ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 11 | November - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PROGNOSTIC FACTORS AFFECTING SURGICAL OUTCOME IN DECOMPRESSIVE CRANIECTOMY IN SEVERE HEAD INJURY

Neurosurgery

Dr Nn Gopal Mch, Professor Neurosurgery, Department of Surgery, MLN Medical College, Prayagraj, UP

Dr Raviraj Patil MS, Assistant Professor, Department of Surgery, MLN Medical College, Prayagraj, UP

Dr Amit Kumar Singh Mch, Associate Professor Neurosurgery, Department of Surgery, MLN Medical College, Prayagraj, UP

Dr Saurabh Anand Dubey DNB, Assistant Professor Neurosurgery, Department of Surgery, MLN Medical College, Prayagraj, UP

Dr Prakshi Solanki Junior Resident, Department of Surgery, MLN Medical College, Prayagraj, UP

ABSTRACT

Introduction Intracranial hypertension occurring after traumatic brain injury (TBI) as a delayed secondary pathologic process initiated at the moment of injury. These lead to a vicious cycle whereby reduced cerebral perfusion pressure (CPP) causes reduction of cerebral blood flow (CBF) and oxygenation, with worsening of brain edema and, eventually, brain herniation, and death. decompressive craniectomy (DC), a procedure consisting on removal of part of the skull and opening of the underlying dura, can be used as a last-tier therapy to mitigate ICP elevation.

Aims And Objectives:

- Effect of duration for hospitalisation and time lapse before surgery and hospital stay.
- GCS Score at time of presentation, before and after surgery and at discharge.
- Post op complications- meningitis, osteomyelitis, epilepsy, surgical site infection, neurological deficits

Materials And Methods: observational study, conducted in a tertiary care institute, collecting data over a period of 1 year. **Inclusion criteria:** GCS ≤ 8. Patients with raised Intracranial pressure with associated Intracranial lesions (SAIH, SDH, CONTUSION etc), Midline shift > 5mm **Exclusion criteria:**Patients with severe co-morbid injuries involving other organs (Polytrauma). Patients with severe co-morbid medical disorders. Inability to understand and give consent. Participants who might not be able to comply with the study procedures till the end of the study. Firearm Injury. **Results And Conclusions** A total of 42 patients aged 5-65 years of age (mean age 43.46±13.75 years) admitted Mean GCS at admission was 5.38±1.28 (Range 3-8). Mean duration of hospital stay was 11.40±5.50 days (Range: 3-22 days). At discharge, only 4 (8.0%) patients achieved score 5 (Good response to treatment) on Glasgow Outcome scale (GOS). 15 (35.7%) expired (GOS 1), 5 (11.9%) were in vegetative state (GOS 2), 8 (19.0%) were severely disabled (GOS 3), and 10 (23.8%) were moderately disabled (GOS 4). Patients with GOS 1 & 2 were classified as Poor outcome (n=20; 47.6%), GOS 3 & 4 were classified as Fair outcome (n=18; 42.9%), and with GOS 5 (n=4; 9.5%) were classified as Good outcome. %). Significant association between unconsciousness at presentation and outcome was observed.Patients with poor outcome presented with significantly lower GCS and had less duration of hospital stay.

KEYWORDS

Decompressive craniectomy, Glasgow outcome score, polytrauma, traumatic head injury

INTRODUCTION

Traumatic head injury is one of the most common causes of admission to the emergency department of a hospital. Trauma in itself is one of the leading causes of mortality, hospitalization and disability throughout the world and among all age groups. Nearly 16,000 persons die every day owing to traumatic injuries inflicted to them. Among different types of traumatic injuries, head injuries hold an important place as head injuries alone are responsible for nearly one-third of total trauma related deaths [1]

Intracranial hypertension is a critical event frequently occurring after traumatic brain injury (TBI) as a delayed secondary pathologic process initiated at the moment of injury. Due to the rigid nature of the skull and the dura, brain edema, expanding hematomas, or blossoming of contusions can rapidly exhaust the compensation mechanisms leading to maintenance of a controlled intracranial pressure (ICP). These events lead to a vicious cycle whereby reduced cerebral perfusion pressure (CPP) causes reduction of cerebral blood flow (CBF) and oxygenation, with worsening of brain edema and, eventually, brain herniation, and death[3]. Following failure of medical management, decompressive craniectomy (DC), a procedure consisting on removal of part of the skull and opening of the underlying dura, can be used as a last-tier therapy to mitigate ICP elevation. Despite controversies, the use of DC has been introduced in TBI guidelines, and its efficacy has been recently considered to be beneficial in terms of improving overall survival as a last-tier therapy, compared to medical treatment[4,5] . Decompressive craniectomy (DC), which is designed to overcome the space constraints of the Monro Kellie doctrine, perturbs the cerebral blood, and CSF flow dynamics. Resultant complications occur days to months after the surgical procedure in a time pattern that can be anticipated with advantage in managing them[6] .

Different methods of DC have been developed for decompression of brain at risk for the sequelae of traumatically elevated ICP. Those include subtemporal decompression, circular decompression, fronto- or temporo-parietal decompressive craniectomy, large fronto-temporo-parietal decompressive craniectomy, hemisphere craniectomy, and bifrontal decompressive craniectomy[7,8].

Long term beneficial effects of decompressive craniectomy have been reported by various researchers[9,10,11,12] but it is still regarded as a salvage surgery. Long-term, deleterious neurocognitive, and psychosocial effects resulting in poor quality of life, and economical burden are well known[11,13]. Apart from its own set of complications, cranioplasty creates serious economical burden[14] in low-to-middle income countries (LMICs).

AIMS AND OBJECTIVES

The aim of this prospective study was to identify the prognostic factors which affect surgical outcome in decompressive craniectomy in severe head injury in a tertiary healthcare centre.

This was done by evaluating the:-

- Effect of duration for hospitalisation and time lapse before surgery and hospital stay.
- GCS Score at time of presentation, before and after surgery and at discharge.
- Post operative complications- meningitis, osteomyelitis, epilepsy, surgical site infection, neurological deficits affecting the surgical outcome in decompressive craniectomy in severe head injury patients.

MATERIAL AND METHODS

This study was conducted in a tertiary care institute by collecting data of severe head injury patients over a period of 1 year. Institutional

Ethics Committee approval was taken for doing this observational study. The study included patients who were diagnosed with severe head injury admitted to our tertiary public hospital.

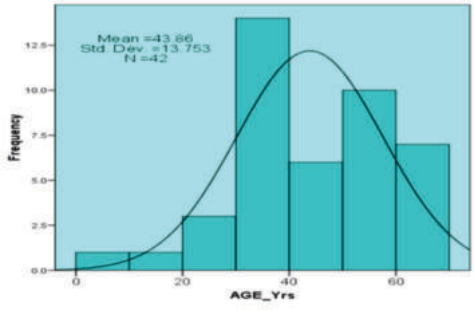
Statistical Tools Employed

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 statistical Analysis Software.

RESULTS

A total of 42 patients attending the tertiary care centre (SRN Hospital, MLN Medical College Prayagraj) with severe head injury using decompressive craniectomy to control intracranial pressure were enrolled in the study after obtaining an informed consent.

Range of age of patients enrolled in the study was from 5 to 65 years, mean age of patients was 43.46±13.75 years.(Graph 1.1) Majority of the patients enrolled in the study were male (73.8%), rest were female (26.2%). Gender ratio in the present study was 2.82.

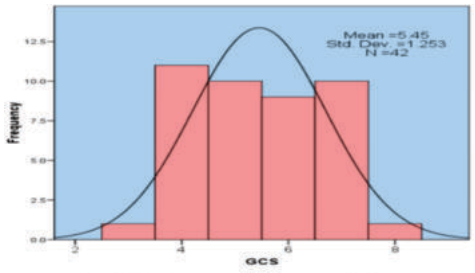


Graph 1.1: Age Profile of Study Population

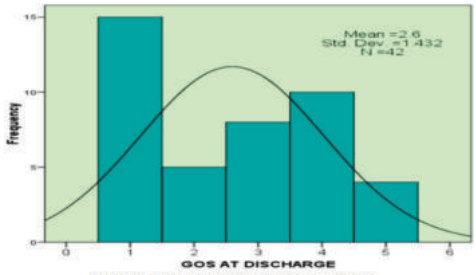
Majority of the patients (81.0%) admitted at our set up had met road traffic accident (RTA), other causes of admission were Fall from height (11.9%) and Assault (7.1%). Majority of the patients reached hospital within 24 h in only 38.1% patients. Surgery could be initiated within 24 hours of the incident (59.5%). At admission, range of score on Glasgow Coma scale (GCS) of patients enrolled in the study was 3 to 8, mean GCS was 5.45±1.25. (Graph 3.1). Range of hospital stay of patients enrolled in the present study was 3 to 22 days, mean duration of hospital stay of study population was 11.40±5.50 days. Range of score on Glasgow Outcome scale (GOS) was 1 to 5, mean GOS was 2.60±1.43. (Graph 3.2) Out of 42 patients enrolled in the study, 15 (35.7%) expired during treatment, had Glasgow Outcome score 1. At discharge, 5 (11.9%) remained in Vegetative state having Glasgow Oucome score 2. Severe disability was observed in 8 (19.0%) patients (Glasgow outcome score 3) while 10 (23.8%) patients had moderate disability(Glasgow outcome score 4). Only 4 (9.5%) patients showed Good response to treatment, having Glasgow Outcome score 5.(Table 2)

Table 1: Clinical Profile of Study Population (n=42)

SN		Statistics	
		No.	%
1-	**Mode of Injury**		
	Assault	3	7.1
	Fall from height	5	11.9
	RTA	34	81.0
2-	**Time lapse of hospitalization**		
	<24 h	26	61.9
	>24 h	16	38.1
3-	**Time delay to Surgery**		
	<24 h	17	40.5
	>24 h	25	59.5
4-	**Mean GCS at admission±SD (Range)***	5.45±1.25 (3-8)	



Graph 3.1 : Glasgow Coma Score at admission



Graph 3.2: Glasgow Outcome Score

Table 2: Distribution of Study Population according to Final Outcome (based on Glasgow Outcome Scale)

SN	Outcome	No. of cases	Percentage
1-	Poor outcome (Death+Vegetative)	20	47.6
2-	Fair outcome (Severe & Moderate)	18	42.9
3-	Good outcome (Good response to Tt.)	4	9.5

Mean age of patients with Poor outcome was maximum (50.00±16.05 years) followed by those with Fair outcome (38.65±8.73 years) and minimum of those with Good outcome (36.50±6.03 years). Difference of age of patients with different outcomes was found to be significant statistically (p=0.017). On exploring the between group differences, significant differences was obtained between patients with Poor outcome and Fair outcome only (Diff. 11.33±4.13 years, p=0.024). Proportion of female patients was higher as compared to males having Poor Outcome (63.6% vs. 41.9%) while proportion of males was higher as compared to females having Fair outcome (48.4% vs. 27.3%) and Good outcome (9.7% vs. 9.3%), but this difference was not found to be significant statistically.(Table 3)

Table 3: Association of Demographic Profile and Final Outcome

SN	Factors	Poor outcome (n=20)		Fair outcome (n=18)		Good outcome (n=4)		Significance of differences	
		Mean	SD	Mean	SD	Mean	SD	F	'p'
1-	Age*	50.00	16.05	38.67	8.73	36.50	6.03	4.508	0.017
		No.	%	No.	%	No.	%	χ^2	'p'
2-	**Gender**								
	Female	7	63.6	3	27.3	1	9.3	1.650	0.438
	Male	13	41.9	17	48.4	3	9.7		

% row-wise

*Tukey HSD Test: Between Group comparison of Age

Majority of patients having Assault and Fall from height injury (66.7% & 80.0%) had poor outcome while majority of the patients with RTA injury had Fair to Good outcome (58.8%) but this difference was not found to be significant statistically. Proportion of patients hospitalized

≤24 hours of accident was higher as compared >24 hours having Fair outcome (57.7% vs. 18.8%) and Good outcome (15.4% vs. 0.0%) while proportion of patients hospitalized >24 hrs was higher as compared to ≤24 hrs having Poor outcome (81.3% vs. 26.9%). This difference was found to be significant statistically. Proportion of patients with initiation of surgery ≤24 hours of accident was higher as compared >24 hours having Fair outcome (64.7% vs. 28.0%) and Good outcome (17.6% vs. 4.0%) while proportion of patients with initiation of surgery >24 hrs was higher as compared to ≤24 hrs having Poor outcome (68.0% vs. 17.6%). This difference was found to be significant statistically. (Table 4) Majority of the patients with Fair outcome and Good outcome (72.2% & 75.0%) showed symptoms of disorientation at admission while only 35.0% patients with poor outcome showed symptoms of disorientation. This difference was found to be significant statistically. Majority of the patients with Poor outcome (60.0%) were unconscious at admission while only 19.0% and 25.0% patients with Fair outcome and Good outcome were unconscious at admission. This difference was found to be significant statistically.

Table 4: Association of Mode of Injury and Time lapse of hospitalization & Surgery with Outcome

SN	Factors	Poor outcome (n=20)		Fair outcome (n=18)		Good outcome (n=4)		Significance of differences	
		No.	%	No.	%	No.	%	χ^2	'p'
1-	**Mode of injury**								
	Assault	2	66.7	0	0.0	1	33.3	6.205	0.184
	Fall from height	4	80.0	1	20.0	0	0.0		
	RTA	14	41.2	17	50.0	3	8.8		
2-	**Time lapse hospitalization**								
	<24 h	7	26.9	15	57.7	4	15.4	12.105	0.002
	>24 h	13	81.3	3	18.8	0	0.0		
3-	**Time lapse surgery**								
	<24 h	3	17.6	11	64.7	3	17.6	10.548	0.005
	>24 h	17	68.0	7	28.0	1	4.0		

% row-wise

GCS of patients with Good outcome was maximum (6.25±1.71) followed by that of Fair outcome (5.94±1.00) and least of those with Poor outcome (4.85±1.14). Difference in GCS of patients with above outcomes was found to be significant. On exploring the between outcome differences statistically, significant difference was found between Poor outcome & Fair outcome only. Patients with Poor outcome had significantly lower duration of hospital stay as compared to those with Fair outcome and Good Outcome (6.95±2.59 vs. 15.56±4.31 & 15.00±3.65). Difference in duration of hospital stay of patients with Fair and Good outcome was not found to be significant.

DISCUSSION

An immediate outcome of severe head injury is sudden rise in intracranial pressure. In a normal individual the intracranial pressure remains between 6 and 16 mmHg. Intracranial pressure over 16 mmHg is an issue of concern, however when intracranial pressure reaches more than 20 mmHg is considered as extremely high requiring immediate treatment . In case the rise in intracranial pressure goes untreated then it can result in either temporary or permanent loss of vision and a severe headache that can last for more than two days. The patient may subsequently show signs of irritation, lethargy, cognitive decline and may exhibit abnormal behavior. A prolonged untreated rise in intracranial pressure could lead the patient to a state of near-unconsciousness, coma, and finally to death.

the present study was undertaken to identify the factors that could help in prognosis of decompressive craniectomy in severe head injury. For this purpose, a prospective observational study was carried out in which a total of 42 patients with severe head injury scheduled to undergo decompressive craniectomy as per indications were enrolled. The age of patients ranged from 5 to 65 years, mean age of patients was 43.46 years and majority of patients were males (73.8%).

As far as rate of poor outcome is considered, it was found to be 47.6% in present study. Among different contemporary studies compared in Table D1 above, this rate varies from as low as 32.7% (Sharda et al.76) to as high as 78.6% (Saade et al.77). The reason for this could be the fact that different case series had different inclusion criteria. In present study, we included only severe head injury cases with GCS Another factor affecting the rate of poor outcome could be difference in time at which outcome was measured. In present study, we limited ourselves to in-hospital outcome only.

Prognostic factors identified in different contemporary studies using Decompressive craniectomy in head injury cases and their comparison with present study

SN	Author (Year), Place	Sample size and characteristic	Poor outcome rate (Death+ Vegetative state)	Factors identified
1.	Gouello *et al.* (2014)[75], France	60 (Mean age 33 years, 76.7% males; Mean GCS 7.23)	38.3%	GCS at admission
2.	Sharda *et al.* (2014)[76], Malaysia	110 (Mean age 35.7 years, 86% males; 318% having GCS<8)	32.7% deaths	Postoperative hypoxia, unmaintained cerebral perfusion pressure and unstable blood pressure
3.	Saade *et al.* (2014)[77], Brazil	56 (Majority 31-40 years; 83.9% males; 51.7% GCS 4 and 5 at admission)	78.6%	Presence of mydriasis with absence of pupillary reflex, scoring 4 and 5 in the Glasgow Coma Scale, association of intracranial lesions and diversion of midline structures (DML) exceeding 15mm
4.	Grille & Tommasino (2015)[78], Uruguay	64 (Mean age 31 years; 79% males; At adm. GCS 7±3)	45%	Post-op intracranial hypertension, low GCS at admission
5.	Sinha *et al.* (2015)[79], India	1236 (Median age 32 years; 81% males; Median GCS 6)	41.7% deaths	Age, severity of head injury, pupillary involvement, presence of preoperative hypotension, midline shift, brain bulge, extradural hematoma, SAH, infarct, polytrauma, performance of an intraoperative duraplasty or a slit durotomy, carrying out a simultaneous contralateral DC; and, the length of hospitalization
6.	Bagheri *et al.* (2017)[82], Iran	61 (Mean age 36.09 years; 59% males; 37.3% had GCS<5; 18% had GCS>18)	45.9%	At admiss8284ion GCS, Pupillary Mydriasis, Midline shift
7.	Dhakre *et al.* (2019)[84], India	96 (67.7% aged 18-40 years; 83.9% males; 22.6% had GCS<8)	50% death and un-favourable outcome	Preop. GCS, Postop. GCS, Postop. Neurological status
8.	Silva *et al.* (2020)[89], Brazil	131 (57.3% aged 19-39 years, 90.1% males; 48.8% having GCS≤8)	74.0% death and un-favourable outcome	At admission GCS
9.	Shukla (2020)[91], India	83 (Mean age 32 years; 81.9% males; Mean GCS 7±3.44)	49.3%	Lower GCS at admission, Occurrence of hydrocephalus, Old age
10.	Tau *et al.* (2020)[90], South Africa	62 (Mean age 36.1 years; 82% males; 58.1% severe head injury)	53%	Mechanism of injury, time lapse from injury to hospital admission, severity of head injury
11.	Present study (2020), India	42 (Mean age 43.46 years; 73.8% males; Mean GCS 5.45)	47.6%	Older age, time lapse between trauma and hospitalization and between trauma and procedure, absence of disorientation, unconscious status at admission, low GCS.

CONCLUSIONS

At discharge, only 4 (8.0%) patients achieved score 5 (Good response to treatment) on Glasgow Outcome scale (GOS). 15 (35.7%) expired (GOS 1), 5 (11.9%) were in vegetative state (GOS 2), 8 (19.0%) were severely disabled (GOS 3), and 10 (23.8%) were moderately disabled (GOS 4). Patients with GOS 1 & 2 were classified as Poor outcome (n=20; 47.6%), GOS 3 & 4 were classified as Fair outcome (n=18; 42.9%), and with GOS 5 (n=4; 9.5%) were classified as Good outcome.

Elderly patients had Poor outcome whereas younger patients had Fair outcome. There was no significant association between Gender and Outcome. Time lapse to reach hospital facility (within 24 hours) and initiation of Surgery (within 24 hours) were significantly associated with better outcome.

Above findings indicated that higher age, unconscious state at admission, low GCS at admission were associated with outcome. Patients with poor outcome were discharged early (because of death), hospital stay of patients with fair and good outcome was higher.

REFERENCES

1. Kasmaei VM, Asadi P, Zohrevandi B, Raouf MT. An epidemiologyic study of traumatic brain injuries in emergency department. Emergency 2015; 3(4): 141–145. Link.
2. GBD 2016 Traumatic Brain Injury and Spinal Cord Injury Collaborators. Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019; 18: 56–87. Link
3. Rossini Z, Nicolosi F, Kolias AG, Hutchinson PJ, De Sanctis P, Servadei F. The History of Decompressive Craniectomy in Traumatic Brain Injury. Front Neurol. 2019; 10: 458.

Link
4. Stocchetti N, Maas AI. Traumatic intracranial hypertension. N Engl J Med. 2014; 370:2121–30.
5. Carney N, Totten AM, O'Reilly C, Ullman JS, Hawryluk GW, Bell MJ, et al. Guidelines for the management of severe traumatic brain injury, Fourth Edition. Neurosurgery. 2017; 80:6–15.
6. Gopalakrishnan MS, Shanbhag NC, Shukla DP, Konar SK, Bhat DI, Devi BI. Complications of Decompressive Craniectomy. Front Neurol. 2018; 9: 977. Link
7. Yang XF, Wen L. Surgical complications secondary to decompressive craniectomy for patients with severe head trauma. Transl. Neurosci. Clin. 2016, 2(1): 59–64. Link
8. Huang X, Wen L. Technical considerations in decompressive craniectomy in the treatment of traumatic brain injury. Int J Med Sci 2010, 7(6): 385-390.
9. Honeybul S, Ho KM. The current role of decompressive craniectomy in the management of neurological emergencies. Brain Inj. 2013; 27:979–91.
10. Servadei F. Clinical value of decompressive craniectomy. N Engl J Med. 2011; 364:1558–9.
11. Van Middelaar T, Nederkoorn PJ, van der Worp HB, Stam J, Richard E. Quality of life after surgical decompression for space-occupying middle cerebral artery infarction: systematic review. Int J Stroke (2015) 10:170–6.
12. Kolias AG, Kirkpatrick PJ, Hutchinson PJ. Decompressive craniectomy: past, present and future. Nat Rev Neurol. 2013; 9: 405–15.
13. McKenna A, Wilson FC, Caldwell S, Curran D, Nagaria J, Convery F. Long-term neuropsychological and psychosocial outcomes of decompressive hemicraniectomy following malignant middle cerebral artery infarctions. Disabil Rehabil. 2012; 34: 1444–55.
14. Chaturvedi J, Botta R, Prabhuraj AR, Shukla D, Bhat DI, Devi BI. Complications of cranioplasty after decompressive craniectomy for traumatic brain injury. Br J Neurosurg. 2016; 30:264–8.
15. Leif-Erik Bohman L Schuster J Decompressive Craniectomy for Management of Traumatic Brain Injury: An Update Curr Neurol Neurosci Rep 2013; 13:392.
16. Marshall LF, Smith RW, Shapiro HM. The outcome with aggressive treatment in severe head injuries. Part I: the significance of intracranial pressure monitoring. J Neurosurg. 1979;50(1):20–5.
17. Schreckinger M, Marion DW. Contemporary management of traumatic intracranial hypertension: is there a role for therapeutic hypo- thermia? Neurocrit Care. 2009;11(3):427–36.
18. Li LM, Kolias AG, Guilfoyle MR, Timofeev I, Corteen EA, Pickard JD, et al. Outcome following evacuation of acute subdural haematomas: a comparison of craniotomy with decompressive craniectomy. Acta Neurochir (Wien). 2012;154(9):1555-61.
19. Weiner GM, Lacey MR, Mackenzie L, et al. Decompressive craniectomy for elevated intracranial pressure and its effect on the cumulative ischemic burden and therapeutic intensity levels after severe traumatic brain injury. Neurosurgery. 2010; 66 (6):1111–8.
20. Patrick O. Eghwrudjakpor and Akaribari B Decompressive craniectomy following brain injury: factors important to patient outcome Libyan J Med, 2010; 5: 4620
21. Chen SH, Chen Y, Fang WK, Huang DW, Huang KC, Tseng SH. Comparison of craniotomy and decompressivecraniectomy in severely head-injured patients with acute subdural hematoma. J Trauma. 2011;71(6):1632-6.
22. Syed A, Ahmad I, Hussain M, Al-Bya F, Solaiman A Outcome following decompressive craniectomy in severe head injury: Rashid Hospital experience Pan Arab Journal Of Neurosurgery 2009; 13(2): 29- 35.
23. Rengachary SS, Batnitzky S, Morantz RA, Arjunan K, Jeffries B. Hemicraniectomy for acute massive cerebral infarction. Neurosurgery; 1981; 8: 321-8.
24. Aarabi B, Hesdorffer DC, Ahn ES, Aresco C, Scalea TM, Eisenberg HM. Outcome following decompressive craniectomy for malignant swelling due to severe head injury. J Neurosurg 2006; 104(4):469–79.
25. Eisenberg HM, Frankowski RF, Contant CF, Marshall LF, Walker MD. High-dose barbiturate control of elevated intracranial pressure in patients with severe head injury. J Neurosurg. 1988;69(1):15–23.
26. Lazaridis C, Czosnyka M. Cerebral blood flow, brain tissue oxygen, and metabolic effects of decompressive craniectomy. Neurocrit Care. 2012; 16(3):478–84
27. Beez T, Munoz-Bendix C, Steiger H. et al. Decompressive craniectomy for acute ischemic stroke. Crit Care 2019; 23: 209. Link
28. Sahuquillo J, Dennis JA. Decompressive craniectomy for the treatment of high intracranial pressure in closed traumatic brain injury. Cochrane Database Syst Rev. 2019 Dec 31;12(12):CD003983.
29. Schirmer CM, Ackil AA Jr, Malek AM. Decompressive craniectomy. Neurocrit Care (2008) 8:456–470,
30. Cooper PR, Rovit RL, Ransohoff J. Hemicraniectomy in the treatment of acute subdural hematoma: a re-appraisal. Surg Neurol 1976; 5: 25-28