A SURVEY OF WAR SURGERY*

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The principles of surgery are continually being enriched by new methods which stand the test of time, but in war-time fresh problems are imposed with such insistence as to demand immediate attention, and often hasty improvisation. It has been delightful to see the enthusiastic reception which has greeted the presentation of our difficulties and the genuine desire to get to work on their solution which has been displayed by the profession both in the United States of America and in Canada. At the outset it may be said that the surgical principles laid down as a result of the last war have stood the test of time, and have remained the sheet-anchor of present procedures; but before surgery can be established on a satisfactory basis it is necessary to consider some of the points in its organization.

Medical Organization

The medical organization for this war has been devised on lines different from those of the last. The policy adopted has been the formation of the Emergency Medical Service for the whole country under the Ministry of Health. Hospitals have been decentralized and re-created as sector hospitals in the countryside, and are responsible for the treatment of sick and wounded, both civil and military, although the existing Service hospitals have carried on as usual. Many of these outlying hospitals have been converted into "special hospitals," such as centres for head injuries, chest injuries, plastic surgery, and orthopaedic surgery. Before the war actually started the medical profession had been voluntarily conscripted. This work was undertaken by the British Medical Association. Every member was card-indexed and his wishes for service consulted, with the result that the Central Medical War Committee is able to satisfy from this pool any demand by the State in the way of personnel in any direction. The staffs of the voluntary and larger city hospitals have been used in manning the outlying sector hospitals. Apart from the inconveniences and the dislocation caused by the migration of large numbers of town folk to the countryside, the health of the population, in spite of rationing and overcrowding in shelters, has remained very good, and we have been free from epidemics. One of the anomalies has been that the health of the children who have remained at home has been better than that of those who have been evacuated. Although such a system has its limitations, as a wartime measure which has now become established it is running fairly smoothly and efficiently.

War Wounds

Early and free surgical excision still remains the basic, and most satisfactory, procedure in the treatment of all war wounds, and although the open Carrel-Dakin method is occasionally employed, the most important change has been the adoption of the closed-plaster method of Winnett Orr and Trueta and the use of drugs of the sulphonamide group for combating infection. The consensus of surgical opinion is that the combination of excision, closed plaster, and sulphonamides has proved a great advance in the treatment of war wounds.

Where this method has been used, as at Dunkirk, the wounded have arrived back in good condition and the wounds have been clean. It gives the maximum of com-

fort and eliminates many of the difficulties of transport. Morale is high, and there is practically none of that distressing condition of "shell-shock" which was so prevalent among the wounded from the trenches during the last war. There is no doubt that the closed-plaster method is a boon to the patient; it gives comfort and rest, and eliminates the dread of the painful daily dressings of the open method. Its greatest objection is the obnoxious smell. However, it requires constant supervision, for on the appearance of a raised pulse or temperature, pain, sleeplessness, loss of appetite, oedema, or coldness of the toes, the plaster should be removed. Where this close observation has not been possible some cases have arrived with spreading infection, sometimes anaerobic, and gangrene beneath the plaster. Under such conditions some surgeons prefer to transport their patients with a peeping window cut in the plaster over the wound, or, if the distances are short, to dispense with it altogether—as in such cases as fractures of the lower limb, in which the Thomas splint with traction has again proved its value.

With regard to sulphonamides, these can be employed in two ways—prophylactically, or locally into the wounds: by mouth, starting with 2 grammes followed by 1 gramme four-hourly up to a total of 20 grammes, or by direct insufflation into the wound in doses varying from 5 to 20 grammes. Experience has confirmed that more satisfactory results are obtained with local application. The chief aim is to get the wounded to the nearest surgical unit within twelve hours, and in these days of mechanized and aerial transport this ideal should be increasingly realized. In hospital the primary considerations are the arrest of haemorrhage and the treatment of shock, whether primary or secondary. It is only then that excision should be carried out. This requires the removal, not too wide, of skin, all devitalized muscle and fascia, and detached fragments of bone and foreign material, so as to obtain a saucer-like wound, which is the most satisfactory for drainage. The more urgent call for early excision is in wounds of entry into fleshy parts with retained missile. In multiple wounds the larger ones only need be excised, as also those wounds complicated by fractures or involvement of joints. Although primary suture of the larger wounds after the application of sulphonamides may be carried out within twelve hours, the general impression is against this procedure. On the other hand, some surgeons have reported success from primary suture in wounds two to three days old, but as infection has already taken place in these late cases formal excision is not indicated: the wound should be opened to provide free drainage, necrotic muscle and retained missiles removed, sulphanilamide introduced, the wound covered with vaselined gauze, and the limb encased in plaster or splinted. When infection has been overcome secondary suture can be undertaken.

Bomb Injuries

Fortunately the number of wounded has not come up to expectation; a higher proportion are mortal, however, and this is reflected in the low percentage of survivals from abdominal and chest wounds in comparison with the more numerous wounds involving the limbs. There is not so much of that extensive ploughing up of the tissues from high explosive and shrapnel as in the last war, for the modern bomb is more destructive than maiming. Its casing is comparatively thin, and its terrific blast breaks this up into numerous small hot fragments which spread out fan-wise in a more or less horizontal direction with low trajectory. Wounding is more common from the secondary effects of the blast, either from shattered glass or from falling masonry. Consequently we may stigmatize this war of aerial bombardment as one of multiple injuries and

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marked traumatic shock. It is often difficult, therefore, to determine which of these small multiple injuries involve the more important structures, such as vessels, nerves, and viscera; and they cannot be dismissed by their apparent triviality, for severe venous thrombosis may follow from infection driven into superficial veins, and nerve injuries in particular are apt to be overlooked.

Regional Injuries

It is impossible in a short paper of this kind to enter fully into the injuries of the different parts of the body, so a brief summary of the most salient points must suffice.

Head.—Four principles of general application may be cited here: (1) Remove infective material and dead brain tissue. (2) Remove blood clot, extradural or subdural, and aerocele. (3) Consider whether a retained foreign body should be removed on account of traumatic epilepsy. (4) There is a definite impression that the sulphonamides tend not only to localize infection but to delay the necessity for operation: this is therefore a hint towards the adoption of more conservative methods. The most important fact to be established is whether the dura has been penetrated or not, and every means should be employed to this end. When the dura is opened damage to nervous pathways, spread of infection to the ventricles and basal cisterna, later abscess, and epilepsy must be borne in mind. The dural wound should not be enlarged unless the surgeon is prepared to remove necrotic brain and clot to prevent tension, otherwise fungus of the brain will develop. Forcible irrigation and suction should be used for this, and at the same time all dirt, foreign bodies, and detached bone must be removed. Repair of the dura is unsafe, and tension should be controlled by repeated lumbar puncture. Retained missiles should be left alone, but if the clinical signs spread and the cerebrospinal protein content increases, bold measures for their removal should be undertaken. Compared with civil injuries, concussion is usually slight, but unconsciousness may occur late and be prolonged. Focal symptoms are frequent: they tend to recover, and operation is indicated only when they come on late.

Abdomen.—The mortality rate from abdominal wounds is high, and the principles of treatment remain fundamentally the same as during the last war. All undoubted peritoneal wounds must be operated on, and the mortality depends largely upon how soon this is achieved. Essentials for success are accurate localization of the missile, local patching instead of resections, and end-to-end anastomosis for preference, control of bleeding, cleaning out of the peritoneal cavity, and—rarely—drainage, except in late cases, and then suprapubically. Time and speed, too, are essential. Multiple ileostomies are of no value, but caecostomy may prove a useful outlet for distension. Sulphanilamide dusted on the suture line, and 5% of this powder, given with saline, into the peritoneal cavity, is a procedure that has been recommended by some surgeons. It is gratifying to hear that retroperitoneal haematoma, so fatal in the last war, has shown some recoveries with chemotherapy. Wounds of the liver, spleen, kidneys, and bladder should be treated on conservative lines. Abdomino-thoracic wounds, whether approached from the abdomen, thorax, or both, should ensure repair of the diaphragm. Late cases of peritonitis in which there is reasonable evidence of involvement of the bowel should be operated upon.

Chest.—Like wounds of the abdomen, chest wounds are of low incidence and high mortality. It is probable that a large number of these cases do not reach base hospitals. Operative intervention for haemorrhage from the parietes or lung should be undertaken at once. Open pneumothorax is the bugbear of these sucking wounds, and must

be stopped up at once by vaselined gauze dressings and strapped. Pressure pneumothorax can be gauged by trachea deviation radiologically and relieved by needling. Repeated aspiration should be performed for haemothorax, and, if infected, rib resection with closed drainage. Foreign bodies, unless large and in the dangerous area of the hilum of the lung and pericardium, are better left alone. For shock and loss of blood, plasma and whole blood are given in large quantities, up to 5 to 6 pints, the aim being to maintain the haemoglobin at about 80%. Oxygen given by the B.L.B. mask is invaluable. Local application of sulphanilamide into the wound is good, but the results of employing it in the pleural sac are as yet inconclusive.

Chemotherapy for War Wounds

Perhaps the most fascinating aspect of the treatment of modern war wounds is the advent of chemotherapy as an adjunct to surgery. Though the use of these sulphur compounds must still be regarded as in the experimental stage, there is a general consensus of opinion that where they have been employed wounds are less heavily infected and in a healthier state than corresponding wounds in the last war. Much experimental work has been done with sulphanilamide, sulphapyridine, and sulphathiazole. Colebrook considers that local application is superior to the oral route, and has higher expectations from the use of sulphadiazine. Fleming prefers sulphathiazole. The effects of these drugs have been most notable in the streptococcal infections, especially in the cleaning up of late wounds. The anaerobe group as a whole is less susceptible to their action, but it is fortunate that *B. welchii* is more susceptible than the other members of this group. Antitoxic sera have also given protection against these infections, but at the moment no comparative results, or results from combined sulphur and toxin prophylaxis, are available. It is considered that these substances, of varying solubility, act direct on bacteria and arrest their metabolism.

Burns

One of the curses of the internal combustion engine is the risk of burns, and the war has acutely accentuated the importance of this problem, which calls so much for teamwork and treatment from different points of view. The tannic-acid method, devised by Davidson of Detroit in 1925, so successful before the war, led to neglect in the study of some of its pathological problems. War burns present special difficulties of their own, in which the primary objects are to save life and limb and to preserve function. The main cause of dissatisfaction with the tannic-acid treatment is that in the commonest types of burns—i.e., those involving the face and hands of airmen—it has led to severe scarring and to gangrene of the fingers. There has followed a great deal of ingenuity in trying out new methods of treatment, but as yet no unanimity of opinion as to their respective values has been arrived at. They may be summarized as follows:

1. The Triple-dye Method.—This, consisting of gentian-violet 2%, brilliant green 1%, acriflavine 0.1%, is recommended by Rear-Admiral Wakeley, who claims that when sprayed on the burn it produces less scarring than tannic acid.
2. The Bunyan Bag.—In this method the burnt surface is isolated in a special watertight envelope, and is irrigated with electrolytic sodium hypochlorite solution (5% milton).
3. The Edinburgh school recommends the application of sulphanilamide and glycerin.
4. Saline baths.

If tannic acid has been found unsatisfactory for certain forms of burns it must not be concluded that it should be discontinued. Outside the areas of the extremities and

flexures it still has firm and ardent advocates, and is considered by many the best form of treatment when applied over a burn dusted with sulphanilamide. Whatever method is decided upon, the burnt area should be thoroughly cleaned with saline and dried with hot air. For this purpose gas-and-oxygen, evipan, and pentothal are the most satisfactory forms of anaesthesia. When the tan falls off in the course of a few weeks the part should be rubbed with lanolin, and any cracks in it can be dusted with sulphanilamide. Tanning has reduced streptococcal infection, but where this is present in late cases the tan should be removed and saline baths given. From the point of view of the plastic surgeon, the school led by Gillies insist that such treatment is satisfactory only for burns of the first and second degrees. For burns of the third degree they recommend surgical excision of the burn, saline baths, and Thiersch grafting as soon as a satisfactory granulating surface has been obtained. By these means unnecessary scarring and deformity are avoided.

Apart from the treatment of the actual burn, it is in dealing with its complications that work is so desirable. Primary shock has a mortality rate of 2% to 3%, whereas secondary shock, which comes on later, has a danger-point during the subsequent twenty-four to forty-eight hours, with mortality as high as 60%. Unless there has been concomitant haemorrhage, blood transfusion is not indicated owing to the concentration of the blood which occurs, and blood plasma must be given to replace protein loss and prevent oedema.

Blast Injuries

The highly explosive force due to the sudden conversion into gases of solid material under great pressure within the modern bomb has given rise to a series of phenomena which have come to be known as "blast injuries." Blast has shown curious anomalies in its direction, distribution, and force. It is probable that these are due to the breaking of the casing at its weakest point and to the waves of pressure being ricocheted or reflected by buildings in the vicinity of the explosion. The effects of blast on animals have been studied by Zuckerman. A wave of high-positive-pressure velocity is created, and this is followed by another of negative decreased velocity exerting a suction-like action. The high-pressure wave falls to atmospheric pressure over a distance of some thirty feet, but proximity to the actual blast does not necessarily determine its effects upon its victims. Usually it gives rise to no surface injury, and is characterized by blood-stained froth at the mouth, which may appear sooner or later, but within ten days. Clinical examination of the chest reveals the signs of pneumonia. Necropsy discloses haemorrhage of varying extent in the substance of the lungs. Similar haemorrhages may also be found in the liver, spleen, intestines, adrenals, kidneys, bladder, and, seldom, the brain. The force of the blast may hurl people against objects and so give rise to secondary injuries, which may cause the blast injury to be overlooked. Fat embolism is also sometimes found at necropsy.

From the surgical point of view these patients give rise to much anxiety. Like pleurisy, the chest condition is often associated with rigidity of the abdomen, and yet due regard must be paid to the possibility of a concomitant intra-abdominal lesion, while in either case inhalation anaesthesia is best avoided.

Crush Injuries

Different methods of warfare either bring new problems or revive old ones in new disguise, and the crush syndrome may well fall into either category. It is characterized by acute renal failure supervening in people who have been pinned down by fallen masonry and have been buried and subjected to pressure for a varying period. There may be

no evidence of any local injury, but, when there is injury, local swelling, oedema, whealing followed by bullous eruption, and patchy areas of anaesthesia appear. A few hours later, in spite of vasoconstriction as shown by pallor, coldness, and sweating, the blood pressure falls and haemoconcentration rises. Later the urinary output diminishes, and albumin and dark brown clots appear in the urine. The patient becomes alternately alert and drowsy, and his blood pressure often rises. Oedema, vomiting, and thirst supervene, the blood urea and potassium become increasingly high, and death takes place about the seventh day. Post-mortem examination shows necrosis of muscle, and cloudy swelling and degeneration of the renal tubules.

Shock

"Shell-shock" to those who knew it during the last war has taken a holiday, and has been replaced by traumatic shock of varying and severe degree; for, apart from wounds, it is a handmaiden to burns, blast, and crush injuries. There is little new to add to the question of shock; but from the observation of cases of uncomplicated shock at Charing Cross Hospital the following points may be stressed. The mental state of the patients, all of whom had received morphine, was quiet and still; very few of them were excited. In general they were pale, dry-skinned, and thirsty; one patient sweated profusely. Some had nausea and vomiting. The pulse was never above 100; its quality varied, being thin, impalpable, or collapsing. In all cases the blood pressure was below 100. A rise of 10 points in blood pressure, and improved temperature and colour and mental state, were taken as indications to warrant surgical intervention. As a rule the need for transfusion was in proportion to the severity of the injuries. Plasma was given, and whole blood if haemorrhage had occurred. In severe shock transfusion may be difficult owing to the collapsed condition of the veins, and local warming of the arm has proved helpful in getting the blood in satisfactorily. The organization of the blood transfusion service has been one of the main successes of our hospital system, and the prompt access to reserves of stored blood has been most helpful and has resulted in the saving of many lives.

HEALTH PROBLEMS IN HONG KONG

According to the report for 1939 of the Director of Medical Services, Hong Kong, the large numbers of Chinese refugees from the neighbouring Sino-Japanese conflict continue to constitute the colony's chief health problem. In July, 1939, the number of persons entering the colony exceeded the number leaving by 327,833. Many of the immigrants are destitute, ill nourished, and diseased, and the overcrowded conditions in which they live are, after malnutrition, the most serious menace to public health. A deputy director of health services was appointed at the end of 1939, and the sanitary inspectorate has been transferred to the direct control of the health officers, so that the much-needed organization of the health services of the colony can now take place. Diseases of the respiratory system (non-tuberculous) caused the largest number of deaths in 1939. Tuberculosis came second, as in 1938, the pulmonary form of the disease being responsible for the majority of the deaths. A blood survey of 1,500 refugees showed a malarial infection of 24%. There were over 9,000 cases of beriberi, 800 cases of cholera, and 3,000 of influenza in Hong Kong during the year under review. In no other part of the British Empire is there more need for active sanitary measures, and, as the report shows, it is only by persistent vigilance that the D.M.S. (Dr. Selwyn Clarke) and his large staff can cope with the problem of maintaining a reasonable standard of public health among the 1,500,000 British and Chinese inhabitants of the colony.