A BACTERIOLOGIC STUDY OF PENETRATING WOUNDS OF THE BRAIN, FROM THE SURGICAL POINT OF VIEW

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In the summer of 1944 there became available for the first time a series of penetrating wounds of the brain due to shell fragments in which the patients had been treated with both sulfadiazine and systemically administered penicillin. This study (Table 1) is based on 50 such wounds, some of which had not been touched whereas others had received preliminary operations at forward hospitals.

There were 42 cases in which bacteriologic studies of the brain were made, either at operation or on admission to the hospital. The wounds were incurred from 3 to 86 days before they were studied, namely, between 11 June 1944 and 26 October 1944. Almost all the wounds were caused by shell fragments. There were retained bone fragments within the brain in almost every case. Smears and cultures were made by Lt. Harry Blechman and doubtful organisms were checked by the 1st General Medical Laboratory. The swabs were bacteriologically sterile in 10 cases, in all of which the scalp had been previously sutured. In the other 32 cases the organisms cultured from the brain were as follows: Staphylococcus aureus, 7 cases; Staphylococcus albus, 17; Streptococcus viridans, 9; non-hemolytic streptococcus, 9; gram-negative bacilli, 6; Micrococcus tetragenus, 4; and Clostridium, 2 cases. Surprisingly, there were no hemolytic streptococci in this series. The gram-negative bacilli were always found in association with coccus forms.

From the study of the x-ray films and findings at operation an attempt was made to estimate the number of cubic centimeters of brain destruction in each case. The figures range from 5 to 250 cc. However, this estimated volume of brain tissue destroyed had no apparent bearing on whether or not there were viable bacteria present in the wound.

There were 32 cases in which separate cultures were made of the superficial and of the deeper layers of the brain wound. In most of these cases the same organisms were cultivated from each layer of the wound. However, there were 3 where the superficial tissues of the brain were sterile but the deep tissues contaminated. Conversely, in 5 cases the superficial brain tissues were contaminated but the deep tissues of the wound were sterile.

Finally, there were 11 cases of wounds previously unoperated on, in which cultures were made at all three levels, scalp or skull, superficial brain, and deep brain. In 9 of these the organisms at all three levels were identical. The wounds underwent thorough debridement of the brain and watertight closure of the dura with a graft of pericranium or of temporal fascia and were

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closed without drainage. Adequate x-ray and surgical facilities, blood transfusions and drugs were available. Definitive operation in all of these cases, except 2, was carried out.

GRAM-NEGATIVE ORGANISMS

In the complete series of 50 brain wounds with dural penetration there were 3 deaths from infection, and in all 3 cases gram-negative bacilli were cultured from the brain prior to the patient’s death. Cairns¹ had previously directed attention to the growing significance of gram-negative organisms in the brain since the advent of penicillin. The present author had found urea useful as an adjunct to the sulfonamide treatment in a case of B. coli meningitis.² Urea was used in the 7 subsequent cases of brain wounds contaminated by both cocci and gram-negative bacilli. The latter were variously described by different laboratories and the terms used included B. coli, coliform group, paracolon, Klebsiella pneumoniae and Aerobacter aerogenes. In addition to the routine surgical treatment and administration of penicillin and sulfadiazine, urea was added in dosage of 30 grams every four hours by mouth. None of these patients died.

CLOSTRIDIAL CONTAMINATION

There were 4 cases of clostridial contamination of the brain, 2 of which are included in Table 1 and in all of which the patient recovered.

Example. This soldier was wounded in action in France on 25 July 1944, by shell fragments which penetrated the left temporal lobe of the brain. At an evacuation hospital a portion of the brain tissue, 3 cm. in diameter, was debrided and a drain was left in place. The patient was in critical condition when placed under the author’s care on 31 July 1944. There was a brain fungus, about 4 cm. in diameter, which was necrotic and was surrounded by profuse pink discharge containing bubbles, and which yielded a foul odor. Clostridium Welchii and Clostridium putrificum as well as Aerobacter aerogenes, hemolytic Staphylococcus aureus and Streptococcus faecalis were cultured from the wound. The patient was given supportive therapy including transfusions of whole blood, penicillin, sulfadiazine and a small amount of gas gangrene antitoxin. On 7 August 1944 another herniated portion of the brain was removed digitally without anesthesia. On 23 August 1944 cerebrospinal fluid suddenly began to gush from one of the two wounds; the brain was obviously under increased tension. Accordingly, the following emergency surgical procedure was undertaken.

The original scalp flap was turned back and revealed a large cerebral fungus from which cerebrospinal fluid issued. There were multiple brain abscesses in the temporal lobe extending in all directions from the wound. There were six discrete pockets of thin, yellow pus. The brain was a veritable honeycomb of fibrous tissue and purulent material. The fibrous tissue was 1 cm. thick in places. The largest individual abscess contained about 10 cc. of pus. Obviously necrotic brain, which was removed, amounted to approximately 150 gm. or a spherical mass 7 cm. in diameter. The left lateral ventricle was opened widely and some of the choroid plexus was removed. The temporal fascia from the anterior portion of the temporal fossa was rotated so that a careful watertight closure of the dural defect was effected. The scalp flap had a very poor blood supply because of its shape, and the incision for drainage at its base. Penicillin, sulfadiazine and urea were administered.

Cultures were made from 4 of the abscess cavities, each of which yielded E. coli and a non-hemolytic anaerobic streptococcus. In addition, the swab from one abscess cavity yielded Clostridium sporogenes. The patient gradually improved and began to say a few words by 10 September 1944. At the time of discharge from the hospital on 30 September 1944 the wound was practically healed.