TREATMENT OF SCALP WOUNDS IN AIR-RAID AND OTHER CASUALTIES

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In a military sense the scalp wound is the most important of head injuries, since it eventually produces the least disability. If disablement does follow it is due to deeper injury, either from penetration of the calvarium and dura or from cerebral contusion. But the development of sepsis in otherwise uncomplicated cases prevents rapid return to work. This has been the case in countries other than our own. Thus Briesen in a review of over five thousand head injuries in Los Angeles remarks that the longest periods of hospitalization were caused by septic scalp wounds. There is another important factor—that an infected scalp wound makes it impossible to undertake such exploratory punctures of the skull and dura as the later progress of the case may demand. Probably only those with considerable knowledge of head injuries realize how important a factor this is. The risk applies not only to air-raid casualties but also to road accidents, especially those of motor-cycle dispatch riders, to which Cairns (1941) in particular has paid attention. While we do not wish to overemphasize the dangers of scalp wounds, or to present the view that only a handful of men know how to treat them, we believe that some guidance will not be taken amiss by those with less experience of these cases.

Mechanism of Injury

A survey of a large number of casualties from several bombed cities indicated that roughly 25% of all patients admitted to hospital suffered from injury to the head, and 75% of these had scalp wounds of some sort. From their number scalp wounds became a problem of importance. The reason for the frequency of head injuries lies in the fact that so many air-raid casualties were caused by the collapse of a dwelling-house. Injuries in the open, in works, or in shelters were much rarer. The common story was that the patient was sitting in the kitchen or downstairs room when the house was shaken down by a near miss. The fact that the details of the injury were generally unknown to the patient was due to the traumatic amnesia that indicated concussion, and to the rapidity, if not the unexpectedness, of events. The scalp wound of the air-raid casualty looks as if finely ground brick, cement, and dirt had been blasted into the exposed tissues by a jet of compressed air. Ingrained in the margins of the scalp, embedded in the periosteum and in the muscle, is commonly a fine layer of this particulate matter. Most of the multiple injuries were due to flying glass; there might be 10 to 50 or more small wounds on the neck, face, and scalp. Eye injuries were frequent, sometimes with penetration of the globe; more often there was conjunctivitis caused by blast-driven grit.

Many of the patients had been buried, and appeared worse than they really were. Cleansing, washing, and shaving the head presented not a few technical difficulties to the uninitiated. Bomb fragments themselves rarely caused the injuries: most scalp wounds, apart from those due to flying glass, resulted

from the crushing of the scalp between the bone and falling debris, or from the ground if the patient was blown over—that is to say, many of the head injuries produced by air raids were caused by blunt types of violence. The scalp was squeezed until it gave way, when lateral movements might have come into play. These wounds were often irregular in shape, with contused edges. It was a characteristic that they were severely grimed: mortar, plaster, and brick dust were rubbed in at the time of impact, or found their way in as the patient lay imprisoned in a heap of rubble. As a generalization it can be asserted that these wounds were much more contaminated than the ordinary accidental scalp wound of peacetime; further, that the force which produced them was much greater. It was not rare to find the pericranium ingrained with dirt, whilst it had often been so severely ground against the bone that a whole area of scalp might be torn away or pulverized out of existence. Most scalp wounds penetrate into the areolar layer between the galea and pericranium, tailing off more superficially at the extremities of the wound. The crushing nature of the injuring force may be recognized in the contused state of the wound margins, the irregular shape of the object by a stellate or pleomorphic pattern. A tearing movement may be added by the sliding of the scalp so that a flap is fashioned; side tracks off the main tract are produced by sliding or by a broad surface of impact. Difficulties in excision may be introduced by the presence of horizontal slits in the scalp parallel to the skull contour. These are due to variable stresses in the layers of the scalp.

The complicated nature of some of these wounds, particularly when tissue has been lost, calls for judgment and technical skill.

Deep Injury in Scalp Wounds

It has been said that penetration of the head by metallic fragments did not prove to be as common as preconceptions forecast. Window glass was a commoner missile, but was usually stopped by the calvarium. This barrier cannot be relied upon, and more than one patient had glass penetration as deep as the hypothalamus. Quite apart from penetration by flying fragments, cerebral contusion was not rare.

Intradural contusion was evidenced by the frequency of the amnesia that betokens concussion, while routine lumbar punctures revealed the presence of blood in the cerebrospinal fluid in some 20% of apparently pure scalp wounds. McKissock and Brownscombe (1941) have had a similar experience in their series of scalp wounds. At the close of the last war one of us described the neurological signs presented by patients hit by high-velocity missiles, a point unrecognized by other observers save one (Hine, 1918). Monoplegias, sensory and visual disturbances, and Jacksonian fits were all observed. It was anxiety on this score that caused the institution of the somewhat ill-received instruction to notify scalp wounds. But there was another reason—the fact that penetration of the skull was too often being overlooked and that these wounds were not being treated with the foresight which their nature demanded.

Open Depressed Fractures

In a physical sense the mass of the moving object, the velocity of the impact, and its surface area determine the nature of the resulting injury. An important additional factor that leads to much diversity of effect is the mobility of the head, which alters the duration of time during which the force is applied. As Trotter and Wagstaffe (1922) pointed out, high velocity and small mass result in local injuries, while the reverse leads to a more general disturbance. A scalp wound incurred in the former conditions tends to be associated with a local depression in the calvarium, in the latter with a linear fracture of the base or vault or with nothing but a general commotion of the brain. Unconsciousness is more likely to be associated with the second type than with the first; a depressed fracture may be present in a conscious patient, as every experienced surgeon knows. But in spite of all teaching some depressed fractures have not been recognized, even though the wound is alleged to have been cleaned up and is sutured. The depression may not coincide with the centre of the scalp wound: the sliding of the scalp, already mentioned, allows for eccentric positioning of the bone damage. Any competent surgeon who has studied the subject can deal with these cases provided he has the right instruments and good lighting. The worst mischief has arisen when the bone injury has been badly dealt with and the wound allowed to become septic. Even the most skilled may then be powerless to save life. Those cases in which the wound overlies a depressed fracture entering the frontal air sinuses are particularly difficult to deal with. The dura is often torn behind the sinus and must be sutured or covered with a fascial graft. All such cases should be sent at once to neurosurgical centres.

Infection in Scalp Wounds

Local infection disables the patient for days, while cellulitis leads to more prolonged disability. It is not generally recognized that when deep infection occurs it always does so only after a latent period of several days, so that if the patient is evacuated the original operator may be unaware of the sequel. Infection most often leads to osteomyelitis if there is an untreated depressed fracture as well.

Our views on infection have been materially altered since the war began. We have come to learn that many of the more virulent organisms do not enter with the missile but are introduced into the wound when it is being dressed. The chief danger to the patient does not lie in the contaminated missile or the dry dust of the house, but in the mouths, throats, or fingers of those who inspect the open wound. The reassuring words of the doctor or nurse bending over the open wound may carry in the streptococcus. Even if he escapes infection through humanitarian utterances he may still become contaminated in the hospital ward. Infection in the operating-room is probably rare now that the cellophane mask is coming into universal use. Hare and Willits (1942) state that 355 peace-time wounds were studied in the emergency departments of four general hospitals and first-aid stations of two industrial plants within two hours of infliction. From only two wounds were haemolytic streptococci grown, and culture proved them to belong to Group H, a group usually not pathogenic for human beings: no infection developed. Few wounds of any severity gave sterile cultures. Of 108 wounds re-examined during convalescence 4 were now found to be infected. Miles *et al.* (1940) had already published similar findings. Hare and Willits conclude that *Str. pyogenes* is not present in the majority of wounds at the time of injury, and their further observations suggest that infection with staphylococci is not invariably due to their implantation at the time of wounding. If infection occurs, therefore, there has been some flaw in the treatment adopted. This is a challenge to surgery which must be accepted. No *laissez faire* attitude with regard to scalp or other wounds is tolerable. They are not doomed to infection.

Surgical Treatment of Air-raid Casualties with Scalp Wounds

All scalp wounds should only be finally sutured and closed definitely in an operating theatre under some type of anaesthesia; and a scalp wound, like any other wound, should

undergo only one surgical cleansing, and that a complete one. It follows that first-aid treatment of scalp wounds should consist only of measures to control hemorrhage and to prevent contamination with pathogenic bacteria.

This dual objective is best achieved by putting sulphathiazole or sulphanilamide, or a mixture of both (up to 5 g.), into the wound (Hawking, 1941), applying sterile dressings, and bandaging firmly to control haemorrhage. Rarely it may be necessary to insert a few sutures if haemorrhage is profuse. Primary closure in poor conditions, as in first-aid stations or surgeries, is a mistake. The wound must then not be further disturbed until the patient is ready to undergo pre-operative preparation in an operating-room. General physical examination and a search for abnormal neurological signs must precede operation, and radiographs of the skull should be taken *if in any way possible*.

Cases classified only as scalp wounds, and sutured, have arrived at neurosurgical centres to have radiographs reveal fragments of bomb casing, stone, or glass lying within and outside the skull. Depressed fractures are readily identified in satisfactory radiographs, and operation is planned accordingly. However, it is the treatment of the common uncomplicated scalp wound that is our primary concern.

When more than one patient with a scalp wound is to be dealt with the wisest plan is to turn over the preparation of each patient, in an ante-room to the theatre, to a special assistant and a nurse, who do nothing else for the time being. This has proved to be a much quicker way than allowing the surgeon to shave the head as well as operate. Even if it means a choice between having an assistant or having a preparer, the decision should be for the latter except when a fracture is present. The actual preparation of the wound is very important; it should be done as follows.

The wound should be filled with sterile gauze and the scalp scrubbed with soap and water. Shaving-cream or powdered or liquid shampoo soap is much superior to etherized green soap, which has poor qualities. Even ordinary toilet soap is to be preferred to it. Once the scalp has been scrubbed clean, with generous application of soap and water, the hair is cut widely with scissors or clippers and the scalp shaved. A wide area must be bared so that the surgeon can more clearly see what his problem is. A circular area with a radius of 3 inches from the wound must be shaved, and if multiple wounds are present or a large laceration has occurred the whole head should be shaved. To shave a scalp quickly and closely, a straight razor, or a safety-razor blade held in an artery clamp, must be used; safety-razors always become choked with a tangle of hair. To those who have dealt with air-raid casualties it will be apparent that this washing and shaving of the scalp is a most essential and not always an easy step in the operative procedure.

With the wound now well defined, the surrounding scalp should be again washed with fresh soap and water and thoroughly irrigated with sterile normal saline. Fresh sterile gauze is placed in the wound and the surrounding scalp then repeatedly scrubbed with 1 in 5,000 perchloride of mercury. Spirit may be used, but is painful on a freshly shaved scalp, as is tinct. iodine 2.5%; proflavine, etc., may be employed. Mechanical cleansing and thorough irrigation with normal saline is, however, the essential procedure. The patient is ready now to enter the operating-room.

Anaesthesia

Novocain should be injected in the subaponeurotic plane and well away from the wound but within the shaved area. A 1% solution of novocain (or one of its equivalents) with 3 drops of 1 in 1,000 adrenaline to the ounce should be used in quantities up to 2 oz. Care must be taken that it does not all go into the subaponeurotic areolar layer or pain will not be fully abolished. The scalp cannot be properly anaesthetized without the right sort of needle. The Labat 7 cm. is the best. It should be pushed its whole length in between skin and galea and the injection made as it is slowly withdrawn. It is then reintroduced in a deeper plane and the procedure repeated before moving on to the next area. By thus surrounding a wound or blocking its nerve supply, complete and satisfactory anaesthesia of the wound edges is obtained and the skull loses its sensitiveness; all the relevant nerve supply enters from the exterior.

The Operation

Once the scalp or the patient has been anaesthetized the wound should be opened up fully with retractors and its interior inspected in a good light. Portions of hair, masonry, dust, and other foreign matter are wiped out with wet swabs and the wound freely irrigated with sterile normal saline. As the wound is usually grossly contaminated with pulverized brick, cement, and dust driven in by the blast, actual application of soap and scrubbing-brush will be necessary. Saline alone will not get rid of dirt. The wound should be thoroughly irrigated with normal saline until it is "white." The floor of the wound is now examined for a crack or depressed fracture or hole of entry.

Scalp wounds are apt to be more complicated than they look, and it is not always possible, unless really good radiographs have been taken beforehand, to know with absolute certainty that a fracture will not be found tucked away under a flap of skin. Even when the wound is first held open a fracture may not be seen.

If there is a depression the operator may run into trouble. The withdrawal of a bone fragment may cause an ugly situation in which every technical aid may be required. The easiest cases are those in which the bone has been fragmented and lies loose in the wound—e.g., in a gutter wound. The most dangerous are those in which a piece of bone is tilted edge-on against the sagittal or lateral sinuses. It is not our purpose to speak of the details of treatment in such emergency situations. But it must be affirmed that an excellent surface operation is within the powers of any surgeon with training, and that attention should be focused on the more superficial parts, deep excursions into the brain being avoided.

If no fracture is found after the wound has been thoroughly gone over, floor and sides, all bruised and damaged soft tissue must be removed from the floor, and the contused edges or even clean-cut edges should be excised. This must be done sparingly because the removal of wide ellipses of scalp leaves concave margins that cannot be approximated, so inelastic is the scalp proper. A slice 2 to 3 mm. in thickness is quite adequate. The hindrances to neat excision are two: first, the vascularity of scalp may cause free bleeding that impedes the view; secondly, irregularities and cross-fissures in the wound may pass beyond the line of the intended cut. The first difficulty is got over by the finger-pressure of an assistant exsanguinating the scalp margins until artery clips can be placed on the galea and turned over. A quick worker can do this single-handed. The weight and pull of the forceps on the galea quickly stops the bleeding while the other side is dealt with. As for the cross-fissures, they do not matter if they are well cleaned and thoroughly irrigated with normal saline so that all dirt is removed mechanically, but if a fissure is large it calls for separate deliberate excision. At this stage sulphanilamide, sulphadiazine, or sulphathiazole, or all three, should be freely dusted into the wound. Closure is effected by one row of sutures if the laceration is not excessively large or bleeding too profuse, and in those rarer wounds which do not divide the galea. Fine silk, "fine dermal," and nylon are all satisfactory suture material, though most neurosurgeons have come to prefer silk. Silkworm-gut, unless it is the finest procurable, is bad for the scalp. Closure of a scalp wound with one row of sutures requires that the skin and galea should be included in the stitch and just enough tension used in tying, so that good apposition is obtained and the margins of the wound lie flat. These stitches are put in at intervals of about 1 cm. When necessary more superficial sutures may be placed between them. A soft rubber (Penrose) drain should be brought out of one end of the incision or through a separate stab wound.

When two rows of sutures are used the deeper layer of stitches takes only the galea; they are inserted about 1 cm. apart; after tying, the ends are cut very short—indeed, practically on the knot. Fine silk or fine nylon is the only type of material suitable for this deep layer of sutures. Buried catgut is thoroughly bad, for it leads to trouble. Linen thread and cotton are little better. The general surgeon would do best to use the one-layer closure. Again, it is best to drain such wounds just as if only one row of sutures had been put in.

Following closure with one layer of sutures, and even if two rows have been used, a *well-padded* and *firmly applied* head-

bandage is required. This, if it produces firm pressure on the scalp wound, will minimize bleeding. Dressings should be changed at the end of 12 to 18 hours—observing the most meticulous technique against droplet and cross-infection—the drain removed, and somewhat less firm dressings applied. Skin stitches may be removed after 3 to 4 days.

Transportation of Cases of Head Injury

It is commonly objected that head injury cases travel badly; but recent experience has shown that they travel well (unless very deeply unconscious or moribund) both before and after operation, and it is important that surgeons correct their view on this matter. There is but little truth in the dogma that these patients cannot be moved, and all recent experience supports the opposite view, provided the journey is not of too long duration. Hence certain cases of injury, when recognized for what they are—scalp wounds, complicated by (1) loss of scalp tissue; (2) fractures of skull, especially those overlying the frontal sinuses; (3) cerebral injury—should at once be moved to a proper centre, where they can be treated and retained. Semi-conscious or unconscious patients should always be nursed, or be transported in the prone or semi-prone position to secure unobstructed breathing and to prevent the inhalation of blood or vomitus.

If through the exigencies of any particular circumstance patients cannot be moved, a thoroughly effective surface operation should be aimed at. Skilful treatment of the superficies leads to primary healing and survival of the patient. Should a deep missile or deeply in-driven fragment require removal later, this can safely be done if the scalp wound is healed. In cases that were admitted to neurosurgical centres with scalp wounds healed or healing and bone fragments embedded in the brain no untoward symptoms developed, though these fragments might have to be removed later.

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SYNCPAL REACTIONS IN BLOOD DONORS

AN INVESTIGATION OF 222 CASES

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The incidence of syncopal reactions in blood donors following donations of blood has attracted the attention of workers in various Blood Transfusion Services, particularly with regard to the possibility of correlating such reactions with certain individual features in the affected donors. An attempt was therefore made to determine by investigation whether the incidence of fainting in blood donors was associated with any constitutional or circumstantial peculiarities in the individuals concerned.

Clinical Features of Vasomotor Reactions

As it was impossible for the limited number of available medical officers to devote time to the careful examination of each donor, no records of pulse rates, blood pressures, etc., were kept, but the following brief classification of the reactions was made according to their severity: Grade 1: Feeling of faintness only, with or without nausea or vertigo, but with no loss of consciousness and only slight after-effects. Grade 2: Loss of consciousness for a short time, but with no alarming or excessively prolonged after-effects. Grade 3: Prolonged loss of consciousness, or unconsciousness of shorter duration with clonic movements or very severe and prolonged after-effects. The incidence of these types of reaction is illustrated in Table VI.