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## Original Articles.

### PERITONEAL SALINE INFUSIONS IN ABDOMINAL OPERATIONS.

A COMBINED CLINICAL AND LABORATORY STUDY OF  
THEIR EFFECTS.\*

JOHN G. CLARK, M.D.

Professor of Gynecology in the University of Pennsylvania,  
AND

CHARLES C. NORRIS, M.D.

Instructor in Gynecology in the University of Pennsylvania.  
PHILADELPHIA.

(From the William Pepper Laboratory of Clinical Medicine, Phoebe  
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At the St. Paul session of the American Medical Association we presented a paper<sup>1</sup> on "The Practical Application in Abdominal Surgery of Scientific Investigations Concerning the Function, Anatomy and Pathology of the Peritoneum," in which the employment of infusions of normal saline solution into the peritoneal cavity after all abdominal operations was advocated. The theory as to its value was based on the proved physiologic fact that there are well-defined currents which waft minute bodies from the lower or more dependent part of the peritoneal cavity toward the diaphragm, through which they gain entrance into the retroperitoneal lymph channels, and thence into the general blood channels. Our experimental work, at that time, had been confined solely to tracing the course of minute innocuous granules, such as India ink and carmine, from the peritoneal cavity into their more remote places of lodgment. This series of experiments unquestionably demonstrated that any foreign material in a finely divided granular state will be transported quickly from the peritoneal cavity; and in some instances, within eight hours, these minute bodies were found deposited in the marrow of the long bones, such as the femur and humerus. They were likewise found in the kidneys, liver, lungs, intestines, and even in the gall bladder in considerable numbers. From these observations we reached the conclusion that not only the kidneys, but likewise the liver, intestines, and even the lungs participated in the elimination of these granules. The employment of saline infusions in the peritoneal cavity is not a novel suggestion, but has been the subject of many active discussions, for it has been earnestly advocated by some surgeons and strongly deprecated by others. From the clinical standpoint we have very closely studied this question for the last five years, and have every reason to extend rather than to limit its employment.

In presenting the results of our experiments at the St. Paul session we recognized discrepancies in our own work, in that we had not yet had sufficient time to carry out, with lethal micro-organisms, experiments analogous to those which we had conducted with innocuous foreign particles. It is the object of this paper to detail the experimental work conducted along the latter line.

Certain general principles which have been established by the combined work of many observers are worthy of restatement before we take up the review of our laboratory and clinical observations. When infectious micro-organisms are introduced into the peritoneal cavity, the lymph and leucocytes which are normally present as a circulating peritoneal medium at once assume a combative rôle. An immediate increase of leucocytes is noted (temporary leucocytosis); but after a few minutes these are transported into the general lymph paths and for a short space of time there is a marked deficiency of leucocytes (leucopenia). Then an exaggerated peritoneal leucocytosis is noted, the intensity of which is in direct proportion to the degree of the irritation. Thus a very irritating fluid, such as turpentine or glycerin, may give rise to so profuse an exudation of serum and escape of leucocytes from the blood vessels into the peritoneal cavity as to actually cause the animal's death through excessive depletion.

In experimental infections of the peritoneum, the index of lethality may be judged by the varying degrees of leucocytosis. Thus an excessive degree of leucocytosis followed by a rapid decrease with increasing gravity of symptoms indicates that the toxicity of the micro-organisms has overcome all phagocytosis or germicidal action of the blood serum, and that there will be a fatal result. Not only on the quick delivery into the peritoneal cavity of serum and leucocytes, but also on their rapid exit depends the safety of the patient in the first stages of peritoneal infection. There are no blood vessels within the body capable of such quick action in this physiologic function as those circulating in the omentum, which hangs as a movable, dependent apron over the intestines. Ramifying in all directions throughout this apron are widespread capillary anastomoses of extremely thin-walled vessels, which provide the best anatomic conditions for the rapid escape of leucocytes and serum into the peritoneal cavity.

If there is this excessive peritoneal leucocytosis after an infection, or from traumatic or chemical irritation within the abdominal cavity, the blood examination after an abdominal operation should serve as an indicator of this phenomenon. Already clinical observations have proved the constancy of the increased leucocytosis after even a minor abdominal operation. A very careful and systematic series of observations has been made

\* Read at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Obstetrics and Diseases of Women, and approved for publication by the Executive Committee: Drs. A. Palmer Dudley, H. P. Newman and J. H. Carstens.

1. THE JOURNAL A. M. A., Aug. 10, 1901, p. 360.

by C. Y. White in the gynecologic wards of the University Hospital. White has stated his conclusions as follows:<sup>2</sup>

**Postoperative Leucocytosis.**—The cause of increase of leucocytes after operation must be due to a number of factors, and first among these is the effect of ether. Lerber, Schultz and Chadbourne found this increase to commence within a few minutes after the anesthetic was given, to increase for several hours, and then to decrease until it reached normal limits, usually in two days. I have found this in four cases of pure etherization, and from this I conclude, as did Chadbourne, that the increase does not seem to depend on the duration of the anesthesia, but on the way the organism reacts to the drug. Besides ether, such factors as the incision into the abdominal wall, hemorrhage, the operative traumatism to the delicate structures within the peritoneum and the breaking up of adhesions, certainly play a part in the causation of this leucocytosis. It is impossible to exclude any one of these causes; taken collectively they produce the postoperative leucocytosis. This was constantly seen in my cases. The highest count was reckoned within five hours after the operation, excepting in severe cases where glass drains were used (in these cases it was about thirty hours) and tended to fall to within normal limits in five days, excepting again in the cases where the glass drain was employed. In these cases it occurred several days later. A. E. Taylor has kindly given me the counts of twenty-two unpublished cases of celiotomies, in which he found similar results. The postoperative leucocytosis in Taylor's series averaged 19,500 cells; in my series 20,975.

From this study of White's summary, it will be noted that after every abdominal operation there is a marked rise in the leucocyte count, the cause of which is attributed by White to many different factors. One point which is especially noteworthy is that in cases in which the glass drain was used the leucocytosis persisted a greater number of days than in those cases in which the abdomen was closed without drainage. We believe that this persistent increased leucocytosis is due to the longer continued peritoneal irritation in the vicinity of the drainage tracts.

With White's study as a basis for comparison we have made a few observations relative to postoperative leucocytosis in cases in which the saline infusions have been used. As yet, however, the number of cases have not been sufficiently extensive to warrant us in drawing well-defined conclusions, and we can only state that when normal salt solution has been used, leucocytosis has been somewhat greater during the first twenty-four to thirty-six hours after the operation. As yet we attach no especial importance to these observations farther than to recall the well-demonstrated fact that even the light flushing of the peritoneal cavity with hot salt solution in animals will invariably produce a general leucocytosis. According to our observations, an early leucocytosis in these cases is invariable, and the greater the leucocytosis, the more quickly will the peritoneal irritation or infection be subdued, unless it is so lethal as to overcome every combative force of the human economy, as is seen in some very lethal cases of streptococcic infection. As a general working law, we would say that the greater the leucocytosis within twenty-four to thirty-six hours after the operation, the more likely is the infection to be overcome.

In beginning our study of the action of the peritoneum with and without the presence of the saline infusions, our first endeavor was to procure unquestionably virulent organisms, for, as is well known, the degree of toxicity of all micro-organisms has a wide range under varying conditions; thus the most active streptococcus by suc-

cessive cultivations may be rendered almost innocuous. While the streptococcus is usually considered the most dangerous of all micro-organisms with which we meet in surgery, we have employed a special genus of *Staphylococcus aureus*, which is even more virulent in its action. Accidentally, in the conduct of a special research by Dr. A. C. Abbott in the Laboratory of Hygiene, this organism was recovered from an acute abscess in a rabbit; its virulence was so intense as to make it difficult to find the minimum lethal dose. One-tenth of a cubic centimeter of cloudy bouillon culture injected into the ear vein of a rabbit caused in a very short time exaggerated toxic symptoms and death. One cubic centimeter introduced into the peritoneal cavity of a rabbit likewise produced the most excessive toxic symptoms, followed quickly by death. By a graduated reduction of the dose we found that one-half a cubic centimeter would invariably cause death, while with smaller amounts some of the animals would survive. In our experiments, two animals, approximately of the same size and general health, were selected. They were anesthetized, the abdomen was prepared for an abdominal operation, and a canula was introduced into the peritoneal cavity without injury to the intestines. In one of the animals one-half a cubic centimeter of bouillon culture was introduced and the wound closed by a sealed dressing. In the other animal, after the same amount of bouillon culture had been introduced, 100 cubic centimeters of normal salt solution at 110° C. were injected through the same canula. The following report of the experiments, as conducted by Dr. Norris, gives an epitomized account of the result and according to our view demonstrates without doubt that the saline infusions acted in a most beneficial way, for by this means 44 per cent. of the infected animals in which it was used were saved, whereas every control animal died.

#### BACTERIOLOGIC REPORT.

In these experiments there were 25 test animals, and a control animal was used for the first eleven injections. The next 13 animals were injected in rapid succession. No control animal was used; but with the twenty-fifth animal, fearing that the stock culture might have decreased somewhat in virulence, another control animal was injected with the same lethal result. Of the 12 control animals employed, all died, the average length of life being a little over thirteen hours (13 1/13). Of the 25 test animals (those in which salt solution was used together with the micro-organisms) 11 are living and well (44 per cent.). The average length of life of the test animals that died was 83 hours, as against 13 1/13 hours in the control animals.

In most of the cases the injected micro-organism was recovered from the majority of the organs. At the beginning of these experiments 1 c.c. of the forty-eight hour cloudy culture was used. This was found to be too lethal in its action, and it was reduced to .75 c.c. This dose was also excessive, and for the last eighteen animals, .5 c.c. was injected, the dose of the control animal being the same as that of the test animal.

#### COMPOSITE TABLES SHOWING THE NUMBER OF TIMES THE INJECTED MICRO-ORGANISM WAS RECOVERED FROM THE DIFFERENT ORGANS.

TEST ANIMALS—11 RABBITS.		CONTROL ANIMALS—12 RABBITS.	
	Times.		Times.
Peritoneum	10	Peritoneum	12
Spleen	10	Spleen	11
Liver	9	Liver	12
Kidney	8	Kidney	6
Gall bladder	2	Gall bladder	2
Lungs	8	Lungs	4
Heart's blood	8	Heart's blood	7

2. University Medical Magazine, June, 1900.

One case of obstruction and two of empyema were omitted from this table, as in the two latter animals infection had probably occurred previous to operation; in the obstruction case, cultures were sterile. In every case the autopsy was made as soon as possible after the death of the animal, usually within two to five hours.

A stock culture of the micro-organism (*Staphylococcus pyogenes aureus*, described above) was made and used throughout; this culture was plated from time to time, to insure freedom from mixed infection. The method of preparing a culture was as follows: Two test-tubes containing sterile bouillon were inoculated from the stock culture. These were placed in the incubator for forty-eight hours, by which time the culture would be decidedly cloudy. In all cases in which a pair of rabbits (one test and one control) was used, an effort was made to procure animals as near the same weight as possible. Only healthy looking rabbits were selected. Ether was administered at each injection, so as to simulate, as much as possible, an actual operation and also to prevent any unnecessary suffering of the animal.

**Method of Operation.**—The lower part of the abdomen was shaved and cleaned with green soap, alcohol, ether and bichlorid of mercury solution. The syringe and needle were boiled and cooled in sterile water. The amount of culture to be injected was measured in a sterile pipette, diluted with 4 c.c. of water, and injected into the peritoneal cavity, care being taken not to wound the intestines, omentum or other organs. In cases in which the salt solution was used, 100 c.c. were introduced through the same canula. A collodion dressing was applied over the seat of the puncture. The animals were carefully marked and placed in large boxes, with plenty of fresh food and water and the greatest care was observed to make the animals as comfortable as possible after the operation.

#### SUMMARY OF POSTMORTEM FINDINGS.

The following diagnoses were made at autopsy on the test animals:

- R. 2. S. Early fibropurulent peritonitis, mixed infection.
- R. 3. S. Fibrinous peritonitis, mixed infection.
- R. 5. S. Obstruction of large intestine. Localized abscess in abdominal wall, walled off from peritoneum.
- R. 6. Toxemia.
- R. 7. General infection. Pneumonia, abscess in both kidneys, general purulent peritonitis.
- R. 9. Pneumonia (double); possible fibrinous peritonitis.
- R. 12. General fibropurulent peritonitis.
- R. 15. Toxemia.
- R. 16. General fibropurulent peritonitis, mixed infection.
- R. 18. General infection?
- R. 19. General purulent peritonitis.
- R. 20. Right-sided empyema.
- R. 21. Similar to 20.
- R. 22. Fibropurulent peritonitis.

Microscopic preparations were made from the different organs. Cloudy swelling was almost invariably found in the liver, spleen and kidney; in general, however, this was not marked. The lungs were usually congested, and it was not uncommon to find red blood corpuscles in the alveolar spaces. In some instances, micro-organisms were found in the stained tissue.

From this review of our experimental work the evidence is conclusive that a large percentage of the animals in which the normal salt solution was injected immediately after the bouillon culture of *Staphylococcus aureus* was saved by this means.

It has been asserted that the distribution of infectious matter within the peritoneal cavity is not only valueless but very dangerous. From a clinical standpoint we have amply proved that the latter statement is ungrounded;

for in a series of 254 laparotomies, in which peritoneal infusions were very largely employed, only seven deaths occurred.<sup>3</sup> In one, a case of general miliary tuberculosis of the peritoneum, death occurred two months after the operation from a general involvement of the lungs and other organs of the body. The second was a case of cancer of the cervix, in which panhysterectomy was performed; no salt solution was used as the pelvic diaphragm was not completely closed, and therefore the solution would not be retained. In this case, the patient died within twenty-four hours after the operation from pulmonary emboli. The third was a general purulent peritonitis; the patient was in *extremis* at the time of the operation, which was hastily performed in the vague hope that she might be saved. Death occurred, however, before the patient reached the hospital ward. In the fourth, a case of general cancer of the peritoneum, only an exploratory laparotomy was performed. No infusion was employed because the peritoneum was already overtaxed and unable to free itself of ascetic fluid. This patient died one week later from the general progress of the disease.

As will be seen from the brief statement of these four cases, the use of the salt solution had nothing whatever to do with the death, for in two of the cases it was not used, and in the other two in which it was employed no ulterior effect could be ascribed to it; for the patient suffering from general tuberculosis survived for two months after the exploratory incision, and the second expired on the operating table.

The three remaining cases were as follows: in one, a patient suffering with a large cystic myoma, death occurred within twenty-four hours after the operation from a virulent fulminating streptococcic infection. This case showed the most intense toxic symptoms and death came with the rapidity which is so characteristic of this fatal poison. In this case, certainly the salt solution in no way retarded the progress of the symptoms. This case also proves the point which we have insisted on, namely, that given a virulent streptococcic infection, in some instances practically nothing which we know of can save the patient. In the next case, the patient was operated on for chronic appendicitis, with extensive adhesions, and right-sided salpingitis; death occurred on the fourth day from intestinal ob-

#### 3. These were as follows:

- Myomectomy, 4.
- Hysteromyomectomy, leaving ovaries, 26.
- Hysteromyomectomy with salpingo-oophorectomy, 4.
- Hysterecto-salpingo-oophorectomy, 7.
- Panhysterectomy, 10.
- Bilateral salpingo-oophorectomy for pyosalpinx, 18.
- Unilateral salpingo-oophorectomy, 37.
- Suspensio-uteri with operation on adnexa, 25.
- Suspensio-uteri with plastic operation on cervix or vagina, or both, 53.
- Suspension alone or combined with Webster's operation alone, 26.
- Gall-bladder operations alone or combined; if combined, included above as well, 4.
- Exploratory laparotomy or laparotomy and drainage, 16.
- Relief of adhesions, 2.
- Appendectomy alone, 9.
- Appendectomy combined with other peritoneal operations, 37.
- Hernia alone or combined with other peritoneal operations, 14.
- Kidney operations alone or combined with other peritoneal operations, 4.
- Laparotomy, etc., including inguinal colostomy, etc., 3.
- Total number of laparotomies, 254.
- Total number of deaths, 7.

In this list of operations only those performed in the Hospital of the University of Pennsylvania have been drawn on for conclusions; for here our conditions were always uniform and the cases were under our constant observation. Were we to have tabulated the large number of operations performed in the St. Agnes, Bryn Mawr and Presbyterian hospitals the mortality statistics would have been about the same.

struction. The last case was one of hepatoptosis, in which the liver had gravitated below the umbilicus. The patient was greatly jaundiced, and was kept quietly in bed for a month, when the jaundice subsided to a sufficient degree to permit the performance of the operation. The liver was suspended, and packing was introduced between the anterior abdominal wall and the liver for the purpose of producing adhesions. In this case the patient again became progressively jaundiced and died on the fourteenth day after the operation.

From this review of the seven fatal cases, only one could in any way be attributed to the use of the saline infusion, in the sense of distributing the poison to the remoter parts of the peritoneum and the general organs of the body.

From this combined clinical and laboratory study, it is evident that the assertion that the use of peritoneal infusions is not beneficial but actually dangerous, has been amply refuted. In the laboratory experiments we saved 44 per cent. of the animals in which the same amount of virulent culture was introduced in the control and test animals. In the first all of the animals, without exception, died; in the second, 4 per cent. were saved and the resistance to the poison in the fatal cases in which the salt infusion was used is shown by the fact that the average life was 69 hours longer than in the control animals.

#### CONCLUSIONS.

From this study we would draw the following conclusions:

1. The use of salt solution does not increase, but unquestionably minimizes the dangers of pyogenic infection.
2. In addition to the reduction of mortality, the convalescence of the patient is rendered infinitely more comfortable and satisfactory through the reduction of thirst, the increase in the urinary excretion, and the minimizing of vesical irritation.<sup>4</sup>

#### DISCUSSION.

DR. J. WESLEY BOVÉE, Washington, D. C.—About five or six years ago I took the same stand that Dr. Clark now takes. There are several reasons for this procedure: one being the lessened mortality where there is sepsis; another being a lessened liability to the formation of adhesions in the pelvis; and another the stimulation which we get directly of the center of circulation along the large blood vessels, thus materially lessening the tendency to shock. It throws the blood to the surface of the body instead of allowing the patient to be bled to death into her blood vessels; and there are various other reasons. I would, however, suggest a temperature for this salt infusion. In nearly every abdominal section during the last four or five years I have left salt solution in the abdominal cavity, but the temperature of the fluid must not be over 115 F. In a few cases where I had the temperature as high as 120 F. there have been some symptoms of intestinal adhesions which I have attributed to too much irritation of the peritoneum. In one fatal case I

found numerous agglutinations of intestinal loops which I firmly believe were due to the irritation of the hot salt solution. The temperature should range from 108 to 115 F.

DR. H. J. STACEY, Leavenworth, Kan.—I want to call attention to the usefulness of using normal salt solution per rectum. I am in the habit of injecting a quart twice a day to increase kidney action and also to prevent thirst. I do not see any necessity or indication for using water above 105 F. A body temperature as high as that is a serious matter, and I believe that better results come from a solution of that temperature than from one having a higher temperature.

DR. F. F. LAWRENCE, Columbus, Ohio—I have noticed a number of times, on filling the abdomen with sterile water or salt solution having a temperature above 106 F., a sudden increase of the symptoms of shock. The theory on which salt solution is used is certainly a rational one. The lymphatics are the scavengers of the body. If the peritoneal cavity is filled with salt solution or any other fluid it not only dilutes the infection, but the enormous quantity of water carried through the lymph channels washes out and dilutes the entire lymph stream.

DR. C. L. BONIFIELD, Cincinnati—One point, it seems to me, is not the same in a physiologic experiment as in actual practice. In the rabbits, the infected fluid was thrown into the peritoneal cavity free, so that it would be carried throughout the entire abdominal cavity. In practice this is not exactly the condition with which we have to deal. In an appendicitis, for instance, the appendix usually does not rupture until a wall of adhesions has been thrown around that portion of the peritoneum. In pyosalpinx there is always some inflammatory reaction before the infecting material is thrown out. In these conditions also, leucocytosis is well under way before the operation is performed. The question at issue is whether it is better to dilute the infection and then scatter it throughout the peritoneal cavity, or to keep it out of the general peritoneal cavity and in its original location if possible. In practice this depends largely on the skill and experience of the operator. The method Dr. Clark described may be the best for him and others of his experience and ability, but I am satisfied it is better for the average operator to protect the general peritoneal cavity in every way possible and, when in doubt, to drain. Salt water may be used freely by the rectum, under the skin or even in the veins. Its beneficial action may be as much due to its aiding the kidneys in the elimination of poison as to its diluting the poison and enabling the peritoneum to absorb it more readily.

DR. EDWIN RICKETTS, Cincinnati—Experimentation on the healthy peritoneum is one thing, and handling a peritoneum that for 48 or 72 hours has been the seat of a pathologic lesion is quite another problem. I was brought up to think that the washing out of the abdominal cavity with warm water or salt solution was a thing to overcome shock, but I have changed my opinion somewhat. I had a case of ruptured extra-uterine pregnancy, at 3½ months, in which the amount of blood in the abdominal cavity was simply appalling. The operation had to be done promptly to save the patient's life. We did not put a drop of water into the abdomen, but with the hips of the patient elevated, we kept everything as dry as possible. The recovery of the patient was more satisfactory than in the cases of Lawson Tait, who filled the abdomen with warm water. As the last speaker said, there are cases of appendicitis in which there is a walling off, and he who breaks that wall opens the door to infection. By washing out the cavity we take chances of spreading the very thing we want to confine. I simply speak of what experience has taught me, to keep my wounds as dry as possible, and then depend on strychnin and hot water enemata after a short anesthesia and a rapid operation.

DR. C. O. THIENHAUS, Milwaukee, Wis.—It must be remembered that, when we have to deal with an infection of the peritoneum originating from the appendix or pyosalpinx or another cause, the bacteria are lying imbedded in the tissues and not on top of the peritoneum from whence they can be swept away by the saline solution. The saline solution

4. As stated in previous communications, the salt infusion should not be employed in those cases in which the absorption of the peritoneum is greatly impaired, as in certain conditions accompanied by ascites, in ruptured extra-uterine pregnancy in which the peritoneum is already overtaxed by the removal of hemorrhagic débris, and in cases in which there is a considerable pus-producing focus left in the peritoneal cavity. In explanation of the latter it may be said that in cases of localized abscess in any part of the abdominal cavity, which may be evacuated effectually by the usual surgical drains, it should under no circumstances be broken up and thus throw the danger of infection on the general peritoneal cavity. In all instances, however, where the abscess sac may be extirpated completely, as, for instance, in pyosalpinx, localized appendicitis, suppurating gall bladder, etc., peritoneal infusions should be employed, and surgical drainage by gauze or glass tubes discarded.

can not reach these bacteria within the tissues. When I have to deal with pus somewhere in the peritoneal cavity and this pus focus is localized by adhesions, which are thin and tender, I do not like to wash out with saline solution for fear the wall of adhesions which Nature has thrown out in self-protection against the spread of infection may give way and allow the saline solution to carry infectious material somewhere else. When general peritonitis is present I make use of the saline solution for mechanical cleansing purposes, but in such cases the surgeon is entirely at the mercy of the bacteria and of the toxins present in the individual case, and in cases of streptococcus infection with high virulence of the bacteria the patients die promptly with and without the saline solution.

DR. V. M. SHOWALTER, Point Clear, Ala.—Several patients in whom I used the salt solution recovered. One patient in whom it was not used died.

DR. CARL WAGNER, Chicago—Eight or ten years ago I was in the habit of using the salt solution very frequently to avoid shock and, perhaps, to dilute infectious matter. I have, however, abandoned this procedure entirely, influenced greatly by the teachings of Schlange, who says that every wound should be treated in as dry a manner as possible. I further believe that in the infected peritoneal cavity the absorbing power is lowered immensely, to such an extent, perhaps, that for hours after the operation no absorption of salt solution left in there, or at least very little, takes place. Since I have adopted this plan of leaving everything as dry as possible, so that even the sponges used are as dry as they can be made, as practiced by Fritsch and others, my cases have been far more successful. Among the numerous laparotomies for extensive pus cases, I have had five successful hysterectomies for puerperal fever. In regard to preventing or overcoming shock, I reason that while the peritoneum in a healthy condition is a very good agent for the absorption of salt solution, it is entirely different in the pathologic state. Furthermore, if the salt solution is not absorbed, its volume has undoubtedly some unfavorable bearing on the intra-abdominal pressure, thus through weight and quantity exerting an impairing influence on the function of the abdominal organs. On the other hand, while the pathologic peritoneum is non-absorbent and needs rest, an entirely different state of condition prevails on the inside of the intestines, the mucous membranes of which are only too avid and able to absorb salt solution. But even here the solution should be administered very judiciously. Enemas of gallons of salt solution, as advised by some of the authors, I consider absolutely wrong from the standpoint that such a great quantity will act as an unfavorable ballast, while pints, administered from half-hour to one-hour or two-hour intervals after the operation, regulated by such indications as the pulse and general appearance give, seem to answer the requirements very favorably.

DR. J. G. CLARK—I am in entire accord with Dr. Bovée that too high temperature may produce very serious injury, even actual destruction and exfoliation of the peritoneal epithelium rather than the stimulating action desired. To avoid this I employ a saline solution at 110 F. In the event of not having a thermometer at hand, the temperature may be sufficiently accurately tested by having the solution poured on the upper arm, and when it is of a degree which may be comfortably borne it is safe for introduction into the peritoneal cavity. I believe it is possible to use too much solution, in other words, to waterlog the patient. Instead of distending the abdomen with salt solution, it is my rule at present to use not more than a liter. In my experience, cases of extra-uterine pregnancy in which rupture has occurred two or more days before operation are not favorable for saline infusions, for in these cases all of the lymph tracts are blocked with debris of broken-down blood, and, therefore, the eliminating functions of the lymph tracts are largely abrogated. In such cases, after having thoroughly cleansed the peritoneal cavity by repeated irrigation, I close without salt solution in the peritoneal cavity, but give even more than the ordinary quantity as a rectal infusion, placing the patient

in such an exaggerated Trendelenburg posture, while she is under anesthesia, as to allow large quantities (1 to 2 liters) to run downward and backward into the upper colon. In several instances, while the abdominal incision is still open, I have seen the salt solution as it was introduced into the rectum, run backward through the descending colon across the transverse colon and up to the head of the cecum, thus proving beyond doubt that the solution goes beyond the sigmoid flexure. By keeping the patient in a slightly elevated posture, absorption rapidly takes place, and the patient, therefore, gets the full benefit arising from the dilution of the blood, which not only promotes the urinary excretions, but also assists in the elimination of the toxic matter. In a case of extra-uterine pregnancy, which died from a slow oozing from a ruptured cornu of the uterus, an autopsy was made, and the diaphragm was found deeply pigmented with blood, not superficially disposed over the entire surface, but completely filling and blocking all of the diaphragmatic lymph spaces. In this case large quantities of serum had transuded into the peritoneal cavity. Leucocytes were there in great abundance, but the exits for these combating factors and bearers of infection were most effectually blocked. In such a case, to further tax a peritoneal cavity by infusing large quantities of salt solution would appear at least unphysiologic, if not actually dangerous. As to appendicitis, I agree with one of the speakers that no greater surgical blunder can be made than to break open an already effectually walled off abscess. Nature here has done more than can possibly be accomplished by the surgeon in recklessly breaking down barriers which have been so effectually built up. In such a case there is no longer a peritonitis or even a peritoneal abscess to deal with, for it has become extraperitoneal through its barriers of adhesions and lymph, therefore the surgical dictum is, open the abscess and drain. My contention is not for the use of saline solution in such cases as these, but it is in cases such as pyosalpinx, ovarian abscess or appendiceal abscess, where the sac itself has been removed, that the peritoneal infusions are not only of value, but are curative and are infinitely more effective in promoting the convalescence and recovery of the patient than is the heavy packing with gauze or the introduction of such an ineffectual drain as a glass tube. Dr. Thienhaus has stated that the organisms are buried in the tissues and, therefore, saline infusions do not reach them. Certainly they are, but if you break up or remove an abscess they are promptly brought to the surface, and some of these organisms, to say the least, must contaminate the surrounding tissues and possibly escape into the general peritoneal cavity. It is in just such cases as these that the drain is of no value and is actually dangerous, while the saline infusions are most efficient. Relative to Dr. Bonifield's discussion, our differences are as wide as the east is from the west. His dictum is: When in doubt, drain; mine is: When in doubt, do not drain. For the last six years I have been studying this question constantly, and my opinion is unalterably fixed. With full respect to Dr. Bonifield's opinion, however, I would say that his opinion is the one which would be most generally sustained. Indeed, it is my rule, when teaching my students, to say to them that they may act on this principle so far as their own practice is concerned if they carry it out as they have seen it conducted in my clinic in the University Hospital, but that when they undergo examinations before state or hospital boards they are to be very guarded in this respect and rather lean in cases of doubt to the use of drainage. This concession, however, is only made in their interests in successfully passing state and hospital board examinations, and with no thought that such teaching is the best.

The intestinal canal, said S. Kellet Smith in the *London Lancet*, is a veritable "ptomain factory and bacterial seminary," and I long have been convinced that the toxic condition of the intestines is a frequent cause of appendicitis as well as a potent factor in causing the high mortality of this disease. We all know that the cases accompanied by constipation are more likely to result fatally than those in which we can procure free evacuation.