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## ORIGINAL MEMOIRS.

### THE INTRA-ABDOMINAL ADMINISTRATION OF OXYGEN.

A FURTHER CONTRIBUTION, WITH REPORTS OF ADDITIONAL CASES.\*

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IN a previous communication<sup>1</sup> I endeavored to give, as briefly as possible, a *résumé* of the medical and surgical uses of oxygen, tracing the therapeutic history of the gas from the time of its discovery to the present day.

In reviewing the literature of the subject I touched briefly upon what has been accomplished with the gas by *inhalation* in various conditions, by *subcutaneous injections*, by *intravenous infusion*, in *obstetrics*, in *children's diseases*, in *gynecology*, in *general therapeutics*, and in *surgery*.

Following this I reported a series of sixteen cases in which oxygen had been employed intra-abdominally according to the method detailed below. These cases were selected from a number in which the gas had been administered in various ways in my services at the New York City Children's Hos-

\* Read before the Society of the Alumni of City (Charity) Hospital, New York, December 9, 1908.

<sup>1</sup> "Oxygen in Medicine and Surgery—A Contribution with Report of Cases," *New York State Journal of Medicine*, June, 1908.

pitals and Schools, the New York Skin and Cancer Hospital, and the New York Polyclinic Medical School and Hospital, as well as in private practice.

The clinical experience from which these cases were drawn was chiefly surgical, and extended over a period of about five years, during which time the gas was employed in the following ways: (1) by *inhalation*; (2) by *infusion into the pleural cavity*; (3) by *injection into abscess cavities, carbuncles, furuncles*, and other inflammations, acute and chronic; (4) by *injection into tuberculous joints*; (5) by *infusion into the abdominal cavity*, allowing the gas to be gradually absorbed, in the following conditions: (a) tuberculous peritonitis, with ascites; (b) after removal of ascitic fluid from whatever cause; (c) following severe laparotomies, for the control of shock, for its influence upon hemorrhage, cyanosis, nausea, and vomiting, and for the prevention of adhesions.

#### ANIMAL EXPERIMENTATION.

In the paper to which reference has been made I also reported animal experiments, which were conducted for the purpose of determining to what extent clinical deductions were capable of verification by laboratory methods. In the conduct of those experiments I received the valuable assistance of Dr. Harold Denman Meeker, Dr. James T. Gwathmey, and Dr. D. R. Lucas.

The work was executed with the following definite objects in view:

1. To determine the absorbability of oxygen.
2. To determine its effect upon (a) blood-pressure, (b) pulse, (c) respiration, (d) degree of anæsthesia, (e) time of recovery after anæsthesia.
3. To effect a comparison between the results upon the above when oxygen is employed and when air is employed.
4. To determine the danger-point of intra-abdominal pressure as manifested by a fall in blood-pressure, respiratory embarrassment, and cardiac failure.

5. To determine the effect of oxygen upon adhesions in the abdominal cavity.

From these experiments the following deductions were made:

(1) Oxygen is completely absorbed in the abdominal cavity. (2) It is a slight respiratory stimulant. (3) It is a slight cardiac stimulant. (4) It has but little effect upon blood-pressure when the pressure of the gas is moderate. (5) It tends to bring an animal quickly from deep anæsthesia. (6) It hastens the recovery of an animal after discontinuance of the anæsthetic. (7) A pressure of more than 1500 mm. of water may cause collapse. (8) Oxygen tends to prevent the formation of adhesions. (9) It quickly changes a dark blood to scarlet in cases of anoxæmia. (10) It stimulates intestinal peristalsis. (11) It is not an irritant to the peritoneum or abdominal viscera.

While the conclusions drawn from the experiments reported in my previous paper have not been in accord, in every instance, with those reached by other workers from similar investigations, in no case have the discrepancies seemed of sufficient importance to warrant a change of view with reference to the possible clinical value of this application of oxygen. Therefore, since the publication of the paper referred to above, I have continued to test the utility of the intra-abdominal administration of oxygen wherever it seemed to be indicated. In this research the field of usefulness has gradually enlarged, as I shall presently show. It is now administered for the following purposes:

1. To lessen shock, hemorrhage, nausea, and vomiting.
2. To overcome negative intra-abdominal pressure after removal of large tumors.
3. To prevent the formation of adhesions.
4. For its effect upon tuberculous peritonitis of certain types.
5. For its effect upon pus-producing organisms and their toxins.

#### METHOD OF ADMINISTRATION.

In the abdominal administration of oxygen I have em-

ployed the so-called pure gas.\* The gas is warmed, usually to a temperature of from 90°-100° F. This is accomplished by passing it through a rubber tube from the tank in which it is compressed into a wash-bottle filled with hot water. From this bottle the partially warmed gas passes through the exit tube, which is coiled in a basin of hot water. This long exit tube is again connected with a piece of glass tubing, and to this, in turn, is attached a piece of sterile rubber tubing through which the gas is introduced into the abdominal cavity. In this last piece of tubing, at the distal extremity, are two openings, one in the end, which is cut off obliquely, and the other in the wall of the tube, near the end.

Instead of the rubber coil in the basin of hot water, a Leiter's coil, or a special metal coil which will allow of the heating of the oxygen, may be employed.

The abdominal wound is closed, except at the lower or upper end, as the case may be, where the free end of the tube is placed within the abdominal cavity. One stitch is introduced above and one below the tube, and these are tied. An interrupted stitch is placed in the peritoneum at this point, ready to be tied, and a purse-string suture is introduced around the tube in the peritoneum, left long but not tied. All layers of the abdominal wall are closed, up to the skin, and the stitches tied, with the exception of those in juxtaposition to the tube. These, layer by layer, are tied after the purse-string stitch has been fastened.

When the desired amount of gas has been introduced the tube is carefully withdrawn and the purse-string stitch tied, all the others being then fastened layer by layer. Care should be taken, of course, to prevent intracellular emphysema, which, while not harmful, may be a source of some discomfort to the patient.

The amount of oxygen to be administered depends upon

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\* The gas which I now employ has been shown by analysis to contain from 94.3 per cent. to 97 per cent. oxygen; 2.37 per cent. to 4.5 per cent. nitrogen; a trace of carbon dioxide; no chlorine; no nitrous oxide. Similar relative purity of the gas used should be insisted upon by the surgeon.

the exigencies of the case. Where there is abdominal distention from ascites or tumor, the girth of the abdomen should be measured before operation, and after removal of the fluid or the tumor the abdomen should be distended to the same or perhaps a little less degree by the admission of oxygen. Where there is no distention of the abdomen a crude yet practical test in the average case is found by first determining that the liver is not adherent to the chest wall and is of approximately normal size, then administering enough oxygen to obliterate liver dulness. A gauge such as is used in measuring the amount of oxygen in animal experiments may be employed.

So far as I have been able to ascertain from a careful review of the literature of the subject, the intra-abdominal administration of oxygen where the gas is allowed to remain *in situ* until absorbed, had not been employed previous to my own work in this line. With the use of oxygen in its nascent state, as in hydrogen peroxide, all are familiar. Thiriari and others have employed the gas in a continuous stream, thus flushing out the abdominal cavity after laparotomies and after evacuation of ascitic fluid in tuberculous peritonitis. The application of the gas in this manner is made with a view of stimulating the tissues, preventing the extension of the inflammation, causing increased phagocytosis and leucocytosis, destroying the germs or diminishing their virulence, neutralizing their toxins, and "substituting an oxygenated emphysema for the microbial emphysema." The gas is introduced in a continuous stream, 40 to 50 litres of oxygen being used at one treatment, always with a free outlet.

In the cases detailed in my previous communication, and in those which I shall now report, the abdomen was ballooned with the gas and the wound carefully closed, according to the method which I have described, the oxygen being allowed to be absorbed gradually by the tissues. In the cases of abdominal distention with ascitic fluid, in certain forms of tuberculous peritonitis, and in some cases where large tumors were removed, the gas was introduced, as previously

stated, to the point of distention caused by the fluid or by the tumor.

In this manner the negative intra-abdominal pressure which follows the removal of fluid or tumors is overcome by a means which gradually and imperceptibly to the patient lessens the pressure, at the same time distending the necessarily torn and bruised tissues until such time as there is very little danger of the formation of adhesions. This, it seems to me, is better than the pressure-pads so often used.

In cases where there is no undue abdominal distention by the pathological process, and yet where the surgical intervention is such as to entail the possibility of severe shock or extensive capillary hemorrhage, with subsequent nausea, vomiting, and abdominal tenderness, oxygen is introduced to the point of removal of all liver dulness, or according to the exigencies of the case.

Thus, in addition to whatever phagocytic and bactericidal action the oxygen may exert, we have a lessening of shock, a control of hemorrhage from small vessels, a decrease of cyanosis, an early improvement of the pulse and respiration, and in many instances such response to the oxygen stimulus that more anæsthetic is necessary in order to keep the patient anæsthetized until the completion of the operation. As a rule, the nausea, vomiting, and abdominal tenderness which so often follow severe operations are much less than one may reasonably expect.

The following additional cases admirably illustrate the action of the oxygen in the manner just described. While some of the cases were of such nature that there is reason to believe recovery would have taken place in any event, the oxygen merely acting as a temporary stimulant, in others the condition of the patient at the time of operation was so bad, or the shock from the operation was so great, that the result without some such support as oxygen seemed to give would have been questionable.<sup>2</sup>

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<sup>2</sup> For report of cases I to XVI, inclusive, see *New York State Journal of Medicine*, June, 1908.

CASE XVII.—A. C., female, aged 44, married, laundress. Prolapsus uteri. Operation, April 2, 1908, divulsion, curettage, appendectomy, suspension of uterus. Condition very poor. Pulse and respiration immediately improved upon the intra-abdominal administration of oxygen, and more anæsthetic had to be given. Recovery uneventful.

CASE XVIII.—G. V., male, aged 51. Seen in consultation with Dr. Henry Franciscus, of Brooklyn, April 24, 1908. Admitted to the New York Skin and Cancer Hospital, April 28, 1908. Irremovable gastric and intestinal carcinoma. Operation May 4. Gastro-enterostomy performed. The patient's general condition was very poor, and the shock from the operation was so great that he came near dying on the table. He rallied, however, as soon as oxygen was introduced into the abdomen. The wound healed by primary union, and the patient did as well as could be expected for three or four days, but coincidental with the total absorption of the oxygen he began rapidly to lose ground, and died, May 11. Postmortem revealed the fact that all of the gas had been taken up by the general system, and that there remained no changes in the peritoneum which could be attributable to the action of the oxygen.

CASE XIX.—J. B., female, aged 38, married, housewife. Endometritis, both ovaries cystic. Operation May 7, 1908. Divulsion and curettage. Left ovary removed; multiple punctures in right ovary; appendectomy. Oxygen administered intra-abdominally exerted a stimulating effect which was distinctly observable. Abdominal tenderness following the operation was less marked than is usual in such cases. Recovery uneventful.

CASE XX.—G. P., female, aged 39, married. Seen in consultation with Dr. M. W. Barnum, of Ossining. Ovarian cyst. Operation at the Ossining Hospital May 16, 1908. Left ovarian cyst weighing six pounds with beginning cancerous degeneration removed; right ovary, also diseased, removed; appendectomy. Shock considerable. The introduction of oxygen caused immediate improvement in the patient's condition. Recovery uneventful.

CASE XXI.—S. A., female. Chronic appendicitis, with many peritoneal adhesions. Operation May 23, 1908. Adhesions broken up and appendix removed. Oxygen administered in this case chiefly with a view to preventing the formation of adhesions.

Recovery was uneventful, and subsequent history has revealed nothing that could be attributed to the return of adhesions, despite the chronic nature of the condition.

CASE XXII.—S. B., male, aged 26. Carcinoma involving omentum, peritoneum, and intestines. Operation, New York Skin and Cancer Hospital, June 4, 1908. The general condition of the patient was so bad and the disease so extensive that nothing more than exploratory laparotomy could be done. Oxygen was introduced, and in a few minutes the patient came out of the anæsthetic and made vigorous attempts to get off the operating table.

CASE XXIII.—D. H., male, aged 35. Admitted to the New York Polyclinic Medical School and Hospital, June 19, 1908. Abdominal distention of six months' duration. Had been previously tapped six times. Refused Talma's operation for cirrhotic liver. Fluid withdrawn under local cocaine anæsthesia and oxygen administered. Patient said he was "buoyed up" by the oxygen and felt better after this than he had for a long time. He noticed a difference in his feelings on this and previous tappings. He insisted upon returning to his home in Florida next day. Oxygen, while diminishing, was still present in the abdomen.

CASE XXIV.—C. E., female, aged 22, married, housewife. Admitted to the New York Skin and Cancer Hospital, June 10, 1908. Extra-uterine pregnancy, ovarian cyst, pelvic peritonitis. Extra-uterine pregnancy, right tube and right ovary removed. Many adhesions around the appendix broken up and appendectomy performed. Oxygen was introduced intra-abdominally. The patient's condition improved at once, her color became better, breathing easier, pulse fuller and slower, and the patient came out quickly from the anæsthetic. Recovery uneventful.

CASE XXV.—M. D. S., female, aged 33, single. Admitted to the Alston Sanitarium June 24, 1908. Fibromyoma of uterus. Operation June 26. Removal of tumor weighing six pounds; right tube and ovary removed; extensive adhesions broken up. Shock very great. Immediately upon the introduction of oxygen into the abdomen the condition of the pulse and respiration improved. There was slight postoperative vomiting, practically no nausea, and very little abdominal soreness. Appetite good immediately following the operation; all food retained. Recovery uneventful.



CASE XXVI.—R. J., female, aged 30, single, teacher. Retro-poused uterus; pelvic peritonitis; chronic appendicitis. Operation, Jamestown Hospital, Jamestown, N. Y., July 12, 1908. Many adhesions around the appendix broken up; appendectomy; uterus suspended. Considerable shock, which was promptly overcome by the intra-abdominal administration of oxygen. Recovery uneventful.

CASE XXVII.—W. E., female, aged 68, married. Referred by Dr. H. T. Wolf, of Yonkers. Abdominal carcinosis, kinking of the gut, with intestinal obstruction. Operation April 14, 1908, at St. John's Riverside Hospital, Yonkers, assisted by Dr. Getty and Dr. John, of the attending staff. The case was so extreme that operative procedure was warrantable only upon the ground of attempting to control the vomiting, which was almost fecal in character. A large amount of fluid was removed from the abdomen, and the intestine straightened. Adhesions around the left ovary broken up and the ovary removed. The patient was practically pulseless. The intra-abdominal administration of oxygen was followed by prompt improvement in pulse, respiration, and general condition. The patient rallied from the operation. There was no subsequent vomiting, except just before her demise. The bowels moved easily, and it would seem that the patient did as well as could be expected so long as the oxygen was in the abdomen, but when this was all absorbed she succumbed from asthenia, four days after operation.

CASE XXVIII.—F. W., female, aged 37, married, housewife. Referred by Dr. William W. Van Valzah. Anæmia, hemorrhoids, chronic appendicitis; left ovary prolapsed and cystic; uterus retroverted and large; many abdominal adhesions. Operation, Woman's Hospital, June 3, 1908. Curettage; modified Gilliam; adhesions broken up; appendix removed; left ovary removed. Considerable shock. Condition perceptibly improved upon the introduction of oxygen and remained good. Recovery uneventful.

CASE XXIX.—R. V., aged 29, female, married, housewife. Exploratory laparotomy, June 12, 1907, at the New York Skin and Cancer Hospital. Papillomatous degeneration of uterus, tubes, and ovaries found, extending to the intestines and well up toward the liver. A detached portion was removed for microscopic examination, the report being "malignant papilloma." Ten days later panhysterectomy was performed and a large

amount of fluid evacuated. A large papillomatous mass in the pelvis was also removed. On November 12, 1907, and again on January 11, 1908, exploratory laparotomy was performed for the purpose of removing fluid and more of the papillomatous masses. At the first two operations no oxygen was administered. In each instance there was considerable nausea and vomiting, and decided abdominal tenderness and soreness. At the last two oxygen was introduced into the abdominal cavity. The patient was absolutely free from pain in each case, there was no nausea, no vomiting; her skin was pink when she left the operating table; she came out of the anæsthetic very promptly, and a few hours after the operation nourishment was taken with relish and retained.

On March 6, 1908, the patient returned to the Skin and Cancer Hospital, when paracentesis abdominalis under local cocaine anæsthesia was made, and eleven pints of serosanguinous fluid evacuated. Oxygen was administered through the paracentesis needle until normal liver dulness disappeared. Patient felt exhilarated. Returned home forty-eight hours later in good condition.

On November 2, 1908, patient was again admitted to the hospital, and on November 4 laparotomy was performed. More adhesions broken up; a number of retroperitoneal cysts in the mesentery evacuated; a mass of friable, papillomatous tissue, as large as two fists, removed from the upper surface of the liver. On account of the tremendous shock the effects of the intra-abdominal administration of oxygen were not so noticeable at the time, but the patient made an uneventful recovery except for persistent vomiting and reverse peristalsis for some days after operation. This, however, soon disappeared, and the subsequent history presents no notable features. This patient is now at home in very fair condition, able to do light housework.<sup>3</sup>

CASE XXX.—M. O., female, aged 53, housewife. Referred by Dr. J. H. Jenkin, of Shrub Oak, N. Y. Right ovarian cyst; multiple uterine fibromata. Operation at the New York Skin and Cancer Hospital, November 18, 1908. Median incision 8 inches in length. Several pints of ascitic fluid evacuated from

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<sup>3</sup> Reported in previous paper as Case XII. Present report embodies subsequent operations.

the peritoneal cavity. Left ovary and tube normal. Right ovary the seat of a very large cyst, which had become adherent to the stomach and other viscera in the upper abdomen. One large and several small fibroids. Panhysterectomy, only the tip of the cervix being left. The entire mass removed weighed 61½ pounds. Shock very great. Oxygen introduced until the abdomen was ballooned up to very nearly the size it was before the operation. Patient's condition improved. During the entire time the oxygen seemed present in the abdomen (between thirteen and fourteen days) the face was somewhat flushed, the lips more than ordinarily moist and red. The bowels moved without catharsis and with only a small enema, at the end of thirty-eight hours. There was no nausea, no vomiting, and no paralysis of the gut, despite the previous intra-abdominal pressure. Recovery uneventful.

From the series of cases previously reported and from those detailed above, it will be noted that the gas was first employed in the manner described for its effect upon pulse, respiration, etc., as outlined; also that our laboratory experiments were directed toward the verification of the clinical experience along these lines. We are now, however, carrying on a series of animal experiments, to be published later, for the purpose of determining the effect of oxygen upon various organisms, both aërobic and anaërobic, particularly upon the common organisms of sepsis encountered within the body cavities.

Along similar lines, acting upon the suggestions held forth by the work of Thiriar and others, Burkhardt, in Germany, has conducted a series of experiments upon dogs and rabbits, for the purpose of determining the action of oxygen on wounds and infections.<sup>4</sup> He confined his attention to the effect of the gas upon staphylococci and streptococci and their poisonous products. Pure cultures of *Staphylococcus pyogenes aureus* exposed to a continuous stream of pure oxygen showed after a few days very badly developed colonies, which grew quickly after removal from the oxygen atmos-

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<sup>4</sup> *Deutsche Zeitschrift für Chirurgie*, vol. xciii, No. 2.

phere. In the incubator the inhibition of growth was less marked, but there was nothing in his experiments that led him to believe that oxygen would entirely inhibit the development of these organisms.

A large part of his investigation was concerned with the question of the extent to which infection of the peritoneum could be influenced by injections of oxygen. It is possible, as he points out, that the filling of the peritoneal cavity with the gas changes the resorptive conditions, or that the oxygen, similarly to normal salt solution, increases the reactive capacity of the peritoneum to infection by bringing about hyperleucocytosis. In the beginning of peritoneal infection there is an energetic absorption, but just as soon as there is a serous or purulent secretion into the peritoneal cavity resorption decreases. As soon as there is a localization of the condition, however, a slowing of absorption is better for the patient because of the danger, in the presence of rapid absorption, that a large amount of bacteria or their toxins may find their way into the blood, thus producing general infection. Oxygen introduced into the peritoneal cavity retards this absorption.

Up to this point our own experiments coincide with those of Burkhardt. He found, however, that oxygen is an irritant to the peritoneum. This has not been our experience. There may be a temporary injection of the capillaries, but certainly no harmful degree of irritation, either in the animals examined, or in the human subject where it has been possible to observe this point.

As I have previously stated, we are now conducting a series of experiments to determine the action of oxygen on certain bacteria and their toxins. In the meantime, we are bearing this feature of the question in mind in our clinical work. While I am certainly not ready to advocate the use of oxygen in every case of septic peritonitis—as I assuredly do feel warranted in using it in tuberculous peritonitis of the cystic or fibrocystic type—nevertheless, in the following cases the gas has been employed so successfully that it gives hope

of some definite utility in septic conditions in the peritoneal cavity.

CASE I.—E. J., male, aged 16 years. Seen in consultation with Dr. A. Austin Becker, Jamestown, N. Y. Acute appendicitis. Operation at the Jamestown Hospital, July 10, 1908. The appendix was found to be gangrenous, with two or three points of ulceration, one ruptured into the peritoneal cavity. The peritoneum was congested for some distance from the caput coli, in the neighborhood of which was a considerable amount of pus and seropurulent material, which was mopped out as far as was possible. The appendix was removed, oxygen introduced, and the wound closed without drainage. Temperature dropped to normal in twenty-four hours, remaining so. Convalescence uneventful, except for an abscess which formed in the deep layers of the wound. This was opened July 16, and allowed to drain for several days. The boy was up and well in two weeks.

NOTE.—The fact that this wound was infected from within is important in relation to the oxygen. There is no question but that this was a septic peritonitis and that the wound was infected from the peritoneum; but where the oxygen was in contact with the infected tissues there was no extension of the trouble. Where, however, the infectious material had come in contact with the walls of the wound not bathed by oxygen, the growth of the bacteria continued.

CASE II.—A. A., female, aged 27, domestic. First seen April 16, in the evening, during an acute attack of appendicitis. Operation, 2 A.M., April 17. The abdomen was found to contain turbid fluid, and the peritoneum to be congested around the caput coli. Some adhesions around the appendix, which was swollen, dark in color, filled with fecal matter, and apparently on the point of rupturing. Adhesions broken up and appendix removed. Oxygen administered intra-abdominally. Temperature dropped to normal within twenty-four hours, remaining so. Recovery uneventful, patient out of the hospital in two weeks. No drainage employed.

Cultures were taken from the peritoneum, and many bacilli coli communis and pus organisms were found.

DR. J. B. GREENE, of Mishawaka, Ind., has furnished me with the data concerning an interesting case in which he em-

ployed oxygen according to the method above described. With the Doctor's kind permission I give below an abstract of the history.

CASE III.—S. B., female, aged 24, married, two children. In an attempt to produce an abortion by means of a wired silk-fibre catheter the patient had punctured the fundus uteri, torn the cervix, and lacerated the vagina on the right side. This occurred at 10 A.M., September 3, 1908. A violent chill followed, the patient went to bed, and another physician was called at 2 P.M. At 8 P.M. patient was taken to the South Bend Hospital, and at 10.30 P.M. she was first seen by Dr. Greene. She was almost *in extremis* at the time, presenting the typical picture of profound sepsis. Believing death to be imminent otherwise, Dr. Greene and his consultants decided to give the patient the only chance afforded by surgical intervention. The abdomen was promptly opened, with as few preliminaries as possible. There was an outpour of blood and fecal matter from the abdominal cavity. The pelvic cavity was filled with clots, fecal matter, and a two months' foetus. The ascending colon was torn from two inches above the ileocæcal junction, down through the cæcum, an irregular triangle, including the appendix, which had been torn from the cæcum. The uterus was lacerated from the right cornu through, into, and including the vaginal wall, and the right ureter was torn off. The bowel was repaired, the uterus removed, the ureter brought up and fastened in the upper angle of the abdominal wound. After as thorough cleansing as was possible under the circumstances, the abdominal wound was closed, with a small rubber drainage tube in the lower angle. Collodion and cotton were applied around the junction of the skin with the tube, and through the tube oxygen was admitted until the abdomen was fairly well distended. The tube was then compressed to retain the gas, which was allowed to escape after about fifteen minutes. The abdomen was again distended with oxygen, the tube tied securely, dressings applied, and the patient put to bed. Only once after the operation did the temperature go above normal. The patient made an uneventful recovery in sixteen days.

On September 26 the abdomen was again opened and the

ureter grafted to the bladder. Uneventful recovery from this operation also.

#### A WORD OF CAUTION.

It should be observed that in all severe laparotomies where oxygen is employed in the manner described, it is of the utmost importance to watch for signs of failing strength after the oxygen is absorbed and the patient no longer receives this stimulus. While we do not believe in "postponed shock," there may be a postponed depression after the oxygen is absorbed, and it is then that one should resort to stimulation by other means, in order to tide the patient over. This depression is in no wise due to the fact that oxygen was administered—it has merely been delayed by the oxygen stimulus—and as soon as noted it should be overcome by the administration of the usual stimulants given under such circumstances. In ordinary cases the gas is absorbed in from thirty-six to seventy-two hours.

#### CONCLUSIONS.

Final deductions concerning the clinical value of oxygen administered intra-abdominally, according to the method above described, cannot be made as yet, but our experience warrants the following tentative conclusions:

1. From Cases I to XVI, reported in my former paper, and from Cases XVII to XXX, detailed above, it may be safely said that oxygen, intra-abdominally administered, has a distinct field of usefulness in lessening shock, hemorrhage, nausea, and vomiting; in overcoming negative intra-abdominal pressure after removal of large tumors; in preventing the formation of adhesions, or, when broken up, lessening the liability of their return; and in influencing favorably certain types of tuberculous peritonitis.

2. From Cases I to II (my own), and Case III (Dr. Greene's), in which the gas was introduced into the peritoneal cavity in septic peritonitis, sufficient beneficial effect was noted to warrant the hope that further clinical experience may establish the efficacy of the gas as an adjuvant in the treatment of this condition.