THE REDUCTION OF HERNIA CEREBRI BY TANTALUM CRANIOPLASTY

A PRELIMINARY REPORT

MAJOR FRANCIS A. CARMICHAEL, JR., M.C., A.U.S.

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HERNIA CEREBRI or fungus cerebri, as the terms have been used synonymically, has long been an enigma of the neurosurgeon. In military practice this distressing complication occurs with such frequency as to constitute a major surgical problem.

While it is not the purpose of this report to discuss all the factors considered to be operative in the production and evolution of this condition, it is well to describe the general nature of battle-inflicted cranio-cerebral injuries and to point out those factors that are generally held to be conducive to the formation of hernia cerebri.

Typically such wounds result from the impact upon and/or penetration of the cranium by high velocity missiles of small mass. The scalp itself may be lacerated or avulsed in any conceivable manner. Fragmentation of the inner and, to a lesser extent, of the outer tables of the skull ensue, the fragments of bone being showered along the projectile path. Considerable portions of the skull may be avulsed in this process and the dura may be disrupted, lacerated or devitalized for distances well beyond the margin of the skull fragmentation. Radial linear fractures usually extend from the area of central fragmentation and occasionally remaining large fragments of skull are left in positions of extreme elevation or depression.

Insinuated into the pulpified cerebral tissue are, from within outward, the metallic foreign bodies, a trail of bone chips, pieces of scalp and hair, fragments of the helmet liner, such as wool threads and fiber, and frequently splinters of the helmet itself. Consequently such wounds are always contaminated if not actually infected. This fact establishes the first condition favorable to the formation of herniation of the brain.

The second factor that may contribute to the formation of brain herniation is failure to attain the criteria of thorough operation. By thorough operation, as officially delineated in this theatre, is meant the removal of all technically and anatomically accessible foreign bodies and bone chips, removal of pulpified cerebral tissue in the wound tract, repair of the dura by primary suture or any effective method of grafting, and suture of the scalp without drainage by any surgically sound manoeuvre.

Thirdly we are confronted by the consideration of intracranial hypertension. In warfare surgical treatment may be administered in a matter of hours or days, depending upon the fortunes of battle. Regardless of time, however, it may be postulated that at some stage cerebral edema will ensue in such wounds with or without operation. The result is of course an increase
of intracranial tension or intracranial mass, which situation logically favors herniation.

Fourthly, any combination of infection, cranial defect, or intracranial hypertension may produce disturbances of vascular cerebral circulation or of the cerebrospinal hydrodynamics. The resultant distortion of the brain may produce ischemic necrosis and may prevent chemotherapeutic agents from reaching the pathological area. In addition, this condition contributes to interstitial edema and thereby to intracranial hypertension.

A fifth closely related factor may be of importance in war wounds. These patients have frequently experienced severe hemorrhage, lengthy periods without food, and energetic efforts at replacement therapy with plasma, blood, and other infusions, all of which alter the osmotic characteristics of the circulating blood.

These then, briefly, are some of the factors that set the stage for the advent of cerebral herniation. Further contemplation of the situation merely gives one the impression that all these factors may become interacting in a vicious cycle of pathophysiological catalyticism.

The conventional mode of treatment of such lesions, as outlined by the experiences of Cushing in the last war, centered about simple and logical principles, namely, the protection of the hernia from irritation by constant soft dressings, resection of the necrotic portions, control of infection, and the reduction of intracranial tension by dehydration and repeated spinal drainages. The statistical results of this treatment are well known. Not infrequently the hernia was not controlled, but rather, herniation was progressive, attended by a corresponding neurophysiological loss. Finally the dreaded sequelae of spontaneous ventriculostomy, ependymitis and death were ever impending.

The mechanical restraint and subsequent reduction of hernia cerebri, which represents a departure from the foregoing conservative therapy, will be described and illustrated by six brief case reports.

Case 1. A 27-year-old infantryman was admitted 8 August 1944. He had been wounded by artillery 12 days previously and had had primary debridement the day of wounding in a forward hospital. The patient was lethargic and complained of headache and blurred vision. There was suggestive weakness of the left lower leg, though cooperation was poor. The optic discs showed early immeasurable blurring. Blood studies were within normal limits. The temperature curve was a few tenths below normal. Radiologic recheck revealed a right post-parietal craniectomy 4 × 5 cm. Five cm. deep to this defect was a solitary bone fragment \( \frac{1}{2} \times 1 \times 2 \) cm. The wound was grossly bulging, and yellowish fluid was exuding from a small aperture in the middle of the incision.

Operation: 9 August 1944. The old wound was reentered. Yellowish necrotic cortex presented beneath. In removing the fungating mass a tract was uncovered from which viscous yellow pus escaped. The abscess was readily evacuated and the bone fragment recovered from the cavity. There was still a disturbing tendency for the brain to continue extrusion. The dura was not repaired. Wishing to restrain the brain from further extrusion, even if only temporarily, a tantalum cranioplasty was carried out, the plate being furnished with a central drill hole through which a latex tube was inserted into the depths of the abscess cavity and brought out through a central stab wound of the scalp. The remainder of the incision was