Bispectral Index monitoring in rats during intravenous propofol anaesthesia.

Yushi U. Adachi, Saori Taharabaru, Maiko Satomoto, Kimitoshi Nishiwaki
Department of Intensive Care Medicine, Nagoya University Hospital
Department of Anesthesiology, Nagoya University Graduate School of Medicine

Background and Goal of Study: Bispectral Index (BIS) monitoring is developed by analyzing of electroencephalogram (EEG) of human during general anesthesia. Recently, some studies reported that BIS monitoring could be useful in an area of veterinary medicine including laboratory animals, such as horse, calf, goat, pig dog, cat and rabbit. Rodents are very popular animals in laboratory investigations; however, there are few reports for BIS monitoring. Thus, we assessed the possibility of BIS monitoring in awake and anesthetized rats during propofol anaesthesia.

Material and Methods: After obtaining approval from the committee of the institute, 10 male SD rats weighing 220-240 g were used. The rats were received brief anaesthesia by inhalation of sevoflurane (3%) and were attached the 4 pierced electrodes on the head. Each rat was given recovery period at least 48 h. The electrodes were connected the leads immediately before the examinations. EEG signal was analyzed by Vista A-3000 (Nihon Kohden, Tokyo, Japan).

Each rat was administered propofol from a tail vein using an infusion pump. The infusion rate of propofol was changed every 10 minutes and the rate was randomly set at 0 (control), 50, 100 and 200 mg/kg/h. Every rat was received subsequent 6 period of propofol anaesthesia (totally 1 h). The BIS Index, spectral edge frequency 95% and amplitude were recorded after the equilibrium period (5 and 10 min) from the change in the infusion rate.

Results and Discussion: Before the induction of anesthesia, all animals were awaking and showed high values of BIS (96.9 ± 1.2). Following to the increase of the infusion rate, the BIS values were significantly decreased and the variance was increased (Table, Fig).

Although the accuracy of monitoring for the depth of anesthesia would not be fully acceptable in the current system, the significant and dose dependent relationships between the infusion rate and BIS values were observed.

Conclusion: There is a room for discussion to evaluate a depth of anesthesia and BIS monitoring in experimental animals; however, the current investigation firstly demonstrated a validity of BIS monitoring in rats during intravenous propofol anaesthesia.

References: Anesthesiology 2016, A4232)

Discussion: The results of current investigation demonstrated that the BIS value of awaking rats were around 100 and were reliable one. Generally, propofol anesthesia reduced the BIS value, however, some of results were inconsistent.

Publications concerning to the recording of Bispectral index in experimental animals (anesthetics) were shown below.

Dog (isoflurane): Bleijenberg EH, et al. Vet Anaesth Analg 2011; 38: 536-43.

Pig (isoflurane, sevoflurane): Martin-Cancho MF, et al. Am J Vet Res 2003; 64: 866-73.

Horse (isoflurane): Haga HA, et al. Am J Vet Res 2002; 63: 438-42.

Calf (isoflurane): Araujo MA, et al. Acta Cir Bras 2015; 30: 67-72.

Goat (isoflurane): Antognini JF, et al. Vet Res Commun 2000; 24: 361-70.

Cat (isoflurane): March PA, et al. Am J Vet Res 2003; 64: 1534-41.

Rabbit (etomidate, propofol, isoflurane): Romanov A, et al. J Am Assoc Lab Anim Sci 2014; 53: 74-80.

Dolphin (propofol): Howard RS, et al: Anesth Analg 2006; 103: 626-32.

Chicken (isoflurane): Martin-Juardo O, et al. Am J Vet Res 2008; 69: 1254-61.

Kortelaine J, et al. (Br J Anaesth 2012; 109: 782-9) demonstrated that a increase in electro-encephalographic gamma activity suggested awakening from **isoflurane** anesthesia in **rats**.

Table. The infusion rate of propofol and the values of Bispectral Index

Propofol infusion rate	Bispectral Index	Spectral edge frequency 95 (Hz)	Amplitude
0 (mg kg ⁻¹ h ⁻¹)	96.9 ± 1.2 [92.9 - 98.7]	22.1 ± 5.2 [10.5 - 27.2]	11.6 ± 1.9 [8.2 - 14.4]
50	79.3 ± 13.9 [39.4 - 95.1]	21.8 ± 2.3 [16.9 - 26.0]	13.2 ± 3.6 [5.7 - 23]
100	73.2 ± 15.4 [34.4 - 97.0]	21.8 ± 2.7 [17.2 - 29.6]	14.4 ± 3.3 [6.7 - 23.6]
200	55.6 ± 25.6 [3.0 - 95.9]	22.8 ± 4.0 [15.3 - 28.8]	12.6 ± 4.2 [5.4 - 20.9]

Data are expressed as mean ± SD. and ranges. *: $p < 0.05$ between groups.

Fig. The infusion rate of propofol and the values of Bispectral Index.

In the current study, the respiratory and cardiovascular parameters were not evaluated. Propofol-induced suppression has a possibility to the change in BIS values. However, these changes would generally reduce the BIS values during anesthesia.

Conclusion: Although there is some limitations and inconsistencies, BIS monitoring might be applicable in rats during perianesthetic period, from the induction of anesthesia to the recovery. Serial evaluation and numerical calculation of the depth of anesthesia might provide detailed pharmacodynamic properties in laboratory animals during general anesthesia.