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Analysis of differences smoking status with perianestesis oxygen desaturation to patients' general anesthesia and regional anesthesia in the Operating Theatre Lubuk Basung Hospital

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Abstract

Background: The rising prevalence of tobacco use in Indonesia over the past decade has prompted concerns about the potential health risks, particularly in the context of surgical procedures involving anesthesia. This study aimed to examine the association between smoking status and the incidence of peri anesthesia oxygen desaturation in patients undergoing general and regional anesthesia. This assessment is becoming increasingly crucial as active smokers may be at an elevated risk of oxygen desaturation, a significant complication that can occur during the administration of anesthesia, both general and regional.
Method: This research is descriptive and analytic with a cross-sectional design and a total sampling of 108 respondents. The data were collected through observation of the oxygen desaturation occurring during the initial 15 minutes of anesthesia.
Results: The results showed a statistically significant difference in oxygen desaturation between active and passive smokers, with a p-value of 0.000.
Conclusion: Most of the respondents 56 people (51.9%) had passive smoking status and 52 respondents (48.1%) with active smoking status. The mean peri anesthesia oxygen saturation in general anesthesia and regional anesthesia patients is 90.00 with a minimum value of 91.00 and a maximum value of 100.00, with a standard deviation of 2.54309.

Keywords: oxygen desaturation; smoking status; anesthesia.

INTRODUCTION

The importance of anesthesia is used to provide deep relaxation for both temporary and prolonged periods in patients undergoing surgical procedures (1). Based on data from the American Statistical Association (ASA), there are 175.4 million patients undergoing general anesthesia procedures worldwide. In addition, the World Health Organization (WHO) explained that there were 86.74 million patients undergoing general anesthesia procedures in Asia and according to Sabadilla Fitri, et al (2023) currently around 4.67 million patients undergo surgical procedures with general and regional anesthesia (2).

Following the application of the two aforementioned anesthesia techniques, bedside monitoring is required as a primary assessment tool to ascertain the status of the airway, oxygenation, ventilation, and perfusion. This is achieved through the use of noninvasive instruments, most notably tensimeters and oximeters (3). Indonesia's Basic Health Research (Riskesdas) in 2018 reported that the total number of smokers aged 15 years and over was 3.8%, with men at 62.9%, and women around 4.8% (4).

Patients with smoking-related comorbidities frequently experience peri anesthesia complications, including tissue hypoxia due to the accumulation of nicotine and carbon monoxide (CO_2) in hemoglobin (5). As stated by in Fadhillah (2020), oxygen saturation is a measure of the amount of oxygen bound to hemoglobin in relation to the body's capacity to metabolize and absorb oxygen.

Research by Adhe et al (2022) said the deterioration of physiological status

associated with alterations in peripheral SpO_2 is influenced by multiple factors, including changes in hemoglobin levels, poor shunts, bradycardia, and excessive sputum production. If not properly managed, this can lead to partial or total airway obstruction, ultimately resulting in death (3).

This finding is consistent with the results of a study by Septia (2016) on the correlation between smoking and oxygen saturation levels among employees at the Faculty of Medicine, Sam Ratulangi University, Manado. The study revealed a significant negative correlation between the frequency of smoking and oxygen saturation levels in the body. (6).

The mechanism of oxygen delivery is controlled by CO_2, which is the primary component of the gas phase of cigarette smoke and has an affinity approximately 300 times greater than that of oxygen to hemoglobin. Excessive CO_2 exposure results in reduced formation of oxyhemoglobin, which leads to tissue hypoxemia in smokers with high levels of physical activity (7).

It is important to identify and assess the "environment" in AMPLE in relation to the patient's smoking history in order to minimize the potential complications of peri anesthesia respiration system. As a consequence of smoking, there is a rapid reduction in the diameter of the airway as a reflex bronchoconstriction due to the inhalation of particles. The early closure of the airways during expiration results in an increased closure volume and alterations in the ventilation-perfusion (V/Q) ratio. The hyperresponsive airways also result in an increased production of mucus and viscosity due to impaired cilia structure and function (8).

An increase in reactive oxygen species (ROS) can activate oxidative stress in the lungs, leading to localized inflammation in the airway and impairing lung function. The ability of the blood to retain oxygen is a significant concern in patients under anesthesia, particularly general anesthesia (9). Smokers experience a reduction in oxygen-carrying capacity, but if they abstain from smoking for ≥12 hours, their oxygen-carrying capacity increases significantly (10).

Based on the findings of Ercan (2021), 25 of the 78 respondents (32.1%) reported engaging in smoking behavior, with an average duration of 4.9 ± 2.6 years. The results demonstrated that the mean oxygen saturation value in the non-smoking group was higher than in the smoking group ($p < 0.05$). In a separate study conducted by Sudaryanto (2016), 90 respondents were surveyed. The majority (53.3%) of respondents fell into the moderate Brinkmann index category, while the lowest oxygen saturation respondents with a mild Brinkmann index numbered 9 (30%). Only 5 (16.7%) respondents exhibited a Brinkmann index in the severe category. These findings suggest that the level of cigarette consumption may influence oxygen saturation levels.

It is crucial to closely monitor hemodynamic parameters in smokers undergoing surgical procedures, with a particular focus on oxygen saturation levels. To ensure that oxygen saturation values remain within the normal range, pulse oximetry derivations should be within the range of ≥ 95-100%. Following a surgical procedure, smokers may experience a decrease in peripheral oxygen saturation, which can significantly impact the efficacy of postoperative anesthesia (11).

In a preliminary study carried out by investigators in the operating room of RSUD Lubuk Basung in December 2023, a total of 427 surgical procedures were observed, including 221 cases that were anesthetized with general anesthesia and 206 cases that were anesthetized with regional anesthesia utilizing the subarachnoid block technique. In an interview with an anesthesiologist who was present in the operating room at RSUD Lubuk Basung, it was explained that the research site had two operating rooms designated for elective procedures. A review of the medical records of five patients admitted between December 18 and 24, 2023, revealed that three of them had a history of smoking, while the remaining two

were non-smokers. Oxygen desaturation was observed in three of the smoker patients, with SpO2 levels ranging from 92-93% to 95-96%. In contrast, the two non-smoking patients exhibited significantly higher levels of oxygen desaturation, reaching 98-100%.

Anesthesia, especially general inhalation anesthesia, has a fairly high risk of experiencing desaturation or a decrease in oxygen saturation from normal values. Excessive secretion production in smokers after general anesthesia inhibits oxygen fulfillment so that saturation decreases, one of the effects of general anesthesia is hypersecretion of mucus and saliva in the airways. So maintaining the effectiveness of the airways through monitoring oxygen saturation is very important to prevent desaturation.(10)

To overcome this problem, surgical patients with a history of smoking require intensive hemodynamic monitoring, particularly with regard to oxygen saturation, given the potential for desaturation during surgery. Peripheral oxygen saturation represents a significant concern during intraoperative anesthesia. Consequently, researchers investigated the relationship between smoking history and the incidence of peri anesthetic desaturation in patients undergoing general and regional anesthesia at Lubuk Basung Hospital.

METHOD

The research method was descriptive analytic with a cross-sectional design and a simple random sampling technique. The study was conducted at the Central Surgical Installation (IBS) of Lubuk Basung Hospital from April to June 2024. The population consisted of patients who had undergone general or regional anesthesia, and a sample size of 108 respondents was selected. Patients who underwent elective surgical procedures under general or regional anesthesia, aged between 17 and 45 years, and classified as physical status ASA I-III, were excluded from the study. Patients aged > 45 years with physical status ASA > 4 are excluded from the study. The independent variable is smoking status in general and regional anesthesia patients. The dependent variable is oxygen desaturation. Primary data were collected via interviews and observations identify demographic characteristics such as age and gender, while secondary data were derived from patient identities in medical records.

RESULTS

A sample of 56 individuals (51.9%) were identified as having been exposed to secondhand smoke, while 52 individuals (48.1%) were classified as current smokers, consisting of 45 males and 7 females [Table.1].

Table 1. Smoking Status in General Anesthesia and Regional Anesthesia Patients

Smoking status	f	%
Pasive	56	51,9
Active	52	48,1
Total	108	100

The mean oxygen desaturation in patients who received regional anesthesia was 98.3333, with a minimum value of 97.6883 and a maximum value of 98.9784. In contrast, the mean desaturation in patients who received general anesthesia was 97.6667, with a minimum value of 96.932 and a maximum value of 98.401. [Table. 2].

Table 2. The average incidence of perianesthesia oxygen desaturation in patients undergoing general anaesthesia or regional anaesthesia.

Oxygen Desaturation	f	Mean	Lower	Upper
Oxygen Desaturation Regional Anesthesia	54	98.33333	97.6883	98.9784
Oxygen Desaturation General Anesthesia	54	97.6667	96.932	98.401

A comparative analysis of oxygen desaturation in active and passive smokers revealed a statistically significant difference, with data indicating that as many as 52 individuals classified as passive smokers experienced oxygen desaturation, yielding a p-value of 0.000 [Table. 3].

Table 3. A comparative analysis of smoking status and the incidence of peri anesthesia oxygen desaturation in patients undergoing general anesthesia and regional anesthesia.

	Smoking status	N	Mean Rank	Sum of Ranks	*P value*
Oxygen Desaturation	Pasive	56	70.11	3926.00	0.000
	Aktive	52	37.00	1960.00	

DISCUSSION

The survey results indicated that 56 individuals (51.9%) reported exposure to secondhand smoke, while 52 individuals (48.1%) reported active smoking, including both male and female respondents.

The primary target organ affected by smoking behavior is the lungs, which suffer from functional impairment as a result. This is related to several factors, including psychological factors that have tolerated excessive cigarette consumption and the community environment (12). The researcher assumed that the study conducted at IBS RSUD Lubuk Basung related to smoking habits could be influenced by various factors, including family involvement and their ability to imitate smoking patterns. It has been demonstrated that the consumption of more than one pack of cigarettes per day can increase red blood cell mass, which is described as a response to tissues not receiving enough oxygen due to CO_2 exposure, thus reducing oxyhemoglobin aninity (6).

The respiratory system can be affected by various diseases such as airway obstruction, respiratory infections, gas exchange-related diseases such as emphysema and chronic bronchitis. An increase in mucus secretion is often observed in patients who smoke and have undergone general anesthesia (13). It is a scientifically proven fact that inhalation agents have the potential to impair the body's physiological reflexes, which are responsible for mucus clearance. If these reflexes are not functioning optimally, the resulting lung tissue destruction and hypoxia can become a significant challenge, and a crucial area of concern in the management of cardiopulmonary complications (14)(15).

The results of this study are supported by the findings of Sumarno et al. (2023), which revealed a statistically significant p-value of 0.000. This indicates that as the number of cigarettes smoked daily increases, the SpO_2 value decreases. This is potentially due to the fact that each cigarette contains approximately 4000 chemicals, many of which have the potential to cause airway obstruction. This is because the covalent bond between carbon and oxygen is a constituent of CO_2 (11).

The smoking status of patients undergoing general and regional anesthesia at IBD Lubuk Basung Hospital is consistent with the findings of Adhe et al. (2020) at Dr. Soedirman Kebumen Hospital, which included 60 respondents. The results indicated that 30 individuals (50.0%) were non-smokers, while 30 individuals (50.0%) were smokers. Additionally, the study indicated that patients who smoke are at an elevated risk of developing respiratory issues due to the effects of cigarette components, which indirectly result in a reduction in oxygen saturation (3).

Oxygen and carbon monoxide exist in a competitive metabolic relationship within the circulatory system. If CO_2 diffuses rapidly throughout the capillaries and alveoli, it will play a role in increasing the production of carboxyhemoglobin (COHb) by acting as a strong ligand for hemoglobin, which can interfere with oxygen transportation to body tissues. The blood of smokers contains 2-2% more COHb than that of non-smokers. A

high ratio can reduce oxyhemoglobin production, thereby rendering smokers more susceptible to hypoxemia. (16).

Clinical manifestations of a change in peripheral oxygen saturation include alterations in hemoglobin levels, fluctuations in blood pressure, inadequate blood flow, and abnormal muscle movements such as tremors or trembling. Additionally, peripheral acral changes, heart rate, and the presence of dark nail polish may be observed. Saturation evaluation is considered less effective when the data is taken when the patient is given oxygenation (3). Consequently, researchers have proposed that data be gathered 5 to 15 minutes post-induction, when oxygen saturation has reached a stable state.

The outcomes of this investigation are consistent with the findings of Nindirah et al. (2016), who obtained a p-value of less than 0.05, indicating that smoking status has a notable impact on oxygen saturation. A previous study by Sudayarto (2016) yielded $p < 0.05$ results. The survey indicated that 30 out of 90 individuals exhibited oxygen saturation levels below the normal range, while 60 individuals showed healthy oxygen saturation levels (6).

The findings of this study are substantiated by prior research conducted by Adhe et al. (2020), which demonstrates a robust correlation between smoking status and intraoperative oxygen saturation during general anesthesia, as evidenced by the p-value of 0.000. The data indicates that the obtained significance is 0.000 lower than the significance level of 0.05, suggesting a correlation between smoking status and intraoperative oxygen saturation during general anesthesia. The odds ratio value of 32,500 highlights that smoking may contribute to reduced oxygen saturation (3).

Cigarette smoking has been linked to the activation of the CYP450 enzyme system, which in turn has been observed to result in alterations in drug pharmacokinetics and cytodynamics. Due to nicotine-induced alterations in the sensitivity of the neuromuscular junction to acetylcholine and enzyme induction, up to 25% of the body will require increased relaxant use (17). Based on the researcher's analysis, the findings of the characteristics of the respondents in this study indicate that those with a history of smoking are more sensitive to anesthetic interventions due to the impact of smoking, which acts as a mediator between peri anesthetic desaturation and other factors.

The recommendations that can be conveyed in this article are: It is expected to be a scientific study material in increasing the reader's insight and can be used as a reference for further research in conducting further research on other factors that can affect oxygen desaturase in general and regional anesthesia patients. And this study can be used as additional information in similar research on General and regional anesthesia.

CONCLUSIONS

1. Preparation in pre-operative requires the role of professional organizers to implement preventive measures for smoker patients who will undergo surgery, such as education about anesthesia procedures for passive smoker patients. Pre-operative assessment requires in-depth assessment that focuses on smoking history, both passive and active, so that complications that may occur can be minimized in the perioperative process.
2. The majority of respondents (56 individuals, representing 51.9% of the total sample) reported a passive smoking status, while 52 respondents (48.1%) indicated an active smoking status
3. The mean perianesthesia oxygen saturation in patients undergoing general anesthesia and regional anesthesia is 90.00, with a minimum value of 91.00 and a maximum value of 100.00. The standard deviation is 2.54309.
4. A statistically significant difference was observed between the oxygen

desaturation levels of active and passive smokers (p-value = 0.000).

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