SURGICAL PRINCIPLES IN DIVISIONAL MEDICAL UNITS

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The work of divisional medical units under conditions of active service is mainly aimed at the efficient evacuation of casualties. It has become clear in the present campaign that a smooth and rigid scheme of treatment and evacuation from aid posts to casualty clearing stations as was possible in 1917-18 cannot be achieved. The medical services in the field must adapt their activities to events, and though it is impossible to forecast the circumstances under which individual units will work, the general principles of wound treatment should form the background of their action in relation to the individual wounded man. There is no doubt that the treatment he receives in the zone in question has a great influence on his subsequent condition, and an attempt will be made below to define what should or should not be done with a wounded man in regimental or field ambulance posts.

We started this war with a clear idea of the ideal wound treatment: this was founded on the experiences of 1914-18, and was to some degree coloured by reports on Spanish practice in their civil war. Since then experiences with our Expeditionary Forces and at home have done little to alter the established principles, though they have brought to light the value of the sulphonamide group of drugs in prophylaxis. Moreover, there has been activity on the research side both in relation to these drugs and into the value of antisera for anaerobic infections. The importance of fluid replacement in the treatment of shock has become fully recognized, and the provision of preserved blood or a substitute has been put on a sound basis.

Importance of Early Operation

Whatever adjuvants to wound treatment we may now possess nothing has lessened the proved importance of early operation for the majority of the wounded if serious infection is to be avoided. The operation in general will be one of débridement or the establishment of drainage, in accordance with the time-lag imposed and the surgical conveniences available. Primary repair is aimed at only for intra-abdominal injuries and those of the chest wall and skull. Primary suture of a somatic wound is not advisable except in very carefully selected cases. The ideal time for operation after the man has been injured cannot be defined with absolute precision. It is generally recognized that the period during which a radical excision or repair operation is likely to be satisfactory is within at most twenty-four hours of injury. Subject to the necessary period of resuscitation most authorities would reduce the ideal time-lag to twelve hours.

Our organization in the forward area is based, therefore, on getting the seriously wounded into the care of a surgical centre with the minimum of delay. The term "surgical centre" is used to imply any organization where formal surgery and the full process of resuscitation can be carried out. The difficulties in conforming to this ideal under the varying conditions of modern war are only too patent. We have to admit this handicap and aim at adaptability and elasticity in this matter as in other spheres of Army activity.

Treatment in Forward Units

The following may be laid down as the procedures to be carried out for the wounded at the aid post before transfer to the surgical centre:

1. A simple dressing of adequate size is applied to the wound if this has not already been done.
2. If the patient has not already received it, A.T.S. (3,000 units) should be given and the fact notified on his field medical card. The employment of anti-gas-gangrene

serum at this stage may be of value, but a decision as to its general use has not been arrived at. Sulphanilamide may be administered to the more seriously wounded, especially in cases in which fractures are present. It should be given by the mouth, a 2-gramme dose to start with and 1 gramme at four-hourly intervals subsequently up to a total of about 20 grammes. A note as to the time the treatment started and the dosage given should always be entered on the man's documents for future guidance. The question of packing the wound with sulphanilamide is referred to below.

3. *Shock*.—The first need of the wounded man is for rest, warmth, relief of pain, and drink. Simple though these demands are in quiet periods, in forward units they cannot always be completely satisfied under conditions of activity. When achieved they go far to bring a man out of primary shock. Transfusion of serum or plasma will of necessity be limited by the conditions of the aid post and other circumstances. In general, it may be said that the transfusion of a pint of serum or plasma at this stage should be reserved for serious fracture cases or for those in which a severe haemorrhage has been controlled by ligature. For a serious burn similar treatment will sometimes be advisable before evacuation, but it is evident that the storage of the necessary material and the conditions for the proper administration of a transfusion will exist only in the larger aid posts.

The following notes are concerned with the treatment of special conditions.

Fixation of Fractures

Satisfactory fixation of fractures before evacuation is of the first importance if secondary wound shock and increased local damage are to be avoided. For fractures of the thigh and in the region of the knee the Thomas splint is of the greatest value. It should be applied in accordance with the recognized method, over the clothes with the boot and sock still in place. Traction is exerted through a clip or skewer attached to the boot or by binding the foot to a foot-plate. Traction should not be severe, nor should it aim at a complete reduction of any overlap of the fragments which may be present. A splint with a large-sized ring must be used for these cases, and therefore the result of forced traction is to push the ring up into the femoral angle, producing a condition that is both uncomfortable for the patient and liable to produce a pressure sore. The tension applied should only be sufficient to stabilize the fragments. The ring of the Thomas splint, when too large, can be to some extent stabilized by packing between the upper part of the thigh and the outer section of the ring. Judicious suspension of the ring from a suspension bar attached to the stretcher will also have the same effect.

Fractures of the tibia and fibula may be treated in the same splint. As a rule little or no traction is required, but control of the rotation of the lower fragment should be obtained by binding the foot to the foot-piece. In fractures of the lower half of the leg a simple box splint with a foot-piece is, I think, preferable. This can be made from Cramer wire splinting or, if this is not available, from boards or Gooch splinting. A similar arrangement should be employed for the splintage of injuries about the ankle or foot.

In the upper extremity, fractures of the humerus in the proximal half of the bone, and including injuries to the scapula, are best fixed by binding the arm to the side with a pad placed between the arm and the chest wall; the forearm is supported by a sling. If the fracture is in the lower half of the bone or about the elbow-joint the use of a posterior splint extending from the shoulder to the hand is desirable, the elbow being set at about a right-angle. This splint is most conveniently made from Cramer wire splinting. If it happens to be available a plaster-of-Paris slat instead of the wire splint will serve even better, but there must be no question of applying a complete encircling plaster bandage in this phase. Fractures of the forearm, wrist, and hand should be immobilized on a section of Cramer wire splinting bent at a right-angle to hold the elbow. It should be noted that fixation of fractures in this

stage aims at immobilization rather than rectification of position. It will be sufficient if the limb is aligned in its splint in approximately the normal position. Tight bandaging, especially of the forearm and about the elbow, should be avoided.

Fractures of both lower and upper jaws can for the purposes of early transport usually be adequately fixed with the four-tailed bandage. If there is a tendency for the tongue to fall back owing to complete destruction of the symphysis, a stitch or two should be used for either fixation or traction. A feeding-cup with a rubber tube extension on the spout will facilitate feeding. If possible the man should be transported in the sitting position.

Spine.—It has become customary to advise the transport of spinal injuries in the prone position. This position is very uncomfortable and distressing for a stretcher journey of any length. Moreover, it renders access for catheterization impossible without considerable disturbance. The theory supporting this practice is that extension of the spine is thereby maintained, the position of extension preventing vertebral displacement and tending to reduce any deformity present. The prone position certainly has the advantage that it prevents the formation of dorsal pressure sores, though not those on the ventral aspect. It is clear that missile wounds of the spine, whether associated with cord symptoms or not, are not subject to this argument. The same may be said of impacted flexion fractures. It is doubtful if the position is of much importance in the case of fracture-dislocations provided that gross flexion of the spine is not allowed to occur. It is therefore advised that spinal injuries should be transported in the supine position. The man should be lifted by three persons, one of them taking care to support the spine at about the level of the injury in such a way as to prevent flexion. On the stretcher the lumbar curve is maintained by a small cushion or folded blanket. For cervical injuries extension is sufficiently maintained by a similar arrangement placed just above the shoulder level. In spinal injuries and wounds in which the cord or cauda has been involved the important point in early treatment is the avoidance of pressure sores and infection of the bladder. Pressure sores on the heels are less likely to form if sock and boot are left on, unless the latter are wet through. If available an air ring should be put under the buttocks. When retention of urine is present a gentle attempt at expression should be made; if this fails and the man is very uncomfortable catheterization may be carried out, but only if it can be done with aseptic precautions. If the case has to be retained for some days or if the period of transport is long, it will be well to tie the catheter in (Taylor, 1941).

Ribs.—If only a few ribs are broken the disturbance necessary for proper strapping should be avoided unless dyspnoea is extreme and the man is clearly unfit for transport. When many ribs are staved in it is best to strap the chest, completely encircling both sides. This fixation of the lower part of the chest will enforce diaphragmatic breathing, but it reduces the dyspnoea resulting from irregular chest movements.

Other Special Conditions

Amputations.—Primary amputation in the forward area should only be undertaken when the lesions of the soft parts are so gross or the damage to the main vessels is so complete that survival of the distal part is out of the question. If evacuation is good even when these conditions are present, operation should be deferred until the surgical centre is reached, so that a more formal procedure can be there carried out than is usually possible in an aid post. It is said that the development of secondary wound shock can be checked (M.R.C. War Memo. No. 1, 1940) in such cases by the application of a tourniquet immediately above the wound.

Chest Wounds.—Wounds in this area rarely require more than a surface dressing unless an open pneumothorax or sucking wound is present. In this latter event it is important to close the opening effectively. Suture with this in view should not be carried out unless complete wound

excision can be coupled with it. A large greased pad covered with mackintosh tissue should be strapped over the opening (Barrett, 1940). Elastoplast will be most satisfactory for the purpose, but ordinary adhesive tape will serve. The strapping should overlap and extend over the whole pad. Occasionally an early pressure pneumothorax may be met with. Cyanosis and dyspnoea, together with displacement of the apex beat and sometimes the trachea, will enable a diagnosis to be made (Sellers, 1941). When it is recognized it should be relieved by needle puncture at once.

Abdominal Wounds.—In the ordinary way the wounds will be protected and the patient marked for early evacuation to the surgical centre. Morphine should be given in those cases in which diagnosis of perforation of the gut is evident from the position of the wound or from the clinical signs. No attempt should be made to return prolapsed viscera or omentum; they should be covered with a normal saline pack or plain dressing and bandaged, a note being made of the state of affairs on the F.M.C.

Head Injuries.—A simple protective dressing only should be employed, even when there is prolapse of brain. A note as to the mental state of the patient and a record of the pulse and condition of the pupils or any paralysis which may be present should be made on the F.M.C.

Burns.—The treatment of burns in the initial phase is directed to preventing shock, which may prove fatal. If, however, the burn is of such a size as not to endanger life the main consideration is quick healing and the restoration of function. The danger to life from extensive burns is best treated by some method of surface coagulation. Tanning has proved the most satisfactory in this respect. The tanning is perhaps best effected with tannafax jelly or the application of compresses wrung out in 2% tannic acid. The latter method of application is most convenient in cases to be evacuated shortly. Smaller burns, and any burns of the face and hands, should not be tanned; they should be powdered with sulphanilamide and then covered with vaselined lint or gauze. No attempt at surgical cleansing is made. There are several pastes on trial for application under these conditions, but it cannot yet be said that any have proved their superiority to the simple method suggested (E.M.S. Memo., 1941).

Haemorrhage.—As a serious problem haemorrhage does not appear as often in aid posts as one would expect from a perusal of first-aid treatises. No doubt if a major vessel is torn open a man dies before aid can be given, and he does not reach the aid post. If a medium-sized vessel is divided completely it has considerable capacity of retraction, and in the condition of shock which is produced by the injury self-sealing will very likely occur. When bleeding is obviously continuing from a wound an attempt should be made at the dressing station to control the bleeding-point with a ligature or forceps. If a tourniquet has been applied it is most undesirable to continue its use for longer than is necessary. In a large proportion of cases in which a tourniquet has been applied in the field haemostasis would have occurred without its use, for it takes place after the tourniquet has been in position for half an hour or so. For haemorrhage from minor vessels firm pressure exerted by a pad bandaged in place, coupled with recumbency, will often suffice for control.

Priority in Evacuation.—When evacuation is normal and the journey to the surgical centre can be effected in about an hour abdominal injuries should have precedence. Fractures and sizable retained foreign bodies should come next, and chest and head injuries last. If the pressure of casualties is very great this order will clearly have to be altered, and the alteration must be determined by the medical officer on the spot, since he has a knowledge of the local conditions and surgical possibilities.

Isolation of an Aid Post.—When evacuation is impossible and an aid post is isolated and therefore saddled with the responsibility for the wounded over possibly a period of several days, it is clear that an attempt should be made to produce the conditions of a surgical centre. In fact, this will not often be practicable on account of the lack of personnel and of the necessary amenities. Formal or radical operations for abdominal wounds will seldom be carried out,

and the same may be said for chest and head injuries. The surgical treatment of open fractures will be directed to effecting free drainage rather than radical wound excision. Amputations should be carried out for gangrene or for local infections which may threaten life.

Pansement d'Attente.—The main efforts of available personnel should be directed to the prophylactic use of sulphanilamide for all serious wounds—or, if circumstances permit, all wounds. This treatment should be made effective as soon as possible. From 5 to 20 grammes should be introduced into each wound, according to its size; a total of 40 grammes should not be exceeded in any individual. Enlargement of the wound may be necessary to give complete access. Foreign bodies which have been located and are easy to remove should be extracted at this stage. The powder should, so far as is possible, be brought into contact with the whole wound surface or track; it should not be tightly packed in. An insufflator, if available, may be used; but it would appear that introduction with a small spoon of known capacity is more convenient. If instead of powdered sulphanilamide the tablets are used, the latter should be crushed before introduction in order to facilitate absorption by the tissue fluids. The prophylactic use of the drug by mouth as detailed above should be reserved for cases in which the development of serious infection is deemed probable: missile fractures and irregular retained foreign bodies are instances which would come into this category.

Summary

The above is a brief outline of the surgical principles which should determine our treatment of the wounded man in the forward area, together with an attempt to summarize practice. In war any set plan can seldom be carried through in every detail. We should have a clear conception of the ideal at which we aim, and in action do our best to attain it despite unforeseen difficulties and inevitable handicaps.

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WORK OF THE LISTER INSTITUTE STUDIES OF VITAMINS IN WHEAT FLOUR

It is fifty years since the Lister Institute (then called the British Institute) of Preventive Medicine was incorporated, but as active work did not begin until 1893 any jubilee commemoration is postponed until the year after next, by which time it is hoped that the dawn of peace will be stimulating research in every field. Meanwhile the report of the Governing Body for 1941 contains an account of much interesting work. Probably the studies on accessory food factors claim the most immediate importance in view of the food situation in this country.

The Division of Nutrition, which is located at Cambridge, has been devoting its energies to filling the gaps in knowledge which still exist as to the nutritive value of different portions of the wheat grain. The flour generally used in this country for making white bread represents 73% of the wheat grain, the remainder being discarded and used for animal feeding. Wholemeal flour (100% extraction) has been shown to be richer in mineral constituents and to contain more vitamin B₁, more of the vitamin B₂ complex, and proteins of higher nutritive value than white bread. But some of the previous investigations are based on results which could be criticized in the light of more

modern methods, and therefore it was thought desirable to investigate further the digestibility of bread made from wholemeal and white flour respectively, the relative nutritive value of the proteins contained in each, and their content of the different members of the vitamin B₂ complex.

Superiority of Wholemeal

So far as digestibility is concerned, the observations were made on six volunteers who for ten or eleven days consumed diets consisting almost entirely of bread made from the different types of flour. In the white bread ingested, "5% of the energy" and 9% of the nitrogen was found in the faeces, the corresponding figures for the wholemeal bread being 13 and 14% respectively. It is calculated that in the manufacture of white flour about 20% of the total energy available to man in the wheat berry is discarded, while of the nitrogen 27% goes into the offals. None of the subjects was adversely affected by the wholemeal breads, of which they consumed 2 to 2½ lb. daily.

The nutritive value of the proteins of white and wholemeal flours was studied by comparing the growth of young litter-mate rats. After adjustments had been made to secure a fair comparison, the rats on wholemeal diets were found during the observation period of nine weeks to have a weight increase nearly twice that of rats on the white-flour diet. A 30% superiority in nutritive value for the proteins of the whole wheat was confirmed by other experiments. Similar experiments on rats were carried out to determine the value of B₂ vitamins in the flours. The diets were made equal in other respects, but the rats receiving the white-flour diet, even though fortified with vitamin B₁, showed a rate of growth which was only about one-half that of the group receiving the wholemeal. The superiority is attributed to the higher content of B₂ vitamins in the wholemeal as compared with the white flour.

Some work has been done on the fat-soluble vitamins in wheat flour. In the process of milling a considerable part of the fat contained in the germ of the wheat grain is disseminated throughout the flour. The fat-soluble vitamins present in this oil are provitamin A (carotenoids) and vitamin E. The biologically active fraction of provitamin A is very small, so small that rats living on a diet composed almost entirely of flour failed to obtain sufficient to protect them from vitamin-A deficiency. Wholemeal flour is no richer than white flour in this respect. The bleaching of flour to get rid of its creamy colour destroys the carotenoid pigments, but the amount is so small that it cannot be regarded as a serious nutritive loss; the possible damage to other nutrients, especially vitamin E, is under investigation.

Yeast as a Human Food

The nutritive value of yeast, with its high content of B vitamins, has been studied, more particularly the supplementary value of the B vitamins of the type of yeast known as *Torula utilis* to those in straight-run white flour. The addition of 2½% yeast to white flour makes it as good a source of B vitamins as wholemeal flour, and the addition of 5% makes it a better source. This amount of yeast may be added to white or wholemeal breads without seriously affecting their palatability, and in soups, meat and vegetable stews, and many other dishes yeast may be added in reasonable amounts with advantage. Work done on vitamin C showed that tomatoes grown in the open had markedly more antiscorbutic potency than those grown under glass. Some biological tests have been carried out on strawberries, the jam of which is popular and can be made available at times of the year when natural vitamin C is not so plentiful as at others. The antiscorbutic potency has been found to be of the same order as that of citrus fruits.