Remarks

ON

THE TREATMENT OF INFECTED, ESPECIALLY
WAR, WOUNDS.

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If any one had told me two years ago that it would be possible to treat large infected wounds in such a manner that they required no special drainage, that they could be safely closed by sutures at any period of their progress, and that the dressings used for them could be left unchanged for from one to six weeks, with a knowledge that healing was making steady progress, I could not have believed it. There cannot now, however, be any doubt of all of these statements, because each one has been proved in hundreds of instances, not only by my cases but by those of others.

These results have been achieved, firstly, by thorough cleaning of the wound and its surroundings, and then the use of antiseptics.

The antiseptics are 1 in 20 carbolic lotion for the skin, cleaning with alcohol and the use of an antiseptic paste for the wound.

The following directions are those given by Sergeant Hunter, dispenser to the Northumberland War Hospital, for the preparation of the paste:

Preparation of the Paste (Bipp).

Iodoform 16 oz., bismuth subnitrate 8 oz., liquid paraffin 8 fl. oz., or a sufficient quantity. The powders are mixed together in a mortar, and the liquid paraffin incorporated. The quantity of liquid paraffin required varies according to the bulk of the powders, the bismuth in particular being liable to a considerable variation in bulk. A sufficient quantity should be added to form a paste. It is then advisable to rub down the paste, in small quantities at a time, on a slab with a spatula, to ensure freedom from grit and dry particles of powder.

I have called this paste "Bipp" because the name indicates its constituents and their proportions, and because a short title is convenient.

One drawback of this method, to which others as well as myself, in both of my published papers, have drawn attention, is the risk of iodoform and bismuth poisoning. (See also Case I.) In our earlier work we used the paste too generously, with the result that some patients suffered from absorption. Since smearing the surface of the wounds and rubbing in the Bipp, removing any excess, we have had no trouble of this sort.

Another drawback is that as iodoform and bismuth are both opaque to x rays, there may be difficulty in the discovery of foreign bodies and unsatisfactory pictures of fractures taken after the paste has been applied.

The method is not ideal—I have never claimed that for it—but the advantage to patients in saving of lives and limbs and suffering, and to those in charge of them in work anxiety and expense is so important at the present time that I feel no hesitation in repeating, to a large extent, what I have previously stated elsewhere.¹ The clinical, bacteriological, and chemical effects of this treatment have been dealt with in two papers² by Drs. Louisa Garrett Anderson, Helen Chambers, and J. N. Goldsmith, with such efficiency that it would be difficult to add anything to them.

My present object is to draw further attention to the technique, which though very simple is seldom carried out quite as I have suggested. It is certain that better methods will be, and may already have been, found; but some of the failures I have seen have clearly been due to faulty surgery and not to the method of treatment. About half of the patients in the latest convoys sent to the Northumberland War Hospital have been so treated. In spite of some incomplete successes all of my colleagues there are agreed that the best wounds by far result from it.

In my previous papers I have tried to emphasize the value of my method in fractures by records of cases and a statement of some results. Compound fractures of all the bones can now be treated with as great ease both to the patient and surgeon as simple fractures are.

Though it is desirable to see the bottom of all wounds, it may be occasionally unwise. A through-and-through

wound, with small entrance and exit openings, may be generally cleansed satisfactorily by passing a long strip of gauze through it and pulling this to and fro as a first step, next by doing the same with a strip of spirit gauze, and finally depositing a layer of Bipp on the inner surface of the wound by spreading a long strip of gauze with the paste, passing it through the track and rubbing in the medicament by pulling the gauze backwards and forwards again and again.

Dissecting out the wound is unnecessary, and in the hands of surgeons who are insufficient anatomists may be dangerous. The most that should be done in this respect is to remove only such portions of tissue as are obviously dead. The drier a wound can be made the better, but some hæmorrhagic oozing does not bar success.

Several wounds bipped at the front have arrived here with drainage tubes or tissue drains or gauze packs in them, and most of them unsutured. Presumably this is from fear of gas infection, and this is too serious a question for any one not dealing with many fresh wounds to attempt to answer, and even with much opportunity it should take considerable time and careful handling. My own experience has been that the fresher wounds are the better they react to Bipp treatment, and I have now closed several without tube or other drainage than is allowed for between interrupted sutures, not too close together. From these the bacteriologist has cultivated *Bacillus perfringens*, tetanus, and a variety of other anaërobic organisms, but the results have always been good.

Silkworm-gut sutures appear to be favoured at the front, and for ordinary septic wounds I recognize that they are best. Thick sterile silk, soaked in tincture of iodine, or dry and rubbed all over with Bipp (for this hint we are indebted to Major Home of the New Zealand Army), is, I think, better for bipped wounds. Silkworm gut is more likely to cut through, and as sutures should be left for a longer time than ordinary, and take a larger, deeper bite of the tissues, silk seems more satisfactory. Especially when granulating surfaces are brought together union is slower than when fresh surfaces are joined, and if sutures be removed too soon, wounds which appear to be healed may open up again; therefore our rule is to leave the sutures for three weeks. For the skin alone, and as accessories, silkworm gut is efficient.

With very few exceptions I close the wounds with interrupted sutures, and even in those most acutely infected have seen no bad results. Indeed, it is especially in such cases that our greatest triumphs have been evident. (See Cases II and IV.)

After the first dressing has been removed, if the wound is clean, granulating, and superficial, we generally now discard Bipp and use ordinary daily dressing, which allows of more rapid healing.

We treat all our wounds with Bipp unless they are small, or superficial, or obviously doing so well as to be best left alone. In some instances, however, especially in cases of compound fracture of the femur which appeared to be so well as to require no heroic measures, we have had to regret this conservative attitude. A flare up later has necessitated free opening and the treatment which should have been undertaken earlier, before active, widespread infection made it both more serious and more difficult.

CASE I.—Case of Bipp Poisoning sent from the Front,
with Multiple Wounds.

A private was wounded on June 22nd, 1917, by a shell. A note from France says:

"June 22nd, 1917. C. C. S., penetrating wound from radial to ulnar side, right forearm. Splinter punctures left hip, thigh, and foot. Abrasions right thigh and lower leg. Incised wound right scapular region. Forearm wounds excised. Foreign body removed. Elbow-joint opened; internal condyle chipped. Bipp.

"June 23rd. Two superficial wounds back closed over Bipp, three wounds, buttock explored; one small piece of metal found; track led to coccyx, which was fractured; third track led into glutei, but did not suggest penetration. All tracks were small; Bipp in each. Right elbow opened on inner side; wound excised with long fragment track, and joint filled with Bipp and closed."

On admission to the Northumberland War Hospital on July 16th, the note made was as follows: A fair, pallid, delicate-looking man of poor physique and with old pyrrhoea. No pain in any of his wounds. Over radial border of right forearm, 2 in. below the elbow, an incised wound, 2 in. long, covered with a scab, healed stitch marks on either side. Over flexor surface of right elbow-joint near ulnar border, a round wound size of a

* This is the type of patient most likely to suffer.

shilling, with Bipp in its depths and very little discharge. This lay in the centre of an inner wound, about 5 in. long, and healed in the rest of its extent and with stitch marks on either side. The remaining wounds were all in satisfactory condition. There was a blue line on the gums at the roots of all the teeth. Though the patient showed no general or local symptoms of poisoning, it seemed as if serious absorption of bismuth was probable.

CASE II.—Case of Compound Fracture of the Ankle-joint: Acute Infection.

A stout alcoholic woman of 60 was admitted to a private hospital on Monday, January 15th, 1917.

History.

On the Saturday night previous to her admission she was getting off a tram car and "went over" on her left ankle. She had great pain but managed to walk home, about five minutes' distance. The doctor who saw her found a compound fracture of the left fibula near the ankle-joint. Her foot was lying on its outer side, and was displaced backwards. X rays showed fracture of the left fibula $1\frac{1}{2}$ inches above the ankle-joint, fracture of the inner malleolus of the tibia, and displacement of the foot outwards and backwards.

The patient came under my care sixteen days after the accident. I am indebted to Dr. Eleanor Walkinshaw for these notes:

She never did well from the time of the accident (see Chart 1)—always complaining of pain in her leg and sleeping badly. I think it probable she would have developed delirium tremens but for a plentiful supply of egg and milk and rum.

Operation (by Professor Morison).

On January 31st the foot and lower part of the leg were swollen to double their normal size, the skin covering the lower third of the leg and foot was bright red and oedematous, and deep fluctuation could be felt.

A long incision—about 6 inches—was made upwards on to the leg and downwards on to the dorsum of the foot from the suppurating wound over the lower end of the fibula. From 4 to 6 oz. of pus escaped. The pus had burrowed upwards between the extensor muscles under the deep fascia and downwards into the ankle-joint. A portion of loose bone was removed from the lower end of the fibula, and the fracture was found to communicate with the ankle-joint. A finger in the ankle joint found the head of the astragalus bare. The edges of the wound

I thought it unlikely that she had any chance of recovery except by amputation, and I do not doubt that any surgeon would have agreed with such an opinion. I know of no other means which could have been used to save this life and leg.

CASE III.—A Fresh Gunshot Wound Treated with Bipp.

Notes by Dr. ELEANOR WALKINSHAW.

History.

The patient was brought in within six hours after having his foot badly lacerated by a shot from a sporting gun. He and his brother were walking together—the latter carrying a loaded gun muzzle downwards, which somehow went off and wounded the patient.

On Admission.

The foot was found to be badly lacerated, and the fourth and

fifth toes and a considerable portion of the outer part of the foot were missing. The jagged ends of the metatarsal bones were projecting into the wound. The second and third toes were damaged beyond repair, the soft parts being pulped and the phalanges fractured.

CHART 1.—Case II. A, Admitted. B, Aperient. o, Operation. c, Wound dressed.

Operation (by Professor Morison).

Soon after admission amputation of the second and third toes was completed. The foot was trimmed up, and the projecting bits of the metatarsal bones were removed. The whole wound was dried, swabbed with spirit and bipped. The skin, some of it badly damaged, was sutured over under tension, with thick silk sterilized and steeped in tincture of iodine. The skin that was damaged and tense was scored all over.

After-Progress.

A fortnight after the operation (see Chart 2) the wound was dressed for the first time. The dressing was almost dry. The large inner part of the wound was healed, but at the outer portion where tension had been greatest and the skin most damaged, there was an area of 1 in. to $1\frac{1}{2}$ in. still unhealed. Bipp was applied again.

January 27th, 1917. Wound quite healed. Patient went home.

CHART 2.—Case III. A, Wound dressed; almost healed. B, Wound dressed; all healed.

were separated by retractors, and the whole of the infected cavity was exposed. It was carefully cleansed, first with dry gauze, then with spirit gauze, in every part of it. The whole interior was then scrubbed with Bipp, including the ankle-joint. The incision wound was closed with five thick silk interrupted sutures soaked in tincture of iodine, but the edges of the original wound could not be brought together. The wound was dressed with Bipp spread on sterile gauze, and over abundant cotton-wool two lateral Gooch splints were applied.

After-Progress.

The night after the operation was the best the patient had had since her accident, and she rapidly recovered her appetite, sleep, and health. (See Chart 1.)

First dressing, February 15th (fifteen days after operation).—There was very little discharge on the dressing, not more than $\frac{1}{2}$ oz. of dark, slimy, thick matter. The incision wound had entirely healed and the sutures were now removed. The original wound was dressed with Bipp, the leg was bandaged in plaster of Paris, and the patient went home.

Second dressing, March 15th (one month after the first).—The plaster was removed, the wound was found to be entirely healed, and the patient was sent home "cured" after her accident. In three months' time she was walking about well.

When I found the condition of this leg and heard the history of the patient's habits and general condition,

CASE IV.—Wound of Hand, Infection of Palmar Bursa probably through Tendon Sheath of Little Finger.

Notes by Dr. NORAH MURPHY.

A private, aged 19, admitted to the Northumberland War Hospital on July 16th, 1917.

History.

Wounded at Ypres on July 6th by shrapnel. Sent to casualty clearing station same day. Note states: "Fourth and fifth fingers removed, wound excised and fracture of carpus—bipping." First inoculation July 6th; second July 9th, because patient showed slight tetanic symptoms.

On Admission.

Hand.—There was an extensive granulating wound extending from the base of the thumb along the radial side of the second metacarpal to the base of the first two fingers down on to the palm and up as far as the wrist. The whole hand, excepting the thumb and index finger, which were fairly movable, was one large wound (see Fig. 1). The fourth and fifth fingers with the corresponding metacarpals had been removed—the third finger was dislocated at the metacarpo-phalangeal joint, and the metacarpal bone was fractured. The extensor tendon to this finger stretched across the dorsal aspect of the wound as a slough. The edge and granulations looked well, there was very little discharge, but on pressing the lower third of the forearm

some pus escaped from the upper part of the wound. The wrist-joint was slightly swollen and a little red. There was no oedema.

Head.—There was a small penetrating wound over the left malar bone; looked clean; had been bipped. Patient had a "black eye" on left side.

FIG. 1.—Condition of hand on admission (Case 1).

Thigh.—Along inner side of left thigh immediately above the internal condyle of femur there was a clean, granulating wound, about 5 in. by 2 in. in size; it had been bipped.

General condition of patient good, but temperature and pulse raised.

First Operation.

On July 20th the forearm was incised on the palmar surface just above the radial side of the wrist-joint; free communication with dorsum made. Bipping. No sutures. Small piece of loose bone removed from left malar.

July 26th. Temperature and pulse still high (see Chart 3). Hand fomented; free discharge of seropus.

Second Operation.

On July 27th the upper edge of the dorsal part of the wound was reflected, and about ½ oz. of thick yellow pus let out. The carpal bones were found to be embedded in pus; all removed excepting the pisiform, trapezium, and trapezoid. There was a tiny erosion of the cartilage over the lower end of the radius. Bipping. No sutures.

July 30th. Temperature and pulse still high. Face wound healed. Hand fomented. To be operated upon to-morrow.

Third Operation (first by Professor Morison).

On July 31st the wound on the flexor surface of the forearm was enlarged sufficiently to expose the whole of the palmar bursa. Good through-and-through communication made with dorsum of hand. Wound cleaned, first with dry gauze, then spirit gauze, and finally bipped gauze pulled through and Bipp rubbed in by to-and-fro movements of gauze. Wounds closed with thick silk sutures.

August 1st. Temperature normal, pulse 100. Patient very well. August 7th. Temperature and pulse normal.

Fourth Operation (second by Professor Morison).

On August 10th an incision made along the ulnar side of the middle finger; phalangeal bones removed. The skin of the finger was turned down over the wound and practically the whole granulating surface covered (see Fig. 2), leaving only two

FIG. 2.—To show condition after operation. The crosses indicate stitches. The transverse marks on the transplanted flap represent scores into the skin to diminish oedema as an aid in the prevention of gangrene.

small areas about ¼ in. on uppermost edge uncovered by skin. The flap was sutured loosely with thick silk, and cross incisions made over the skin surface (see Fig. 2). Bipp gauze laid over the stump. There was very little bleeding on removing the tourniquet.

August 11th. Patient very well. No rise of temperature.

August 24th. First dressing after second operation (fourteen days). Dressing blood-stained, almost dry. No sign of infection of wound, and finger appeared to have healed over raw

area. Sutures undisturbed. (The dressing was done to show surgical visitors the case, otherwise it would have been left unchanged for another week.)

August 31st. Healed except for small granulating area size of a 3d. piece on dorsum at root of thumb. All stitches removed.

Gunshot wounds of the knee-joint are reported among the most serious injuries. My personal experience of them has been limited to wounds of some duration, so that I can only suggest a method for trial with Bipp.

Clean bullet wounds so often heal well that they are exceptions, and should be dealt with on ordinary lines. If the joint goes wrong, or the injury is complicated by a fracture, or the wound is due to large shell fragments, my treatment would be:

1. Apply extension strapping or glue dressing below the knee.

2. Disinfect the skin surrounding the wound and the joint (1 in 20 carbolic).

3. Apply a tourniquet.

4. Cover up everything except the knee with sterile and moist antiseptic towels.

5. Open the joint through a horseshoe-shaped incision, dividing the patellar ligament and the musculo-aponeurotic structures on each side of the joint, but avoiding damage to the lateral ligaments on either.

6. Reflect the patella, exposing the joint and subcutaneous pouch. Mop—gently, very gently, not scrub or wipe—with dry sterile gauze, any discharge from both.

7. Flex the joint fully, and clean the posterior portion of the cavity by gentle dry mopping.

8. Gradually extend the joint; fill it with spirit and gently mop dry.

9. Remove the tourniquet with the limb elevated to a right angle, and keep it there with the joint compressed under gauze pads for four minutes. Then clamp any bleeding points with Lane's haemostatic forceps.

10. Rub a thin layer of Bipp over the whole joint surfaces with a finger. Rubber gloves are understood.

11. As soon as bleeding has ceased suture the patellar ligament with strong mattress sutures and close the remainder of the deep incision with interrupted catgut sutures, holding the joint capsule with interrupted sutures of fine catgut. Close the skin with interrupted sutures of thick dry sterile silk smeared with Bipp.

12. Dress the wound with gauze wrung out of spirit, and over this abundant cotton-wool but no bandage.

13. Fix the limb with two—inner and outer—Gooch splints, the inner reaching from perineum to sole of foot, the outer from tip of trochanter to sole. On top of the ordinary bandage apply an oblique one at the top, another above and below the knee, and one above the ankle, of plaster-of-Paris.

14. As soon as the patient is in bed apply a 15 lb. weight for continuous extension.

Unless there is need the dressing should not be changed for three weeks. As soon after as the wound is healed movements and massage should commence.

Preparation, Sterilization, and Keeping of Bipp.

Mr. Sidney Dunstan, chemist and dispenser to the Royal Victoria Infirmary, has supplied a note as to his preparation and sterilization of Bipp and for keeping it in very convenient tubes.

The method adopted by myself in making Bipp is as follows:

Iodoform	...	...	...	440	grams
Bismuth subnitrate	...	...	...	220	"
Paraffin	...	...	...	220	"
			M.S.A.		

The bismuth and paraffin are sterilized by dry heat at a temperature of 120° C. for half an hour, the bismuth after

cooling is mixed with the iodoform in a mortar which has been sterilized by means of boiling water and formalin. The paraffin is added to the mixture at a temperature of 90° C. and thoroughly mixed, then put into specially made collapsible tubes with nozzle ends, holding 40 to 80 grams. The paraffin used should be semi-solid, odourless, and tasteless, melting point 45° C., free from acidity and carbonizable organic impurities. The iodoform should be free from moisture, acids, and fixed impurities. It is also necessary that the bismuth be chemically pure, free from arsenic, and care taken in sterilizing that the temperature does not rise too high, otherwise nitrous fumes will be evolved.

A paste made by this method is found to be fairly solid in consistency, shows no signs of separation or decomposition, and is perfectly sterile, as certified by Dr. Slade, bacteriologist to this infirmary.

Should a paste be required of a softer consistency the formula may be modified as follows:

Iodoform	...	...	...	440	grams
Bismuth subnitrate	...	...	...	220	"
Paraffin base	...	...	...	220	"
M.S.A.					

Paraffin base:

Paraffin melting point 45° C.	...	...	19	parts
Paraffin liq., sp. gr. 880	...	...	40	"

Special tubes with keys, suitable for the above preparation, can be obtained from Whitelaw and Co., Saville Row, Newcastle-on-Tyne, and tubes ready charged with Bipp sterilized according to my method are obtainable from the Numol Company, 3, College Street, Newcastle-on-Tyne.

Though this method has been used chiefly for war wounds it is applicable, as Case II shows, in civilian cases. My colleague, Dr. Samuel Whyllis, tells me that the method has revolutionized mastoid surgery, and I have a report from a London throat and ear surgeon telling me how much benefit had followed its use in his work—in mastoid cases.

Summary of Technique.

1. Under an anaesthetic, usually open ether, cover the wound with gauze wrung out of 1 to 20 carbolic acid, and clean the skin and the surrounding area with the same lotion.

2. Open the wound freely and, if possible, sufficiently to permit of inspection of its cavity. A guide—a finger is the best if the size of the wound permits of it, and if not a thick probe—should be introduced to the bottom of the wound and held there and fully exposed. In doing this special regard must be paid to nerve trunks and muscular branches of nerves, since the division of blood vessels, excepting the largest, and of muscles themselves does little harm as compared with that of the disability following nerve damage. Cleanse the cavity with dry sterile gauze mops, Volkmann's spoon, etc., and remove all foreign bodies.

3. Mop the surrounding skin and the wound cavity with methylated spirit and dry it.

4. Fill up the whole wound with Bipp, rub it well in with dry gauze. Then remove all excess, leaving only a thin covering over the wounded surface. Dress the wound with sterile gauze and cover all with an absorbent pad, which is held in position by sticking plaster and a bandage. This dressing requires no change for days or weeks if the patient is free from pain and constitutional disturbance. Should, however, discharge come through, the stained part must be soaked in spirit and a gauze dressing wrung out of the same applied as a further covering.

Redressing is very simply done. After removal of the old dressings the wound is covered with a dossil of wool soaked in spirit, and the sticky dirty-looking discharge is wiped off the surrounding skin until it is clean.

I am indebted to Colonel Adams for leave to publish the military cases.

REFERENCES.

- ¹ *Lancet*, August 12th, 1916; *British Journal of Surgery*, April, 1917.
- ² *Lancet*, March 3rd, 1917.

DR. WARDELL STILES of the United States Public Health Service urges careful examination of all recruits of the National Guard and National Army, especially from the south, for hookworm. The parasite was found in forty-seven among seventy-five recruits. Dr. Stiles calls attention to the great danger of carrying the infection from America to Europe.

REPORT ON WOUND TREATMENT BY BRILLIANT GREEN PASTE.

BY

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It has been abundantly proved by experience that to secure efficient sterilization of an infected wound it is necessary to apply antiseptic remedies, not occasionally, but continuously. There are two means of obtaining this end. The one is the use of the Carrel method of frequent introduction of fluids through rubber tubes, and the other is the thorough application of a paste to every hole and corner of the wound, as exemplified by the popular bipp of Rutherford Morison. Both these methods have drawbacks. The Carrel technique needs much attention, and when the patient is travelling this may not always be secured. The soaked dressings need daily changing. The tubes are liable to come out and it may need an anaesthetic to replace them. In "straft" times it may be frankly impossible to devote sufficient time to carry it out.

Bipp is much less trouble, but presents drawbacks of another sort. It is occasionally poisonous, either from the bismuth or the iodoform, or both. It may delay healing; when the stitches are taken out after secondary suture the wound may fly open. It leaves a residue in the tissues, opaque to the x rays, which may give rise to trouble later. One of us has seen an unnecessary operation in England to remove iodoform from a hole in a tibia, suggesting in the skiagram a metallic fragment; and on another occasion, in civil practice, iodoform put into a tuberculous os calcis two years before was mistaken for a sequestrum.

We have therefore been employing for some months the paste introduced by Captain Hey, after long research into many methods, consisting of brilliant green, boric acid, French chalk, and liquid paraffin. It presents the following advantages:

1. It is non-poisonous. The symptoms of boric acid poisoning—persistent vomiting and a peculiar rash—should be watched for, but although in many cases we have used very large quantities of the paste we have seen no ill effect result from its use.

2. It is painless.

3. In the great majority of cases it almost completely sterilizes the wound in three days, so that secondary suture can be performed even in large wounds complicated by bony injury. Small, completely excised wounds can be primarily sutured.

4. The wound need only be dressed about once in four days.

5. No permanent residue is left to interfere with immediate healing.

Before applying the paste the wound must be thoroughly opened up and excised, and any foreign bodies removed. If this is not possible—for example, in a shocked patient with multiple wounds or with a long deep track exposing important structures—we prefer to use Carrel's method. The paste is only to be applied if it can be applied completely. The wound ought to be dry and not bleeding, but a certain amount of oozing can be checked by a gauze plug (preferably paraffin gauze, which is easier to remove). The paste should be rubbed in thoroughly. It soon washes off the skin or gloves.

By this method we have been able with fair consistency to obtain healing within a fortnight of cases of compound fracture even when complicated by joint injury, big buttock wounds and deep muscle wounds. We have excised an elbow-joint full of pus, and obtained primary healing in a fortnight.

The usual procedure is to stain the track of the missile, excise and paste it, and either leave it open or insert a few central sutures. On the third or fourth day a smear of the deepest part of the wound is taken. If *B. perfringens* is absent, as is almost invariably the case, and the organisms are not more than six to the field, we completely close the wound by secondary suture. Often the