THE EMERGENCY TREATMENT OF WOUNDS.

BY

LIEUT.-COLONEL A. J. HULL, F.R.C.S., R.A.M.C.

It has been abundantly proved by the experience of war that wounds treated by excision heal in many cases by primary union. Further, the fact is established that even when primary union does not occur the more serious types of infected wounds are avoided by this measure, provided the wound is so treated at a suitable time. Anatomical considerations, of course, prevent complete excisions in many cases.

The successful treatment of wounds depends upon the stage at which the wound comes under treatment. Wounds, fortunately, pass through a pre-inflammatory stage, and during this stage it is possible to remove the infected tissues, leaving a non-infected wound. Carrel has shown that a wound passes through a fairly definite chronological sequence. During the first few hours following its infliction a wound is comparatively clean, judged by bacteriological tests. The smears are usually negative. The organisms have not had sufficient time to multiply in order to appear in the secretions. At the end of five or six hours organisms are frequently found in smears, and after twelve hours the wound has commenced to react. Polymorphs appear in large numbers, and bacteriological examination shows a large number of organisms; moreover, the organisms have now spread to the depths of the wound and abound in the particles of fractured bone. It follows that during the first twenty-four hours the wound is amenable to surgical treatment, and after that period an inflammatory stage appears, during which the results of excision have been very much less satisfactory.

The ideal treatment for infected gunshot wounds is to excise them during the pre-inflammatory stage—that is, within twenty-four hours of the infliction. The exigencies of war will more often than not make this impossible. The question therefore arises whether it is possible to prolong the pre-inflammatory stage.

Several observers working with flavine have recorded the appearance of the wounds, which are described as *in statu quo*. There appears to be suppression of suppuration and inflammatory reaction during certain stages of treatment. It may be possible to make use of this or a similar reagent in order to prolong the pre-inflammatory stage sufficiently to allow surgical technique to be employed during the optimum period.

The only treatment which a wound at present receives in war previous to being excised or otherwise dealt with at a casualty clearing station is the application of a first field dressing. It is true that this statement requires modification, inasmuch as it may be injuriously redressed on several occasions, thus delaying the cleansing operation; but the depths of the wound, the shattered fragments of a fractured bone, the parts that really matter, receive no treatment.

In fact, in spite of the advances in surgery, particularly in the treatment of wounds, the emergency treatment is no more efficacious than it was in the days of the Trojan wars. The dressings applied to wounds before the arrival at a casualty clearing station have no influence whatever upon the infection in the depths of the wounds. Improved results of the treatment of wounds can only be achieved by some method of either excising the wound during the pre-inflammatory stage or by prolonging that stage, and research in the latter direction appears to be most desirable.

The old first field dressing appears to be totally inadequate. It is suggested that, as soon as practicable after the infliction of a wound, it should be instilled with some non-irritating antiseptic, in order to inhibit the growth of micro-organisms. Within the first few hours, unless septic foreign matter remains in the depths of the wound, pathogenic organisms are found to be few in numbers and confined to the surface of the wound.

When septic foreign bodies are retained in a wound, the growth of organisms would be enormously retarded by the presence of an inhibiting antiseptic. Septic cloth would become soaked with the reagent injected, and would become comparatively innocuous. Excision of the wounds would be carried out in due course with greatly enhanced likelihood of primary union.

Several reagents which are non-irritating inhibitors of septic organisms are available. Flavine in 1 in 1,000 solution or dichloramine-T would appear to be suitable antiseptics for the purpose. Brilliant green is frequently used (as recommended by Captain Hey) as an antiseptic stain. The wound is filled with brilliant green, which acts as a guide to infected tissue, previous to the excision of the septic area. This reagent would fulfil a double purpose if instilled into the wound at an early stage, by acting as an inhibitor of sepsis, and a guide to the septic tissue. Eusol and Dakin solutions would be too evanescent and too transient in their action for this purpose—as, in fact, they are for any wound treatment during transport.

If a 5 per cent. solution of salt be combined with the antiseptic reagent, the micro-organisms will not only be inhibited in the wound, but an outpouring stream of serum will be produced which will carry infection from the wound, and prevent the ingress of organisms.

The technique of wound instillation is of the simplest possible description. The chosen solution is instilled by means of a fine glass nozzle attached to a Higginson's syringe, care being taken to inject fluid into the depths of the wound. This treatment is certainly not beyond the scope of an advanced dressing station.

There is also indication for the use of this method in casualty clearing stations. In times of pressure a patient may have to wait a day or more before an operation can be performed. The preliminary instillation of the wound with an inhibiting antiseptic solution may make the difference of the wound being operated upon in the pre-inflammatory stage, or when suppuration has commenced. Still more desirable is such treatment when it is necessary to transfer a patient to the base from casualty clearing stations without operation.

I am not at present prepared to recommend the indiscriminate irrigation of wounds of the head and trunk as a preliminary measure, particularly if performed by unskilled hands, but I think its use in the case of wounds of the extremities, particularly compound fractures, is strongly indicated.

The use of preliminary instillation may be objected to on the grounds that the nozzle may introduce infection and that the injection of fluid may spread sepsis. A glass nozzle is easily sterilized between each injection, even at an advanced dressing station, and it is extremely doubtful if such sterilization is necessary. The injection of antiseptic fluid will not spread infection beyond the original limits of the wound, which would become infected in any case. Carrel made use of the instillation treatment in the later treatment of wounds, particularly after wound excision.

By beginning wound instillation within an hour or so we are treating a wound which is bacteriologically as sterile as an excised wound, and but for the tissue necrosis which follows gunshot wounds the early instillation of a suitable antiseptic might replace wound excision.

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TEMPORARY CAECOSTOMY IN RESECTION OF THE DISTAL PORTION OF THE COLON FOR NON-OBSTRUCTIVE CONDITIONS.

BY

GORDON TAYLOR, M.A. ABERD., M.S., B.Sc. LOND.,
F.R.C.S., MAJOR R.A.M.C. (T.C.),
SENIOR ASSISTANT SURGEON, MIDDLESEX HOSPITAL, ETC.

This note has been written to draw attention to a little surgical manoeuvre which has been of service to me in cases of resection of portions of the distal half of the large intestine. This step in the surgical technique of excision of any portion of the large bowel between the splenic flexure and the sigmoid colon I learnt in the course of conversation with a very distinguished Scottish surgeon who employed it, but in France I have met with very few surgeons who appeared to be familiar with the procedure, either in theory or in practice. It is of course established now that excision of portions of the large intestine for gunshot injury in the "forward area" is only

rarely indicated; and, indeed, in the few papers upon gunshot wounds of the abdomen which have been sent to me by my surgical friends, or to which I happen at present to have access, there is scarcely any record of resections of the large bowel, and hardly a note of a successful case.

A. I have employed temporary caecostomy in the United Kingdom in cases of *resection of the large intestine for carcinoma* originating in any part from the splenic flexure to the pelvic colon. I am not referring to cases of intestinal obstruction above an operable cancerous growth, where, of course, the obstruction must be relieved by operation before any idea be entertained of extirpating the tumour, but I am advocating temporary or provisional caecostomy in cases of excision of a carcinomatous splenic flexure, descending, iliac or pelvic colon, where no obstruction exists. The opening acts as a vent for gases generated in the colon above and near the suture line, and acts as a safety valve in preventing any strain on the junction.

I am aware of the brilliant results obtained in excisions of cancerous segments of the large bowel by distinguished operators, but I submit that this little point of technique may be of value to surgeons of ordinary dexterity; it has certainly added to my mental comfort in the treatment of these cases, and it has as certainly promoted the convalescence of the patients.

B. I have also on several occasions made use of temporary caecostomy when operating in the United Kingdom to close a *proximal inguinal colostomy* performed in France for some severe gunshot injury of the rectum. Opinion is not yet finally settled as to the best means of closing an inguinal colostomy, but I have personally usually performed an intraperitoneal operation, excising the "spur" and practising end-to-end union of the bowel. In such cases, as in those of excision of a carcinoma, I have found temporary caecostomy to be a measure of safety. It might appear to be a retrograde step to substitute a stoma in the right iliac fossa for one of the left side, but if the caecum is simply anchored to the parietal peritoneum the opening closes readily enough, especially if the drainage tube in the caecum be inserted after the manner of a Senn's gastrostomy. I have never had to undertake any operation to close a caecostomy performed in this way, and the stoma generally closes in ten days to a fortnight.

C. Excision of portions of the distal colon for *gunshot injury*. It is an axiom of military surgery that in the cases of gunshot wounds of the bowel the least possible should be done, and that suture should be preferred to resection unless the latter is inevitable. The whole experience of the surgery of this war has demonstrated that suture suffices in the large majority of cases of injury to the colon; by reason of the size of this portion of the intestinal tract its wounds are mostly of the nature of perforations or tears, and the bowel is rarely completely divided. Moreover, the absence of numerous loops and coils makes multiplicity of wounds of the colon uncommon when compared with their frequency in the small intestine. Nevertheless, I do claim that there are certain cases of gunshot injury of the large intestine where a resection of the damaged portion is indicated, more especially when infarction of the bowel is present. Further, in some cases where the wound of the large intestine has been of such magnitude or difficulty of approach as to suggest the formation of an artificial anus, recourse might well be made to excision and suture, when the high mortality of the colon anus is borne in mind. The adoption of this procedure would, of course, be influenced by the general condition of the patient.

If excision is to be practised let the removal be free, and let the bowel sections be planned in accordance with the dictates of general surgical experience. The wide removal of damaged bowel and of the adjacent damaged and devitalized retroperitoneal tissue which the resection facilitates finds justification not only in being in keeping with the ordinary rules for the treatment of gunshot wounds by excision of the damaged area, but also by the end-results in those cases in which this more drastic operation has been undertaken. With few exceptions these have all been cases of gunshot injury to the distal portion of the large intestine, and in these the temporary or provisional caecostomy performed at the time of resection has proved to be a measure of safety. The opening has been made into the caecum at the end of the operation while the sister is suturing the skin of the laparotomy

incision. The "gridiron" method affords convenient access to the caecum, and the drainage tube is inserted like a Senn's gastrostomy. If a collodion or mastisol dressing be applied to the laparotomy wound, there does not appear to be any extraordinary risk of infection of the latter.

CASE I.—*Penetrating Wound of Abdomen; Severe Wound of Caecum and Ascending Colon; Excision of Caecum, Ascending Colon and Hepatic Flexure; End-to-side Union of Ileum and Transverse Colon; Suture of Jejunum.*

Pte. J. K. was admitted on November 20th, 1917, into a casualty clearing station with two penetrating wounds of the abdomen. Two fragments of shell had entered the abdominal cavity through the right flank, and the caecum and ascending colon were both badly damaged and perforated, the latter being almost completely divided. There were four wounds of the jejunum, which were sutured. Operation was performed about ten hours after the man was hit, and at the time he was in rather poor condition. The wounds in the flanks were widely excised, and subsequently vigorously treated by Carrel's method; the terminal part of the ileum, the caecum, ascending colon and hepatic flexure were excised, and an end-to-side junction performed between ileum and the transverse colon. The patient made a good recovery and was evacuated to the base, and I last heard of him in an unsolicited letter from the medical officer in charge of a Red Cross hospital in the South of England, telling me of the patient's complete recovery, and congratulating me on the successful case.

CASE II.—*Penetrating Wound of Abdomen; Resection of Jejunum; End-to-end Union; Resection of Distal Part of Transverse Colon, Splenic Flexure, and Descending Colon; End-to-end Union; Caecostomy.*

Lieut.-col. W. was admitted into a casualty clearing station in the early hours of a February morning with a penetrating wound of the abdomen, produced by a shell fragment. The piece of shell entered the left flank, completely dividing his descending colon and shattering its adjacent edges. The upper jejunum was the site of several large perforations, and its mesentery was perforated and bleeding; three feet of jejunum were resected and an end-to-end junction performed. The missile had made a large rent on the posterior aspect of his transverse colon, and passing forwards and to the right had just penetrated the anterior surface of this portion of the bowel. It was deemed safer to excise the damaged portion of the transverse colon, splenic flexure, descending and iliac colon, and an end-to-end junction was performed between the proximal portion of the transverse colon and the sigmoid flexure. The wound of entry was excised widely and "Carrelled"; a temporary caecostomy was then performed. Apart from massive collapse of the lower lobe of his left lung and some trouble with the laparotomy wound, the patient made a good recovery, and was evacuated to the base a month later, and subsequently to England.

CASE III.—*Penetrating Wound of Abdomen; Perforations of Jejunum Sutured; Resection of Small Intestine; Wounds of Sigmoid Resected.*

Pte. C. W. was admitted into a casualty clearing station in the early hours of a January morning with a penetrating wound of the abdomen, due to a fragment of shell. After the patient had been warmed and resuscitated for a couple of hours, the abdomen was opened, and nine or ten perforations of the jejunum were sutured, and in addition a resection of 18 in. of small intestine lower down was performed. Four wounds of the sigmoid were found, two of which were on the mesenteric border. As the bowel was in a state of infarction, the damaged portion was resected, and an end-to-end junction made. The foreign body was removed from the musculature of the left flank, and the damaged tissues widely excised; a temporary caecostomy was performed. The patient's recovery was uneventful, the caecostomy closed after ten days, by which time the rectum was acting satisfactorily, and he was evacuated to the base in three weeks, and subsequently went to England. Curiously enough, this patient's father had undergone an abdominal operation at my hands in Middlesex Hospital some few years ago.

CASE IV.—*Penetrating Wound of Abdomen; Large Tear of the Iliac Colon; Limited Resection; Temporary Caecostomy.*

Pte. D. L. was admitted into a casualty clearing station on November 21st, 1917, with a shell wound penetrating the left side of the abdomen. The fragment had entered the left iliac fossa in front and had passed downwards and backwards, shattering the anterior part of the crest of the ilium and emerging over the left hip. There was at least a pint and a half of fluid in the lower part of the abdominal cavity, consisting largely of blood, but also of extravasated intestinal contents. Some fourteen hours had elapsed since the patient was hit, and this fluid possessed a distinctively offensive odour. The damaged segment of the colon was resected—about 2½ in. in all—and an end-to-end union performed. The wounds of entry and exit were widely excised, the loose fragments and the damaged bone were removed, and Carrel's treatment carried out with vigour; temporary caecostomy was performed. The patient made a good recovery, and by the time he was evacuated to the base his lower bowel was acting satisfactorily, and the caecostomy had closed.

Two of these cases are of special interest, inasmuch as they are resections, not only of portions of the large intestine, but also of the small. Satisfactory accounts of these two were obtained on April 23rd.

I would reiterate that the operation of excision of a damaged portion of large intestine is by no means advocated as an alternative to suture, but as an expedient to which it is sometimes justifiable to resort. The narration of the above cases will show that they have all been of a severe type, and that two, indeed, have been double resections. The purpose of the paper is merely to show that caecostomy is a measure of safety in cases of resection, and that the latter operation is justifiable in a certain few cases of gunshot injury. These cases have been operated upon in an advanced clearing station, which in its operating theatre and in the heating arrangements of the wards bore the impress of the engineering and architectural abilities of its then commanding officer; but I have also been fortunate in enjoying the assistance of an anaesthetist and of operating theatre sisters of far more than ordinary skill.

Sir Harold Stiles has very kindly allowed me to make use of his name in connexion with this communication, and in a personal letter he writes: "Whenever I resect a carcinoma, an artificial anus, or a faecal fistula of the distal half of the large intestine, the last step in the operation consists, as a matter of routine, in stitching a small area of the caecum to the abdominal wall, so that a small opening can be made into it at the end of twenty-four or forty-eight hours." I very gratefully acknowledge my indebtedness to him for this valuable hint in surgical technique, for although I have usually made my opening in the caecum at the same time as the resection was performed, and although the minutiae of the actual operative procedure may differ, the idea I learnt in visits to Sir Harold at the Chalmers Hospital, Edinburgh.

For permission to use the notes of the military cases included in this paper I am indebted to Lieut.-Colonel E. F. L'Estrange, R.A.M.C.

THE LOCAL APPLICATION OF LIQUID GLUCOSE IN THE TREATMENT OF CERTAIN SUPER- FICIAL BACTERIAL INFECTIONS.

BY

T. H. C. BENIANS, F.R.C.S.ENG.,

PATHOLOGIST TO THE PRINCE OF WALES'S GENERAL HOSPITAL,
TOTTENHAM.

THE object of this note is to call attention to a method of treatment which in certain conditions that I have observed has produced very good results and which is perhaps deserving of wider use.

Glucose is in frequent use in the laboratory as a bacterial foodstuff, and its application to the site of an infection might at first seem not to be in the best interests of the infected host. But it may be that there are other ways of frustrating the ill effects of the invading bacteria than by their partial destruction with disinfectants. For instance, by altering the nature of the substrate on which they are acting, their products might be rendered less harmful; or the infected region might be made more suited as a nidus for some harmless organism which would then more easily displace the pathogenic one.

The following factors have to be considered to bring about an understanding of the principle which I have tried to exploit in the adoption of this method, and these will be the best guide to its use in any particular instance in which it may seem to be indicated.

1. Almost all pathogenic bacteria are capable of fermenting glucose, some of them, however, much more slowly than others.
2. During fermentation a definite acidity of the medium is produced.
3. Many of the bacterial toxic bodies, using the term in its widest sense, are formed to the greatest advantage in a definitely alkaline medium, and the production of these substances is in some cases distinctly inhibited by the presence of glucose; diphtheria toxin is an instance in point.
4. Stinking discharges are in most cases due to the tryptic digestion of proteins, and this is a form of enzyme

action which can only go on to advantage in an alkaline substrate, and which ceases in the presence of even a slight degree of acidity. This form of digestion, as it may be called, is analogous to that which goes on in the intestine with the formation, among other stinking bodies, of indol and skatol. The formation of indol by bacteria is said to entirely cease in the presence of a very small amount (0.25 per cent.) of glucose. That, as a matter of fact, I think, must depend on whether the particular bacteria ferment glucose rapidly or whether they first commence to digest the proteins. Certainly some bacteria, as, for instance, those causing the foul smell in ozaena, will produce a small amount of indol in the presence of considerable amounts (4 per cent.) of glucose.

Bearing these factors in mind we can briefly consider the clinical conditions in which I have tried this method, or seen it tried. In these infections the bacteria are carrying on their existence outside the body—that is, on the skin or mucous membrane, and not in the tissues themselves. In a sense these conditions are analogous to the "carrier" states with which we are familiar in certain other diseases, notably in meningococcus and diphtheria infections.

Bromidrosis.—This is a condition of stinking sweat, which, as I have shown, responds rapidly to the local application of glycerin.¹ I have as yet had only one opportunity of treating a case with glucose, but in this instance it was effective, as in those cases treated with glycerin.

Ozaena.—This condition of fetid rhinorrhoea is in most cases due to a massive infection of the nasal mucosa with a specific organism, the principal characteristic of which, as far as we are concerned here, is that it grows very freely in neutral broth, producing much indol and a very foul smell. It grows with difficulty in acid broth (+30 and upwards) and there is no smell and no production of indol. It grows fairly well in 4 per cent. glucose broth without any smell, and with a gradual production of acidity, and in this culture, as in the acid cultures, it rapidly dies out. A considerable number of cases of this condition have been treated by Mr. C. H. Hayton at my suggestion both with glycerin and with glucose, by swabbing over the mucosa of the nose once or twice daily with a 25 per cent. solution, with the result that the secretions of the nose have become acid, and the specific bacilli have been to a large extent, in some cases completely, killed out, and replaced by staphylococci and streptococci, the foul smell and the incrustation of the nose clearing up concurrently. I am at present only vouching for the principle of this method of treatment, which seems to hold the elements of success. The final results as to permanency of cure or mere alleviation of symptoms in these cases we hope to embody in a later paper. At present glycerin has given the better results, probably on account of its special physical properties; but it is difficult to obtain.

Chronic Otorrhoea.—Mr. Hayton tells me that he has treated several old-standing cases of this condition with success. Others who have tried the method in these cases say that they have seen no improvement. Obviously the mechanical conditions here may be totally different from those met with in a mere mucous membrane infection.

Chronic Vaginal Discharge.—At the Tottenham venereal clinic, in conjunction with Mr. E. Gillespie and Mr. F. L. Provis, I have had the opportunity of observing and treating a number of cases on this principle. Most of them were long-standing instances of persistent discharge not reacting to disinfectant douches. Some were known to be of gonococcal origin, in some there was no proof that they had had this infection at any time, and the condition seemed to be due more to the faulty anatomical conditions not uncommonly found in multiparae. The treatment was carried out by the patients themselves either by douching twice daily with a 25 per cent. solution of liquid glucose in warm water, or by the introduction nightly of a glucose pessary (25 per cent. glucose made up in a gelatin basis). We found in most cases that the purulent discharge rapidly diminished, in some cases it cleared up completely, and the vaginal secretions resumed their normal acid reaction. We are not prepared to assert that the condition can be cured by this means; some cases have relapsed after being clear some months since discontinuing treatment, some have not at present relapsed, but in any case to assert a