

## NOTES ON SURGICAL WORK IN A GENERAL HOSPITAL WITH SPECIAL REFERENCE TO CARREL-DAKIN'S METHOD OF TREATMENT.

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THE following is written from notes made by me during the period of seven and a half months when I acted as officer in command of the surgical division of a general hospital at a port of embarkation.

The situation of the hospital made it necessary that a certain number of beds should be left in reserve for cases from ambulance trains and ambulance transports when from any cause Cross Channel traffic was held up.

During the period under review battle casualties were treated, also 481 operations under general anæsthetic were performed on local admissions.

Cases admitted had been treated by the various methods advocated for war surgery.

(1) *Flavine*.—A number admitted from a casualty clearing station had been treated by flavine and Z paste and had been kept by that casualty clearing station for a period of from six to ten days. The results were exceptionally satisfactory. The wounds in nearly all were closed, in some the sutures had been removed, in others the sutures were removed in this hospital. Only two showed signs of inflammation, one of these was a case of very severe multiple wounds which would account for the incomplete operation performed. Where the patient can be kept under observation and an early and complete operation performed, this seems an ideal method of treatment.

(2) *B.I.P.P.*.—Cases did not arrive in the same satisfactory condition, most of them were thoroughly septic and one was not favourably impressed by the results of this method in the cases admitted. In my practice, with two exceptions *B.I.P.P.* was used only as a sequel to Carrel-Dakin's method when the wound surface had become flat or too small for the application of Carrel tubes. In the latter part of the period it was replaced by chloramine four per cent in vaseline.

(3) *Salt Pack*.—Cases arrived bathed in foul smelling discharge; gas gangrene cases arrived with this dressing. Salt dressings were continued for a short time by one surgeon. *Bacillus pyocyaneus* was a constant complication and the hæmorrhagic granulations were a constant drain on the patient's vitality.

One personally preferred a method which was not accompanied by the odoriferous dressings the salt pack entails.

(4) *Carrel-Dakin's*.—These invariably arrive in good condition and if the complete operation had been performed and the technique strictly carried out it was often difficult to realize that the patient was suffering

from a dangerous wound. An example of this, an officer friend of mine, arrived after a very long train journey. He was sitting up on his stretcher looking quite fit. Ten days previously he had been hit by a piece of shell-casing two inches by one inch in the right lumbar region, there had been a nasty jagged wound and rupture of the colon. Operation within twelve hours, foreign body and fragments of clothing removed, lacerated muscles and fascia excised, and rent in colon closed. Carrel-Dakin's dressings. On admission temperature normal, one Carrel tube in superficial wound, remainder closed and healed.

Carrel-Dakin's method gave the greatest satisfaction to me and was carried out thoroughly with the following technique. X-ray photos accompanied the patient to the theatre. Ether soap followed by methylated spirit and two per cent iodine were used to disinfect the skin. Free incisions were made exposing all injured structures and opening up dead spaces, foreign bodies, if present, were removed and fragments of clothing looked for; all dead tissues, fascia, muscle and fragments of bone without periosteal attachment to the shaft were excised and all bleeding and oozing were controlled. Carrel tubes were then placed in every part of the wound so as to ensure flow of antiseptic towards the surface. Gauze soaked in Dakin's solution was placed lightly on the tubes. The adjacent skin surface was spread with gauze soaked in sterilized vaseline. The dressing was completed by applying a large Carrel dressing held in place by wooden clothes line pegs. When the general condition of the patient made speed imperative and the local conditions made complete operation dangerous, the injured part was rapidly explored, incisions made to allow the Carrel tubes to reach the depth of the wound. This manoeuvre was so satisfactory that a second and complete operation could be performed without danger of septic absorption. As regards after-treatment, the surgeon assisted by a sister, nurse and orderly, no more than one has for any other method, could carry out the dressings. The same preparations and precautions were used as for an aseptic operation as far as sterilization of dressings, instruments and gloves is implied.

The gloved hands were never permitted to touch the dressings. With each of the team doing his or her allotted part, ten large dressings could be accomplished in an hour. Sisters soon became expert in this technique and taking the place of the surgeon could carry out the dressings with success, the only difference being that the time occupied for each dressing was perhaps a little longer. Delay in rapid improvement led one to suspect errors in technique, such as insufficient opening up of tracks or in comminuted fractures, necrosis of a doubtful fragment, or tubes badly placed.

*Bacteria Counts.*—This work was very efficiently carried out by a V.A.D. nurse trained in the work. The results were charted. Variations in the curve led to scrutiny of the technique. Of 1917 admissions with

1,100 operations there were forty deaths; many of these were admitted moribund from trains or hospital ships and included 3 cases of tetanus, 2 gas gangrene, 5 fractured femurs, and 2 unoperable neck wounds, 4 knee cases septicæmic on admission, 1 secondary hæmorrhage which developed gangrene after necessary ligation of the femoral artery, 2 buttock cases (one of these had longitudinal fracture of the neck of the femur with infection of hip joint); and many severe head injuries.

The success of the Carrel-Dakin's method was obvious from the first. Secondary hæmorrhage practically completely disappeared from cases under treatment. There were three hæmorrhages, two of these were reactionary, the third was a true secondary hæmorrhage from an external saphenous vein easily controlled without anæsthetic. Patients were cheerful and happy. Dressings were not dreaded and the nursing staff were pleased with the rapid convalescence of their charges.

#### IMMOBILIZATION OF FRACTURES.

Splints of every pattern supplied by the base medical stores were on charge so that the idiosyncrasy of surgeons in this respect had full scope. The splints most in favour were Thomas's arm and leg with or without superstructure; special splints were also obtained. At the end of the period under review, two officers who made a special study of constructing splints for individual cases were attached. I had not an opportunity of seeing splints for femurs, but their arm and lower leg splints were excellent. Compound fractures both upper and lower arm were amongst the up patients very soon after admission; their apparatus, combined with Carrel-Dakin's technique gave very good results. The large Carrel dressings are supplied to this hospital by the Irish War Hospital Supply Depot, Merrion Square, Dublin.

#### NOTES ON A FEW TYPICAL CASES ARE GIVEN.

Pte. B., shell wound, right thigh, large through-and-through wound, exuding foul smelling pus, thigh brawny and tender, temperature 101° F., pulse 120. X-ray showed comminution of the shaft of femur just below the trochanteric line; there was complete destruction of four inches of the shaft.

*First Operation.*—Day of admission. Entrance wound enlarged, bone debris and tags of muscle removed and wound washed through with H<sub>2</sub>O<sub>2</sub>. Femoral artery seen and felt pulsating in the inner margin of wound. Large exit wound packed. Carrel-Dakin's dressings, Thomas's splint. Sixth day patient looks well; discharge still profuse but not foul smelling.

*Second Operation.*—Ends of bone fully exposed and spiculæ rounded off. Sloughing tags of muscles and fascia excised. Dressings as after first operation. Transferred to England twenty-nine days from date of

admission in good general condition, with good callus at ends of both fragments. Temperature, 98.6° F., pulse 72. Wound closed to a healthy granulating cup of  $\frac{1}{2}$  ounce capacity.

Pte. T., shell wound, compound fracture middle third of femur admitted with Carrel-Dakin's dressings, local condition, no swelling and no inflammation. Casualty clearing station report: "Large shell fragments removed. X-ray, comminuted shaft of femur. One large wedge-shaped fragment lying away from the shaft, small piece of metal lying between ends of bone. Good alignment of fragments."

*Operation.*—Using electric vibrator, the foreign body was felt by exploring finger and removed. The wedge of bone was replaced, Carrel-Dakin's dressings continued. Seventeen days later X-ray showed distinct callus, temperature never above 99° F., pulse 80 to 96. Transferred to England on the eighteenth day.

Pte. M., rifle bullet wound, left leg. Compound fracture femur. Brawny œdema of whole thigh. Temperature 101° F.; pulse 126. X-ray, severe comminution of  $3\frac{1}{2}$  inches of middle of shaft; fragments of bone and broken up rifle bullet embedded in surrounding muscles.

*Operation.*—The wound was opened up to the full extent of the bone lesion, a large quantity of blood-stained pus evacuated, bone debris and one piece of bullet casing removed. Carrel-Dakin's dressings and Thomas's splint, fixed extensions. The discharge became albuminous, and temperature settled down to normal by the twelfth day, but temperature rose again and the discharge became purulent. X-ray showed two pieces of necrosed bone and two fragments of bullet.

*Operation.*—Fourteenth day. The rapidly closing wound was opened up, the two sequestra were lifted out; using the electric vibrator, the fragments of bullet were localized and removed. The bottom of the wound cavity contained a quantity of bone sand. I made a counter incision and washed out the cavity, using H<sub>2</sub>O<sub>2</sub> followed by Dakin's solution. Carrel-Dakin's continued. From this date temperature remained normal. Patient transferred to England at the end of the sixth week. The counter opening was completely healed; the original wound admitted only one Carrel tube to the depth of one inch.

Rifleman S., shell wound left thigh. Entrance anterior surface, exit posterior and external. Compound fracture lower end of femur, local gas infection, knee tense and full of fluid. X-ray report, "oblique comminuted fracture, junction of middle and lower third of femur, lower fragment split longitudinally almost to the knee joint."

*Operation.*—Day of admission. Anterior wound opened up in the line of the muscle to an extent of about five inches, small fragments of bone removed, the wound washed through with hot saline, exit wound packed, Carrel-Dakin's dressings, Thomas's splint. The knee joint aspirated, about twenty cubic centimetres of cloudy fluid were removed, ten cubic centimetres one per cent formaline injected. The pathologist reported that the fluid

contained pus cells; no organisms were isolated. This patient's temperature remained unstable for one month, but his general condition improved. The knee required aspiration on two subsequent occasions. X-ray twenty-one days after admission showed necrosis of the inner portion of the lower fragments. This was removed and at the same time the knee was aspirated for the third time. Transferred to England on the fifty-fourth day. Temperature normal, wound admits one Carrel tube down to the bone, which was clean and healthy.

Pte. H., shell wound left knee. External condyle of femur almost completely destroyed. Comminution of head of fibula and outer articular surface of tibia. Temperature subnormal, pulse 120, wound foul smelling and discharging freely.

*Operation.*—Second day after admission. The knee was completely opened by turning up the flap with the patella and the uninjured inner superficial tissues; pus poured from every portion of the synovial pouch. The cartilages and ligaments were excised. Put up on bent Thomas's splint, Carrel-Dakin's dressings.

*Second Operation.*—Tenth day. Excision of the remaining articular surface of knee joint, same dressings and splints. Three days later the bones were brought together and the splint straightened. Two Carrel tubes were placed in the dead space behind the bones in addition to those on the superficial raw surface. This patient ran a high temperature until the seventeenth day, when œdema and redness were noticed over the calf; under general anæsthetic pus was found in the deep calf muscles. The temperature now settled down and remained normal. Transferred to England at the end of the seventh week, temperature normal, wound covered with smooth, healthy granulations, with apparently firm union of the bones. Dressings, chloramine ointment.

Pte. S., rifle bullet wound, thigh, left. Entrance wound one inch below Poupart's ligament, external to femoral vessels.

Condition: thigh very tense, painful to touch, wound discharge foul smelling, temperature 102° F., pulse 120. X-ray, complete destruction of neck of femur. Fracture of the acetabulum and ascending ramus of the ischium. Fragments of rifle bullet, one in region of fractured ischium, two in the buttock muscles.

*Operation.*—Wound enlarged to four inches, head of femur extracted, bone debris removed. Pus was found to be tracking up under Poupart's ligament and behind the peritoneum. Carrel-Dakin's dressings. Patient very collapsed. Intravenous saline and stimulants administered before return to ward. Seventh day, general condition not improved, temperature 102.4° F., pulse 140, very toxic, discharge fœcal odour.

*Second Operation.*—The wound enlarged upwards to Poupart's ligament. The hand passed into this wound felt the lower lip of the acetabulum and part of the ramus of the ischium lying free; both came away, and at the same time the base of the rifle bullet was removed. The cavity was filled with saline, and was twenty ounces capacity. A counter incision was made

to facilitate lavage. A large drainage tube ten inches long, with lateral openings, was passed through the counter opening into the pelvis. This opening was then packed and Carrel-Dakin's dressings continued. This case was dressed daily. The general condition improved rapidly, but temperature and pulse remained unstable for nearly three months. Three more operations were required before all the dead bone and fragments of bullet were finally cleared out. He was transferred to England four months and twenty-four days after admission, wounds completely healed, a large mass of callus taking the place of his hip joint. He was fat and looked quite well.

#### CAPTAIN BOURNE'S CASES.

Lieutenant M., gunshot wound, thigh, compound fracture femur. Lay out in a shell hole two and a half days; admitted with Carrel-Dakin's dressings and Thomas's splint. Condition, two incised wounds, lateral aspect of thigh just above knee joint, clean, granulating and discharging pus. Thigh swollen. Temperature 99° F. X-ray, "fracture immediately above condyles, no lateral displacement, slight shortening."

*Operation.*—Wounds enlarged, fracture explored, knee-joint opened, Carrel tubes down to bone and posterior to it, œdema relieved by a few superficial incisions, leg put on McIntyre splint, no extension possible. Twelfth day, wounds closing rapidly; discharge albuminous. Seventeenth day, discharge entirely clear, wounds almost closed. Thirtieth day, union of bone apparent, last Carrel removed, gentle movement of knee at each dressing. Forty-fifth day, dry dressing, good union of fragments. Transferred to England looking perfectly fit.

Lieutenant R., rifle bullet, flesh wound thigh, left; entrance and exit wounds; outer aspect of thigh, brawny induration and dark redness between the wounds; also much tenderness; patient looked very ill; temperature 101.4° F.; pulse 120.

*Operation.*—Complete opening up of track between the wounds; also of two loculi, tracking upwards and downwards. The exposed muscles looked black and sloughy. Carrel-Dakin's dressings. Temperature remained up for four days, pulse dropped to 90 on the second day; fifth day, microbe count 1 in 10, wound partially closed, skin-graft on small remaining raw area. Transferred to England with stitches removed: patient convalescent.

Lieutenant P., gunshot wound leg, right; compound fracture lower third of femur, admitted with Carrel-Dakin's dressings; Thomas's splint, wounds discharging freely; no pain or tenderness; temperature 99° F.; no operation necessary, as complete operation had been performed at casualty clearing station; Carrel-Dakin's dressings continued. X-ray, abduction of upper fragment, upwards and outwards; displacement of lower fragment; displacement reduced. For the first week temperature varied between 98° and 100° F.; discharge albuminous. Eighteenth day: Wound almost closed, Carrel-Dakin's dressings discontinued. Twenty-fifth day: Bony union obvious thirty days from date of wound. Twenty-eighth day: Transferred to England convalescent.

Captain L., shell wound, thigh, right; flesh, severe; small gangrenous entrance wound; outer aspect of thigh. There was an area of brawny induration; skin a dull red flush. Patient looked very ill; temperature 100° F.; pulse 100; considerable pain. X-ray localization of shell fragment.

*Operation.*—Free incisions, exposing gangrenous muscle; shell fragment and particles of clothing removed. Dressing eusol pack, as the general oozing could not be controlled. Second day: Pack removed; Carrel-Dakin's applied. Fifth day: Sloughs separated, wound perfectly clean, microbe 10 to field. Twenty-fifth day: Microbe count 1 in 2 fields; wound closed. This wound showed count 1 in 2 fields on the twelfth day, but patient had typical attack of trench fever, in consequence of which the operation had to be postponed. Transferred to England convalescent.

Pte. C., admitted from hospital ship which had been mined. Condition: lacerated wound of inner aspect of thigh; tissues very much soiled and lacerated.

*Operation.*—Four hours after admission; damaged tissues excised; Carrel-Dakin's dressings. Fourth day, wound closed; healed without incident.

Pte. B., gunshot wound; pelvis and rectum. When taken over, appeared to be dying. Temperature 97° F.; pulse 103. Condition: entrance wound lateral aspect of right buttock. Exit large explosive wound left buttock, both discharging faeces and pus. Unfit for operation; wounds closed cleaned. Second day: General condition slightly improved.

*Operation.*—Colostomy, glass rod passed through mesocolon; four sutures. Sixth day: Colostomy opened; colon and wounds washed out. Carrel-Dakin's dressings to wounds. Rectal examination: Transverse wound in the posterior wall deep to coccyx.

This case improved rapidly. Slept well and put on flesh, but convalescence was delayed by the following complications: (1) Superficial abscess in posterior aspect of right thigh. (2) Colostomy spur collapsed permitting faeces to soil the wounds. (3) Ischio-rectal abscess on the right side. Five weeks from date of first treatment, the buttocks wounds having almost closed.

*Operation.*—Removal of coccyx, exposure of large wound of posterior wall of rectum, which was closed with two layers of sutures. Transferred to England one month later on the high road to recovery.

Captain McD., gunshot wound left thigh; compound fracture femur. Admitted with salt pack. Condition: small entrance wound on inner side of thigh just below pubic spine. Large funnel exit wound immediately posterior to great trochanter. Upper part of thigh not unduly swollen, but profuse foul discharge escaped from exit wound when salt pack removed; and a thin turbid fluid with a few gas bubbles issued from entrance puncture; complaining of great pain. Temperature 101° F. X-ray, comminution of the shaft of femur 3½ inches; large wedge of bone, including the lower part of great trochanter lying free.

*Operation.*—Entrance and exit wounds enlarged to the bone, loose

fragments replaced in line of bone, none removed; Carrel-Dakin's dressings; McIntyre's splint, ten pound-weight extension. Fifth day: Wound cleaning, discharge less, temperature, 99° F. Tenth day: Temperature up again; discharge increased and very purulent. Fourteenth day: Second operation, wounds slightly enlarged; four sequestra removed. Large wedge still left in situ, in hope it would unite. Twentieth day: Temperature up to 102° F., wounds very dirty, discharge very offensive. Twenty-second day: Third operation. Removal of loose triangular piece of bone-forming bulk of great trochanter. The bone was rotten and cancellous tissues contained thick pus. Buttock wound slightly enlarged. Carrel-Dakin's dressings, Thomas's straight splint. Condition very bad, required intravenous saline and other stimulants before leaving theatre. From this date condition gradually improved. The limb was brought to a position of extreme abduction to keep lower fragment in line with upper fragment. Two months later, entrance wound healed, large posterior wound now a granulating cavity about  $\frac{1}{2}$  inch square. X-ray, "good alignment; callus bridging the gap between the fragments." Measurements, only  $\frac{1}{2}$  inch shortening. Still in hospital when I left.

These cases are selected as they go far to prove that the Carrel method of instilling a potent antiseptic is both a life and a limb saving technique. Cases which arrived with the treatment in progress, even though the tubes might have been displaced in transit and a further operation proved necessary, could be approached without anxiety. In some other cases I would have amputated without hesitation as the only means of saving life but for this method.

Secondary hæmorrhages need never occur if the technique is faithfully carried out. The method goes as nearly to giving complete physiological rest as it is possible. Dressings need only be 48-hourly except in very septic cases, and there is none of that terrible nerve racking which other dressings entail. Patients watch the progressive improvement of their wounds with the greatest interest.

I attended a lecture on salt pack method in 1916. One of our most eminent consultants, in summing up, stated a well known fact "When animals are wounded they go away to a quiet place and sleep and either die or get better." This was the condition of affairs implied for the salt pack dressing, but in Carrel-Dakin's technique we have the physiological rest reinforced by the scientific destruction of the local poison.

In January, 1917, I had ten days leave to Paris to study the methods of treatment at the various hospitals. I was surprised at seeing the following posted in Dr. Tuffior's wards "*Tout blessé qui suppure a le droit d'en demander la raison à son chirurgien.*" By the courtesy of Dr. Chutro in permitting me to watch various cases from date of operation, one could not help agreeing with the terms of the notice. For our base hospitals I would change the notice to read: "Wounded who continue to suppurate have the right to demand the reason from the surgeon."



## GENERAL SURGERY.

As noted in a previous paragraph there were 481 major operations of a general surgical nature. A hundred of these were for appendix conditions with ninety-eight per cent recovery. The incision recommended by Battle was used in ninety-five per cent. I modified it slightly by carrying the incision lower than recommended, by this I left the semilunar fold intact. Jackson's parieto-colic membrane was found in two cases, Lane's bands in three.

*Cause of Two Deaths.*—First: almost moribund from general peritonitis at time of operation. Second: Portuguese soldier; gangrenous appendix involving caput cæcum; died from obstruction caused by mass of fæces the size of a large orange, producing volvulus.

*Appendix Abscess.*—This condition was treated by drop irrigation with Dakin's solution, six or eight drops to the minute. The abscess cavity closed with extraordinary rapidity and cases of fæcal fistula yielded in a surprisingly short time.

I hope a full report of this will be published by Captain Bourne, who adapted the Carrel technique for this condition. One case will be sufficient to illustrate.

*Operation by the Consulting Surgeon.*

Captain X., admitted from ambulance train. Diagnosis appendix abscess. Appendix removed, pus sponged out of deep abscess cavity which tracked down to the left side of the rectum; depth of cavity 9½ inches. Second day: Irrigation commenced; discharge profuse, fæcal odour. Ninth day: Abscess cavity had completely closed, leaving small granulating wound on the skin surface; temperature remained normal from the third day.

*Enteric Ulcer.*—Two cases: Pte. B., died one month after operation from intercurrent acute general tuberculosis. Captain X. transferred to England convalescent.

*Acute Renal Cases.*

*Perinephric Abscess.*—Two; operation; recovery.

*Hydro-Pyonephrosis.*—One; operation; died.

*Acute Cholecystitis.*—One.

Operation in two stages.—First, drainage; second, excision of gall bladder.

*Note.*—A pure culture of paratyphoid bacillus was grown from the contents of the gall bladder, though there was no history of this disease. Transferred to England convalescent.

*Gastric Ulcer.*—One case, Spanish sailor. The ulcer was closed and gastroduodenostomy performed. Transferred convalescent.

In the work of a large hospital, the best results are obtained not by the work of the officer-in-charge alone, but require in addition the zealous and enthusiastic co-operation of all the staff. I wish to express my thanks, in particular to Captain Bourne, and to the sisters, whose careful attention to detail largely contributed to the success obtained in the use of the Carrel-Dakin method.