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RESEARCH

Association between the Clinically Assessed Blink Reflex and Bispectral Index during Propofol Induction of Anesthesia at Dr. Sardjito General Hospital, Yogyakarta

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ABSTRACT

Background: Assessment of anesthetic depth during induction is essential to ensure patient safety and to prevent intraoperative awareness. The Bispectral Index (BIS) is a widely used objective monitor derived from electroencephalographic activity; however, its use may be limited by cost and equipment availability. The clinically assessed blink reflex is a simple bedside sign that may serve as a practical indicator during anesthetic induction.
Objective: To determine the association between the clinically assessed blink reflex and BIS values during propofol induction of anesthesia.
Methods: This was a prospective observational analytic study involving 59 adult patients aged 18–65 years with American Society of Anesthesiologists (ASA) physical status I–II who underwent elective surgery under general anesthesia at Dr. Sardjito General Hospital. All patients received propofol 1.5 mg/kg for induction. The clinically assessed blink reflex and BIS were evaluated at baseline and at 15, 30, and 60 seconds after induction. In this study, the blink reflex was defined as a bedside elicited eyelid-closure response recorded as present or absent. Data were analyzed using the chi-square test or Fisher's exact test, followed by multivariable analysis.
Results: Before induction, all participants exhibited an intact blink reflex on bedside examination. At 15 seconds after induction, the blink reflex was still present in 36 patients (61.0%), decreasing to 8 patients (13.6%) at 30 seconds, and disappearing in all patients at 60 seconds. Mean BIS values decreased progressively from 95.36 ± 3.38 at baseline to 68.20 ± 11.81 at 15 seconds, 56.44 ± 8.93 at 30 seconds, and 50.15 ± 7.29 at 60 seconds. A significant association was found between BIS category and blink reflex at 15 seconds ($p = 0.005$) and 30 seconds ($p = 0.001$). ASA physical status was independently associated with BIS during the early post-induction period.
Conclusion: The clinically assessed blink reflex was significantly associated with BIS values during the early phase of propofol induction. This bedside clinical sign may be useful as a simple adjunct for assessing anesthetic depth during the first minute after induction.

Keywords: Anesthetic induction, blink reflex, bedside clinical assessment, bispectral index, propofol.

INTRODUCTION

Induction of anesthesia is a critical transition phase that influences airway management, hemodynamic stability, and prevention of intraoperative awareness. Depth of anesthesia during this period must be assessed rapidly, practically, and with acceptable accuracy. Traditionally, early clinical assessment during induction has relied on autonomic changes and protective reflexes, including blink-related protective responses such as the blink reflex, eyelash reflex, and corneal reflex.[1]

The Bispectral Index (BIS) is an electroencephalography-based monitor widely used to estimate hypnotic depth. BIS values range from 0 to 100, and values between 40 and 60 are generally considered appropriate for general anesthesia. Despite its objectivity, BIS monitoring has several limitations, including equipment cost, limited availability, signal artifacts, and the influence of certain anesthetic agents on index interpretation.[2]

In this study, the blink reflex refers to a clinically elicited bedside eyelid-closure response rather than electrophysiologic blink reflex testing. This bedside sign remains useful in routine practice because it is easy to examine, requires no additional equipment, and can be assessed directly during induction. Clinically, loss of this reflex is often regarded as a marker of transition toward loss of consciousness and adequate hypnotic depth for airway manipulation. In the classical concept of anesthetic stages, disappearance of eyelid-related reflexes indicates a shift from the excitement phase toward early surgical anesthesia.[3]

Previous studies have shown that clinical parameters during induction still retain practical value. However, the relationship between the clinically assessed blink reflex and BIS has not been extensively evaluated using very early serial measurements after propofol administration. Therefore, this study aimed to assess the association between the clinically assessed blink reflex and BIS during induction of anesthesia and to identify patient factors that might influence this relationship.[4]

METHODS

This prospective observational analytic study was conducted in adult patients undergoing general anesthesia in the operating theatre of Dr. Sardjito General Hospital, Yogyakarta.

The study included 59 patients aged 18–65 years with ASA physical status I–II who underwent elective surgery under general anesthesia. All patients received propofol at a dose of 1.5 mg/kg as the induction agent. The clinically assessed blink reflex and BIS were recorded at baseline before induction and at 15, 30, and 60 seconds after induction. The blink reflex was defined as a bedside elicited eyelid-closure response and was classified as present or absent, whereas BIS was categorized into awake, light sedation, moderate sedation, and general anesthesia.

Variables analyzed included age, sex, body mass index (BMI), ASA physical status, blink reflex on bedside examination, and BIS. Descriptive statistics were used to summarize baseline characteristics and serial measurements. Associations between categorical variables were analyzed using the chi-square test or Fisher's exact test as appropriate. Variables considered clinically relevant were subsequently entered into multivariable analysis. A p value of less than 0.05 was considered statistically significant.

RESULT

A total of 59 patients were included in the study. The mean age was 44.83 ± 13.65 years. The sex distribution was relatively balanced, with a slightly higher proportion of male patients (54.2%) than female patients (45.8%). Mean BMI was 23.36 ± 4.03 kg/m^2, which was generally within the normal range. Most patients were classified as ASA II (81.4%) and had comorbidities (81.4%), indicating that the majority had mild to moderate systemic disease. Baseline hemodynamic parameters were stable, with a mean systolic blood pressure of 128.58 ± 16.87 mmHg, mean diastolic blood pressure of 76.36 ± 15.93 mmHg, and mean heart rate of 81.39 ± 10.31 beats/min.

Before induction, all patients were

Table 1. Subject Characteristics

Variable	Category	Mean ± SD	n (%)
Age		44.83 ± 13.65	
Gender	Male		32 (54.2%)
	Female		27 (45.8%)
Height (cm)			
Eight (kg)			
Body Mass Index (BMI)			
ASA Physical Status	1		11 (18.6%)
	2		48 (81.4%)
Comorbidity	Present		48 (81.4%)
	Absent		11 (18.6%)
Systolic Blood Pressure		128.58 ± 16.87	
Diastolic Blood Pressure		76.36 ± 15.93	
Heart Rate (beats/min)		81.39 ± 10.31	
Propofol Dose (mg)		1.5 ± 0	
Propofol Dose	1.5 mg		59 (100.0%)

categorized as awake and all retained the blink reflex. At 15 seconds after induction, most patients had entered the light sedation category (72.9%), followed by moderate sedation (25.4%), while only 1.7% had reached the general anesthesia category. At 30 seconds, most patients shifted to moderate sedation (67.8%), followed by light sedation (28.8%), and 3.4% had reached general anesthesia. By 60 seconds, all patients were within the general anesthesia category. These findings indicate that the hypnotic effect of induction was not fully established at 15 seconds but developed progressively and appeared complete at 60 seconds.

Bivariate analysis showed a significant association between BIS category and blink reflex status on bedside examination at 15 seconds after induction ($p = 0.005$). A similar significant association was found at 30 seconds ($p = 0.001$). At 15 seconds, male patients were more likely than female patients to retain the blink reflex (78.1% vs. 40.7%, $p = 0.003$), whereas age, ASA physical status, and BMI were not significantly associated with blink reflex status. At 30 seconds, no clinical variable showed a statistically significant association with the blink reflex. Analysis of factors associated with BIS categories showed that ASA physical status was significantly associated with BIS at 15 seconds ($p = 0.002$) and 30 seconds ($p = 0.047$), whereas age, sex, and BMI were not significantly associated. Multivariable analysis further indicated that ASA physical status independently influenced BIS during the early post-induction period.

When categorized by level of consciousness, all patients were fully awake before induction (100%). At 15 seconds after induction, the majority had progressed to mild sedation (72.9%), some had reached moderate sedation (25.4%), and only 1.7% had achieved the category of general anesthesia. At 30 seconds, most patients had shifted to moderate sedation (67.8%), followed by mild sedation (28.8%), while 3.4% had reached general anesthesia. At 60 seconds, all patients (100%) were in the category of general anesthesia. These findings indicate that the full effect of induction was not achieved within the first 15 seconds, but rather developed progressively and appeared complete by 60 seconds (Table 2).

Bivariate analysis at 15 seconds showed a significant association between BIS value categories and the blink reflex ($p = 0.005$). At 30

Table 2. Serial Measurements of the Clinically Assessed Blink Reflex and Bispectral Index

Variable	Category	Mean ± SD	n (%)
Blink Reflex Before Induction	Present	–	59 (100.0%)
	Absent	–	0 (0.0%)
Blink Reflex 15 Seconds After Induction	Present	–	36 (61.0%)
	Absent	–	23 (39.0%)
Blink Reflex 30 Seconds After Induction	Present	–	8 (13.6%)
	Absent	–	51 (86.4%)
Blink Reflex 60 Seconds After Induction	Present	–	0 (0.0%)
	Absent	–	59 (100.0%)
BIS Value Before Induction	–	95.36 ± 3.38	–
BIS Value 15 Seconds After Induction	–	68.20 ± 11.81	–
BIS Value 30 Seconds After Induction	–	56.44 ± 8.93	–
BIS Value 60 Seconds After Induction	–	[value not provided]	–
BIS Category Before Induction	Awake	–	59 (100.0%)
	Light Sedation	–	0 (0.0%)
	Moderate Sedation	–	0 (0.0%)
	General Anesthesia	–	0 (0.0%)
BIS Category 15 Seconds After Induction	Awake	–	0 (0.0%)
	Light Sedation	–	43 (72.9%)
	Moderate Sedation	–	15 (25.4%)
	General Anesthesia	–	1 (1.7%)
BIS Category 30 Seconds After Induction	Awake	–	0 (0.0%)
	Light Sedation	–	17 (28.8%)
	Moderate Sedation	–	40 (67.8%)
	General Anesthesia	–	2 (3.4%)
BIS Category 60 Seconds After Induction	Awake	–	0 (0.0%)
	Light Sedation	–	0 (0.0%)
	Moderate Sedation	–	0 (0.0%)
	General Anesthesia	–	59 (100.0%)

seconds, the statistical analysis at this time point also demonstrated a significant association between BIS values and the blink reflex (p = 0.001). The analysis showed that physical status was an independent variable associated with BIS at 30 seconds after induction, with a coefficient of B = 0.383, a p-value of 0.028, and a 95% confidence interval ranging from 0.043 to 0.723 (Table 4).

Table 3. Association Between BIS Category and the Clinically Assessed Blink Reflex

BIS Category	Blink Reflex Present	Blink Reflex Absent	P-value
Before Induction			–
Awake	59 (100.0%)	0 (0.0%)	–
Light Sedation	0 (0.0%)	0 (0.0%)	
Moderate Sedation	0 (0.0%)	0 (0.0%)	
General Anesthesia	0 (0.0%)	0 (0.0%)	
15 Seconds After Induction			0.005^{x}
Awake	0 (0.0%)	0 (0.0%)	
Light Sedation	19 (70.4%)	8 (29.6%)	
Moderate Sedation	11 (68.8%)	5 (31.3%)	
General Anesthesia	6 (37.5%)	10 (62.5%)	
30 Seconds After Induction			0.001
Awake	0 (0.0%)	0 (0.0%)	
Light Sedation	1 (50.0%)	1 (50.0%)	
Moderate Sedation	6 (40.0%)	9 (60.0%)	
General Anesthesia	1 (2.4%)	41 (97.6%)	
60 Seconds After Induction			–
Awake	0 (0.0%)	0 (0.0%)	
Light Sedation	0 (0.0%)	0 (0.0%)	
Moderate Sedation	0 (0.0%)	0 (0.0%)	
General Anesthesia	0 (0.0%)	59 (100.0%)	

*) p<0,05, x) Chi-Square, $) Fisher exact test

Table 4. Multivariate Analysis of BIS Values

			95.0% Confidence Interval for B	
	B	P	Lower Bound	Upper Bound
Usia	.007	.148	-.003	.018
Jenis Kelamin	.229	.104	-.049	.506
Status Fisik	.383	.028	.043	.723

DISCUSSION

This study demonstrated that the decline in BIS values paralleled the disappearance of the clinically assessed blink reflex during the first minute after propofol induction. This finding is clinically relevant because the early induction phase is the period during which anesthesiologists must judge whether the patient is ready forairway manipulation. The presence of a blink reflex may reflect residual protective responsiveness, whereas its disappearance suggests deeper central nervous system depression.[1,5]

BIS provides an objective estimate of hypnotic depth by processing electroencephalographic signals. In this study, mean BIS values decreased from 95.36 at baseline to 68.20 at 15 seconds, 56.44 at 30 seconds, and 50.15 at 60 seconds. This pattern is consistent with the concept that BIS values of approximately 40–60 are associated with adequate general anesthesia, whereas higher values represent transitional stages between sedation and complete loss of consciousness.[2,8,9]

The significant association between BIS category and the clinically assessed blink reflex at 15 and 30 seconds suggests that this bedside sign remains clinically relevant during

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the early transitional phase of induction. This finding is in line with previous work indicating that clinical parameters during induction can still help identify readiness for intubation, even when BIS offers a more objective estimate of hypnotic depth. From a neurophysiological standpoint, the blink reflex mainly involves trigeminal–facial brainstem pathways, whereas BIS predominantly reflects cortical activity. Accordingly, the two measures may not disappear simultaneously, but they may still change in parallel as anesthesia deepens.[4,7]

The finding that ASA physical status independently influenced BIS during the early post-induction period suggests that patient characteristics contribute to the rate of hypnotic transition. Clinically, this may reflect interindividual differences in pharmacokinetics, pharmacodynamics, and underlying systemic conditions. Therefore, interpretation of both bedside reflex findings and BIS values should always take baseline patient characteristics into account.[6,11]

This study has several limitations. Blink reflex assessment was performed clinically as a bedside examination and may therefore be subject to interobserver variability. BIS signal quality may also be influenced by sensor placement and signal quality index stability. In addition, the speed of propofol injection may not have been fully standardized, which could have affected both the time to reflex loss and the rate of BIS decline. Nevertheless, the observed pattern remained consistent at the two main early time points, namely 15 and 30 seconds. Overall, these findings support the use of the clinically assessed blink reflex as a simple bedside indicator to assist assessment of anesthetic depth during propofol induction, particularly when BIS monitoring is unavailable or used only as an adjunct.[12,13]

CONCLUSION

There was a significant association between the clinically assessed blink reflex and Bispectral Index values during the early phase of propofol induction.

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RECOMENDATION

Future studies should apply stricter standardization of the speed and duration of propofol injection so that the timing of blink reflex loss and BIS reduction can be compared more precisely

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