



Use of Bispectral Index Monitoring to Predict the Outcome of Patients with Posterior Reversible Encephalopathy Syndrome: Two Case Reports

Tsai-Shan Wu¹, Yin-Tzu Liu², Zhi-Fu Wu³, Wei-Cheng Tseng³, Hou-Chuan Lai³

¹Taipei Medical University, ²Department of Anesthesiology, Wanfang Hospital, ³Department of Anesthesiology, Tri-Service General Hospital and National Defense Medical Center, Taipei, Taiwan

Posterior reversible encephalopathy syndrome (PRES) is a reversible neurologic disorder characterized by a variety of symptoms such as seizures, headache, vomiting, altered mental status, and visual disturbances. Bispectral index (BIS) monitor is a kind of electroencephalography and is widely used in anesthesia depth surveillance. In intensive care units, BIS has been used to survey sedation and predict prognosis of coma patients. Here, we report two cases diagnosed radiologically with PRES that had persistent consciousness disturbance resulted from severe life-threatening complications. In our patients, they progressed with different BIS values and different outcomes. We advise that BIS should be used in intensive care as an adjunctive monitor when patients' consciousness status could not be predicted.

Key words: Posterior reversible encephalopathy syndrome, bispectral index, outcome

INTRODUCTION

Posterior reversible encephalopathy syndrome (PRES) is a neurological disorder and presented by a variety of neurological signs and symptoms, including headache, visual disturbance, consciousness problems, seizures, focal neurological deficits, and it mostly happens in female patients.¹ It is usually associated with preeclampsia/eclampsia, solid-organ transplant procedures, autoimmune diseases, and immunosuppressive agents with few cases reported caused by blood transfusion.^{2,3} Recent studies have reported that PRES-associated mortality was 5%–19% and there were severe functional impairments in 36%–44% of patients.⁴

Electroencephalogram such as bispectral index (BIS) monitoring is a widely used clinical technique to monitor depth of anesthesia, prevent awareness and postoperative delirium, and affect surgical morbidity.⁵⁻⁷ Besides, it is used in the intensive care unit (ICU) for sedative surveillance⁸ and can be used for prediction of the prognosis of ischemic stroke patients.⁹

To the best of our knowledge, there is no study describing the use of BIS for predicting the neurological prognosis of PRES. Here, we report two PRES cases using BIS to assess consciousness status.

CASE REPORTS

Case 1

A 31-year-old female without remarkable medical history was presented with abdominal pain, persistent vaginal bleeding, shortness of breath, and general weakness after normal spontaneous delivery. Under the diagnosis of postpartum hemorrhage, emergent operation was performed to repair perineal laceration wound, and 2500 ml blood loss was recorded. She underwent bilateral internal iliac arterial embolization following surgery, and she was sent to the ICU postoperatively. In the ICU, she lost 5700 ml of blood again even after resuscitation.

Her blood pressure highest up to 180/100 mmHg was noted since day 7 and consciousness became stupor even after flumazenil using. Brain magnetic resonance imaging (MRI) showed vasogenic edema over cortical and subcortical regions of bilateral occipital, parietal, frontal lobes, and bilateral cerebellum. PRES was diagnosed [Figure 1]. Labetalol and

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Corresponding Author: Dr. Hou-Chuan Lai, #325,
Section 2, Chengkung Road, Neihu 114, Taipei,
Taiwan. Tel: +886-2-87927128; Fax: +886-2-87927127.
E-mail: m99ane@gmail.com

nicardipine were given for controlling hypertension. On day 17, her consciousness remained stupor (E3-4M4-5VT). We put a BIS monitor on her and the values were around 35–89 without burst suppression (BS) under propofol sedation. We adjusted the dosage of propofol for sedation to keep BIS around 70.¹⁰ On day 23, tracheostomy was performed due to persistent consciousness stupor and failure to weaning ventilator.

On day 27, she received total abdominal hysterectomy due to uterine rupture with intra-abdominal sepsis. On day 30, she received exploratory laparotomy to check bleeding and ligation of bilateral internal iliac arteries and right infundibulopelvic ligamentous vessel, with plenty of blood and blood clot about 3100 ml over peritoneal and pelvic space. On day 35, BIS values were around 70–85. Fortunately, on day 37, her consciousness became alert, tracheostomy was removed on day 40, and she was discharged without residual neurological deficit.

Case 2

A 33-year-old female who just normal spontaneously delivered her first baby was admitted due to yellow skin turgor and tea color urine. During hospitalization, disseminated intravascular coagulation, liver and renal function impairment, and jaundice were noted. She was suspected for hemolysis, elevated liver enzymes, and low platelet syndrome accompanied with fulminant hepatitis B flaring up with decompensated liver failure. She received plasma exchange for three times but in vain.

On day 3, she became comatose with seizure attack, and brain image showed PRES [Figure 2], and her condition deteriorated rapidly. On day 7, she received emergent living donor-liver transplantation under total intravenous anesthesia,¹¹ and the BIS monitor showed 10–20 and BS ratio around 98%–100%

during operation. In ICU, the BIS monitor showed 10–20 and BS ratio around 98%–100% after surgery. In the early morning of day 8, liver function test and her renal function improved, she regained consciousness, and the BIS showed 85 without BS. Unfortunately, on day 9, the BIS value dropped to 2 and BS ratio 98% while 1350 ml fresh bloody discharge from the surgical drainage was noted. We kept fluid resuscitation with colloid and blood and emergent exploratory laparotomy to check bleeding was performed immediately. Pupil dilatation from 2 to 8 mm without light reflex and absent both gag reflex and painful stimulants response were noted, and the Glasgow Coma Scale (GCS) was E1-M1-VT. Brain MRI showed multifocal intracranial hemorrhage, severe brain/cerebellum swelling, uncal herniation, and brainstem compression. The BIS monitor showed 0–1 and BS ratio around 98%–100%. The risk of neurosurgical intervention was high and supportive treatment was suggested. She expired on day 11.

DISCUSSION

In our patients, the outcome from survival to death and the corresponding BIS value was >75 and 0. In our cases, multiple comorbidities such as decompensated liver failure, sepsis, and hemorrhagic shock made it difficult to assess neurologic function and prognosis. Our first patient woke up and BIS value was higher than 75 on the 31st postoperative day as an acceptable course of blood transfusion-induced PRES and the neurologic outcome was fair. For the second patient, we have known that solid-organ transplantation, further immunosuppressant, and blood transfusion are the main risk factors for PRES.² The BIS values also were consistent with MRI and clinical neurological signs.

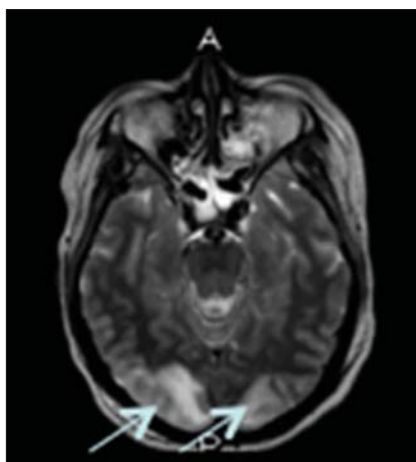


Figure 1: Brain magnetic resonance imaging showed patchy T2 hyperintensity over cortical and subcortical regions of bilateral occipital, parietal, frontal lobes, and bilateral cerebellum are noted

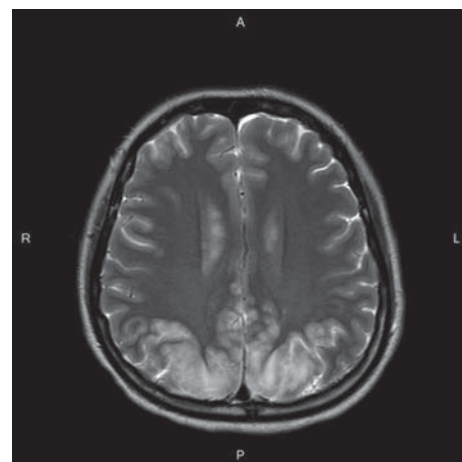


Figure 2: Brain magnetic resonance imaging showed diffuse symmetrical hyperintensities on T2-weighted image in bilateral occipital lobes, primarily in the cortical regions with cytotoxic and vasogenic edema

BIS values were significantly different between patients who recovered consciousness and those with poor neurologic outcome. Fàbregas *et al.*⁹ have reported that the maximal BIS value was 52.3 and 69 associated with a probability of 0.5 and 0.9 of recovering consciousness, respectively, in severe brain injury patients without sedation. In addition, an abnormal BIS trace was strongly associated with poor neurologic outcome in patients with severe ischemic-hypoxic brain injury undergoing emergency surgery and that a normal BIS value could indicate that patients are more likely to survive with a good neurologic outcome was reported.¹² Miao *et al.*¹³ also reported that the mortality rate was significantly lower in patients with a BIS value >32.5 than in patients with a BIS value of ≤32.5 within 2 weeks in coma patients. In a 171-patient study, those with a BIS <10 suffered 91% overall mortality while BIS >20 was associated with 36% overall mortality.¹⁴ Besides, Mahmood *et al.* reported that 44 patients with severe traumatic brain injury worsened to brain death, and their respective BIS values progressively decreased to 0.¹⁵ Park *et al.*¹⁶ have reported that the mean BIS values of the good outcome and poor outcome were 35.6 and 5.5, respectively, in out-of-hospital cardiac arrest patients during early targeted temperature management. These reports demonstrated that the greater BIS value was, the better patient's mental status and outcome would be.¹⁷ Accordingly and as our cases, BIS may be a noninvasive, objective, and convenient method to predict neurological outcomes.¹⁸

BIS monitor was not designed as a monitor of neurologic outcome during intensive care. Because there are many confounding factors that may affect our interpretation, caution is needed while using BIS under these circumstances. There are situations that BIS may be falsely low, such as hypothermia, use of sedative drugs, and neuromuscular blockade medication.⁹ On the other hand, the appearance of paradoxical electroencephalograph delta rhythm and artifacts from the pulsations of temporal artery or movements of the eyes or head, pacemakers, use of external rewarming devices, and catecholamine infusions may result in an increase of BIS values.^{19,20} In addition, seizures also affect BIS monitoring with higher or lower value.¹⁴

CONCLUSION

Our case reports suggest that BIS monitoring provides useful prognostic information in PRES patients. There is evidence of its use as a prognostic tool, but decisions should not be made on BIS values alone. Further investigation is necessary.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have

given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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