Craniocerebral Gunshot Wounds in Civilian Practice

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NEUROSURGICAL understanding of missile injuries of the head is derived from information compiled during the four major wars of this century.1,4,6,12,18,20,24 Consequently, the concepts guiding the care and treatment of civilian gunshot wounds have, for the most part, been extrapolated from military experiences. The fundamental difference between military and civilian cranioencephalonic injury is related to the high velocity of the military missile compared to the low velocity in civilian injuries. Thus the broad extent of tissue damage noted in military practice is the result of the disruptive force caused by these exceptionally high levels of kinetic energy.7,20,25 This is rarely encountered in civilian practice.

Although the mechanism of tissue disruption by high velocity missiles is not completely understood, it has long been recognized that even small missiles at high velocity will cause extensive tissue damage.7,12,25 Kinetic energy varies with the square of the velocity and linearly with missile mass. If one considers power rather than kinetic energy, then another parameter is introduced and one may say that power, or the rate at which the energy is expended, varies with the cube of the missile velocity.7,25

Clinical evidence, compiled during wartime, corroborates these physical considerations. High velocity military wounds cause extensive tissue damage at great distances from the missile track.4,20 If left unattended, these wounds become devascularized, hemorrhagic, proteinaceous masses impregnated by foreign body fragments, all of which predispose to a suppurative process.2,22,28,33 If an infection does not develop, large gliotic areas often result, which may become the nucleus of epileptiform discharges. The two may occur together. The wars of this century have provided ample evidence that such military wounds must be treated by careful and extensive debridement coupled with painstaking wound closure.4,20,26

The purpose of this study is to examine the cranioencephalonic injuries from relatively low velocity missiles encountered in civilian practice, to assess whether such injuries require the same surgical management outlined by the military neurosurgeon,4,18,20 to evaluate the importance of adequate preoperative angiographic studies, and to analyze the results of a less radical treatment.4,8,20

Clinical Material

From January 1, 1964, through June 30, 1968, we studied 150 patients with cranioencephalonic gunshot wounds at Cook County Hospital in Chicago, Illinois. These patients constitute 93% of all those with such injuries treated at this institution during the period of our study; the remaining 7% were either admitted to nonsurgical services or their admission records have been lost in the interim. Patients dead on admission are not included in this series.

All patients with a Cook County Hospital admission diagnosis of gunshot wound of the head, whether seen first in another hospital or not, were initially evaluated in Cook County's trauma unit. Each was examined and treated by a general surgical and a neurosurgical resident. Multiple injured patients with severe chest, cardiac, or hemorrhagic problems were treated in a team manner by the appropriate staff personnel.30

Patient Evaluation. We have divided the patients in this series into five stages according to the severity of their symptoms:

Stage I. These patients were alert, without history of unconsciousness, and with no neurological deficit. They were admitted for observation. If there was a depressed fracture, bilateral carotid angiography was performed to exclude a clot before the fractures were elevated.

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Stage 2. Although alert with no history of unconsciousness, these patients had a definite “localizing” neurological deficit. Bilateral carotid angiography was performed immediately.

Stage 3. Patients in this group were awake but somnolent, agitated, or confused, with a history of unconsciousness and often a definite personality change since the time of injury. We performed emergency tracheostomy on Group 3 patients who exhibited signs of respiratory difficulty, to avert the danger of acidosis secondary to the central respiratory depression caused by increased intracranial pressure. Bilateral carotid angiography was performed on all patients in this group.

Stage 4. These patients all were comatose, responding only to painful stimuli, or to verbal stimuli when reinforced with pain. Some required tracheostomy. Many deteriorated quickly to Stage 5, and most died immediately or in spite of removal of the precipitating intracranial clot.

Stage 5. In addition to being comatose, all of these patients showed decorticate or decerebrate responses to painful stimulation and all remained comatose until death.

Use of Angiographic Observations. In patients with depressed fractures without transdural penetration, when angiography revealed no subdural or intracerebral clot we did not open the dura if it was found intact. When angiography revealed a surgically amenable lesion beneath an intact dura, the dura was opened and the lesion attacked.

In patients with transdural penetration, no extensive debridement was done along the missile track. Deeper missiles were left in place if angiography revealed no shift of vessels to indicate either intra- or extracerebral hematomas. When, on the other hand, angiography revealed the presence of a hematoma, either intra- or extracerebral, then regardless of the patient’s normal neurological status the clot was removed.

Mortality. There was a direct relationship between the over-all mortality and the time lapse between injury, initial first aid, admission to a referring hospital, admission to Cook County Hospital, and definitive surgery. For ease of interpretation, we will refer to that group of patients first seen in other hospitals as Group A, and to that group seen only at Cook County Hospital as Group B. Upon cursory examination, it would appear that there is no significant difference between the mortality rates of the two groups. However, study of Table 1 illustrates the impressive changes in stage which occur before definitive surgical and medical treatments are begun.

Other factors than time contributed to the mortality:

1. The extent of injury to vital structures as reflected by the clinical “stage” of the patient on admission (Table 2).

2. Logistical data. In contrast to military patients who undergo standardized evacuation procedures, civilians with gunshot wounds follow many courses en route to definitive therapy. In Chicago, the “nearest hospital” practice is followed. This entails the transportation of the injured patient to the nearest hospital, irrespective of any other considerations.

3. Age. The older the patient, the more fragile he is with respect to the injury.

4. The effect of the number of Stage 4