JHNS
Journal of Holistic Nursing Science
E-ISSN: 2579-7751 P-ISSN: 2579-8472
Journal of Holistic Nursing Science

Article journey
Submitted
18/5/2023
Revised
19/7/2023
Accepted
19/7/2023
Online first
19/7/2023

CASE STUDIES

Caring a patient with brain injury experiencing increased intracranial pressure: A case report

Ridwan Ridwan[1], Rezeki Nur[2], Kasmawati Karim[3]

Author information
[1,2] Department of Nursing, Nursing Academy of Mappa Oudang, Indonesia
[3] Department of Nursing, Bhayangkara Mappaoudang Hospital, Indonesia

Ridho.Hazel@gmail.com

https://doi.org/10.31603/nursing.v10i2.9137

Abstract
Traumatic Brain Injury (TBI) is a significant contributor to mortality and a critical global health concern. Elevated intracranial pressure (ICP) appears to be an acute and potentially fatal complication that requires increased focus from clinical nurses within hospital settings. It is critical to manage patients with TBI who also have elevated ICP to prevent an ICP extremity. This research aimed to assess the efficacy of SIKI in treating patients with TBI. This study presents the case of a 12-year-old child who sustained an epidural haemorrhage due to a traffic accident and had a mild to moderate traumatic brain injury. Nursing care is administered through monitoring interventions and ICP improvement management. Due to the clinical advantages, healthcare industry policymakers should recommend using SIKI during TBI treatment.

Keywords: Brain injury; nursing care; intracranial pressure; nursing intervention; hospital care

Introduction

Traumatic brain injury (TBI) is a major global health issue that contributes to the high trauma fatality rate (Krishnamoorthy, Komisarow, Laskowitz, & Vavilala, 2021). In 2014, the Centers for Disease Control and Prevention (CDC) recorded 2.53 million TBI-related emergency department visits, roughly 288,000 TBI-related hospitalizations, and 56.800 TBI-related deaths (Capizzi, Woo, & Verduzco-Gutierrez, 2020). A large-scale study of 9959 patients discovered that TBI mortality was higher in adults (16-55 years) than in children (0-15 years) (Emami et al., 2017). According to Basic Health Research data, TBI accounted for 11.9% of all injuries involving any part of the body in Indonesia (Siahaya N, 2020). The Glasgow Coma Scale (GCS) frequently categorizes TBI as mild, moderate, or severe. Mild TBI is defined as GCS 13-15, loss of consciousness 0-30 min, altered consciousness up to >24 h, standard imaging, and post-traumatic amnesia 0-1 day. Meanwhile, moderate TBI is defined as GCS 9-12, loss of consciousness >30 min and 24 h, disturbance of consciousness >24 h, normal or abnormal imaging, and post-traumatic amnesia >1 d and 7 d. (Capizzi, 2020). TBI occurs in 80% of instances as mild, 10% as moderate, and 10% as severe (Whitaker-Lea & Valadka, 2017).

Raised intracranial pressure (ICP) is a severe life-threatening consequence that nurses caring for TBI patients handle regularly. The primary goal of nursing care for a TBI patient is to prevent subsequent brain damage by reducing increasing intracranial pressure (Padayachy, 2016). ICP management is at the core of neurocritical care. Monitoring and managing ICP can help prevent morbidity and mortality from secondary brain damage (Changa, Czeisler, & Lord, 2019). ICP monitoring can be performed invasively or non-invasively. Noninvasive monitoring can be used as a routine alternative when invasive monitoring support is not available (Raboel, Bartek, Andresen, Bellander, & Romner, 2012). Many new approaches have been developed to monitor ICP non-invasively (Muller et al., 2023), including Monitoring and Management of ICP on Indonesian Nursing Intervention Standards (SIKI). SIKI is a standard reference for Indonesian nurses when selecting and implementing nursing actions to deliver nursing care. Nursing interventions in SIKI include monitoring and management of increased ICP. In this case, we used the SIKI to monitor and manage ICP recovery in an epidural hematoma patient with mild to moderate TBI who showed evidence of neurological deficit. In

this case, we report a pediatric patient with mild to moderate TBI who experienced epidural bleeding due to a traffic accident. Nursing care focused on noninvasive ICP monitoring and management interventions based on SIKI.

Case report

A 12-year-old female patient arrived at The Emergency Room (ER) after being injured in a traffic accident while riding her motorcycle. The initial nursing examination at the ER revealed that her eyes opened voluntarily, that she could answer questions and execute directions correctly, and that she had GCS 15 (E4 V5 M6). The patient complained of severe headaches, scoring a seven on the Numeric Rating Scale. Other sections of the body have no wounds or damage. Shortly after the occurrence, the family who delivered him reported a history of vomiting and fainting. Vital signs, symptoms of elevated ICP, and neurologic deficit throughout his stay at the ER are further detailed in Table 1. An emergency CT scan was performed and showed subdural and epidural temporooccipital hemorrhagic right temporoparietal region with a fracture of the right temporal bone **(Figure 1)**. The patient was moved to the General Pediatric Unit (GPU) five hours after being observed in the ER. GCS, vital signs and pupil reflexes were all within expected norms while at the GPU. After six hours of treatment at the GPU, the patient's GCS (E3 V4 M6) dropped, necessitating his transfer to the Intensive Care Unit (ICU).

The patient appeared restless, GCS 13 (E3 V4 M6) with anisochore pupils and a retarded light reflex on the right, and blood pressure and pulse continued to rise. The patient's health improved on the second day after being treated in the ICU. The pulse is bradycardic, and the GCS (E3 V4 M5) is low. A repeat head CT scan was promptly done, which revealed a more significant epidural hematoma in the temporooccipital region than the previous head CT scan **(Figure 1)**. On the first day in the ICU, postoperative circumstances improved significantly. The patient was allowed to return to the GPU on the second postoperative day. The patient's condition improved until the fifth postoperative day, when he was allowed to go home. The table shows the findings of hemodynamic assessment and observation and symptoms of increased intracranial pressure discovered from when the patient was admitted to the hospital until he was allowed to go home **(Table 1)**.

Nursing diagnoses are developed following the Indonesian Nursing Diagnosis Standards (SIKI). Nurses at the GPU enforce the primary nursing diagnosis of the risk for inadequate cerebral tissue perfusion in the presence of risk factors for a head injury. The intended nursing outcome based on the Indonesian Nursing Outcome Standards (SLKI) is enhanced cerebral perfusion. Intracranial pressure monitoring is an SIKI-based nursing intervention to prevent or reduce the danger of cerebral tissue perfusion. The table shows observation, therapeutic, educational, and collaborative strategies for monitoring increasing intracranial pressure **(Table 2)**. The nurse made a nursing diagnostic of diminished intracranial adaptation capacity caused by an epidural hemorrhagic while the patient was being treated in the ICU. The exact diagnosis was still made after the patient had a craniotomy and evacuation of the hematoma. The predicted nursing outcome is enhanced intracranial adaptive capacity. Nursing interventions for ICP control are used to detect and manage elevated pressure in the cerebral cavity. The table shows the actions of observation, therapy, education, and collaboration to address increasing intracranial pressure **(Table 2)**.

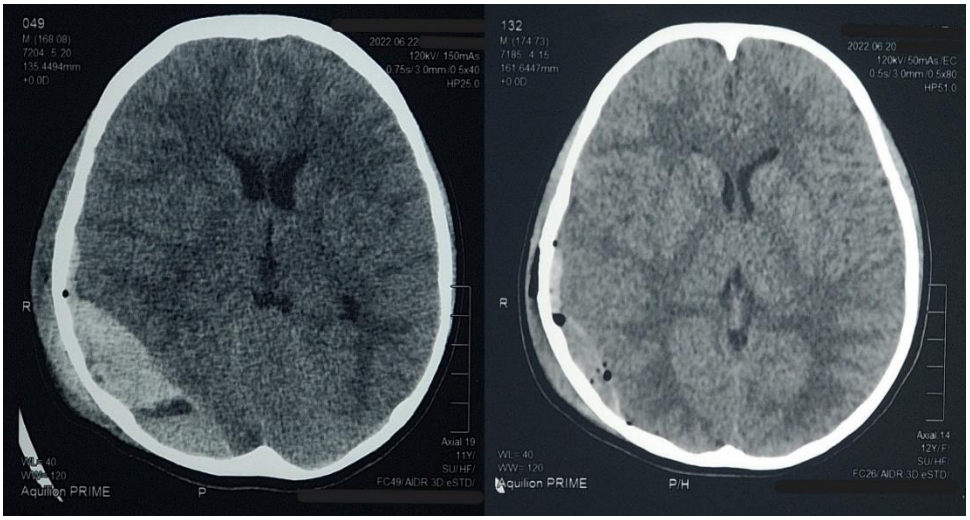

Figure 1. CT scan (right) showed epidural hemorrhage in the temporo-occipital region dextra carried out based on the nurse's report. Increased blood volume compared to initial head CT scan (left).

Discussion

Nursing interventions for these patients are focused on noninvasive monitoring and ICP management. Six variables are evaluated when selecting nursing interventions: expected patient outcomes, nursing diagnosis features, the research basis for intervention, the practicality of intervention, individual acceptability, and the capacity of nurses (Kumar, 2007). Monitoring intracranial pressure does not effectively address cerebral perfusion risk nursing difficulties. The risk of inadequate cerebral perfusion is when the patient faces a decrease in blood circulation to the brain (PPNI, 2016). Head injury resulting in epidural hemorrhage is a risk factor for the patient's decreased cerebral perfusion in this case.

Table 1. Observation results

ICP parameters	Perioperative phase						
		Pre-op day 1		Pre-op day 2	Pre-op day 3	Post-op day 1	Post-op day 2
	ER	GPU	ICU	ICU	ICU	ICU	GPU
	11:00	17:00	23:00	16:00	16:00	16:00	16:00
Vital sign							
BP (mmHg)	110/70	110/70	140/100	157/97	146/93	106/63	110/70
HR (bpm)	80	84	110	63	61	79	82
RR (bpm)	20	20	20	18	16	18	16
MAP	83	88	113	117	110	77	83
Defisit neurologis							
GCS	15 E4V5M6	13 E3V4M6	13 E3V4M6	12 E3V4M5	12 E3V4M5	15 E4V5M6	15 E4V5M6
Pupil							
Diameter (mm)	<2.5/<2.5	<2.5/<2.5	4/<2.5	4/<2.5	4/<2.5	<2.5/<2.5	<2.5/<2.5
Light reflex	+/+ fast	+/+ fast	+/+ fast	+/+ slow	+/+ slow	+/+ fast	+/+ fast
Liquid balance 24h (cc)	-	-	-1332	-1223	+121	-1088	-

ICP: Intra Cranial Pressure, BP: Blood Pressure, HR: Heart Rate, RR: Respirasi Rate, MAP: Mean Arterial Pressure, ER: Emergency Room, GPU: General Pediatric Unit

Cerebral vasodilatation occurs with severe head injuries, resulting in a reduction in cerebral artery pressure and an increase in cerebral blood flow. This can result in a permanent and disastrous increase in ICP (Kinoshita, 2016). Identifying the cause of ICP, monitoring increased blood pressure, monitoring heart rate, monitoring irregularity of the respiratory rhythm, monitoring decreased consciousness, monitoring pupil response, monitoring the effects of environmental stimuli on intracranial pressure, and maintaining the head position and neutral neck (head up) are all interventions based on SIKI for the diagnosis of intracranial pressure monitoring in this case (PPNI, 2018). ICP must be monitored to be effectively treated. Invasive and noninvasive ICP monitoring are both options. Invasive approaches for ICP monitoring continue to be the gold standard. The ICP monitor measures intracranial volume changes invasively via pressure within the ventricles or brain tissue then converts them into numbers and waveforms that can be evaluated. The most often utilized ICP monitors are ventriculostomy catheters with EVDs and fibre-optic intraparenchymal catheters (Sacco & Davis, 2019).

Clinical evaluation, ways of leveraging natural bony windows in the skull, methods of analyzing cerebral fluid dynamics qualities, electrophysiological methods, imaging methods, and innovative methods can all be used for noninvasive ICP monitoring (Padayachy, 2016) (De Moraes & Silva, 2021). All ICP monitoring interventions that we performed, in this case, were noninvasive methods based on the results of physical examination and clinical symptoms. This case can provide recommendations for interventions for nurses to carry out noninvasive ICP monitoring if ICP monitoring tool support is not available or if the patient has not had an Extra Ventricular Drainage (EVD) installed. ICU nurses enforce nursing problems of decreased intracranial adaptive capacity before and after patients undergo surgery. This diagnosis is defined as a disturbance of intracranial dynamic mechanisms in compensating for stimuli that can reduce intracranial capacity. The etiology of diagnosis, in this case, is the presence of cerebral edema due to epidural hemorrhage (PPNI, 2016). Impaired intracranial adaptive capacity is one of the most common neurological problems in critically ill patients. It is a significant cause of intracranial hypertension and, if not treated properly, will most likely harm the patient's prognosis and may lead to further brain injury or death (Zhang et al., 2017). Patients

with traumatic brain injury causing intracranial hypertension with reduced intracranial adaptive capacity are prone to periods of increased ICP (Fan, Kirkness, Vicini, Burr, & Mitchell, 2010).

Table 2. Nursing diagnosis, nursing outcomes and nursing intervention

Nursing Diagnosis (SDKI)	Nursing Outcomes (SLKI)	Nursing Intervention (SIKI)
Risk for decreased cerebral perfusion	• Increased level of consciousness (GCS 15) • Headache decreased • Anxiety decreased	ICP Monitoring • Blood pressure • Heart rate • Respiration rate • Level of consciousness • Pupil response • Maintaining head position head up 15°-30°
Decreased adaptive intracranial capacity	• The level of awareness increases • Headache decreased • Anxiety decreased • Blood pressure improves • Bradycardia improved • Improved pupil response • Improved light reflex	ICP Monitoring • Assessing the aetiology of increased ICP • Monitoring respiratory status • Monitoring fluid intake and output • Promoting supportive environment • Giving the head position head up 15°-30° • Preventing seizures • Maintaining normal body temperature • Administering sedation and anticonvulsants

ICP: Intracranial Pressure, MAP: Mean Arterial Pressure

This nursing problem is overcome by management interventions to increase ICP. Actions taken include identifying the causes of increased ICP, monitoring signs and symptoms of increased ICP (increased blood pressure, bradycardia, irregular breathing patterns, decreased consciousness), monitoring mean arterial pressure (MAP), monitoring respiratory status, minimizing stimulus by maintaining a calm environment, provide a head-up position of 15-30˚, prevent seizures, maintain average body temperature, and collaborate with sedation/anticonvulsants. Nursing interventions during the initial period of increased ICP can reduce the potential risk of secondary neurological disorders (Fan et al., 2010). Increased intracranial pressure not treated with good initial management will experience refractory intracranial pressure (rICP). rICP will cause significant secondary brain injury and permanent loss of function (Sacco & Delibert, 2018). In this case, one of the nurse's therapeutic acts is to keep the head elevated (head up). Head elevation is a common nursing practice to decrease elevated ICP and prevent complications in patients suffering from neurotrauma or other disorders requiring intracranial hemodynamic care. Routine treatment of patients with head injuries with 30-degree head elevation within 24 hours after injury leads to a constant drop in ICP and an increase in Cerebral Perfusion Pressure (CPP) without any associated alterations that compromise cerebral oxygenation (Ng et al., 2004). However, several studies recommend adjusting the degree of elevation of the head based on the results of monitoring parameters such as ICP, CPP, Mean Arterial Pressure (MAP), and Amplitude of Intracranial Pulse Pressure (ICPPA) (Burnol et al., 2021) (Mahfoud, Beck, & Raabe, 2010).

In this instance, the ICU nurse noticed an increase in the region of bleeding on the CT scan of the head and immediately performed surgery in consultation with a neurosurgeon. According to studies, repeat head CT scans effectively detect the expansion and addition of cerebral lesions, necessitating adjustments in the therapy of elevated ICP (Doddamani, Gupta, Singla, Mohindra, & Singh, 2012). In this example, a craniectomy was performed to remove the hematoma. Craniectomy is the surgical removal of a portion of the skull to relieve brain pressure. This is one of the second-line therapies for lowering ICP (Sahuquillo & Dennis, 2019). The GCS value improved six hours after surgery, showing that ICP was adequately reduced.

Conclusion

Nursing interventions for improving ICP control based on SIKI are critical in minimizing the deterioration of epidural hematoma patients' conditions and death due to head trauma. Following the initial CT scan of the head, a follow-up CT scan of the head was performed 48 hours later, and the decision to perform surgery was made based on the nurse's report to the doctor in charge based on the results of observations and the implementation of ICP improvement management interventions. It is advised that the primary nurses in the pediatric neurology nursing unit and critical nursing execute observation, education, therapeutic, and collaborative activities to monitor interventions and manage SIKI-based ICP improvement. The limitations of this case are that ICP monitoring is still performed non-invasively. Nonetheless, this approach can avoid the worsening of the illness and reduce death, particularly in patients with high mortality predictors such as age, GCS value, location, and increased bleeding. Further research or case studies that apply monitoring and management of ICP with invasive methods in cases of TBI undergoing surgery are needed.

Author's declaration

The authors made substantial contributions to the conception and design of the study and took responsibility for data analysis, interpretation, and discussion of results. For manuscript preparation, all the authors read and approved the final version of the paper.

Funding

None declared.

Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

Acknowledgements

The author would like to thank all the nursing staff in the Love Bird Room and ICU at Bhayangkara Hospital Makassar.

References

Burnol, L., Payen, J. F., Francony, G., Skaare, K., Manet, R., Morel, J., … Gergele, L. (2021). Impact of Head-of-Bed Posture on Brain Oxygenation in Patients with Acute Brain Injury: A Prospective Cohort Study. Neurocritical Care, 35(3), 662–668. https://doi.org/10.1007/s12028-021-01240-1

Capizzi, A., Woo, J., & Verduzco-Gutierrez, M. (2020, March 1). Traumatic Brain Injury: An Overview of Epidemiology, Pathophysiology, and Medical Management. Medical Clinics of North America, Vol. 104, pp. 213–238. https://doi.org/10.1016/j.mcna.2019.11.001

Changa, A. R., Czeisler, B. M., & Lord, A. S. (2019). Management of Elevated Intracranial Pressure: a Review. Current Neurology and Neuroscience Reports, 19(12). https://doi.org/10.1007/s11910-019-1010-3

De Moraes, F. M., & Silva, G. S. (2021, May 1). Noninvasive intracranial pressure monitoring methods: A critical review. Arquivos de Neuro-Psiquiatria, Vol. 79, pp. 437–446. https://doi.org/10.1590/0004-282X-ANP-2020-0300

Doddamani, R. S., Gupta, S. K., Singla, N., Mohindra, S., & Singh, P. (2012). Role of repeat CT scans in the management of traumatic brain injury. The Indian Journal of Neurotrauma, 9(1), 33–39. https://doi.org/10.1016/j.ijnt.2012.04.007

Emami, P., Czorlich, P., Fritzsche, F. S., Westphal, M., Rueger, J. M., Lefering, R., & Hoffmann, M. (2017). Impact of glasgow coma scale score and pupil parameters on mortality rate and outcome in pediatric and adult severe traumatic brain injury: A retrospective, multicenter cohort study. Journal of Neurosurgery, 126(3), 760–767. https://doi.org/10.3171/2016.1.JNS152385

Fan, J. Y., Kirkness, C., Vicini, P., Burr, R., & Mitchell, P. (2010). An approach to determining intracranial pressure variability capable of predicting decreased intracranial adaptive capacity in patients with traumatic brain injury. Biological Research for Nursing, 11(4), 317–324. https://doi.org/10.1177/1099800409349164

Kinoshita, K. (2016). Traumatic brain injury: Pathophysiology for neurocritical care. Journal of Intensive Care, 4(1), 1–10. https://doi.org/10.1186/s40560-016-0138-3

Krishnamoorthy, V., Komisarow, J. M., Laskowitz, D. T., & Vavilala, M. S. (2021, September 1). Multiorgan Dysfunction After Severe Traumatic Brain Injury: Epidemiology, Mechanisms, and Clinical Management. Chest, Vol. 160, pp. 956–964. https://doi.org/10.1016/j.chest.2021.01.016

Kumar, C. P. (2007). Application of Orem's Self-Care Deficit Theory and Standardized Nursing Languages in a Case Study of a Woman With Diabetes. International Journal of Nursing Terminologies and Classifications, 18(3), 103–110.

Mahfoud, F., Beck, J., & Raabe, A. (2010). Intracranial pressure pulse amplitude during changes in head elevation: A new parameter for determining optimum cerebral perfusion pressure? Acta Neurochirurgica, 152(3), 443–450. https://doi.org/10.1007/s00701-009-0520-1

Müller, S. J., Henkes, E., Gounis, M. J., Felber, S., Ganslandt, O., & Henkes, H. (2023). Noninvasive Intracranial Pressure Monitoring. 1–27.

Ng, I., Lim, J., Wong, H. B., Czosnyka, M., Marion, D. W., & Hoff, J. T. (2004). Effects of Head Posture on Cerebral Hemodynamics: Its Influences on Intracranial Pressure, Cerebral Perfusion Pressure, and Cerebral Oxygenation. Neurosurgery, 54(3), 593–598. https://doi.org/10.1227/01.NEU.0000108639.16783.39

Padayachy, L. C. (2016, September 1). Noninvasive intracranial pressure assessment. Child's Nervous System, Vol. 32, pp. 1587–1597. https://doi.org/10.1007/s00381-016-3159-2

PPNI. (2016). Standar Diagnosis Keperawatan Indonesia: Definisi dan Indikator Diagnostik (1st ed.). Jakarta: DPP PPNI.

PPNI. (2018). Standar Intervensi Keperawatan Indonesia: Defensi dan Tindakan Keperawatan (1st ed.). Jakarta: DPP PPNI.

Raboel, P. H., Bartek, J., Andresen, M., Bellander, B. M., & Romner, B. (2012). Intracranial pressure monitoring: Invasive versus noninvasive methods-A review. Critical Care Research and Practice, 2012, 3–7. https://doi.org/10.1155/2012/950393

Sacco, T. L., & Davis, J. G. (2019). Management of Intracranial Pressure Part II: Nonpharmacologic Interventions. Dimensions of Critical Care Nursing, 38(2), 61–69. https://doi.org/10.1097/DCC.0000000000000341

Sacco, T. L., & Delibert, S. A. (2018). Management of Intracranial Pressure: Part I: Pharmacologic Interventions. Dimensions of Critical Care Nursing, 37(3), 120–129. https://doi.org/10.1097/DCC.0000000000000293

Sahuquillo, J., & Dennis, J. A. (2019). Decompressive craniectomy for the treatment of high intracranial pressure in closed traumatic brain injury. Cochrane Database of Systematic Reviews, 2019(12), 1–71. https://doi.org/10.1002/14651858.CD003983.pub3

Siahaya N, H. L. A. O. (2020). Prevalensi Kasus Cedera Kepala berdasarkan Klasifikasi Derajat Keparahannya pada Pasien Rawat Inap di RSUD DR. M. Haulussy Ambon pada Tahun 2018. Molucca Medika, 12(2), 14–22.

Whitaker-Lea, W. A., & Valadka, A. B. (2017, May 1). Acute Management of Moderate-Severe Traumatic Brain Injury. Physical Medicine and Rehabilitation Clinics of North America, Vol. 28, pp. 227–243. https://doi.org/10.1016/j.pmr.2016.12.002

Zhang, X., Medow, J. E., Iskandar, B. J., Wang, F., Shokoueinejad, M., Koueik, J., & Webster, J. G. (2017, July 24). Invasive and noninvasive means of measuring intracranial pressure: A review. Physiological Measurement, Vol. 38, pp. R143–R182. https://doi.org/10.1088/1361-6579/aa7256