Indonesian Journal of Global Health Research
Volume 8 Number 6, December 2026
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

PREOPERATIVE HEMOGLOBIN LEVELS AS A FACTOR ASSOCIATED WITH TIME TO REGAIN CONSCIOUSNESS IN PATIENTS UNDERGOING GENERAL ANESTHESIA

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ABSTRACT
Recovery time is an important indicator of the success of general anesthesia. One factor that influences it is hemoglobin levels, because hemoglobin plays a role in transporting oxygen to tissues, including the brain. Low hemoglobin levels can reduce oxygen supply and potentially slow recovery of consciousness after anesthesia. This study aims to determine the relationship between preoperative hemoglobin levels and recovery time in general anesthesia patients at Dr. Reksodiwiryo Padang Level III Hospital. This study used an Observational Analytical design with a Cross Sectional approach. The study was conducted at Dr. Reksodiwiryo Padang Level III Hospital, with a sample of 81 respondents selected using the Consecutive Sampling technique. Hemoglobin level data were taken from preoperative laboratory tests, while recovery time was assessed using the Aldrete Score, and analyzed with the Spearman's rho test. The results showed that the majority of respondents Most respondents had preoperative hemoglobin levels <12 g/dL (58%) and a recovery time of 31–60 minutes (53.1%). Respondents with hemoglobin levels <12 g/dL experienced more delayed recovery of consciousness, while respondents with normal hemoglobin levels (12–16 g/dL) tended to achieve recovery of consciousness within 0–30 minutes. There was a relationship between preoperative hemoglobin levels and recovery time of consciousness in general anesthesia patients at Dr. Reksodiwiryo Hospital, Padang, with a p value = 0.000; r = 0.805. There was a relationship between preoperative hemoglobin levels and recovery time of consciousness in general anesthesia patients at Dr. Reksodiwiryo Padang Hospital.

Keywords: aldrete score; anemia; general anesthesia; preoperative hemoglobin; recovery time

How to cite (in APA style)
Elfira, Y., Irwadi, I., & Fatimah, F. (2026). Preoperative Hemoglobin Levels as A Factor Associated with Time to Regain Consciousness in Patients Undergoing General Anesthesia. *Indonesian Journal of Global Health Research*, *8*(6), 1315–1320. https://doi.org/10.37287/ijghr.v8i6.2815.

INTRODUCTION

Anesthesia is a procedure used to eliminate pain through specific techniques during surgery. It can be administered as general anesthesia (GA), regional anesthesia (RA), or local anesthesia (LA). Local anesthesia causes a loss of sensation in a specific, limited area of the body. Spinal regional anesthesia results in a loss of sensation across a larger area of the body by specifically blocking spinal tissues or associated nerves. In contrast, general anesthesia typically renders the patient unconscious, ensuring they feel nothing or remain asleep throughout the surger (Senapathi & Widnyana, 2020). According to World Health Organization data (2022), more than 240 million surgical procedures are performed, the majority of which involve general anesthesia. The Am erican Statistical Association (ASA) also reported in 2024 that 175.4 million people worldwide underwent surgery under general anesthesia. In Indonesia, data from the Ministry of Health (2023) indicates that the number of patients undergoing surgery with general anesthesia exceeded 1.4 million (Fauziyyah et al., 2025). The success of anesthesia is determined not only during the surgical procedure itself but is also reflected in the post-anesthesia recovery phase. A key indicator for assessing the success and safety of general anesthesia is the patient's time to regain consciousness. This timeframe reflects the patient's ability to return to full consciousness and physiological stability following the discontinuation of anesthetic agents. Recovery of consciousness from general anesthesia is defined as a physiological state characterized by the return of neuromuscular conduction, airway protective reflexes, and awareness (Suratinoyo, 2022). Recovery of

consciousness is assessed using two distinct methods: the Post-Anesthesia Discharge Scoring System (PADSS) is used for outpatients, whereas the Aldrete Score is employed for postoperative patients being transferred to a general ward. The Aldrete Score is the standard tool used to evaluate postoperative recovery of consciousness (Wahyuni et al., 2023). A delayed recovery process is an undesirable event in anesthesia, commonly referred to as "delayed emergence" or "delayed recovery." This occurs when a patient fails to regain consciousness within 30 to 60 minutes after anesthesia; notably, approximately 90% of patients regain full consciousness within 15 minutes Factors influencing the time to regain consciousness include patient-related variables, surgical and anesthetic complications, and pharmacological factors. Both pharmacological and non-pharmacological factors contribute to complications associated with post-anesthesia recovery (Nugrahani et al., 2023). Hemoglobin level is a hematological parameter that plays a crucial role in the recovery of consciousness following general anesthesia. Hemoglobin (Hb) is a conjugated protein found within red blood cells. It functions as an oxygen-transporting protein, distributing oxygen to all body tissues, including the brain. A decrease in hemoglobin levels can reduce oxygen supply to tissues, potentially disrupting cellular metabolism and delaying the recovery of consciousness after anesthesia. Conversely, abnormal hemoglobin levels can also affect physiological stability during the perioperative period. Therefore, understanding how hemoglobin status contributes to the quality of recovery of consciousness is important in the context of postoperative assessment (Atik et al., 2022). The purpose of this study is to determine the relationship between hemoglobin levels and the time required for consciousness to return in patients following general anesthesia, while considering anemia as a potential factor that may influence the duration of recovery of consciousness.

METHOD

This study employed an observational analytic design with a cross-sectional approach; this design was selected because the researchers aimed to examine the relationship between the two variables without administering any interventions or treatments to the patients at Dr. Reksodiwiryo Level III Hospital, Padang. Hemoglobin level data were obtained from preoperative laboratory tests, while recovery time was assessed using the Aldrete Score. Data were analyzed using the Spearman's rho test. The study was conducted at Dr. Reksodiwiryo Level III Hospital, Padang, with a sample of 81 respondents selected via consecutive sampling.

RESULT

Table 1.
Frequency Distribution of Preoperative Hemoglobin Levels in Patients Undergoing General Anesthesia

Hemoglobin	f	%
< 12 (Abnormal)	47	58
12-16 (Normal)	34	42
Total	81	100.0

Table 1 shows that more than half of the respondents—specifically 47 individuals (58%) undergoing general anesthesia at Level III Hospital Dr. Reksodiwiryo Padang had preoperative hemoglobin levels below 12.

Tabel 2.
Frequency Distribution of Time to Regain Consciousness in Patients Undergoing General Anesthesia

Time to Regain Consciousness	f	%
0-30 minute	38	46.9
31-60 minute	43	53.1

Table 2 shows that more than half of the respondents—specifically 43 individuals (53.1%)—who underwent general anesthesia at Level III Dr. Reksodiwiryo Hospital, Padang, had a recovery time of 31–60 minutes.

Tabel 3.
Crosstabulation of Anemia and Time to Regain Consciousness in Patients Undergoing General Anesthesia

Hemoglobin \ Time to Regain Consciousness	0-30 menite		31-60 menite		Total	
	F	%	f	%	f	%
< 12 (Abnormal)	6	12.8	41	87.2	47	100
12-16 (Normal)	32	94.1	2	5.9	34	100

It was found that more than half of the respondents—specifically 43 individuals (53.1%)—who underwent general anesthesia at Dr. Reksodiwiryo Level III Hospital, Padang, had a recovery time of 31–60 minutes.

DISCUSSION

Hemoglobin Level

The study results indicate that more than half of the respondents—specifically 47 individuals (58%)—undergoing general anesthesia at Dr. Reksodiwiryo Level III Hospital in Padang had preoperative hemoglobin levels below 12 g/dL. Hemoglobin is a key component of red blood cells responsible for binding and transporting oxygen from the lungs to all body tissues, including the brain. Low hemoglobin levels reflect a reduced oxygen-carrying capacity of the blood, resulting in inadequate oxygen supply to the tissues. This condition significantly impacts the function of vital organs—particularly the brain—which has a high oxygen demand and is highly sensitive to hypoxia (Atik et al., 2022). In research conducted by Robincun Ngala (2024) regarding the relationship between anemia and lengthening of recovery time in patients after general anesthesia at the Central General Hospital, Prof. Dr R.D Kandou Manado found that anemia has a high risk of causing a delay in recovery time after surgery, this is because oxygen transport is disrupted. Decreased hemoglobin or the number of red blood cells which greatly decreases causes inadequate oxygen to reach all tissues and develops into hypoxia, so that the brain lacks oxygen levels which increases the risk of delays in recovering from consciousness after surgery (Elfira et al., 2024). Physiologically, hypoxia resulting from anemia directly impacts central nervous system function. An oxygen-deprived brain experiences reduced neuronal activity, which hinders the recovery of consciousness following anesthesia. Furthermore, hypoxia can slow the metabolism of anesthetic drugs within the body, thereby prolonging their effects and extending the time required to regain consciousness. This underscores the fact that low hemoglobin levels affect not only oxygenation but also the elimination of anesthetic drugs. Thus, the study findings indicate that the majority of patients exhibited low hemoglobin levels (<12 g/dL), a factor that potentially increases the risk of delayed recovery of consciousness.

Time to Regain Consciousness

The study results indicate that the majority of respondents—specifically 43 individuals (53.1%)—undergoing general anesthesia at Dr. Reksodiwiryo Level III Hospital, Padang, had a consciousness recovery time of 31–60 minutes. Consciousness recovery time is a crucial indicator for assessing the success of anesthesia management and the patient's physiological status following surgery. This recovery duration is influenced by various factors, such as the patient's pre-operative condition, the type and duration of anesthesia, and physiological factors like hemoglobin levels. In this study, the prevalence of recovery times in the 31–60 minute range suggests the presence of factors contributing to a tendency for delayed recovery of consciousness. Research by Robincun Ngala (2024) found that 51.8% of anemic patients undergoing general anesthesia experienced prolonged consciousness recovery times; notably, all patients with severe anemia experienced such delays. These findings reinforce the significant association between anemia and the duration of consciousness recovery following anesthesia. Stimulation of the Pericardium 6 (P6) point reduces the release of serotonin (5-HT_3) and dopamine (D_2) in the chemoreceptor trigger zone (CTZ) and the nucleus tractus solitarius (NTS); thus, applying pressure to the P6 point can reduce the incidence

of postoperative nausea and vomiting (PONV) (Lestari et al., 2022). Mechanical pressure on the Neiguan acupressure point activates mechanosensory receptors (such as Aβ and Aδ fibers) located in the skin and tissues surrounding the median nerve. The resulting sensory impulses are transmitted via afferent fibers to the spinal cord and subsequently to the brainstem—specifically the nucleus tractus solitarius (NTS) and the area postrema—which play vital roles in regulating nausea and vomiting reflexes (Sarif *et al.* 2024). Activation of this pathway triggers the release of inhibitory neurotransmitters, such as endorphins and gamma-aminobutyric acid (GABA), which suppress the activity of emetogenic neurons. Consequently, serotonin (5-HT) release from enterochromaffin cells and dopaminergic transmission in the chemoreceptor trigger zone (CTZ) are inhibited (Sarif et al., 2024). Thus, stimulating the P6 point can reduce postoperative nausea and vomiting (PONV) (Lestari et al., 2022). Based on these findings, the researchers conclude that PONV decreased following the administration of Naiguan acupressure therapy to patients who had undergone spinal anesthesia. This intervention leads to reduced sympathetic nervous system activity and increased release of endorphins and GABA—substances that inhibit the vomiting center in the medulla oblongatathereby significantly alleviating the post-anesthesia response of nausea and vomiting.

The Relationship Between Preoperative Hemoglobin Levels and Time to Regain Consciousness in Patients Undergoing General Anesthesia

Statistical analysis in this study indicates a relationship between hemoglobin levels and the time to regain consciousness in patients undergoing general anesthesia at Dr. Reksodiwiryo Level III Hospital, Padang. The Spearman's rho test yielded a Sig. (2-tailed) value of 0.001, meaning the alternative hypothesis (Ha) was accepted and the null hypothesis (Ho) was rejected; the correlation was negative, with a coefficient of 0.805. Thus, it can be concluded that preoperative hemoglobin levels are strongly associated with the time to regain consciousness in general anesthesia patients at Dr. Reksodiwiryo Level III Hospital, Padang. This study supports the findings of Robincun Ngala (2024), identifying hemoglobin levels as a contributing factor to delayed recovery of consciousness. Hemoglobin is a respiratory protein responsible for the primary functions of transporting oxygen to tissues and carrying carbon dioxide back to the lungs. It is transported within the circulation by erythrocytes. In the blood, the majority of oxygen binds to hemoglobin (97%), while the remainder dissolves in the plasma (3%). Hemoglobin deficiency inevitably leads to oxygen insufficiency, which—in advanced stages—can cause tissue necrosis and even become life-threatening. Delayed recovery of consciousness following general anesthesia is a known complication associated with reduced hemoglobin levels in patients (Kijima et al., 2020).

Kijima et al. (2020) explained that low hemoglobin levels, which cause intraoperative hypoxia, are a factor contributing to postoperative cognitive impairment. This aligns with the Aldrete Score—a metric for assessing recovery from general anesthesia—which incorporates cognitive and motor functions as indicators for determining recovery status. The Aldrete Score is a scoring system used to evaluate a patient's post-anesthesia readiness prior to discharge from the recovery room. This assessment comprises five key components: motor activity, respiration, circulation (or blood pressure), level of consciousness, and oxygen saturation. Each component is scored from 0 to 2, resulting in a maximum total score of 10. Patients are considered to have regained consciousness and are deemed fit for transfer if they achieve a score of 8 or 9. This study indicates that respondents with decreased hemoglobin levels experienced a delay in regaining consciousness post-surgery. However, this delay is also influenced by other contributing factors, such as age, physical status, duration of surgery, and the anesthetic agents used. The study concludes that preoperative hemoglobin levels are associated with the time taken to regain consciousness; the lower the patient's hemoglobin level, the greater the risk of delayed recovery of consciousness following general anesthesia. Low hemoglobin levels reduce the blood's capacity to transport oxygen to body tissues—including the brain—thereby affecting neurological function and slowing the process of regaining consciousness. Consequently, delayed recovery of consciousness is a multifactorial condition requiring comprehensive attention throughout the perioperative period to minimize post-

anesthesia complications. Anticipating such delays is essential for delivering superior anesthesia nursing care.

CONCLUSION

Based on the study regarding the relationship between preoperative hemoglobin levels and the time to regain consciousness in patients undergoing general anesthesia at Dr. Reksodiwiryo Level III Hospital, Padang, it can be concluded that the majority of respondents exhibited low preoperative hemoglobin levels (47 respondents or 58.0%) and experienced a delayed return to consciousness (43 respondents or 53.1%). The findings indicate a strong relationship between preoperative hemoglobin levels and the time to regain consciousness in these patients. This suggests that preoperative hemoglobin status should be a key consideration during patient preparation and management, as suboptimal hemoglobin levels may influence the process of regaining consciousness following anesthesia. Consequently, monitoring preoperative hemoglobin levels can play a crucial role in identifying patients at risk of a delayed return to consciousness.

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