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The effect of various anesthesia techniques on changes in leukocyte types

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Abstract

Background: Surgery and anesthesia can affect the immune and neuroendocrine systems which can cause the release of hormones and cytokines as a result of changes in the body's physiological responses. Neuroendocrine pathways to the immune system related to stress responses due to surgery. surgery and a decrease in the number of T lymphocytes causes a shift in the balance between immunosuppressive regulatory T lymphocytes and immune-triggering T helper and cytotoxic T cells in a predominance of regulatory T cells. Apart from causing a decrease in the number of T lymphocytes, it also causes suppression of NK cells and an increase in the number of neutrophils. Research purposes determine the effect of various anesthetic techniques on changes in leukocyte count levels.
Method: This research is a type of experimental research with a pre-pos test group design approach. The samples for this study were taken from patients undergoing surgery and anesthesia with inclusion criteria: age 17-65 years, ASA 1-2, no infectious diseases. The sample size is the sampling technique is Consecutive sampling. Sample measurements were taken from venous blood before and after surgery and anesthesia. The parameters measured are leukocyte counts which include leukocytes, basophils, neutrophils, monocytes and lymphocytes. Blood samples were taken before surgery and anesthesia, and 2 hours after surgery and anesthesia using a hematology analyzer. The analytical tests used are the parametric dependent test (paired T-test) or the non-parametric Wilcoxon test and the independent test.
Results: There is a significant difference in the count of leukocyte types between general anesthesia and regional anesthesia
Conclusion: General anesthesia can increase leukocyte counts significantly compared to regional anesthesia, but eosinophils are not significant in both groups

Keywords: Anesthesia, immune system, leukocytes.

INTRODUCTION

The immune system acts as a protector from foreign objects. Surgery and anesthesia can affect the immune and neuroendocrine systems which can cause the release of hormones and cytokines as a result of changes in the body's physiological responses. This process can occur either via direct mechanisms or hormonal pathways(1,2). Changes in hormone concentrations can affect the immune system in various ways. The occurrence of leukocytosis after surgery using ether, first reported in 1899 by Chadbourne, was caused by sympathomimetic anesthetic agents(3)

Based on literature studies, this is also followed by an increase in catecholamines due to surgical stress due to injuries, extent of surgery, patient age, general health conditions, drugs used such as anesthetics, opioids, post-surgical pain and blood transfusions.(4,5). There are various studies to assess neuroendocrine responses, such as measurement of interleukins (IL-6, TNF-α), cortisol levels, C-reactive protein (CRP), and leptin levels. It is known that surgery and a decrease in the number of T lymphocytes causes a shift in the balance between immunosuppressive regulatory T lymphocytes and immune-stimulating T helper and cytotoxic T cells in the

predominance of regulatory T cells6,. Apart from causing a decrease in the number of T lymphocytes, it also causes suppression of NK cells and an increase in the number of neutrophils.

Based on previous studies conducted on mice given a concentration of 3% Sevoflurane for 40 minutes, given for 3 weeks resulted in a decrease in lymphocytes and leukocyte counts(6). Some inhalation anesthetic agents and opioids that can cause changes in the immune response are ketamine, halothane, sevoflurane, morphine and fentanyl (7). Based on literature studies, differences in anesthesia techniques including general, spinal and balanced anesthesia techniques have never been found. So researchers are interested in conducting research with the research question, "How can various anesthetic techniques such as general, spinal and balanced anesthesia influence the immune response on leukocyte counts?"

Research purposes: to determine the effect of various anesthetic techniques on changes in leukocyte count levels

Special purpose:

1. Identifying leukocyte count levels based on general, spinal and draw anesthesia techniques.
2. Identify leukocyte count levels based on general, spinal and balanced anesthesia techniques based on age, duration of surgery, type of surgery and use of anesthetic drugs.
3. Analyzing the effect of changes in leukocyte count levels before and after general anesthesia techniques (inhalation and intravenous).
4. Analyzing the effect of changes in leukocyte count levels before and after spinal anesthesia techniques.
5. Analyzing the differences in increasing leukocyte count levels between general, spinal and balanced anesthesia

METHOD

This research is a type of experimental research with a pre-post test group design approach. The samples for this study were taken from patients undergoing surgery and anesthesia with inclusion criteria: age 17-65 years, ASA 1-2, no infectious diseases. The sample size is the sampling technique is Consecutive sampling. So the number of samples is 35

The analysis test used is the parametric dependent test (paired T-test) or the non-parametric Wilcoxon test. This test was carried out to analyze the effect before and after anesthesia techniques, both general and spinal anesthesia. Meanwhile, an independent analysis test was carried out to analyze the differences between leukocytes from general and spinal anesthesia techniques.

Data collection techniques

Sample selection was based on inclusion criteria, taking venous blood Count the types of leukocytes (neutrophils, monocytes, basophils, lymphocytes and leukocytes before performing general and spinal anesthesia techniques. Induction of general anesthesia and spinal injection were performed. 2 hours after general induction and spinal sampling Blood sampling Count the types of leukocytes (neutrophils, monocytes, basophils, lymphocytes and leukocytes after general and spinal anesthesia techniques) with a hematology analyzer.

RESULTS

1. Description of Research Place

The IBS room at Bumiayu Regional Hospital consists of 3 IBS rooms consisting of one specialist anesthetist, 2 anesthetists, 6 surgical nurses and 3 midwives. Data collection was carried out from June to August

2023 with 35 respondents in the general anesthesia (GA) group and 35 regional anesthesia (RA) groups. Leukocyte data before anesthesia was taken based on medical record data, while leukocyte data after anesthesia was taken 2 hours after the procedure.

2. Respondent Characteristics

Table 1 Frequency Distribution of Respondent Characteristics

Variable	GA group		RA group			Pvalue
	Mean ± SD	(%)	Mean ± SD		(%)	
Age < 50 ≥ 50	50.2 ±12.2		45±10.4			0.26*
Anesthesia technique a. ETT b. TIVA c. LMA	 0 6 29	 0 17.1 82.9	 a. Spinal b. Epidural c. Caudal block	 33 0 2	 94.2 0 5.71	0.17*
Length of surgery a. < 1 hour b. 1-2 hours c. >2 hours	 14 21 0	 40 60 0		 21 11 3	 60 31.4 8.57	0.39*
Types of Surgery a. General Surgery b. Obstetric Surgery c. Urological Surgery d. Other surgery	 22 9 2 2	 62.8 25.7 5.7 5.7		 8 21 3 3	 22.6 60 8.6 8.6	0.26*

Table 2. Average Results of Leukocyte Segment Examination

Variable	Mean ± SD		P value	Variable	Mean ± SD	P value
GA Group	Before	After		RA group Before	After	
Leukocytes	8267.7±4567.3	10338.7 ± 2819.3	0.03*	9457.7±5857.9	9338.7 ± 4819.3	0.26*
Basophils	0.32±0.12	0.72±0.47	0.04*	0.22±0.19	0.37±0.15	0.15*
Eosinophils	0.44±0.22	0.35±0.21	0.08*	0.24±0.31	0.23±0.14	0.09*
Neutrophils	77.24 ± 13.12	85.14±15.12	0.04*	67.64±11.13	69.32±12.16	0.08*
Lymphocytes	13.33±3.24	8.33 ± 1.24	0.03*	13.33±3.24	12.3±3.18	0.19*
Monocytes	3.61 ± 2.01	4.11±3.21	0.04*	4.11±3.11	4.91 ± 2.01	0.18*

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DISCUSSION

Respondent Characteristics

Based on table 1, data shows that the average age of respondents is 45-50 years, which indicates that this age category is middle adulthood(8). The majority of people who undergo surgery are over 50 years old. The results of this study are in accordance with research(9)The higher the age, the higher the prevalence of surgery. Based on research results(10)The death rate in adulthood is lower than in old age. According to(11)Aging is related to changes in structure, morphology and decreased body function.

Aging is a gradual and irreversible pathophysiological process, besides that there is a decrease in tissue and cell function and an increased risk of various diseases related to aging, including neurodegenerative diseases, cardiovascular diseases, metabolic diseases, musculoskeletal diseases, and immune system diseases. Although the development of modern medicine has improved human health and extended life expectancy, as society ages, various chronic diseases(12)is gradually becoming a major cause of disability and death in elderly individuals. Based on table 1, it can be seen that there were no respondents who used the ETT general anesthesia technique. It is assumed that the research site used is a type D hospital.

Based on research results(13,14)that the type of hospital will influence the facilities and characteristics of respondents, both in terms of number, complexity of disease and type of surgery. This can also be seen in the results of table 1, most of which were general surgery in the GA group, the majority of which were based on the results of observations when collecting data on surgical procedures at the research site which were less varied. General surgery is surgery, the majority of which are herniectomy, appendectomy, haemorrhoidectomy. This is in accordance with the research results(15) which states that there are differences in the type of surgery between general anesthesia and spinal anesthesia regarding the type of surgical procedure. The majority of surgery durations based on table 1 are in the range of 1-2 hours. This is in accordance with research(16) that the average duration of spinal anesthesia is 1-1.5 hours.

Based on the research results shown in table 2, data shows that there is a significant difference in the count of leukocyte types between general anesthesia and regional anesthesia. These results are in accordance with the research results(17,18,19,20). Total leukocyte count (TLC) and neutrophil lymphocyte ratio (NLR) are greater in general anesthesia than in spinal anesthesia. This is because the surgical incision results in the triggering of stress hormones, resulting in suppression of the immune system and susceptibility to inflammation. Increased TLC and decreased NLR may also risk infection. Anesthetic drugs can modulate pro-inflammatory and anti-inflammatory drugs, thereby causing a decrease in lymphocytes(21). This is also in accordance with the results of Kim Je's 2023 research, that there was an increase in leukocytes and a decrease in lymphocytes 24 hours after anesthesia, but this was not followed by an increase in monocytes. Neuroendocrine changes, namely the release of stress hormones at the baseline of this study, can be influenced by stress or anxiety before surgery. This is one of the confounders of the baseline TLC results which are taken based on the patient's medical records 24 hours before surgery. In this study, the use of hypnotics was associated with changes in leukocyte levels compared to before and after anesthesia, indicating a decrease in the number of lymphocytes. This may be due to a response to drug dosage. Other studies have also revealed that activation of the neuroendocrine system during anesthesia and surgery may result from the release of neuroendocrine hormones and cytokines. Furthermore, Leukocytosis can occur in response to anesthesia by various hormones, cytokines and acute phase reactants; lymphocyte apoptosis; or suppression of neutrophil apoptosis(22,23).

Based on table 2, it can be seen that there is no significant difference in eosinophils before and after general anesthesia and regional anesthesia. Based on research

results(24)that increased eosinophils can influence complications that occur during anesthesia such as bronchospasm, stridor and laryngospasm, but there is no change during intra-anesthesia.

CONCLUSIONS

General anesthesia can increase leukocyte counts significantly compared to regional anesthesia, but eosinophils are not significant in both groups

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