ABDOMINAL SURGERY UNDER LOCAL ANESTHESIA *

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The literature on local anesthesia deals so uniformly with arguments regarding the merits of local as compared with general anesthesia that one hesitates to bring up for discussion that phase of the subject. The personal equation, however, enters so largely into the question that the advantage of one over the other, aside from the element of safety, will depend to a great extent on the experience of the operator. Those who are for any reason unable successfully to perform a large variety of operations under local anesthesia are at once a unit in deciding that general anesthesia has more advantages. On the other hand, those who can with satisfaction perform a large variety of operations by the local method will be found to hold the opposite view. It must be admitted that at the present time a vast majority of surgeons believe that general anesthesia is the method of choice, and that local anesthesia should be reserved for minor and for extreme cases. That sentiment is undergoing a rapid change in favor of local anesthesia must be admitted also. It is my belief that the opinion of a surgeon regarding the relative merits of the two methods will vary in accordance with his experience, and that the more experience one has with local anesthesia, the more successful he will be with it and the more enthusiastic he will become regarding its use. I believe that local anesthesia represents one of the greatest advances of the time, and

Fig. 1.—Pneumatic injector: A, glass cylinders for procain; B, pressure tank for compressed air; C, motor; D, rheostat; E, compression pump; F, cotton filter; G, air gage; H, valves; I, flexible metal tubing; J, cutoff; K, needle; L, suction bottle; M, rubber tubing for suction; N, suction tip; O, towel rack.

that, provided no other method is discovered to supplant general anesthesia, the latter will to a large degree be replaced by the local method.

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ADVANTAGES OF LOCAL ANESTHESIA

I shall enumerate some of the advantages of local over general anesthesia, and reserve the balance of the time allotted me for a consideration of the methods which, in our hands, have given satisfaction.

Fig. 2.—Pneumatic injector, "set up," filled and ready for use. Note sterile towel, protecting tubing. By turning down the upper end of this towel we develop the diaphragm shown in Figures 5 and 7.

First of all, the one great advantage of local over general anesthesia is that of safety. That procain is safer than any of the general anesthetics is, I believe, admitted by all. The other main points to be considered relate to the comfort of the patient and the efficiency of the anesthesia. There is some question as to which of these two points should be considered the more important. While the comfort of the patient is an extremely important matter, I consider the manner of performing the operation of even greater consequence. I wish, therefore, to call attention to some significant factors relating to the efficiency of an operation performed under local as compared with one performed under general anesthesia.

In all operations one is confronted with the consideration of such factors as hemorrhage, sepsis, trauma, exposure, time and shock. These factors are not necessarily mentioned in the order of their importance; as a matter of fact, their relative importance varies in different operations. I wish briefly to consider each one of these factors in relation to these two methods of anesthesia.

Hemorrhage.—It is pretty definitely established that shock bears a direct relation to the amount of blood lost during an operation. In local anesthesia, the use of epinephrin and the possibility of doing

more deliberate work give one a control over the blood supply that is superior to that offered under general anesthesia. Another factor which is not fully appreciated by those who do not do a fairly large amount of local work is the turgescence of the vessels, especially

in the venous system, when general anesthesia is used. This is especially noticeable in work about the neck and head, and is also markedly apparent in abdominal work. The distended and engorged vessels so frequently seen during general anesthesia are uniformly collapsed during local anesthesia.

Fig. 3.—Pneumatic injector, cutoff and suction tubing within easy reach of surgeon's hand, and separated from the injector and anesthetist by sterile towel.

Sepsis.—The dangers from sepsis probably differ very lightly in the two forms of anesthesia. To my mind, however, what advantage exists is in favor of local anesthesia, for the reason that operations performed under local anesthesia may be done more deliberately and with more attention to detail than is possible when general anesthesia is used. In abdominal work, especially, the excursion of the abdominal viscera with respiration, during general anesthesia, is oftentimes marked, and may cause considerable embarrassment. The placid condition of the viscera under local anesthesia possibly gives one technical advantages. In the case of localized abdominal infections, for instance, it is not uncommon to see a spread of the infection result from the struggles of the patient while going under or emerging from general anesthesia; and I myself have witnessed a number of cases in which localized abscesses had ruptured internally during anesthetization or at operation. On the other hand, with a perfect local anesthesia and careful handling of a patient I have never seen this accident occur. During operation, abdominal packs may be introduced without danger of rupturing an abscess, and after operation the perfect physical rest attained aids in preventing the spread of a septic process. Postoperative vomiting and restlessness undoubtedly interfere with nature's process of localizing abdominal infections.

Trauma.—One of the greatest advances in surgical technic of the last two decades has resulted from the realization that the tissues should be traumatized as little as possible during surgical operations. To local anesthesia, and to those who have employed it, must

largely go the credit for this advance. Sepsis and morbidity following operations are closely related to the degree of trauma inflicted during operation. I am sorry to say that one still sees, all too frequently, a violation of the principle that the tissues should be traumatized as slightly as possible, and in this regard those using local anesthesia are not the offenders, but are, as a class, leaders in teaching the necessity of delicate handling of the tissues.

Exposure.—When one observes the exposure that may be obtained in abdominal work under a good infiltration anesthesia, resulting in a negative intra-abdominal pressure, with the viscera retracting from the laparotomy wound instead of extruding through it; when one sees organs lying in their natural position, devoid of engorgement and motion, he must at once realize that nothing but the most profound general or spinal anesthesia will give as good an opportunity for inspection and operative work in this region. True, the viscera may not be delivered or displaced and handled as readily; distant digital explorations are not so easily made, and adherent masses are not so easily dealt with. If we confine the use of local anesthesia, however, to the class of cases in which it is indicated, and if we agree that, to a large extent, visual rather than digital exploration should be made within the abdominal cavity, local anesthesia compares favorably in offering adequate exposure.

Time.—The element of time quite naturally presents itself along with the other factors. The argument so frequently presented that the excess of time required for local over general anesthesia cannot be spared by the surgeon should, it seems to me, be unworthy of consideration. I wish to consider the element of time only in relation to the patient's welfare. Other things being equal, it will, I think, be admitted that an operation which is done deliberately will receive more atten-

Fig. 4.—Apparatus in use: Abdominal tumor delivered. Relative positions of anesthetist, patient, surgeon, pressure and suction tubing, with sterile towel as diaphragm definitely isolating the operative field. Injector is to the right, outside the field of the illustration.

tion to detail and be performed with more finesse than when the surgeon is making every effort to finish the operation as quickly as possible. A consideration of this feature must surely result in findings in favor of local over general anesthesia.

Shock.—Assuming that the amount of hemorrhage and trauma are reduced by the use of local anesthesia,

the natural inference would be that there would be less shock following operations performed under local anesthesia. This is undoubtedly true and this fact is, I think, recognized by all. It will take but a small series of major abdominal operations performed under local anesthesia to convince anyone that the condition of the patients following these operations is not to be compared with the condition we are accustomed to see after serious abdominal sections performed under general

change to general without hesitancy when it is advisable.

A discourse on this subject would be incomplete without a reference to the question of local anesthesia in children. In our experience, abdominal operations may be performed on children with as great facility as on adults, or even greater. We have repeatedly made laparotomies on very young children without signs of distress from the time the abdomen was opened until the closure was made. In two recent cases of hypertrophic pyloric stenosis, in babies under 6 weeks of age, the entire operation was completed without an outcry or expulsive effort on the part of the babies. This operation, which is considered a serious one, is by this method converted into what might be called a minor procedure, which may be carried out with almost ridiculous ease.

TECHNIC

The local anesthetic of choice is procain, 0.5 per cent. in Ringer's solution, combined with epinephrin, 5 drops to the ounce.

In all except hernia cases we depend on a direct infiltration of the abdominal wall rather than on a conduction anesthesia. All layers of the abdominal wall are infiltrated before the incision is made. We consider the necessity of supplementary injection of procain as an indication that our technic has been faulty.

In making the infiltration, minute attention is given to details. The ideal aimed at is to deposit the fluid equably throughout the desired area without any sensation of pain on the part of the patient after the first needle prick, which is made for the production of the initial intradermal wheal. All subsequent wheals are made from beneath (Fig. 5), and the intradermal wheal is repeated only for the purpose of secondary introductions of the infiltrating needle as the field is traversed. Aside from the wheal points, the skin is anesthetized by a subdermal infiltration. A 4-inch record needle, No. 23, is used. Through this a wall of infiltration is built beneath the proposed line of incision, with a base of from 2 to 3 inches in width, the apex being the line of incision through the skin (Fig. 6).

Equipment. — Ten years ago we discarded the syringe and substituted the pneumatic injector (Figs. 1, 2 and 3) for this work. This apparatus gives us a constant flow of the solution with a steady pressure controlled by a cutoff, which is ideal from the standpoint of ease of manipulation. With this instrument the ordinary abdominal wall can be anesthetized in from two to three minutes, and, as the incision may be made immediately, much time is saved. The average time, from the beginning of the administration of the anesthetic until the abdomen is opened, is from five to seven minutes. Throughout

Fig. 5.—Sectional views of the skin: *a*, method of making first dermal wheal; *b*, painless subcutaneous method of making secondary wheals; *c*, method of making subdermal infiltration.

anesthesia, even though fairly careful technic has been followed in the latter. Three or four of these patients operated on during a morning can be cared for by a student nurse during the rest of the day, while she attends to her other duties, whereas few surgeons would be careless enough to leave any patient who has had general anesthesia without constant attendance on the part of a nurse for a few or perhaps several hours following the operation. The absence of thirst, nausea and vomiting, with their resultant dangers and disagreeableness, the low percentage of gas pains, which occur almost directly in proportion to the amount of trauma inflicted by abdominal packs and handling, are in marked contrast to that which takes place in patients who have been operated on under general anesthesia. I believe that surgeons have become so accustomed to feeling that the patient who must undergo a surgical operation is entitled to twelve, twenty-four or thirty-six hours of "hell" following it, that we do not appreciate the seriousness of the condition. Would it not be a good plan for every surgeon to spend occasionally the following twelve to twenty-four hours in the ward with several of the patients on whom he had operated under general anesthesia during the forenoon? The education obtained would almost equal that acquired by having the method applied to oneself.

The percentage of abdominal operations that may be performed with satisfaction under local anesthesia will, as I have already stated, depend largely on the experience of the operator. I have found that conditions which a few years ago I thought were amenable only to surgery under general anesthesia I now handle with the greatest ease and satisfaction under local anesthesia. The realization of the fact that operations begun under local may be finished under general anesthesia, in case it becomes necessary, has greatly increased the scope of the method. At present we begin all of our abdominal operations, regardless of the age of the patient, under procain anesthesia, and

Fig. 6.—Section of abdominal wall, showing area infiltrated.

this procedure every effort is made to eliminate the slightest sensation of pain on the part of the patient. If this is accomplished and the abdominal walls gently retracted vertically, the abdominal viscera will not protrude through the opening but will fall away from the field of operation, and, by making use of the force of gravity, all the viscera in the region of the incision may be examined visually without handling. Per contra, should the injection be carelessly or too rapidly made, or certain sensitive areas be missed in making the infiltration, and the incision thereby cause pain, there will be established a combative action on the part of the patient, and an expulsive effort which will cause an extrusion of some of the viscera. In the absence of acute infections and marked distention of the intestine, the viscera should not protrude through the abdominal wound in the presence of a perfect local anesthesia, unless, perhaps, the patient should inadvertently cough, sneeze or laugh.

Retraction of the Abdominal Wall.—Careless or vigorous retraction of the abdominal wall will also produce the expulsive effort which we wish to avoid. With the flaccid abdominal walls usually found under local anesthesia, only the mildest kind of retraction is necessary. I find that the most satisfactory retractor is the wire automatic, which gently and symmetrically spreads the incision (Fig. 7).

Sensitive Areas.—There has been considerable investigation concerning the sensations within the peritoneal cavity. Observations vary in this regard, and different patients seem to vary to some extent. The areas are more or less constant, however, in response to pain sense. We have found pressure and traction on the round ligaments of the uterus to be painful; and that the ovarian pedicles, the meso-appendix and the region of the cystic duct, are also sensitive. Traction on the mesentery is much more apt to cause nausea than acute pain, and one must be especially careful about making traction on the cecum and duodenum.

SCOPE OF LOCAL ANESTHESIA

Lower Abdomen.—All pelvic conditions of a simple nature may be handled under local anesthesia with great satisfaction. As a certain percentage of pelvic work, however, either is complicated by the sequelae of infectious processes or must be done to eradicate malignant disease, one encounters a fairly large percentage of cases that are difficult to handle under straight infiltration anesthesia.

Caudal Anesthesia.—For a number of years we have been testing a combined caudal anesthesia with an infiltration of the abdominal wall in conditions in which difficult pelvic work is anticipated. The anesthesia acquired in this way is usually ideal, and the complete Wertheim may be performed, or, in fact, any pelvic operation may be readily performed under the combined method.

The administration of procain by the caudal method is simple and is quickly given. In my experience, patients are more apt to show toxic symptoms when this form of anesthesia is employed than if infiltration only is used. A number of patients have shown pallor,

increased respiration and pulse rate, faintness and occasional nausea. While we have seen nothing to be alarmed about, I believe that the utmost care should be used in making the injection. It should be made through a flexible needle, which is not liable to break off in the canal, and the injection should be made slowly. A rapid injection will cause pain and is said to be more apt to cause toxic symptoms. Furthermore, one should avoid making the injection directly into the blood stream.

In the surgery of the bladder, prostate and pelvic organs this anesthesia is ideal, provided it is proved safe.

Above the pelvis we have had little difficulty in making intestinal resections, even with glandular involvement. We have performed several colectomies and colostomies, enterectomies and enterostomies. In the upper abdomen, the stomach, duodenum and gallbladder have most often been dealt with. With an adequate and properly placed incision, visual examination of this important region may be made with entire

satisfaction. We have made gastric resections for carcinoma and perforated ulcer, pylorectomies, gastrotomies and gastro-enterostomies under local anesthesia without the patients complaining of pain. Cholecystostomy is an exceedingly simple procedure, in most instances, under local anesthesia. When it comes to the removal of a gallbladder, we have been unable to develop a painless operation. We have, however, accomplished the removal in over 90 per cent. of our cases without resorting to general anesthesia, always allowing the patient the privilege of taking a general anesthetic if the distress becomes too marked. Traction on and clamping of the cystic duct is invariably painful, although in recent cases an infiltration between the gallbladder and the liver and about the cystic duct has rendered the operation almost painless.

Work on the common duct will depend entirely on its accessibility. We have removed stones from the common duct and explored this organ numerous times without the least difficulty. Of course, the presence of marked adhesions, with the retraction of the organ up behind the liver, will necessitate general anesthesia.

In gallbladder and duct work it is inadvisable to dislocate the liver, as is recommended for cases under general anesthesia. Instead of "up-ending" the liver outside of the abdominal cavity, we produce much the same effect by using blunt retractors on the liver edge and "up-ending" it beneath the ribs, thus bringing the gallbladder and ducts into view. During this procedure one pad of gauze holds the stomach and pylorus downward and to the right, while another pad is placed between the gallbladder and the duodenum. With perfect anesthesia, only slight retraction is necessary. If the anesthesia is incomplete, however, and the patient strains, nothing can be accomplished by the method.

One of the most satisfactory conditions to handle under local anesthesia has been extensive adhesions between the viscera or omentum and the abdominal wall. Ample incision and vertical retraction will allow the adherent viscera to hang from the abdominal wall in such a position that the adhesions may be divided

Fig. 7.—Automatic wire retractors.

on the white or bloodless line, and the most extensive work may be done with slight or no discomfort to the patient.

All plastic surgery on the abdominal wall, with or without adhesions, falls readily into the ideal class for local anesthesia.

One of the disconcerting factors in abdominal work under local anesthesia is the occasional vomiting of the patient. While this accident is generally due to some overt manipulation, it has to be reckoned with, and we have not been able entirely to eliminate it. This emergency has not arisen in more than 5 per cent. of our cases.

OBJECTIONS TO LOCAL ANESTHESIA

The objections to the local method are both real and imaginary. There is undoubtedly a class of cases in which general anesthesia should always be used. There is, I believe, also a class in which local anesthesia should always be used. That the latter class could be greatly increased with an improvement over the results obtained at present in the large clinics I also firmly believe. The objection that wide explorations cannot be made under local anesthesia is to some extent true, and yet it is to a large degree offset by the fact that wide explorations not made under the direction of the eye seldom give authentic information. How absurd it is, for instance, to see a surgeon extend his gloved hand to the region of the kidney and state that that kidney is normal, and perhaps at the next operation deliver a kidney and spend a considerable time endeavoring to decide whether or not it is normal! Yet we see this absurd procedure carried out daily at many of our best clinics. Of course, a very advanced pathologic condition may be recognized by the introduction of the hand to some distant part of the abdomen; but there are few instances of this kind which cannot be diagnosed before the exploration is made, and, in cases in which the pathologic condition is not advanced, this method of examination is usually unsatisfactory. Furthermore, the introduction of the hand, under local anesthesia, is not an exceedingly painful procedure. With the abdominal wall elevated there is usually room to insert the hand and part of the arm with almost no contact with the surrounding tissues. It is my custom to examine the pelvic organs in gallbladder cases, and vice versa, although, for the reasons already mentioned, I feel that such examinations are possibly overrated with regard to their value.

Working under local anesthesia requires more time, but experience and proper equipment bring this much discussed factor into comparative insignificance. The strain on the surgeon is undoubtedly greater when working under local anesthesia; but if we accept the dictum that the all important factor is the patient's welfare, this objection must be eliminated; and the experience of the surgeon will here, again, make a decided difference. During recent years I find much more comfort in operating on patients under local than under general anesthesia.

CONCLUSION

The use of local anesthesia should no longer be confined to minor surgery and to cases in which the patient apparently cannot undergo the ordeal of taking a general anesthetic.

With proper equipment and technic, a large proportion of major surgery may be done under local anesthesia with greater safety, less trauma, more complete-

ness and less postoperative discomfort than when general anesthesia is employed.

Children lend themselves readily to the method.

The abdominal field presents a most excellent territory for the use of local anesthesia.

ABSTRACT OF DISCUSSION

DR. P. G. SKILLERN, JR., Philadelphia: The pneumatic injector devised by Dr. Farr greatly facilitates and accelerates the establishing of local anesthesia, since it does away with the necessity of picking up and putting down one syringe after another. I have used his apparatus with great satisfaction, and should call this method "operating de luxe." As emphasized and practiced by Dr. Crile, operating under local anesthesia develops a gentleness of touch and technic that is of benefit to the patient. I do not think that local anesthesia has made the progress in surgery it should. Every one ought to be using it today. It is wonderful to be able to operate on these patients, painlessly, without loss of conscience, and have them go back to their room and greet their friends immediately afterward. Surely this is better than the distressing picture we see so often after ether anesthesia, the patient unconscious, tossing about and vomiting in the presence of his anxious relatives and still facing the dangerous after-effects of ether, such as pneumonia, etc. Some claim pneumonia follows the use of local anesthesia, but I have never seen it and cannot figure how it could occur, provided the chest is protected from exposure. The point I wish to bring out very strongly is my belief that local anesthesia should be used—and that nothing else should be used—in a patient suffering from great toxic shock. The illustration, *par excellence*, is acute intestinal obstruction. The high mortality in acute intestinal obstruction is due to the patient already severely shocked from toxins having superimposed on that another toxin in the form of ether. The present high mortality of the acute intestinal obstruction operation will be lowered decidedly if we employ local anesthesia and not ether.

DR. C. N. COWDEN, Nashville, Tenn.: The pendulum is swinging the other way, and the surgeon who is not giving much study to local anesthesia at this time is missing a great opportunity of keeping himself abreast of the times. The post-operative effects of ether are to be remembered forever. It is practically accepted by every one that procain in large dosage is virtually free of toxic effect. One great difficulty is our lack of confidence in our ability to do these operations under local anesthesia. It is difficult to infiltrate a nerve, but we get practically the same effect by infiltration of the area through which the nerves pass. Gentleness in handling tissues, the sharp knife or scissors, lack of blunt dissection are factors which make for the success of operation under local anesthesia. Quinin and urea hydrochlorid has been responsible for some of the unpopularity of the local anesthesia operation, but the disastrous effect of that has now been banished. Operation under local anesthesia is one of the greatest advances made in the last year or two. The automatic injector adds greatly to the success of the method.

DR. J. A. RUBIN, Pittsburgh: Local anesthesia is the coming thing. I have been operating rather extensively under local anesthesia for about six years. Possibly the reason surgeons have failed to develop their local anesthesia technic is the fact that in a great many cases there is sloughing of the wound. Quinin and urea hydrochlorid is very bad for that. Procain alone will not give the desired anesthesia; it must be combined with epinephrin. In operating the field is dry; there is very little bleeding, and the operation is almost like a dissection on a fresh cadaver. By keeping the anesthetized area an inch or more away from the incision we can, in large measure, prevent sloughing or necrosis of tissue.

DR. A. C. SCOTT, Temple, Texas: When one undertakes to explore the abdomen under local anesthesia he can get just so far. The peritoneum cannot be anesthetized throughout. Although you may anesthetize the abdominal wall completely you will not be able to anesthetize the whole abdominal cavity. According to Dr. Farr you should depend more on visual

than on digital exploration. This is very good so far as it goes, but it seems to be a confession that the exploration cannot be made completely. I would not feel satisfied to close the abdomen without feeling the gallbladder, kidneys, pancreas and other viscera. You cannot make a satisfactory exploration of the abdomen without using the sense of touch. In anesthetizing the peritoneum near the abdominal incision, one of the best bits of technic is, as soon as a small opening is made through the peritoneum, to slip one finger on the inside of the peritoneum about 2 inches back from the margin of the wound and by placing the hypodermic needle directly through the rectus muscles the point of the needle touches the finger; the opening in the needle is exactly in the right position to infiltrate the subperitoneal tissue at the site of the most sensitive nerves. By doing that up and down both sides of the incision you secure the best sort of anesthesia of the abdominal peritoneum in the neighborhood of the wound. One part of abdominal work which cannot be done with local anesthesia without pain is in conditions in which you have to make traction on the mesentery. As soon as you pull on the meso-appendix in appendix operations, pain is produced. In ovarian cyst found during pregnancy, when you fear to give a general anesthetic we get magnificent results from local anesthesia. I have used it in diffuse peritonitis where the patient had double pneumonia and yet I did not dare let the peritonitis go without drainage and had equally good results. I have also used it in gastrectomy and conditions of that kind.

DR. ROBERT E. FARR, Minneapolis: I am not much of a golf player and do not believe in making all shots with one stick. However, when I do shoot I generally use my best stick. To my mind, the best stick in anesthesia up to date is local anesthesia, providing it can be used successfully. We see the same difficulty today with local anesthesia that we usually see when a man reads a paper on this subject. He is like the Christian scientists: he will not argue. These papers are discussed by local anesthesia enthusiasts who spend their time picking out a few of the known shortcomings of the method. Dr. Scott says: "You can not explore the abdomen." I say I can. If he cannot, I can not help that. Dr. Ruben says: "We have necrosis of the skin." I say we do not. We never have necrosis of the skin. If we keep the epinephrin below five drops to the ounce and put procain up in Ringer's solution, and make subdermal instead of intradermal infiltration, we do not have necrosis. Local anesthesia should not be blamed for the shortcomings of those who use it. I have been trying to make the use of local anesthesia simple. This can be done by the method I described and by the use of the apparatus shown. If by this method we can get anesthesia in approximately 100 per cent. of cases, why should we introduce double the amount of anesthetic surrounding the field of incision instead of infiltrating directly into it? Nerve blocking has its place and is an excellent method, but it requires an expert to spear for nerves, and this method will never become common. The method should be simple and easy for all to learn. I am not in sympathy with the idea of reserving local anesthesia for extreme cases. If this is a good thing for bad cases it should be a good thing for good cases. I believe that it is a good thing for all cases in which it can be used.

Virginia Antituberculosis Work.—The work is done county by county. One of the workers gets permission to appear before the council or board of supervisors, outlines the nature of the work and asks to be allowed to make certain investigations, saying that no obligation is attached to this, but that when the work is completed, certain reports and resolutions will be made which can be acted on at the discretion of the governing bodies. A few interested people are interviewed, the field nurse is introduced, and she does the rest, such as get in touch with families and with the doctors of the community, and offers her services for instructive care and beside nursing when necessary. She will send patients to sanatoriums, arrange for free clinics, and health talks in the churches and at public meetings.—*Journal of Outdoor Life*.

STUDIES IN INFLUENZA AND PNEUMONIA

IV. FURTHER RESULTS OF PROPHYLACTIC INOCULATIONS *

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To determine the value of vaccination against disease, it is essential that the disease shall be one which a relatively large number of persons will develop unless protected, and that it be accompanied by serious consequences. These conditions were amply fulfilled during the pandemic of influenza. Moreover, the vaccine should contain the killed bacteria that produce symptoms and which are at least contributory to the cause of death. We have attempted, so far as possible, to fulfil this requirement by making a careful bacteriologic study of the disease, and by incorporating into the vaccine the important bacteria isolated. The epidemic was severe, and the need and the demand for vaccination were great; a large number of cases were available for bacteriologic study and to supply the proper strains for the vaccine. Vaccinations in large numbers during the past ten years with bacteria belonging to the group found in influenza have at least proved harmless, and in the case of pneumonia, prophylactic vaccinations have been successfully carried out by Wright,¹ Lister,² and Cecil and Austin.³ A splendid opportunity to study the effect of prophylactic inoculation was at hand. Owing to the foresight of the founders of the Mayo Foundation, necessary funds to meet the emergency were available. A large amount of the vaccine has been prepared and sent gratis on request to numerous physicians on condition that reports of the results be returned.

In a previous report,⁴ the reasons for the use of a mixed vaccine containing, as far as possible, freshly isolated strains were discussed. It was pointed out that the streptococci, especially green-producing streptococci from influenza, have certain peculiar properties. The preliminary results, as reported from the use of this vaccine, indicate that considerable protection is afforded against influenza and especially against the accompanying pneumonia. Vaccinations were begun soon after the onset of the epidemic. The period of observation was six weeks. It is our purpose in this paper to emphasize essential points in the preparation of the vaccine, to present further results from its use, and to record certain immunologic experiments.

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¹ This paper and that of Dr. G. W. McCoy which follows are part of a symposium on "Influenza." The remaining papers and the discussion will appear next week.

² Read before the joint meeting of the Section on Pharmacology and Therapeutics, the Section on Pathology and Physiology and the Section on Preventive Medicine and Public Health at the Seventieth Annual Session of the American Medical Association, Atlantic City, N. J., June, 1919.

³ Wright, A. E.; Morgan, W. P., et al.: Observations on Prophylactic Inoculation Against Pneumococcus Infections and on the Results Which Have Been Achieved by It, *Lancet* 1: 1-10 (Jan. 3) 1914.

⁴ Lister, F. S.: Prophylactic Inoculation of Man Against Pneumococcal Infections and More Particularly Against Lobar Pneumonia; Including a Report on the Results of the Experimental Inoculation, with a Specific Group Vaccine, of the Native Mine Laborers Employed on the Premier (Diamond) Mine and the Crown (Gold) Mines in the Transvaal and the de Beers (Diamond) Mines at Kimberley—Covering the Period from Nov. 1, 1916, to Oct. 31, 1917, Publications of the South African Institute for Medical Research, Johannesburg, South Africa, W. E. Hortor and Company, Ltd., 1917, pp. 1-30.

⁵ Cecil, R. L., and Austin, J. H.: Prophylactic Inoculation Against Pneumococcus, *J. Exper. M.* 28: 19-41 (July 18) 1918.

⁶ Rosenow, E. C.: Prophylactic Inoculation Against Respiratory Infections: Preliminary Report, *J. A. M. A.* 72: 31-34 (Jan. 4) 1919.