Case Report

Use of bispectral index for detection of partial cerebral hypoperfusion during cervical spine surgery: A case report

ABSTRACT

The BIS value may decrease by cerebral hypoperfusion. We report a case in which the BIS value suddenly decreased during cervical spine surgery, which led us to find cervical screws compressing the vertebral arteries. In a 79-year-old man undergoing cervical spine surgery, the BIS suddenly decreased from about 40 to 10-20, about 4 h after the start of surgery. Intraoperative 3-dementional computed tomography indicated that both the two tips of cervical screws inserted in the 6th cervical vertebra were within bilateral transverse foramens. These cervical screws were removed, and the BIS increased immediately. The cervical screws were re-inserted again thorough the same vertebra into the bilateral transverse foramens, and the BIS decreased immediately. Postoperatively, cerebral hypoperfusion due to compression of bilateral vertebral arteries by two cervical screws was identified. The BIS may be a useful to detect cerebral hypoperfusion due to compression of the vertebral artery by a cervical screw.

Key words: Bispectral index, cerebral hypoperfusion, cervical spine surgery

Background

The bispectral index (BIS) is used as a monitor to measure the depth of general anesthesia. Previous reports have indicated that the BIS may be useful to detect global cerebral hypoperfusion,[1-5] such as during cardiac surgery, cardiac arrest, and hypoxia. We report a case in which the BIS was found useful in detecting partial hypoperfusion during cervical spine surgery.

Case Report

A 79-year-old man (height 173 cm, weight 59 kg) visited our hospital because of cervical back pain. There were motor paralysis and sensory disorder in the fingers of both hands. Computed tomography (CT) indicated a melting change of the fourth and fifth cervical vertebrae. He was diagnosed with pyogenic spondylitis. Therefore, the patient was scheduled to undergo two-stage surgeries: first, posterior fixation of the cervical spine, and second, anterior fixation of the cervical spine.

In the operating room, we applied routine monitors and the BIS monitor. After that, we performed awake nasotracheal intubation. After confirmation of tracheal intubation, general anesthesia was induced with propofol 100 mg,

Access this article online	
Website: https://journals.lww.com/sjan	Quick Response Code
DOI: 10.4103/sja.sja_761_23	

How to cite this article: Suzuki H, Doi K, Asai T. Use of bispectral index for detection of partial cerebral hypoperfusion during cervical spine surgery: A case report. Saudi J Anaesth 2024;18:280-2.

Hiroaki Suzuki, Kazuki Doi, Takashi Asai

Department of Anesthesiology, Dokkyo Medical University Saitama Medical Center, Minamikoshigaya, Koshigaya City, Saitama, Japan

Address for correspondence: Dr. Hiroaki Suzuki, Department of Anesthesiology, Dokkyo Medical University Saitama Medical Center, Minamikoshigaya 2-1-50, Koshigaya City, Saitama, Japan.
E-mail: hiroszk8@dokkyomed.ac.jp

Submitted: 11-Sep-2023, **Accepted:** 12-Sep-2023, **Published:** 14-Mar-2024

fentanyl 0.1 mg, and neuromuscular blockade achieved with rocuronium 50 mg. General anesthesia was maintained with propofol 2.0–2.6 $\mu g \cdot ml^{-1}$ (target-controlled infusion) and remifentanil 0.2–0.4 $\mu g\ kg^{-1}\ min^{-1}$. To use a motor evoked potential (MEP) during surgery, neuromuscular blockade was antagonized with sugammadex sodium 200 mg.

During surgery, the BIS had been stable around 40. Approximately 4 hours after the start of surgery, the BIS suddenly decreased to 10–20. We could not find any apparent reasons for the sudden decrease in the BIS. However, we felt that a more likely reason was that the screws in a cervical vertebra obstructed the blood flow to the brain. As the surgeons planned to perform intra-operative 3-D CT, CT was taken at this point. Intra-operative 3-D CT indicated that both the tips of cervical screws inadvertently inserted to the bilateral transverse foramens of the sixth cervical vertebra [Figure 1A], indicating that the screws compressed the vertebral arteries. When these cervical screws were removed, the BIS returned to about 40. When surgeons re-attempted to insert cervical screws to the sixth cervical vertebra, and the BIS decreased immediately again.

With the guide of image radiography, surgeons finally could insert the screws without decreasing the BIS value. The 3-D CT confirmed the correct positioning of the screws, and the cervical vertebrae were fixed. Nevertheless, the BIS started to decrease to around 20–25 again and remained at low values until the end of surgery. After the end of surgery, general anesthesia was stopped, and the BIS returned to 80–90. We extubated the patient's trachea after confirming that the patient was awake.

After surgery, there was no new neurological deficit. Nevertheless, a CT taken 4 days after surgery indicated that both the tips of cervical screws at the sixth cervical vertebrae were again located in the bilateral transverse foramens [Figure 1B]. In addition, 3-D CT angiography indicated the right vertebral artery at the level of the sixth cervical vertebra was not shown, and the left vertebral artery from this arterial origin to the level of the sixth cervical vertebra was not shown [Figure 2]. The diagnosis of a stenosis of the right vertebral artery and an occlusion of the left vertebral artery was made, which were caused by compression of the bilateral vertebral arteries by the two screws.

Five days after the surgery, he underwent the second surgery. General anesthesia and surgery were uneventful, and there was no new neurological deficit during the entire peri-operative period. The patient was discharged from our hospital without anything new on the 30 days after the second surgery.

Discussion

We have found that the BIS may be a useful monitor to detect partial cerebral hypoperfusion during cervical spine surgery.

The brain is perfused by the bilateral internal carotid arteries and the basilar artery arising from the union of the bilateral vertebral arteries. The bilateral internal carotid arteries and the basilar artery are connected via the arterial circle of Willis. Therefore, even if one of the arteries that perfuse the brain is occluded, regional hypoperfusion may not occur. However, in our patient, there was a possibility of regional hypoperfusion in the area perfused by the basilar artery. Post-operative 3-D CT angiography indicated that there were severe stenosis of the right vertebral artery, occlusion of the left vertebral artery, and hypoplasia of the right posterior communicating artery. Therefore, there was a possibility that the area perfused by the basilar artery mainly perfuses by the left posterior communicating artery, and the blood flow

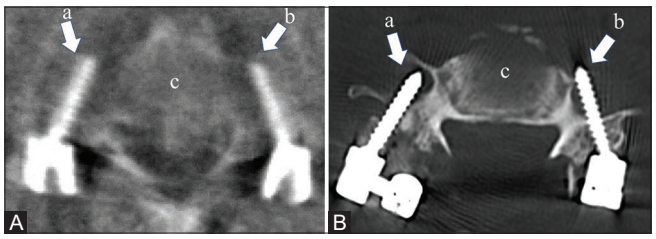

Figure 1: Intra-operative (A) and post-operative (B) 3-D CT showing that the two tips of right (a) and left (b) cervical screws are within the bilateral transverse foramens of the sixth cervical vertebra (c)

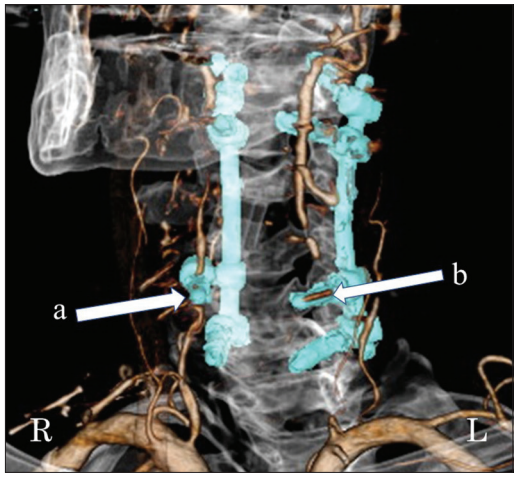

Figure 2: Post-operative 3-D CT angiography of the vertebral arteries. The stenosis of the right vertebral artery at the level of the sixth cervical vertebra compressed by a cervical screw (a) and the occlusion of the left vertebral artery at the sixth cervical vertebra compressed by a cervical screw (b)

in this area might be reduced. However, it is not clear why the BIS, which analyzes mainly the electroencephalogram of the frontal lobe, decreased by hypoperfusion in the area perfused by the basilar artery. The BIS may decrease due to regional cerebral hypoperfusion in the area perfused by the basilar artery.

In our patient, 3-D CT taken after re-insertion of the screws confirmed that the screws were in the correct position. Nevertheless, after fixation of the cervical vertebrae, the BIS started to decrease again. The exact reason for the decrease in the BIS is not clear. Nevertheless, a CT taken 4 days after surgery indicated that the tips of re-inserted screws had dislodged again to the bilateral transverse foramens. Therefore, it is likely that these re-inserted screws dislodged during fixation of the cervical vertebrae and might have compressed the bilateral vertebral arteries again, leading to the decrease in BIS.

Previous studies have shown that in patients whose carotid artery was clamped during carotid endarterectomy, some patients did not develop new neurological deficit with the decrease in the BIS, whereas the others developed new neurological deficit without the decrease in the BIS.[6,7] In our patient, the BIS decreased several times during surgery, and the BIS remained at low values until the end of surgery, but there was no new neurological deficit after surgery. Because of these, the BIS may not be a reliable monitor to predict a new neurological deficit.

In conclusion, the BIS may be useful in detecting cerebral hypoperfusion during general anesthesia.

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.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Das SN, Kiran U, Bhan A. The use of bispectral index for diagnosis of aortic arch arterial occlusion. J Cardiothorac Vasc Anesth 2005;2:275-6.
2. England MR. The changes in bispectral index during a hypovolemic cardiac arrest. Anesthesiology 1999;91:1947-9.
3. Chakravarthy M, Patil T, Jayaprakash K, Shivananda N, Jawali V. Bispectral index is an indicator of adequate cerebral perfusion during cardiopulmonary resuscitation. J Cardiothorac Vasc Anesth 2003;17:506-8.
4. Hayashida M, Chinzei M, Komatsu K, Yamamoto H, Tamai H, Orii R, *et al*. Detection of cerebral hypoperfusion with bispectral index during paediatric cardiac surgery. Br J Anaesth 2003;90:694-8.
5. Azim N, Wang CY. The use of bispectral index during a cardiopulmonary arrest: A potential predictor of cerebral perfusion. Anaesthesia 2004;59:610-2.
6. Deogaonkar A, Vivar R, Bullock RE, Price K, Chambers I, Mendelow AD. Bispectral index monitoring may not reliably indicate cerebral ischaemia during awake carotid endarterectomy. Br J Anaesth 2005;94:800-4.
7. Bonhomme V, Desiron Q, Lemineur T, Brichant JF, Dewandre PY, Hans P. Bispectral index profile during carotid cross clamping. J Neurosurg Anesthesiol 2007;19:49-55.