OBSERVATIONS ON INFECTION IN PENETRATING
WOUNDS OF THE HEAD

MAJOR STUART N. ROWE, M.C., A.U.S., AND
MAJOR OSCAR A. TURNER, M.C., A.U.S.

(Received for publication April 19, 1945)

The prevention and control of infection in penetrating head wounds forms the basis of much of the treatment from the time of injury until healing occurs and is one of the major responsibilities of the Army neurosurgeon. The almost universal employment of sulfonamides and penicillin has resulted in material changes in the frequency, the symptomatology, the course, and the outcome of wound infections. These changes in turn have modified the surgical treatment of cranio-cerebral injuries and their sequelae. The following observations relative to these modifications are based upon clinical experiences in a fairly large series of battle casualties seen in a neurosurgical center in the first five months following the landings in Normandy. At the present time a statistical analysis of these cases is not possible. It is convenient to consider separately wound infection, meningitis, and brain abscess.

WOUND INFECTION

Approximately 15 per cent of the head wounds showed some degree of infection. Gross involvement of the brain with the formation of cerebral fungus has been infrequent, particularly since the first month. With very few exceptions the wound infections appear to be due either to incomplete debridement of the missile tract, particularly failure to remove all indriven bone fragments, or to closure of the scalp under excessive tension. In a few instances the wound breaks down from no apparent cause other than excessive contamination.

It is frequently difficult to tell whether a wound is healing properly since under the influence of chemotherapy the characteristic signs of infection may be absent. Local swelling may be the result of cerebral herniation through a dural defect, subgaleal cerebrospinal fluid collection, hematoma, edema of the scalp, or pus. Redness of the scalp rarely occurs and tenderness is so deceptive as to be of little diagnostic value. Thinning and darkening of an apparently healed scalp incision has frequently been the only evidence of an underlying collection of pus. Furthermore, the usual signs of systemic reaction to infection, such as fever and leukocytosis, are rarely present until the process is well advanced. Not infrequently judicious exploration of the wound with a small instrument may be the only method of establishing the diagnosis. If the wound is clean this does not seriously delay healing.

The treatment of these infections consists essentially in the establishment of adequate drainage, and the intensive local and systemic use of
Chemotherapy. In most instances the wound must be widely reopened to prevent the development of pockets of pus and extension of the infectious process to the deeper structures. Penicillin has been effectively employed locally in solution (10,000 units per cc. of saline) through a Dakin tube laid in the wound and carried out through the dressing. This method permits the frequent instillation of the drug (usually 10,000 units every three hours) and can be carried out satisfactorily by the nursing staff. It has the further advantages of permitting aspiration of pus from the wound before each instillation, and of securing adequate distribution of the drug throughout even a deep wound. Inasmuch as the tube represents foreign material in the wound and a possible avenue for secondary infection, it seems preferable not to allow it to remain in place for more than one week. In the presence of a cerebrospinal fluid leak the tube should not be placed in the depths of the wound since a fistulous tract may form about it. Dry penicillin mixed with sulfanilamide crystals (5 to 10,000 units of penicillin to each gram of sulfanilamide) has been dusted into the wound as an alternative method of local application. This method permits greater concentration of the drug within the wound with less loss through the dressing. However, it has the disadvantage of requiring frequent dressings. In our experience daily replenishing of the drugs has proven adequate for most wounds.

In all cases both penicillin and sulfadiazine have been employed systemically. Penicillin has been given intramuscularly in doses of 10,000 units every three hours in the average case. In critical cases both the dosage and the frequency of administration have been increased. Sulfadiazine has been employed in the usual doses and followed by blood level determinations.

**Meningitis**

Meningitis is one of the most serious complications of penetrating wounds of the head and in our series has occurred in approximately 4.5 per cent of the cases. The likelihood of its occurrence is dependent to a large extent upon the course of the missile and it is convenient to consider separately those cases in which the wound involved the vault of the skull alone and those in which there was associated perforation of the orbit or the paranasal sinuses.

An infected wound may serve as the source of meningitis in the presence of an open dura mater, particularly when there is direct communication with the subarachnoid space or ventricular system (Case 1). Infection in the wound even with exposed cortex is rarely followed by meningitis or extensive cerebritis unless there is a discharge of cerebrospinal fluid. Under these circumstances revision of the wound, including repair of the dural defect, should be carried out without delay. We have come to believe that even in the presence of an already established meningitis constant re-infection can be avoided only by prompt closure of the cerebrospinal fluid fistula even if a fascial graft is necessary. In this type of case the intraventricular administration of penicillin may be of great value.