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## **Decreased bispectral index as an indicator of syncope before hypotension and bradycardia in two patients with needle phobia**

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We report two cases who exhibited a decrease in their bispectral index (BIS<sup>TM</sup>) score, associated with syncope during venipuncture in patients with suspected needle phobia. In case 1, the reduction in BIS score occurred during the development of hypotension and bradycardia and may well have been caused by cerebral hypoperfusion. In case 2, the patient lost consciousness

with decreasing BIS score before hypotension and bradycardia; this patient's condition could not be completely explained by cerebral hypoperfusion as a result of a vasovagal reflex because the patient's blood pressure and heart rate remained normal during the syncopal episode.

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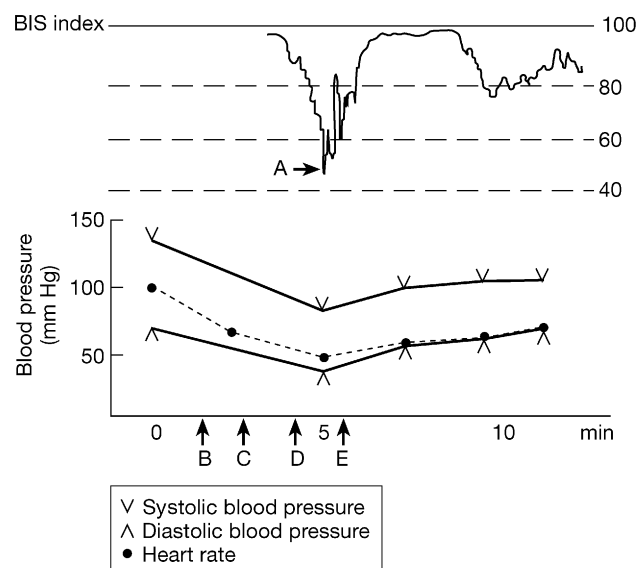
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The bispectral index (BIS™) is currently used to monitor the depth of sedation or general anaesthesia.<sup>1</sup> Fainting or vasovagal syncope before the induction of anaesthesia is not uncommon.<sup>2,3</sup> We report two cases of syncope accompanied by decreased BIS score before sedation in patients with suspected needle phobia.

## Case reports

### Case 1

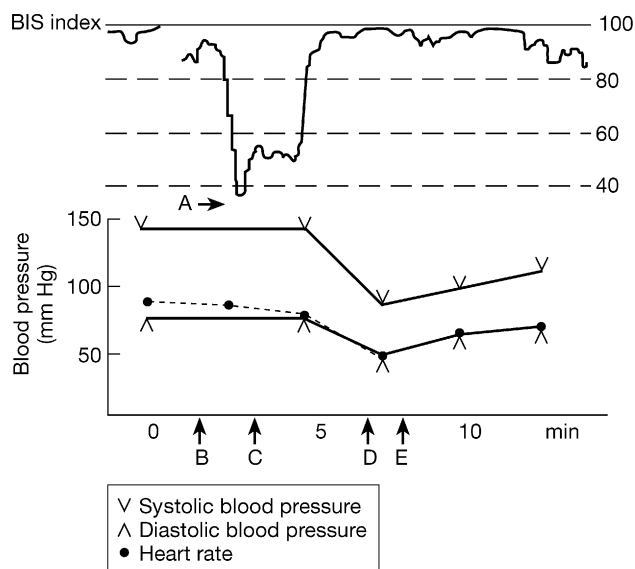
A 27-yr-old male, weighing 62 kg, was scheduled to undergo dental implantation. He had a history of fainting during a phlebotomy procedure and an anxiety disorder. A psychiatrist had prescribed fluvoxamine maleate (50 mg twice daily), a potent and selective serotonin reuptake inhibitor, for the treatment of this anxiety disorder. The patient had been taking this medicine for 5 yr before the scheduled dental implantation. Propofol sedation with local anaesthesia was planned for dental implantation because of his past history. Before the commencement of sedation and the surgical procedure, the patient was lying on a dental chair. A vital signs monitor (Lifescope®; Nihon Kohden, Tokyo, Japan) was used for routine monitoring, including blood pressure, arterial oxygen saturation and an electrocardiogram (ECG). The sensors of the BIS monitor (Aspect A2000; Aspect Medical Systems, Newton, MA, USA) were placed on the forehead in accordance with instructions. Just before venipuncture, he had a heart rate of 96 beats min<sup>-1</sup>, an arterial blood pressure (BP) of 135/67 mm Hg, a respiratory rate (RR) of 14 bpm, a pulse oximeter reading (SpO<sub>2</sub>) of 98% and a BIS score of 95. During venipuncture, the patient complained of nausea and dizziness. He had a weak arterial pulse, he was sweating and his breathing was irregular and shallow. At this time his heart rate was 35 beats min<sup>-1</sup>, BP 78/30 mm Hg and SpO<sub>2</sub> 83%. Immediately after the onset of the bradycardia and hypotension, the BIS score decreased to 42 (Fig. 1) and the patient lost consciousness. Immediately, we administered 100% oxygen, raised his legs, infused i.v. fluid and i.v. atropine 0.5 mg. After about 2 min, the patient had recovered from the syncopal attack. His heart rate, BP, SpO<sub>2</sub> and BIS score returned to normal levels. Immediately after recovery, propofol sedation was started. The heart rate, BP and SpO<sub>2</sub> remained stable and normal and the BIS score ranged between 70 and 90 during sedation.



**Fig 1** Decreased bispectral index (BIS) followed by hypotension in case 1. A=decrease in BIS score to 42; B=venipuncture; C=nausea and dizziness; D=hypotension and bradycardia; E=atropine sulphate and propofol.

### Case 2

A 29-yr-old male, weighing 56 kg, visited our hospital for tooth extraction. He had a history of two experiences of abnormal emotional upset during injection of local anaesthesia for a dental procedure and at venipuncture for fluid infusion. Tooth extraction was planned under local anaesthesia and i.v. sedation with propofol. The heart rate, BP, SpO<sub>2</sub> and BIS were monitored in the same manner as in Case 1. Before sedation, his BP was 130/70 mm Hg, heart rate 80 beats min<sup>-1</sup>, RR 16 bpm, SpO<sub>2</sub> 98% and BIS score 98. The first attempt at venipuncture was not successful. A transient decrease in SpO<sub>2</sub> (92%) associated with breath-holding was observed during the second venipuncture but the RR and SpO<sub>2</sub> recovered to 18 bpm and 96% respectively. Immediately after the second venipuncture, the patient complained of an unpleasant feeling and lost consciousness. At that time, his pulse was regular with an adequate volume and a rate of 68 bpm. The BIS score decreased to 35 when the fainting episode occurred, although the heart rate and BP



**Fig 2** Decreased bispectral index (BIS) before hypotension and bradycardia in case 2. A=decrease in BIS score to 35; B=venipuncture; C=seizure; D=hypotension and bradycardia; E=atropine sulphate and propofol.

were maintained at 70 beats  $\text{min}^{-1}$  and 130/80 mm Hg respectively. Shortly thereafter, a seizure of the entire body occurred and continued for a few minutes. By the end of the seizure, the BIS had increased to 98. After this, bradycardia and hypotension developed, but the BIS score remained between 95 and 98 (Fig. 2). During the entire episode, the  $\text{SpO}_2$  and RR ranged between 92 and 98% and 16 and 20 bpm, respectively. The patient was treated by raising his legs, infusing dextrose saline i.v. and the i.v. administration of atropine 0.5 mg. Sedation with propofol was started a few minutes after the syncope and seizure episodes had ended, when the patient's consciousness level, BP, heart rate,  $\text{SpO}_2$  and BIS score had returned to normal. There were no abnormal events, and BP, heart rate and  $\text{SpO}_2$  were stable and within normal ranges during sedation. The BIS score was between 60 and 80 during sedation.

## Discussion

Although the BIS is not a specific index of consciousness, it correlates with wakefulness,<sup>4</sup> learning<sup>5</sup> and the conscious processing of information.<sup>6</sup> In the present cases, BIS changes were recognized by chance during syncope. Anxiety, fear and pain associated with dental treatment may evoke physiological, behavioural, motor or cognitive changes. In case 1, the patient had a past history of a fainting attack during a phlebotomy, while Case 2 had a history of injection and venipuncture phobia. According to the classification of the American Psychiatric Association, both cases were classified as blood-injury-injection phobias.<sup>7</sup> Syncope is a sudden transient loss of consciousness that may

be the result of cardiovascular, neurological, metabolic or psychological disorders, or iatrogenic events.<sup>8</sup> Among these disorders, vasovagal syncope (also called neurocardiogenic syncope or neurally mediated syncope) has been reported as the cause of over half of dental office emergencies.<sup>9</sup> Though vasovagal syncope tends to occur when the subject is in a standing position, it can also occur when the subject is in a supine position.<sup>2 3 10</sup> In the present cases, both patients fainted while in a supine position. In Case 1, pain, anxiety and fear at venipuncture triggered an intense parasympathetic state leading to bradycardia and hypotension. Bradycardia and hypotension probably caused cerebral hypoperfusion, resulting in a syncopal attack.<sup>8 11</sup> Decreased BIS was accompanied by cerebral hypoperfusion in case 1, as in other reported cases.<sup>12 13</sup>

The second case shows that syncope and a decreased BIS score can be caused by factors other than cerebral hypoperfusion. The patient lost consciousness with a rapidly decreasing BIS score immediately after venipuncture, although BP, heart rate and  $\text{SpO}_2$  remained normal. Hyperventilation, hysteria and other forms of psychogenic unresponsiveness<sup>14 15</sup> are possible causes of the seizure and syncope. However, our patient did not hyperventilate and recovered from the syncopal attack and seizure with no postictal signs or symptoms of epilepsy. The reduction in the BIS score was not due to seizure because the decrease in the index occurred before the muscle contraction and was not influenced by abnormal electrical discharges in the brain. The BIS score increased after the seizure, probably as a result of electromyographic activity arising from the muscle contractions.<sup>1 16</sup> The syncopal episode was brought on by an intense emotional experience, consisting of anxiety, fear and pain at the time of venipuncture; the episode was considered to result from centrally mediated vasovagal syncope. Thus, the cortical processing of emotional fear, stress and pain appears to have been conveyed to the medullary cardiovascular centre through the limbic system. The limbic system is known to be concerned with emotions, and stimulation of the limbic sympatho-inhibitory centre causes hypotension and bradycardia in some animal species.<sup>17 18</sup> Mercader and colleagues<sup>19</sup> observed an increase in EEG slow-wave activity and delta waves during syncope and in patients before syncopal episodes. These EEG wave changes were associated with the onset of bradycardia, hypotension and clinical symptoms.<sup>19</sup> Unfortunately, we were unable to analyse EEG components.

Whatever the case, the BIS observed in both cases was caused by syncope, reflecting centrally mediated brain activity in response to emotional stress and pain.

Syncope and a decrease in BIS may precede hypotension and bradycardia in patients with needle phobia.

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