WAR WOUNDS AND AIR RAID CASUALTIES

The following is one of a series of lectures on the Treatment of War Wounds and Air Raid Casualties recently delivered at the British Postgraduate Medical School

WAR SURGERY IN SPAIN—II

TREATMENT OF SEPTIC WOUNDS

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Prophylaxis we have already dealt with. Treatment has radically altered since the days of the war of 1914–18. The advocates of irrigation now recognize that "it is the mechanical washing far more than the action of the antiseptic that is responsible for any improvement." I am boldly going to say that I doubt if irrigation will long survive at all. The principles of treatment are still as for a fresh wound—removal of foreign matter and non-viable tissue, if not already done, followed by immobilization, elevation, and non-interference. To secure the latter, open wound treatment is ideal. For the removal of non-viable tissue in an infected wound maggots are unsurpassed, and I hope this method will be developed extensively. All this remains, however, in most cases insufficient. Free drainage of pus is essential, and the simplest and surest way to obtain this is by adequate and careful, but liberal, counter-incision, with the insertion of soft corrugated rubber drains for a few days only. Perhaps one should add the further instruction not to get worried, and to remember that the soundest criterion is this: Is the patient in pain? If he is, treatment has been inadequate and must be improved. But if he is free from pain, probably all that is needed is a little patience. And I would stress both how important is this criterion of pain, and how well pain can in most cases be rapidly eliminated by correct treatment. It should also be stressed that morphine exists to be given, not merely to be withheld. A good surgeon will in these cases give morphine freely, but will also be able to cease to give it within a few days. Where the treatment is grossly incorrect, and the pain consequently severe, no amount of morphine will control it, and yet the patient will become an addict, however sparingly the drug may be given, if he survives that long.

Sulphanilamide was given to a number of my cases, but without any quotable results, although I myself felt sure that it had been effective in certain instances. I will only venture the opinion that dosage must be very large if the drug is to be given at all. I kept two patients with septic meningitis alive on it for about a week after they should in the natural course of events have died, by using dosages up to 14 grammes in the twenty-four hours. But both died in the end, after showing the most remarkable clinical improvement. In Barcelona sulphanilamide was being tried out on a large scale, but unfortunately we shall probably never know the results owing to the capture of the city and the consequent disorganization of the Republican Medical Service.

Gas Gangrene

The anaerobic infections form a special class. It must be stressed that massive gangrene leading to a fatal termination in a matter of hours comprises only a very

small percentage of the anaerobic infections that are met with in war surgery, though it remains, of course, the most important form. Prophylaxis is on the lines already indicated. The primary suture of amputations is especially liable to lead to gangrene, and I finally came to the conclusion that it should never be performed under field conditions. This conclusion is in agreement with the tendency in the great war.

The closed amputation as a cause of gangrene is only a particular instance of the danger of primary suture in general if it is not carried out with meticulous care and if the case is not kept under strict and constant observation in the immediate post-operative period. A second factor making for gangrene is ischaemia. Even a moderate degree favours the anaerobes. This is a legitimate ground for timidity in applying plaster-of-Paris immediately after operation. Nevertheless I am firmly of the opinion that it is not a sufficient ground for actually not applying plaster—at least when the case can be retained in the hospital of operation. But it is an indication for completely splitting and even opening up the plaster.

Another fact that should be stressed is the extraordinarily variable toxicity of anaerobic infection: certain localized abscesses, containing gas in appreciable quantity, may be quite without any general toxic effects. In other cases a very localized infection without any massive gangrene can lead to death in five to eight days, with a toxic jaundice and confluent bronchopneumonia. Further, it must be remembered that metastasis is very apt to occur. This is the reason why it is so dangerous not to amputate immediately a lower limb that has lost its blood supply. Other metastases occur in cases of gangrene, the organism in the new focus not necessarily being an anaerobe. For instance, the leg of a Spanish soldier aged 35 was amputated in guillotine fashion above the knee for gangrene of the leg. The open stump never showed any sign of infection, yet the man's temperature rose steadily over several days, until finally he developed jaundice and started to vomit. A subphrenic puncture on the right side drew thin stinking pus; a rib resection was performed in the expectation of finding a subphrenic abscess, but there was no sign of one. A needle was inserted into the liver and about 40 c.cm. of pus withdrawn. A rubber drain was inserted for twenty-four hours. As the vomiting continued, three litres of glucose saline were given intravenously, with some insulin. The vomiting ceased at once, and the man made an uninterrupted recovery, no further pus coming from the incision, which healed rapidly. Facilities for a culture of the metastatic organism were not available, but it was certainly not an anaerobe, as there was no gas escape on entering the abscess. The odour of the pus was that of *B. coli*.

A further fact worth mentioning, because not often found in what first-hand literature there is on gas gangrene, is that severe anaerobic infections almost invariably involve bones. In fact, if a localized anaerobic infection develops in a wound diagnosed as of soft parts only, an unsuspected bone injury will often be found. Such cases are apt to be dangerous.

Again, with regard to treatment: amputation is *not* indicated except in cases of massive gangrene. In these

cases amputation must be performed without even half an hour's delay, and with every precaution against shock, as the blood pressure will already be very low. In other cases the wound must be thoroughly opened up and all necrotic tissue removed. The wound is then left fully open. The results of treatment on these lines at the Lina Odena Hospital for Gangrene in Madrid were remarkable, with only some 15 per cent. mortality. Serum was used, especially intramuscularly, in the vicinity of the infection. Employing a French polyvalent serum, I also had the impression that this serum was definitely antitoxic and that it was more useful given locally. Finally, it may be stated that the incidence of gas gangrene is heavier in the lower limb than in the upper limb, and also, it would seem, more dangerous.

Conservative Treatment of Injuries of the Upper Limbs

I will now say a few words on conservative treatment of severe limb injuries. In the upper limb there is almost never an indication to amputate. Cases, of course, frequently arrive at the casualty clearing station with the limb already gone, but during my eight months at the front I amputated only one hand, or, rather, a few remnants of what had been a hand. It is perfectly feasible, and even easy, to save an upper limb which may be almost completely severed. If the neurovascular bundle in the arm is intact a very good result can be confidently expected. The whole shaft of the humerus may be shattered into a multitude of fragments, and yet an excellent result be obtained. That a very large bone defect is not a serious matter was illustrated by a radiograph which showed a four-inch tibial graft comfortably replacing almost the whole lower half of the shaft of the humerus. Function in this case was perfect except for some 30 degrees limitation of extension at the elbow, due to a twelve-months delay in the case coming to be grafted.

To obtain good results in severely shattered limbs all that is necessary is to apply the three general principles mentioned in the introduction on wound excision—namely, immobilization, elevation, and non-interference—after, of course, thorough and careful excision. But it is precisely for such cases that the immediate post-operative use of plaster-of-Paris is essential. As this method of treatment of fresh wounds, irrespective of bone injury, is little known in England, a case history may be worth giving by way of illustration.

Pedro, a Spaniard aged 22, arrived at the C.C.S. in February, 1937, with the left arm completely mangled, necessitating amputation above the elbow. The right forearm was also in such a state that I should in those days have amputated had it not been for the fact that the other arm was lost. Both bones were splintered, and there was so much soft tissue damage that the whole middle third of the forearm appeared pulped. The median nerve was intact but was dangling free for some three inches of its length. At operation the ulnar artery was damaged, or perhaps an already existing injury was disturbed, causing fresh haemorrhage, and the artery had to be tied off. After removal of what seemed like half the muscular tissue of the forearm the skin was sutured completely on the dorsal and incompletely on the volar aspect, leaving a considerable gap for which no skin was available. A thin layer of sterile unmedicated gauze (about four thicknesses) was then applied, and over it an unpadded plaster cast from the deltoid to the metacarpo-phalangeal joints. The whole limb was elevated on an abduction (aeroplane) splint. The post-operative course was afebrile, and when the cast was changed in fourteen days for removal of the sutures the open wound presented healthy granulations, with a rapidly advancing epithelial margin. In three weeks active move-

ments of the fingers were beginning, and there was never, throughout the month for which the case was under my observation, any median nerve pain.

I know of no other treatment that could possibly have given this result. Not only was the primary wound excision essential but also the immediate immobilization and aseptic occlusion in the plaster cast, together with elevation to reduce oedema and prevent ischaemia. This procedure involved a certain risk of secondary amputation for gangrene; but it offered the only hope of preserving functional usefulness of the hand. It is not a procedure suitable for casualty clearing stations in a time of pressure, but it is eminently applicable to severe limb injuries received within twelve hours at base hospitals. It must be strongly emphasized that the surgeon must be familiar with non-padded plaster technique, with perfectly soft slabs invariably applied as a base and allowed to harden before the application of circular bandages. Lack of familiarity on the part of surgeons with this technique may account for some of the existing opposition to the wholesale use of plaster in war-time. On the other hand, an ignorant use of this method will lead to wholesale ischaemia and gangrene. The obvious solution lies in the systematic peace-time training of future war surgeons in modern methods of traumatology.

Both immobilization, in the case of injuries to the arm and shoulder, and elevation, in the case of arm, forearm, and hand, require an apparatus for abduction of the limb. There are two fundamentally different methods of obtaining this abduction. Each is in my opinion necessary, the indication for the one or the other depending on the type of case. The first is a thoraco-brachial plaster spica. This was the standard treatment popularized by Bastos in Madrid and later brought to Barcelona by D'Harcourt and others. Bastos's paper on war-time fractures of the humerus should be consulted (*Revista de Sanidad de Guerra*, No. 2, 1937). The essential principle is that even infected fractures of the humerus are found to do very well in a closed plaster, even without any Winnett-Orr operation before its application. However, it has to be recognized that this is not always the case, and that open treatment is sometimes essential. For such cases the abduction splint popularized by Böhler is essential. There is, however, nowadays not the slightest indication or excuse for any other form of splinting of the upper limb for injuries down to and including the elbow. These two forms are adequate for all, and superior to any other. What must be stressed is the difference between the two, as this is not always fully appreciated.

The thoraco-brachial plaster is applied with the homolateral shoulder dropped, and the arm abducted to 45 degrees only, neither more nor less. In this position reduction of displacement is excellent, and the only disadvantage is that the shoulder is almost completely immobilized in a position which may make subsequent full abduction difficult to restore. Otherwise the method gives excellent results for severe comminuted and infected fractures of the humerus, for which absolute immobility is essential.

The abduction splint, on the other hand, is applied in an entirely different manner. It is applied with and keeps the homolateral shoulder raised, and is failing in its function if it does not do this effectively and permanently for so long as it stays in use. It is essential that the shoulder should be kept raised, as otherwise the upper fragment is pulled down by the pectoral, and considerable angulation results. What is even worse, the splint becomes at the same time a drag on the limb instead of

a support for it, and non-union is quite likely to occur. In an infected case a chronic osteomyelitis will develop.

With both methods the arm must of course be brought forward to a line forming an angle of 45 degrees with the sagittal plane. This position is in the case of a plaster jacket easy to retain. In the case of the abduction splint it is much more difficult. To obtain increased stability the Barcelona surgeons were in the habit of fixing the splint to the body, not with calico bandages but with either a few plaster-of-Paris bandages or with starched crinoline bandages, which are almost as effective and are lighter. The lightness of the abduction splint, made of well-padded Cramer wire, is one of its advantages over the plaster spica. Its other advantage is in the retention of partial mobility of the shoulder-joint. Its disadvantage is that it does not give quite such good immobilization and is more difficult to apply. It is to be noticed, however, that both appliances allow the patient to be ambulant within a few days of his injury if his general condition permits; but their greatest merit is that they assist in an almost complete disappearance of that scourge of war hospitals—chronic sepsis. Very large stocks of Cramer wire should be prepared for war-time use. It is cheap, simple, adaptable, and clean, and should long ago have entirely replaced all wooden splinting, which now has no place anywhere but in a museum.

OPERATION FOR SEVERED TENDONS

Before leaving the subject of the upper limb I will mention here a little operation which has proved useful for severed tendons, and which provides, I think for the first time, a useful function for that bugbear of plastic surgery, scar tissue. It has already been mentioned that when a tendon has been severed it is useless and harmful to attempt to effect a primary tendon suture. If a successful primary union of the skin is achieved the tendon ends can subsequently be freed and sutured. If, however, the wound heals by granulation there will be a large or small fixed scar, involving both tendon ends. The operation consists in excising the superficial portion of this scar under a local anaesthetic and an Esmarch bandage. The deep portion is then freed but left in continuity with the two tendon ends. The patient is instructed to move his finger or fingers until a satisfactory result is achieved. The skin is then sutured, if necessary after a lateral counter-incision and whole-skin lateral transposition, with an epithelial inlay graft laid over the bare area, which is of course not over the original wound. The patient is instructed to give the fingers constant exercise to maintain tendon mobility. Results in a series of three cases were surprisingly good.

Conservative Treatment of Lower Limb Injuries

In the course of the Spanish War the Braun-Böhler splint for the lower limb entirely replaced all others. All forms of lower limb splint which do not rest firmly on the bed are now museum pieces, except for the sole purpose of transport of fresh casualties. All forms and modifications of Thomas and Hodgen splints are therefore out of date in the wards. Secondly, where traction has to be applied at all it should nearly always be skeletal. I say "nearly," only because cases sometimes occur in which this is impossible. In such, heavy traction simply cannot be applied. For fractures of the femur the best form of traction is through the condyles of the femur, with a Kirschner wire and stirrup. The reason is that the knee-joint does not tolerate prolonged traction, and that since these severe compound fractures often require

up to two or even three months of continuous traction, damage to the knee-joint must be avoided. If traction has to be applied below the knee a pin is better than a wire. The traction must never be less than 10 kg. at first, and the foot of the bed must be elevated not less than 50 cm. Abduction is essential for a good result in all cases save those of fracture of the lower third of the shaft.

Under this standard treatment compound fractures of the femur have become relatively simple to handle. Even in the most severe cases the patient is able to lift himself for a bed-pan almost at once. Mortality from fractured femurs is now extremely low. In a continuous series of sixty-eight cases handled by me in casualty clearing stations from February to September, 1937, and retained up to the tenth day or longer, there was a total mortality of seven, including three deaths within twenty-four hours from very severe multiple injuries, one accidental death from a spinal anaesthetic, one pulmonary embolism, one death from gas gangrene of an unoperated haematoma, and one death from shock twenty-four hours after amputation for injury to the femoral artery. So that of these seven deaths at least two were due to bad surgery, leaving only five as a residual, for the present unavoidable, mortality of about 7 per cent. The most interesting fact, however, was not the low mortality but the entire absence of sepsis in all the survivors, who were evacuated to base hospitals with normal temperatures and no signs of bone infection. Unfortunately I cannot claim, as I at one time thought I could, that none of these cases developed an osteomyelitis, because I subsequently saw a troublesome osteomyelitis develop in a supracondylar fracture after one month of apparently perfect recovery under traction. However, it is clear that early immobilization in an efficient form does give astonishing freedom from bone sepsis.

On the home front it is clear that all fractured femurs should be evacuated at once on a Thomas splint to a specialized base hospital, which they should reach within twelve hours, without change of stretcher. Operative intervention and immediate skeletal traction would be applied at this specialized base hospital. With regard to the leg, it should be stressed that bone injury, however extensive and severe, is never nowadays in itself an indication for amputation.

Personally I do not like weight traction for fractures of the tibia or of the tibia and fibula. In a large proportion of cases double pinning for the first three to six weeks is perfectly feasible and satisfactory, followed by a weight-bearing plaster and sticks—no crutches. In general, it may be said that limb injuries of all kinds have become far more ambulant, and much sooner ambulant, than was the case in the war of 1914–18. With such treatment atrophy and oedema of the foot in leg injuries completely disappear. It is especially important that injuries to the metatarsals should be well plastered and the patients be got walking early.

Wounds of the knee-joint present certain special features. First, in the case of no other joint is prophylaxis so important. Excellent results are given by early excision with suture of the skin only, without drainage, followed by immediate temporary immobilization on a Braun splint, under slight traction (2 kg.) if there is a fracture of the condyles.

In a few days, when danger of septic arthritis is over, any fracture of the condyles is treated as a closed fracture. If sepsis is established lateral drainage of the joint, as advocated by Mitchiner, is the first step, but is often

insufficient, especially if there is extensive comminution of a condyle. In the latter case the most radical excision is necessary to save the limb; for this a ruthless exposure is necessary, and, in fact, has no disadvantage, since a good arthrodesis is the best result that can be hoped for. A standard treatment has not yet been achieved for these very difficult cases; but I am fairly certain that the treatment, when it does become standardized, will include immobilization in plaster-of-Paris in preference to attempted immobilization under traction, which is inefficient and, in my experience, gives inferior results.

TUBERCULIN TESTS IN CATTLE

Bovine tuberculosis is one of the most serious scourges that afflict the cattle population of this country. It is impossible to assess with accuracy the extent of the loss it causes to owners of herds through the death of affected animals and the seizure of diseased carcasses, or indirectly through falling off in condition of cattle and the diminution of milk supply, but it has been estimated that the annual loss amounts to as much as £2,000,000. The disease in dairy herds is also important in that it is responsible for much severe tuberculosis in human beings, particularly children.

The possibility that tuberculosis might be eradicated from the herds of this country has received serious attention only of recent years, but the launching of the "Milk Special Designations Order" of the Ministry of Health and the "Attested Herd Scheme" of the Ministry of Agriculture is a clear indication that the disease is now being attacked on a fairly extensive scale. The tuberculin test is the sheet-anchor of all schemes for the eradication of tuberculosis, and its value for the detection of tuberculous animals has been amply substantiated. Recent years have seen notable modifications in regard to the method of production of tuberculin, and also in respect of the modes of its application.

The Joint Tuberculosis Committee of the Medical Research Council and the Agricultural Research Council has been particularly concerned with the need for detailed research into various problems associated with the tuberculin test. Certain aspects of this work were undertaken at the Institute of Animal Pathology, University of Cambridge, by Professor J. B. Buxton and Mr. R. E. Glover, and the results of their investigations are published in the report which has now been issued.¹

It is widely known that no biological assay is 100 per cent. efficient, and the tuberculin test is no exception to this rule. The intradermal method, widely applied in this country, is undoubtedly highly accurate, but experience has shown that when attempts are made to eradicate tuberculosis by systematic testing difficulties and discrepancies may arise. The report seeks to explain some of these anomalies. After dealing with the different methods of applying the tuberculin test, sections are devoted to the value of several types of tuberculin, sensitization and desensitization of tuberculous and non-tuberculous cattle to tuberculin, and the possibility of "doping" against the various tests. Experiments are also described in which attempts were made to sensitize normal cattle to tuberculin itself; and, finally, the significance of reactions resulting from infections with organisms closely allied to the bovine tubercle bacillus is discussed in detail.

The report provides information of both a general and a particular nature to all who are interested in the eradication of tuberculosis from the herds of this country.

¹ *Tuberculin Tests in Cattle*. Agricultural Research Council Special Report Series No. 4. H.M. Stationery Office. (1s. 6d.)

LONDON AND COUNTIES MEDICAL PROTECTION SOCIETY

The annual meeting of the London and Counties Medical Protection Society was held at Victory House, Leicester Square, London, on June 8. Sir CUTHBERT WALLACE, who presided, referred to the loss which the Society had sustained in the death of Dr. Hugh Woods, its former secretary, Mr. Sydney Spokes, a vice-president, and, more recently, Dr. Marguerite Kettle, a member of the council, who, he said, had impressed them all with her wisdom and goodness, and whose death was a severe loss to the Society as well as to medical journalism.

Sir Cuthbert Wallace said that the Society continued to be prosperous. Over 1,000 new members were elected last year, against which had to be set a loss of some 450 due to death, retirement, and removal on non-payment of subscription. The number of applications for advice and assistance was just over 1,800. He went on to refer to the extreme importance, alike from the point of view of the Society and of members' own interests, of keeping good notes of cases. A good record of a case increased the practitioner's chance of winning through and made any action by the Society on his behalf much easier. But worse than having a bad or inadequate record was to alter a record which had been made; this had happened on several occasions, and, of course, it cut the ground from under the Society's feet in defending the practitioner.

Mr. W. M. MOLLISON, treasurer of the Society, spoke of its financial position, which, he said, was very sound. During the past ten years the invested funds had increased from £32,000 to £72,000, and the total income from all sources for 1938 was £18,615. The cost per member, which in recent years has considerably exceeded the £1 subscription, was last year only just over 18s.

On the motion of Mr. G. F. STEBBING, chairman of council, seconded by Dr. C. O. HAWTHORNE, Sir Cuthbert Wallace was re-elected president. The vice-presidents, treasurer, retiring members of council, and the secretary (Dr. R. W. Durand) were all re-elected, and votes of thanks were accorded to the legal advisers (Messrs. Le Brasseur and Oakley) and the Society's staff.

A "Compensation-minded" Public

The annual report, which was adopted at the meeting, stated that there was ample evidence that the public was becoming increasingly "compensation-minded," and that membership of a protection society was a necessity for practitioners. This fact was being recognized to an increasing extent by local authorities and voluntary hospitals in that many of them made it a condition of employment that their medical and dental employees should be members of a recognized protection society and should insure themselves against professional risks. The British Medical Association in its model scheme for public medical services advocated such membership as a condition of participation in the service, and the British Dental Association in its model forms of agreement for partnerships and assistantships included a clause stipulating that the practitioners concerned should be members of such a society.

The criticism has been made that the power granted to the council of the Society to decide whether or not a particular case should be undertaken on behalf of a member is undesirable and that some clearer definition on the lines of an insurance policy might be adopted. The council considers that such a change would be detrimental both to the individual member and to the Society. At present the council is free to undertake any particular case, and many cases which an insurance company might refuse are undertaken because it is considered that they may affect the professional interest of an individual member or of a large body of members. Were the Society to be conducted on insurance company lines it would naturally have to consider settling each case as cheaply as possible. The annual report as usual contains an epitome of interesting cases which have come the way of the solicitors during the year.