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Letter to the Editor

Traumatic acute extracranial cerebral herniation: How much do we know?

Samer S. Hoz[1], Zahraa F. Al-Sharshahi[1], Mohammed A. Alrawi[1], Mohammed A. Al-Dhahir[2]

[1]Department of Neurosurgery, Neurosurgery Teaching Hospital, Baghdad, Iraq, [2]Department of Neurosurgery, Strong Memorial Hospital University of Rochester, Rochester, New York, United States.

E-mail: Samer S. Hoz - hozsamer2055@gmail.com; *Zahraa F. Al-Sharshahi - zahraaalsharshahi@rcsi.com; Mohammed A. Alrawi - grayfoxm86@gmail.com; Mohammed A. Al-Dhahir - dr.mohammed.aldhahir@gmail.com

***Corresponding author:**
Zahraa F. Al-Sharshahi,
Department of Neurosurgery,
Neurosurgery Teaching
Hospital, Baghdad, Iraq.

zahraaalsharshahi@rcsi.com

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Traumatic acute extracranial cerebral herniation is defined here as the acute extrusion of brain tissue outside the open scalp wound at the time of initial insult, a remarkably rare presentation of penetrating traumatic brain injuries. Acute extracranial cerebral herniation may be caused by a variety of mechanisms, including penetrating, blunt, and crush head injuries. It is specifically related to severe head injuries where the mechanism involves generating large missiles. Examples of such injuries include those caused by blasts, especially where improvised explosive devices are used, projectile tear gas canisters, and some firearms. As the missile penetrates the head, a pressure wave is propagated, resulting in brain extrusion outside the confinement of the skull.

The purpose of this paper is to shed light on these unique injuries and to explore their prognostic significance. This discussion is gleaned from our extensive experience with brain trauma victims at the Neurosurgery Teaching Hospital in Baghdad, Iraq. To the best of our knowledge, apart from one series that was recently reported by our institution, no such cases have been discussed in the literature.[2]

TYPES OF EXTRACRANIAL CEREBRAL HERNIATION

There exist two primary types of extracranial cerebral herniation; postoperative and traumatic.[1,7] Postoperative extracranial cerebral herniation occurs through a surgical wound, following decompressive craniectomy, for example.[7] Traumatic extracranial cerebral herniation can be categorized into acute and late forms. Acute herniation presents at the time of initial insult, commonly at the missile exit wound, while late herniation progresses gradually (over days to weeks) and is mostly the result of a poorly secured dural defect. It is important here to draw the distinction between external cerebral herniation and post-traumatic encephaloceles, the latter is covered by brain meninges and is outside the scope of this discussion.[3,4]

MANAGEMENT OF TRAUMATIC ACUTE EXTRACRANIAL CEREBRAL HERNIATION

Clinically, brain tissue is seen extruding beyond the scalp wound. Radiographically, skull fracture, parenchymal herniation, and multiple associated brain injuries are frequently noted. While the surgical treatment of these injuries is encompassed by the concepts of damage

control neurosurgery, their potentially unique management requirements remain an unexplored mystery.

DAMAGE CONTROL NEUROSURGERY (DCNS)

DCNS is an emergency procedure performed by the neurosurgeon in conjunction with the trauma team. It is indicated in the military, rural, and remote environments. DCNS extrapolates from the overarching principles of damage control surgery. The difference between DCNS and "standard" neurosurgery is not so much in the nature of the surgery but with the speed and efficacy of the operating team. The essence of DCNS is to minimize secondary insults to the injured brain and to promptly evacuate existing intracranial hematomas.[5,6,8]

In patients with traumatic acute extracranial cerebral herniation, initial steps surgical steps include the removal of the herniated brain tissue (non-viable by definition) and simple wound closure.[5,6]

Further, surgical management should be guided by the patient's Glasgow coma score (GCS) and typically involves the following steps: (1) cleaning and debridement of the injury field, (2) hemostasis, (3) removal of liquified brain tissue, (4) circumferential removal of the surrounding bone (bone nibbling) until the dural edge is reached, (5) dural patching by means of natural (fascia Lata or periosteum) or synthetic grafts, (6) water-tight dural closure (when possible), and (7) wound margin debridement and repair.[5,6]

TRAUMATIC ACUTE EXTRACRANIAL CEREBRAL HERNIATION AS A POOR PROGNOSTIC INDICATOR

In our sample of 75 blast-induced traumatic brain injury (bTBI) victims that were admitted to the neurosurgery teaching hospital in Baghdad following the civilian-targeted, double car bomb suicide attack in 2009, 70.1% (n = 53) presented with acute extracranial cerebral herniation of the scalp wound. Such patients had a higher 30-day mortality rate compared to those without extracranial brain herniation; 64.1% versus 9%, respectively (P = 0.0001), noting that the mean initial GCS was 7.4 and 12.9 for both groups, accordingly. Patients with herniated brain tissue were also more likely to experience certain complications including seizures (P = 0.0475), cerebrospinal fluid leak (P = 0.0019), and cerebrospinal fluid infection (P = 0.0019). Victims with extracranial brain tissue herniation tended to be older than 60 years of age, and they shared the following characteristics: (1) GCS scores lower than 8, (2) unequal or bilaterally dilated, non-reactive pupils, (3) multiple intracranial shells on head CT, (4) intraventricular hemorrhage, (5) multiple lobe brain lobe injury, (6) a missile trajectory involving both the X and Y-axis, and (7) multiple extracranial injuries.

In another series reported by our center, acute extracranial cerebral herniation has been identified in ten victims with penetrating head injuries caused by projectile tear gas canisters. All ten victims died within 1–3 days of hospital admission. The amount of herniated brain tissue was noticeably larger in this cohort compared to the bTBI group, a finding that could possibly be explained by the difference in the mass, volume, and speed of the implicated missiles.[2]

KNOWLEDGE GAPS AND FUTURE RESEARCH DIRECTIONS

Traumatic acute extracranial cerebral herniation is an exceptionally unusual occurrence with many surrounding obscurities. From a wound-ballistic point of view, parameters such as weaponry type, projectile size, trajectory, and velocity need to be investigated as potential instigating factors. Clinically, injury features, particularly the location and the volume of the herniated brain parenchyma, may be of significance. In addition, identifying the neurological sequelae of such injuries and their relation to long-term morbidity and mortality rates is a step toward improving patient outcomes.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Gilardi BR, López JI, Villegas AC, Mora JA, Rodríguez OC, Appendini RC, *et al*. Types of cerebral herniation and their imaging features. Radiographics 2019;39:1598-610.
2. Hoz SS, Aljuboori ZS, Dolachee AA, Al-Sharshahi ZF, Alrawi MA, Al-Smaysim AM. Fatal penetrating head injuries caused by projectile tear-gas canisters. World Neurosurg 2020;138:e119-23.
3. Jindal G, Kumar A, Gamanagatti S, Sinha S. Posttraumatic transcalvarial brain herniation into the eyelid. Emerg Radiol 2010;17:507-9.
4. Kariyattil R, Muthukuttiparambil U. Traumatic acute brain herniation through the ear in a child: Concealed compound fracture. Sultan Qaboos Univ Med J 2012;12:352-6.
5. Rosenfeld JV. Damage control neurosurgery. Injury 2004;35:655-60.
6. Rubiano AM, Maldonado M, Montenegro J, Restrepo CM, Khan AA, Monteiro R, *et al*. The evolving concept of damage

control in neurotrauma: Application of military protocols in civilian settings with limited resources. World Neurosurg 2019;125:e82-93.
7. Sinclair AG, Scoffings DJ. Imaging of the post-operative cranium. Radiographics 2010;30:461-82.
8. Teff RJ. Use of neurosurgical decision-making and damage-control neurosurgery courses in the Iraq and Afghanistan conflicts: A surgeon's experience. Neurosurg Focus 2010;28:E9.

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