to ensure that the patient receives his morphia is to have a special chart drawn up and each dose initialled as it is given.

Morphia 1/4 grain every four hours is usually sufficient for an adult patient, though more may be needed for a start. Later it may be possible to reduce the dose. It should be given day and night irrespective of whether the patient is awake or asleep. Morphia is stopped as soon as there is no evidence of peritonitis, usually by the third or fourth day. There is no danger of habit-formation under these circumstances.

Drug Treatment.—The introduction of the sulphanilamide group of drugs gives a new weapon worth trying in these cases. As streptococci and coliforms are common invading organisms in peritonitis, the inhibitory action of these drugs on such organisms may be a valuable aid to the patient’s defence. Sulphanilamide appeared to help Cases 4 and 5. I propose to use these drugs in full doses in future.

Serum Treatment.—Hamilton Bailey advises injecting antigas-gangrene serum into the abdominal cavity before the peritoneum is closed. I did this in Cases 4 and 5. It is worth trying and certainly does no harm.

Feeding the Patient.—Until the peritonitis has subsided and the bowels open, no solid food should be given. 10 per cent glucose, solution flavoured with lemon or orange juice, and broth alone are given, as much as the patient can take.

Dangers after Operation.—The two main dangers to be watched for are early circulatory failure within the first few days and paralytic ileus.
Patients with general peritonitis, specially old or very young patients, are liable to sudden collapse. Pain and restlessness (see Case 6) are important factors in bringing this on; hence the value of morphia. The pulse becomes rapid and almost imperceptible at the wrist, the extremities become cold and the respirations short and rapid, the clinical picture closely resembling shock, a form of which it is. The treatment, which must be prompt if the patient is to be saved, is that for shock. If left in Fowler's position he will die. He must be laid flat and the foot of the bed raised on blocks. The risk of subphrenic collection has to be taken—better a subphrenic abscess to deal with later than a dead patient. He is packed with hot bottles or an electric cradle and given continuous slow intravenous saline.

Coramine in repeated doses is useful. The patient usually responds fairly rapidly to this treatment but should not be put back into Fowler's position until twenty-four hours later, though it is unnecessary to keep the foot of the bed raised once the pulse recovers. Case 3 responded dramatically to this treatment. In Case 6 it was not given until too late.

Paralytic ileus is the greatest danger following peritonitis. It usually occurs on the third day. The picture is a combination of intestinal obstruction and toxæmia. The abdomen becomes distended and silent, and an enema produces little or no result. Vomiting begins, typically a dirty brown fluid, though rarely truly fecal. The pulse-rate rises and its tension falls. Respirations increase and the extremities become cold, often clammy. There is restlessness and thirst and a dry brown tongue.

Here again America has given us a method of treatment which has entirely changed the prognosis in these cases. Wangenstein in 1933 published an account of a treatment he had evolved which, like Murphy's contribution thirty years earlier, has saved many lives. Briefly, it consists of continuously draining the upper part of the alimentary canal by a duodenal tube, at the same time replacing the fluid lost by continuous slow intravenous infusion of normal saline. This continues until the bowel regains its tone; it may take hours, it may take days. The patient lies flat on his back in bed but is allowed two pillows. A soft duodenal tube with several lateral openings is passed into the stomach via the nostril and the stomach contents aspirated. The tube can be allowed to pass on into the duodenum or else just remain in the stomach according to the length. It is strapped to the face and aspiration is carried out at hourly intervals. An excellent aspirator is the large bottle and suction syringe used for aspirating pleural effusions. After each aspiration the patient is allowed a little glucose lemon drink or broth, but no solid fluid. The slow intravenous saline is best given via a vein at the ankle. Under this treatment the vomiting ceases and the distension soon becomes less. The tube is left in until the bowels open, which may take days.

The fluid output (vomit, urine, etc.) is carefully charted, and the saline given intravenously is graded so as to more than balance this. The rapid improvement in the patient's circulation usual in such cases is due to this
restoring of the body fluid and chlorides. If severe circulatory collapse occurs during the treatment, the addition of a drug such as neo-synephrin (Stearns) to the infusion of saline may be life-saving.

Less serious and much more common is distension prior to the bowels opening. Provided there is no distension, I never worry unduly about a bowel action, though I must confess I am happier when they have acted. When distension begins, however, it is time to get the bowels open or the case may pass on to paralytic ileus. An enema and large fomentations to the abdomen are usually effective. In one case (Case 3), when paralytic ileus was impending, hourly injections of 0·1 gramme acetylcholine bromide (a parasympathetic stimulant) combined with a rectal tube produced first flatus then a bowel action after three hours.

Two other complications must be mentioned in conclusion. Pelvic abscess, indicated by a swinging temperature after the first week, is not serious and can be opened rectally or vaginally after fourteen days. Subphrenic abscess is not common after appendicitis. It is difficult to diagnose and should be suspected in the presence of a swinging temperature with no other obvious cause. X-ray and an exploratory needle through the diaphragm will confirm the diagnosis. It is best drained by the transpleural approach through the diaphragm.

CASE REPORTS.

Case 1.—B. T., girl, aged 14. History of abdominal pain for five hours, first umbilical then settling in right iliac fossa. Nausea but no vomiting. Pulse 80, temperature 100° F. Marked tenderness and hyperesthesia over appendix but only slight rigidity. At operation free non-purulent fluid was present in abdominal cavity and a thickened appendix becoming gangrenous was removed. Closed without drainage and she was put on morphia which was discontinued the next day. Her recovery was uneventful and she was allowed up on the seventh day. This case was caught in the very early stage of general peritonitis, before the peritoneal fluid had become purulent. The appendix had not perforated.

Case 2.—W. H., male, aged 22. History of acute abdominal pain for twenty-four hours, at first umbilical then settling in right iliac fossa. Nausea and vomiting. Had taken castor oil and had a bowel action. Pulse 96, Temperature 100·2° F. Rigidity and tenderness of lower abdomen maximal over right iliac fossa. No hyperesthesia. At operation a gangrenous retrocecal appendix was removed. It had perforated at the base over a fecolith. Pus was present in right iliac fossa and pelvis, which was swabbed dry. Abdomen was closed without drainage and the patient put into full Fowler's position (after his return to consciousness) and given continuous rectal saline. Morphia ½ grain was given four-hourly until the fourth day. The temperature was down by fifth day and further convalescence was uneventful.

Case 3.—I. R., girl, aged 8. History of abdominal pain for three days.
Vomited at onset. Temperature 101° F., pulse 120. Marked tenderness in right iliac fossa but no true rigidity. At operation (a right paramedian incision was used in this case) a perforated gangrenous appendix was found in the retrocolic position, with a localized collection of foul-smelling pus. This was mopped dry and the appendix removed. A drain tube was put from the rectocæal space through a stab in the flank, because I was doubtful about some of the adjacent omentum. It served no useful purpose and was removed the next day. The abdomen was closed and the patient put on morphia ½ grain every four hours and into Fowler’s position on recovery from the anaesthetic. Fourteen hours later I was called urgently to find her collapsed and shocked, with a scarcely palpable pulse. After prompt restorative measures (raising foot of bed, hot bottles, rectal saline) she improved considerably, and by next day was fit to put back into Fowler’s position. Two days later she developed abdominal distension with no result from enemas. 0·1 gramme acetylcholine bromide was injected and repeated at hourly intervals. After an hour she passed flatus through a rectal tube, and after three hours her bowels opened. Subsequent convalescence was uneventful, except for some minor wound infection.

Case 4.—P. B., girl, aged 10. History of severe, mid-line, lower abdominal pain for nine hours. She had been given castor oil, but had vomited it. Her mother, of low mentality, had made her walk a quarter of a mile to my Medical Inspection Room, and thought she had something wrong with her hip because she limped! She had generalized abdominal rigidity maximal over the right iliac fossa, where there was special tenderness. Temperature 100° F., pulse 88.

At operation the abdominal cavity was full of semipurulent fluid. A gangrenous perforated appendix was removed. The abdomen was mopped dry and closed without drainage, leaving behind 10 c.c. anti-Welchii serum. 5 c.c. of soluseptasine was given intramuscularly and morphia ½ grain every six hours (she had morphia ½ grain prior to operation). Rectal saline was begun and she was put in the high Fowler’s position. By the third day she was much better, with her morning temperature down and her abdomen quite soft. Morphia was stopped. Castor oil that evening produced a bowel action. Her subsequent convalescence was complicated only by a wound infection in the second week.

Case 5.—H. L., Sepoy, aged 30. Gave a history of abdominal pain of sixty hours’ duration (his medical attendant thought he had malaria). He had generalized abdominal tenderness and rigidity maximum over right iliac fossa. Temperature 103° F., pulse 106.

At operation a foul-smelling general peritonitis was present, the smell suggesting B. coli. In the darkish peritoneal fluid floated flakes of lymph and sloughed appendix. The bowel was red and acutely inflamed. His appendix, which was gangrenous to the base and partly sloughed away, was removed, the abdomen mopped dry and closed without drainage, leaving behind 20 c.c. antigas-gangrene serum. He was given continuous rectal
saline, morphia $\frac{1}{4}$ grain every four hours, and 5 c.c. prontosil soluble three times daily. By the third day his abdomen was soft and he was taking fluids by mouth freely. His bowels opened on the fifth day following calomel on the night before and morphia was discontinued. He now developed a foul wound infection with evening temperature. By the fourteenth day his wound was clean, but he still ran an evening temperature. At this stage jaundice of his conjunctivae was noticed. He died of suppurative pylephlebitis of the liver just six weeks after the operation. Sulphanilamide had no effect.

Case 6.—Hindu boy, aged 12. History of five days' abdominal pain and vomiting. He was brought to hospital because of his leg, being unable to extend his right thigh for abdominal pain. He had marked abdominal tenderness and rigidity, maximum over right iliac fossa. Temperature 103° F., pulse 100. There was a retrocaecal gangrenous appendix, and a large collection of foul-smelling pus localized in the iliac fossa and pelvis. Appendix was removed, pus swabbed out, and the abdomen closed without drainage. He was put on morphia $\frac{1}{8}$ grain every four hours, rectal saline and prontosil (two tablets three times a day). The next day his condition was good. I arrived on the morning of the third day to find a cold, pulseless, moribund boy still propped up in Fowler's position. They told me he had collapsed four hours previously after a restless night, but they had done nothing about it. Morphia had been discontinued the day before against my orders. I gave him full treatment for shock immediately, but he died two hours after. His blood Wassermann, taken by the Indian house surgeon for some reason known best to himself, was returned strongly positive.

**Comments on Cases.**

Of the six cases, five recovered from their peritonitis. Case 5 died later, but not of peritonitis. Case 6 was in some respects not a fair test, as the morphia treatment was discontinued against my orders, and no attempt was made to treat his collapse until too late. His chances were not improved by the fact that he was syphilitic. They all illustrate the danger of delay in surgical treatment.

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