ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Trauma

Editor
Iype Cherian, MD
Bharatpur College of Medical Sciences, Chitwan, Nepal

SNI
Open Access

Case Report

Aggressive internal and external decompression as a life-saving surgery in a deeply comatose patient with fixed dilated pupils after severe traumatic brain injury: A case report

Hiroki Ebise, Yuichi Kubota, Hidenori Ohbuchi, Naoyuki Arai, Mayuko Inazuka, Mikhail Chernov, Hidetoshi Kasuya

Department of Neurosurgery, Medical Center East, Tokyo Women's Medical University, Tokyo, Japan.

E-mail: Hiroki Ebise - herocky.ebi@gmail.com; *Yuichi Kubota - kubota.yuichi@twmu.ac.jp; Hidenori Ohbuchi - hide.ohbuchi@gmail.com; Naoyuki Arai - naoyukisensei0816@gmail.com; Mayuko Inazuka - apprivoiser.ferrrox@gmail.com; Mikhail Chernov - chernov.mikhail@twmu.ac.jp; Hidetoshi Kasuya - hkasuya@twmu.ac.jp

***Corresponding author:**
Yuichi Kubota,
Department of Neurosurgery,
Medical Center East, Tokyo
Women's Medical University,
2-1-10 Nishiogu, Arakawa-ku,
Tokyo-116-8567, Japan

kubota.yuichi@twmu.ac.jp

Received : 13 May 2020
Accepted : 26 June 2020
Published : 11 July 2020

DOI
10.25259/SNI_271_2020

Quick Response Code:

ABSTRACT

Background: To maximize control of the intracranial pressure in deeply comatose patients with malignant cerebral swelling, combination of the surgical techniques for internal and external brain decompression may be reasonable, as demonstrated in the presented case.

Case Description: A 55-year-old man was admitted with Glasgow Coma Scale (GCS) score 4, maximally dilated pupils, and absence of the pupillary light and vestibulo-ocular reflexes. Head CT revealed massive acute subdural hematoma, prominent brain shift with subfalcine and transtentorial herniation, and diffuse subarachnoid hemorrhage. Large size decompressive craniectomy and evacuation of subdural hematoma were done, however, prominent swelling of the brain and its protrusion through the bone defect remained. Therefore, extensive temporal lobectomy and removal of the bulk of temporal muscle were additionally attained followed by lax duraplasty. Gradual recovery of the patient was noted from the 1st postoperative day, and on the 70th day, his GCS score was 4T4. Three months later, his condition corresponded to the Glasgow Outcome Scale score 3 (severe disability).

Conclusion: Aggressive internal and external decompression with combination of large size craniectomy, extensive temporal lobectomy, removal of the bulk of temporal muscle, and lax duraplasty should be considered as possible life-saving option in cases of neurosurgical emergencies with malignant cerebral swelling.

Keywords: Decompressive craniectomy, Malignant cerebral swelling, Severe traumatic brain injury, Temporal lobectomy, Temporal muscle resection, Transtentorial herniation

INTRODUCTION

Extremely large size craniectomy, sometimes referring as hemicraniectomy, has been applied widely for external decompression to control intracranial pressure (ICP) in cases of extensive hemispheric infarction, severe traumatic brain injury, and other neurological and neurosurgical emergencies accompanied by malignant cerebral swelling.[5,6,12] Technically, such surgery usually includes a large question mark-shaped skin flap, frontotemporoparietal

craniotomy with removal of the bone flap, wide opening of the exposed dura, and lax duraplasty (using various materials) to cover the entire bone defect.[9] In more severe cases, in particular accompanied by the transtentorial (uncal) herniation, for more effective ICP control, additional internal decompression with extensive resection of the temporal lobe was suggested.[7] Furthermore, extensive resection of the temporal muscle and fascia in addition to decompressive craniectomy was advocated in cases of malignant hemispheric infarction to further release pressure on the underlying edematous brain.[8,13] Herein, we discuss how combined use of all aforementioned techniques may augment the effective control of ICP after life-saving surgery in a deeply comatose patient with malignant cerebral swelling caused by severe traumatic brain injury.

CASE DESCRIPTION

A 55-year-old man was found unconscious on the street and transferred to the emergency center of our hospital. At admission, the patient's vital signs were stable, but he was unresponsive, the Glasgow Coma Scale (GCS) score was 4 (eye opening, 1; verbal response, 1; and motor response, 2), both pupils were maximally dilated (diameter, 6.5 mm), and pupillary light reflexes on both sides and vestibulo-ocular reflex (VOR) were absent. There were no visible local head injuries. Head CT revealed massive acute subdural hematoma above the right cerebral convexity causing prominent brain shift with subfalcine and transtentorial herniation, the obliteration of basal cisterns, as well as diffuse subarachnoid hemorrhage [Figure 1a-c]. Immediately upon diagnosis, burr hole above the hematoma was made under local anesthesia, dura was opened, and subdural drainage tube was inserted. The patient was transferred to the OR, where large size right-sided decompressive craniotomy with removal of the bone flap was done and subdural hematoma was evacuated. However, prominent swelling of the brain and its protrusion through the bone defect remained, thus it was decided to perform internal decompression with extensive resection of the lateral and medial part of the right temporal lobe. Thereafter, frontal and parietal lobes still remained swollen, thus for the avoidance of brain compression after surgery the bulk of the temporal muscle down to the zygomatic arch was removed from the skull in one piece along with the periosteum. Extensive lax duraplasty with DuraGen® (Integra LifeSciences, Princeton, NJ) was done, probe for ICP monitoring was inserted, and skin was closed. No subdural or subcutaneous drainage was left.

Postoperative course

Immediately after surgery, CT demonstrated significant reduction of the brain shift, "reappearance" of the ambient cistern, large area of infarction within the right parietal and occipital lobes caused by compression of the posterior cerebral artery at the time of herniation, and subcutaneous hematoma [Figure 1d-f]. The patient underwent standard treatment in ICU, including normothermia therapy. On the 1st postoperative day, his best motor response was characterized as withdrawal to pain, diameter of the left (contralateral) pupil reduced from 6.5 to 3.5 mm, and VOR has recovered, whereas on the 3rd day, the left pupil started to react to light [Table 1]. Gradual recovery of the patient continued thereafter. On the 45th day after primary surgery, cranioplasty and ventriculoperitoneal shunting were done, and on the 70th day, he was transferred for further treatment to the neurorehabilitation facility. At that time, his GCS score was 4T4 (eye opening, 4; verbal response, tracheostomy; and motor response, 4) and CT demonstrated asymmetric hydrocephalus, extensive

Table 1: Dynamics of consciousness level and related reflexes in a reported patient with malignant cerebral swelling caused by severe traumatic brain injury with massive right-sided acute subdural hematoma causing prominent brain shift and subfalcine and transtentorial herniation, who underwent craniectomy with aggressive internal and external decompression.

	At admission	After decompressive surgery						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
GCS score								
Eye opening	1	1	1	1	1	1	1	1
Verbal response	1	1	1	1	1	1	1	1
Motor response	2	4	4	4	4	4	4	4
Pupil diameter (mm)								
Right	6.5	6.5	6.0	6.0	6.0	5.0	5.0	5.0
Left	6.5	3.5	3.0	3.0	3.0	2.5	2.5	2.5
Pupillary light reflex								
Right	-	-	-	-	-	-	-	-
Left	-	-	-	+	+	+	+	+
Vestibulo-ocular reflex	-	+	+	+	+	+	+	+

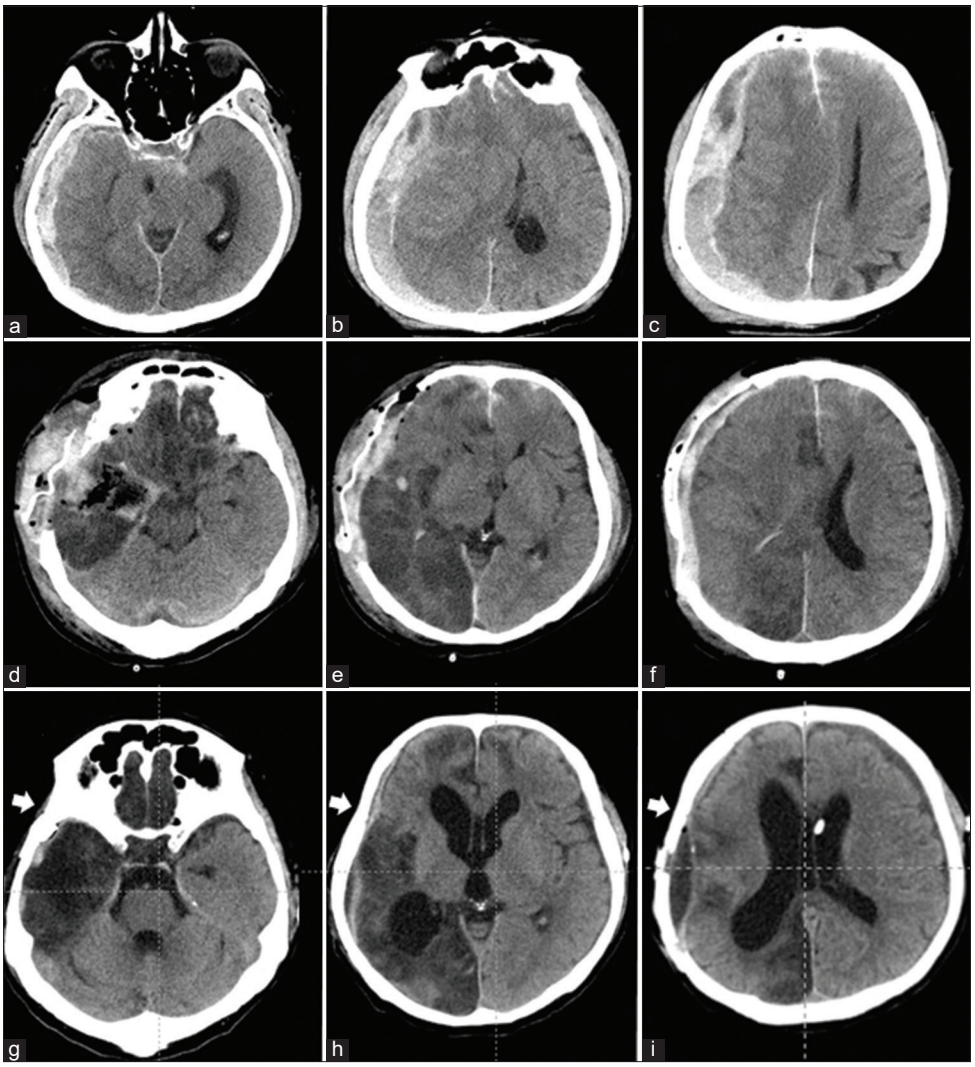

Figure 1: Sequential head CT examinations in a 55-year-old man with severe traumatic brain injury. At the time of admission (a-c), massive acute subdural hematoma above the right cerebral convexity causing prominent brain shift with subfalcine and transtentorial herniation, the obliteration of basal cisterns, as well as diffuse subarachnoid hemorrhage were seen. Immediately after surgery directed at the evacuation of subdural hematoma, right temporal lobectomy, and external decompression (d-f), the "re-appeared" ambient cistern can be clearly visualized, as well as wide area of infarction within the right parietal and occipital lobes caused by compression of the posterior cerebral artery at the time of herniation, and subcutaneous hematoma. At the time of discharge after cranioplasty and ventriculoperitoneal shunting (g-i), asymmetric hydrocephalus, extensive infarction of the right parietal and occipital lobes, and small epidural CSF collection are evident, as well as absence of the right temporal muscle (arrows), which was resected at the time of decompressive surgery.

infarction of the right parietal and occipital lobes, and small epidural CSF collection in the right temporoparietal area [Figure 1g-i]. At 3 months after discharge, the condition of the patient corresponded to the Glasgow Outcome Scale (GOS) score 3 (severe disability).

DISCUSSION

It is well recognized that decompressive craniectomy may be quite effective for ICP control in cases of malignant cerebral swelling caused by massive acute stroke and severe traumatic brain injury.[5,6,12] Several randomized controlled trials conducted in Europe evaluated effectiveness of such surgeries in comparison to conventional therapy for the management of middle cerebral artery infarction and revealed their positive impact on the reduction of case fatality and poor outcomes if performed within 48 h after clinical onset in patients < 60 years of age.[3,4,11] However, unfavorable results, corresponding to the Modified Rankin Scale score 4–6, at 1 year after surgery still were rather common (50–53%),[4,11] which might be in part attributable to insufficient brain decompression at the time of intervention.

Internal decompression with temporal lobectomy also demonstrated its usefulness in control of ICP in cases of malignant cerebral swelling caused either by massive hemispheric infarction or by severe traumatic brain injury.[2,10] A classical experience of epilepsy surgery postulates that resection of the dominant and nondominant temporal lobes up to, respectively, 40 mm and 60 mm from their tip, may be sufficiently safe. Although such traditional consideration based purely on anatomical data clearly may raise some concerns, realization of temporal lobectomy within such limits during life-saving surgery in cases of neurosurgical emergencies may be quite reasonable. It is important to underline, that for effective brainstem decompression, complete removal of not only lateral, but medial temporal lobe structures, including uncus, is necessary.

Swelling of the temporal muscle in the presence of bone defect after decompressive craniectomy may result in additional "secondary" brain compression. For avoidance of such a complication, extensive resection of the temporal muscle and fascia down to the zygomatic arch has been proposed.[8,13] Of note, chewing problems after such procedure are reportedly mild since grinding phase requires only one-third of the maximal bite force, thus can be sufficiently compensated by the masseter and medial pterygoid muscles.[1]

Finally, any decompressive craniectomy should presume wide lax duraplasty to cover the entire bone defect, which can be done with the use of various materials.[7]

Decompressive craniectomy is usually performed as life-saving surgery for neurosurgical emergencies, such as massive cerebral infarction or severe traumatic brain injury. In these cases, it may be quite difficult to predict subsequent clinical course, in particular, the possible development of uncontrolled intracranial hypertension with secondary brainstem compression. Therefore, if such surgery is performed in deeply comatose patient with transtentorial herniation and intraoperative evidence of malignant cerebral swelling, for achievement of the maximum effects on the ICP control, combination of the various techniques for internal and external decompression of the brain may be reasonable. As demonstrated in the presented case, such an aggressive surgical strategy may be beneficial for survival, while further experience is needed for detailed evaluation of the long-term functional outcomes.

CONCLUSION

Aggressive internal and external decompression with combined use of large size craniectomy, extensive temporal lobectomy, removal of the bulk of the temporal muscle and fascia down to the zygomatic arch, and wide lax duraplasty should be considered as possible life-saving surgical option in cases of neurosurgical emergencies accompanied by malignant cerebral swelling, prominent brain shift, and transtentorial herniation.

Declaration of patient consent

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Gibbs CH, Mahan PE, Lundeen HC, Brehnan K, Walsh EK, Sinkewiz SL, *et al*. Occlusal forces during chewing-influences of biting strength and food consistency. J Prosthet Dent 1981;46:561-7.
2. Hakan AK, Daltaban IS, Vural S. The role of temporal lobectomy as a part of surgical resuscitation in patients with severe traumatic brain injury. Asian J Neurosurg 2019; 14:436-9.
3. Hofmeijer J, Kappelle LJ, Algra A, Amelink GJ, van Gijn J, van der Worp HB. Surgical decompression for space-occupying cerebral infarction the hemicraniectomy after middle cerebral artery infarction with life-threatening edema trial [HAMLET]: A multicentre, open, randomised trial. Lancet Neurol 2009;8:326-33.
4. Jüttler E, Schwab S, Schmiedek P, Unterberg A, Hennerici M, Woitzik J, *et al*. Decompressive surgery for the treatment of malignant infarction of the middle cerebral artery (DESTINY): A randomized, controlled trial. Stroke 2007;38:2518-25.
5. Kapapa T, Brand C, Wirtz CR, Woischneck D. Outcome after decompressive craniectomy in different pathologies. World Neurosurg 2016;93:389-97.
6. Lanzino G. Decompressive craniectomy for acute stroke: Early is better. J Neurosurg 2008;109:285-6.
7. Nussbaum ES, Wolf AL, Sebring L, Mirvis S. Complete temporal lobectomy for surgical resuscitation of patients with transtentorial herniation secondary to unilateral hemispheric swelling. Neurosurgery 1991;29:62-6.
8. Park J, Kim E, Kim GJ, Hur YK, Guthikonda M. External decompressive craniectomy including resection of temporal muscle and fascia in malignant hemispheric infarction. J Neurosurg 2009;110:101-5.
9. Quinn TM, Taylor JJ, Magarik JA, Vought E, Kindy MS, Ellegala DB. Decompressive craniectomy: Technical note. Acta Neurol Scand 2011;123:239-44.
10. Robertson SC, Lennarson P, Hasan DM, Traynelis VC. Clinical course and surgical management of massive cerebral infarction. Neurosurgery 2004;55:55-62.

11. Vahedi K, Vicaut E, Mateo J, Kurtz A, Orabi M, Guichard JP, *et al*. Sequential-design, multicenter, randomized, controlled trial of early decompressive craniectomy in malignant middle cerebral artery infarction (DECIMAL Trial). Stroke 2007;38:2506-17.
12. Winter CD, Adamides A, Rosenfeld JV. The role of decompressive craniectomy in the management of traumatic brain injury: A critical review. J Clin Neurosci 2005;12:619-23.
13. Yu SH, Kim BC, Choi JY, Lee JI, Cho WH, Choi HJ. Addition of resection of temporal muscle and fascia in decompressive craniectomy in the treatment of traumatic brain injury. Korean J Neurotrauma 2016;12:84-8.

How to cite this article: Ebise H, Kubota Y, Ohbuchi H, Arai N, Inazuka M, Chernov MF *et al*. Aggressive internal and external decompression as a life-saving surgery in a deeply comatose patient with fixed dilated pupils after severe traumatic brain injury: A case report. Surg Neurol Int 2020;11:181.