LARGE skull defects, such as those occurring after a hemicraniectomy, can lead to the unusual “syndrome of the trephined” or “syndrome of the sinking skin flap” with a deterioration in neurological status. This deterioration is usually reversed following adequate cranioplasty. In some cases, the posture of the patient is strongly related to neurological status and state of the craniectomy site scalp.

Case Report

This 77-year-old man presented with a 12-hour history of severe headache and confusion without a clear history of trauma. The patient was currently taking aspirin. At the hospital, there was a rapid deterioration in the sensorium to a GCS score of 7/15 with normal pupils. A CT scan of the brain showed a large, left, frontoparietal ASH (Fig. 1) with midline shift. An emergency left frontotemporoparietal craniotomy and evacuation of the hematoma. On the 9th postoperative day there was deterioration in sensorium associated with a sunken scalp flap and worsening midline shift on CT. A significant improvement in sensorium and a filling up of the scalp flap occurred after maintaining the patient’s head in a dependent position. The patient subsequently made an excellent recovery following replacement of the bone flap. The pathophysiology of “syndrome of the trephined” or “sinking skin flap syndrome” is reviewed. (DOI: 10.3171/2009.3.JNS0984)

**Key Words**  
- syndrome of the trephined  
- sinking skin flap syndrome  
- craniectomy  
- cranioplasty

**Abbreviations used in this paper:**  
ASH = acute subdural hematoma; CBF = cerebral blood flow; GCS = Glasgow Coma Scale; ICP = intracranial pressure.
The term “motor trephine syndrome” has been used to describe a delayed motor deficit occurring after decompressive hemicraniectomy, which reverses rapidly following cranioplasty.12–14

Rapid Neurological Change Related to Posture

Neurological deterioration and its rapid recovery with a change in head posture1,5,9 or cranioplasty,8,13,15–17 as observed in our case, has been previously documented. Nakamura et al.9 noted prompt reversal of speech worsening and right hemiparesis after moving the patient to a horizontal or Trendelenburg position, along with restoration of the curvature of the scalp flap. Guido and Patterson5 described 2 patients with a combination of a skull defect and a lumbar CSF leak with a dramatic change in neurological status related to posture. Both patients had blood injected into the epidural space of the lumbar theca, with excellent clinical recovery and a filling out of the sunken decompression site. Recently, Bijlenga et al.1 described a patient with orthostatic sinking of the skin flap along with parkinsonian tremor, abducens nerve palsy, and mydriasis. All of these signs resolved soon after the patient lay down and after cranioplasty.

Pathophysiology of the Syndrome

Various theories have been proposed for the occurrence of this interesting syndrome. These theories are briefly summarized below.

Compression of the Underlying Cortex by an Infolded Scalp. A compression of the underlying cortex by an infolded scalp has been postulated as a cause of neurological deficit by various authors.5,9,16,17 The removal of a large bone segment will leave the cranium with a flaccid area of scalp, which as a result of the gradient between atmospheric and ICPs will displace inwardly and press over the cortex.

Changes in CBF. Radiological studies including xenon CT, perfusion CT, and dynamic CT imaging have shown improvement in CBF following cranioplasty at the site of the craniectomy, and at distant sites including the opposite hemisphere.5,13,14,15 The reduction in CBF in the patient who undergoes a craniectomy can occur because of a deformity of intracranial structures,17 transmission of atmospheric pressure to the cerebral vasculature,10 and impairment of venous return as a result of local cerebral compression by the inwardly depressed scalp.5,13,15 A change in compliance of the CSF space following cranioplasty could also influence the cerebrovascular resis-
tance and autoregulatory function of CBF in both hemispheres.15

Cerebrospinal Fluid Hydrodynamics. Fodstad et al.2 observed changes in CSF hydrodynamic parameters that could be caused by the atmospheric pressure acting directly on the underlying cerebral tissue in the absence of a bone flap. In the upright position the ICP is normally negative in a closed skull. If there is a cranial defect present the ICP will tend to equalize with the atmospheric pressure, which in turn will cause an increase in the ICP if the patient is in the sitting position. The removal of a large bone segment will leave the cranium with a more or less flaccid area that should contribute to changes in elastance and volume variables, and such changes were identified in their patients. Similar findings are noted in animal studies.6

Yamaura and Makino7 found normalization of CSF pressure after cranial repair, suggesting that the intracranial relationships were reformed, including the ventricular system and subarachnoid space over the convexity. Stiver et al.14 found a high incidence of contusions and lacer system and subarachnoid space over the convexity.

If the patient is in the sitting position. The removal of a bone flap. In the upright position the ICP is normally negative in a closed skull. If there is a cranial defect present the ICP will tend to equalize with the atmospheric pressure, which in turn will cause an increase in the ICP if the patient is in the sitting position. The removal of a large bone segment will leave the cranium with a more or less flaccid area that should contribute to changes in elastance and volume variables, and such changes were identified in their patients. Similar findings are noted in animal studies.6

Yamaura and Makino7 found normalization of CSF pressure after cranial repair, suggesting that the intracranial relationships were reformed, including the ventricular system and subarachnoid space over the convexity. Stiver et al.14 found a high incidence of contusions and CSF flow derangements in the form of CSF hygromas in patients with the “motor trephine syndrome.” These investigators postulated that derangements in CSF flow cause leakage and transgression of CSF and edema into previously contused and injured parenchyma, analogous to the transependymal CSF flow and edema in patients with normal pressure hydrocephalus.

“Syndrome of the trephined” or “syndrome of the sinking skin flap” is an unusual condition in patients with large skull defects, in which progressive neurological deterioration occurs in association with the scalp flap sinking into the defect. In our case both these features were promptly reversed and corrected by lowering the patient’s head, and subsequently by cranioplasty.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References