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

INJURIES OF THE LOWER LIMB—I

BY

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During the great war it soon became clear that no effort should be spared to find any method of treatment that would lessen the permanent drain upon the nation caused particularly by gunshot wounds of the lower limb. General principles became established, and of these perhaps the most important was the early operative treatment, as the only means of avoiding those terrible septic complications that are the cause of the majority of bad results. Hence the really important surgery is done, if possible, at casualty clearing stations and not at the base. But the responsibility of those concerned with the after-treatment is not less than that of the operator. Obviously the title of this lecture includes many injuries occurring in times of peace. The treatment of these will not differ in times of war, excepting that greater delay in transport is liable to occur and evacuation will necessitate changing the patient's doctor probably several times.

First-aid Treatment

One cannot escape the impression that those who survive a bombardment such as is now possible from the air may receive wounds of greater severity than the average wounds sustained during 1914-18. Wounds of the soft parts may be so slight that the injured can hobble to an aid post, or so severe that traumatic shock is serious. In fact, an extensive injury or multiple wounds of the thigh may be accompanied by as much shock as with a fractured femur or mutilated leg. Haemorrhage will aggravate such a condition.

The aid post, or immediate, treatment will consist sometimes in dealing with haemorrhage and always in the application of a dressing (first-aid or shell). Immediate evacuation of the severer cases on a stretcher is carried out, if possible. It must be appreciated, however, that the prevention and early treatment of shock are of paramount importance in all but slight gunshot wounds of the lower limb. It was soon appreciated that immobilization of a badly damaged limb was a factor in limiting shock. This can be best achieved by the early application of a Thomas splint over boot and trousers, which also provides some relief of pain during transport. The Thomas's splint drill as set out in the 1935 *Royal Army Medical Corps Training Manual* is somewhat cumbersome, but can be carried out efficiently by a trained squad. A simpler method described in the British Red Cross Society's *First Aid Manual* can be used by two persons (Fig. 1). The apparatus is limited to the splint and three bandages. Administrative officers and surgeons should neglect no opportunity of impressing on those working at first-aid posts in air raid areas that prevention of shock and immobilization of the lower limb followed by quick evacuation to an operating centre will save both lives and limbs.

General treatment, before operation, in prevention of shock and injection of sera (described in a previous lecture), is followed by that applicable to wounds of the lower limb. This will differ according to the length of time after injury that the patient reaches the operative

centre. First, in the pre-inflammatory period, it will comprise (1) primary excision and suture (rarely), (2) incision, or excision and cleansing of the soft parts, (3) treatment as (2) of wounds complicated by fracture or joint lesion; secondly, in the inflammatory period, in treatment of inflammation of phlegmonous type (usually streptococcal) and treatment of gas gangrene.

A description of the third, or suppurative, period is uncalled for here. It is seen after road accidents, and is familiar to you. Reference to knee-joint suppuration will be made later.

FIG. 1.—Use of a Thomas splint. A.—Thomas's splint with bandage looped over side irons to make a trough. B.—Thomas's splint applied. Note trough made of bandage, clove-hitch around ankle, with bandage carried round bars and tied at notch at end of splint. Bandage below knee prevents leg rising off splint. End of splint is resting on rolled-up rug; a bandage holds this in place. This, or an additional one, should hold the splint to the rolled rug and stretcher; it is not shown doing so, in order to expose the extension bands.

Instead of the clove-hitch extension, a skewer may be passed through the upper of the boot, just in front of the heel, and cords attached to each end.

The Pre-inflammatory Period

PRIMARY EXCISION AND SUTURE

This is seldom applicable to the lower limb. It is a method which, when successful, is economical in healing-time and in saving pain. It is not recommended if more than six hours have elapsed since the injury. It is suitable in the gluteal region in the case of a shallow wound caused by a bullet or a small piece of shell. Occasionally a wound of the thigh where the places of entry and exit are only two inches apart may be so treated. The method should not be employed when there is another serious wound from which the lymphatics and veins pass through or near the smaller one. Nor should it be used if the operative technique necessitates the removal of a piece of metal, cloth, or mud.

INCISION, OR EXCISION AND CLEANSING OF SOFT PARTS

With a well-organized medical service this is the routine line of treatment. It should be carried out as soon after the wound as possible, during the period when the muscles and cellular tissue appear normal and when there is no swelling or lymphatic infection. This state may last for twelve or twenty-four hours, but seldom longer. During this period large incisions, with the removal of foreign bodies

(such as clothing) and projectiles, are not dangerous. After this time similar incisions, particularly in muscle, will lead to an aggravation of local and general signs and usually septicaemia.

After clinical and radiological examination the patient is anaesthetized and an extensive area of skin shaved and cleaned. If the wound is of soft tissues only, and can be excised without damage to blood vessels and nerves and without making a very large wound, this should be carried out: it may be possible in the gluteal area and on the outer side of the thigh, but seldom in the calf. If incision cannot be done, the skin edges, underlying fat, and maybe aponeurotic tissue are excised and the opening of the wound or wounds enlarged in the long axis of the limb. The operator has to use discretion with regard to the extent of removal of contused and dirty muscle in the course of the wound. All foreign bodies should be removed if possible, particularly from the thigh and calf. Search for a piece of clothing just distal to the portion of projectile should never be neglected. Rough treatment of the tissues is to be avoided. Haemostasis is important, and extravasated blood in buttock, calf, and thigh must be removed. Time is undoubtedly wasted in a large muscular area in trying to extract many pieces of a projectile such as a hand grenade. In such cases the larger wounds are dealt with alone.

At this stage no counter-opening for drainage is made. The wound is washed out—my own preference is for spirit if available—and then the smaller wounds are packed loosely with gauze wrung out in 1 in 1,000 solution of flavine. In the larger injuries lint smeared with petroleum jelly is applied to the edges of the wound, Carrel's tubes are inserted, and gauze packing is placed at the orifice. The details of this technique have been described by another lecturer, but stress may be laid on the correct method of placing the gauze at the orifices, and not between the deep parts of the wound and the tubes (Fig. 2)—an all-important point in treating the thigh. The

FIG. 2.—Showing introduction of Carrel's tubes into wounds of thigh. Gauze packs are placed correctly at opening of wounds in (A), whereas in (B) they are wrongly placed between Carrel's tubes and the wound surface.

instillation of Dakin's solution soon becomes standardized in a hospital dealing with many wounded.

TREATMENT WHEN FRACTURE OR JOINT LESION EXISTS

The preliminary treatment is that just described. The incisions are made by preference on the anterior aspect of the thigh or leg, so that the irrigating fluid comes in contact with the bone. If a counter-opening is made, the fluid runs out and much of the objective of the Carrel method is lost. In the case of the femur it is important to make the incision of sufficient length to allow irrigation of every portion of the fracture, and to pack the wound at the openings so that the muscular mass does not fall together. This is aided by large rubber tubing three centimetres in diameter.

The removal of bony fragments which are loose or nearly so is important. Small fragments should be extracted, particularly when in muscle: here in the presence of mild infection they cause suppuration, which spreads rapidly both in the thigh and in the calf. Large fragments usually have some periosteal attachment. They should be left in the thigh and leg unless drainage is obstructed. If articular cartilage is on a large piece the piece should be removed, otherwise the joint will certainly become infected. Rarely, such a fragment acts as a foreign body. Even if only one-third of the circumference of the bone is left new bone may form from the fragment. The treatment of wounds involving the knee-joint will be described later.

The Inflammatory Period

Streptococcal infection of gunshot wounds of the thigh and calf often gives the muscles the appearance of a solid yellowish mass. At this stage surgical intervention should be minimal (unless the indication is to amputate). A small incision for the removal of a piece of shell, if possible with the introduction of Carrel's tubes, should be made. This limited procedure is of great importance if the femur or tibia is fractured. If amputation does not appear necessary, an attempt should be made to direct Carrel tubes into each area of wound surface. If there is improvement and suppuration occurs later, further operative treatment will be required.

These cases are the most difficult ones met with in surgery of the lower limb, particularly when the upper third of the thigh is affected and the upper part of the leg has a wound extending into the knee-joint. In the latter case amputation is undoubtedly a life-saving measure, whereas it is rarely even contemplated in the former. It may be pointed out that in civilian practice the extensive opening up of open fractures of the femur during the inflammatory period has been followed by disastrous results.

Gas-gangrene infection of the thigh and calf was particularly common among troops who were evacuated direct to the base or reached operating centres behind the front line after delay; it was uncommon in thigh wounds which were dealt with in the pre-inflammatory period. The general signs of septicaemia from an aerobic infection are no less striking than the local ones. When the patient suffers from severe shock, restlessness, and nausea, and has a rapid small pulse, amputation occasionally saves life. When the general condition is little, or not, affected, incisions throughout the whole length of the quadriceps and right down to the femur may be valuable. If possible the vascular sheath should be incised to limit pressure on the vessels. In many of these cases amputation is indicated. In rare instances the gas infection is limited to a muscle group. If this be so the whole muscle tissue should be ablated. Irrigation of these wounds is employed.

Before leaving the technique of operative treatment, the possibilities of secondary suture consequent on primary excision and sterilization by the Carrel-Dakin method should be considered. During the war, when conditions allowed, the extent of the infection was tested by the periodic estimation of "organisms per field." When only one or two organisms were present per field on subsequent days, secondary suture with a few thick silk-worm-gut sutures was employed. Naturally this was impossible at times of pressure, and was generally interfered with by transportation of the patient.

Fig. 1 is reproduced from the British Red Cross Society's *First Aid Manual*, by kind permission of the publishers.