

ORIGINAL ARTICLE

The comparison between the effects of bupivacaine spinal anesthesia and sevoflurane general anesthesia for cesarean section on apgar score

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ABSTRACT

The use of the anesthetic technique for cesarean section is still debatable because of the side effects caused by anesthesia for mothers and neonates. The success in determining the anesthetic technique can be seen from the outcome of the final condition of the mother and the neonates. The assessment of the success in the determination of the anesthetic technique used in the delivery in neonates has been performed using the Apgar score by looking at the clinical status of the newborn in the first and fifth minutes. This study aimed to compare the Apgar scores between newborns delivered under sevoflurane general anesthesia and bupivacaine spinal anesthesia in a cesarean section. This was a cross-sectional retrospective analytical study on 40 newborns delivered through cesarean section during the period of August to November 2021 at the Melinda Mother and Child Hospital Bandung, Indonesia. The results of this research showed that there was no significant difference in the first minute ($p=0.054$) and fifth minute ($p=0.708$) APGAR Scores between newborns born under general anesthesia and spinal anesthesia. Sevoflurane general anesthesia and bupivacaine spinal anesthesia group do not affect the APGAR score and both anesthetic groups have a good effect on the newborns.

Keyword: APGAR Score, Bupivacaine, Cesarean section, General Anesthesia, Spinal Anesthesia, Sevoflurane

INTRODUCTION

Cesarean section is the delivery of a fetus through an incision in the abdominal wall (laparotomy) and uterine wall with the condition that the uterus is intact and the fetal weight is above 500 grams.¹ In Indonesia, according to the 2013 Basic

Health Research (*Riset Kesehatan Dasar*, RISKESDAS) data, the proportion of cesarean section births is 9.8%, with the highest one seen in DKI Jakarta province with 19.9% and the lowest is in Southeast Sulawesi with 3.3%. The pattern of the cesarean section, according to the characteristics,

shows the highest proportion of caesarean section is observed in the population living in urban areas (13.8).² The percentage caesarean section increased from 11% in the 2007 Indonesian Demographic and Health Survey (IDHS) to 27% in the 2012 IDHS and increased again to 31% in the 2017 IDHS.³ To support the success of a caesarean section, it is necessary to pay attention to the selection of anesthetic techniques by prioritizing the safety of the mother and baby. The anesthetic techniques used in caesarean section consisted of general anesthesia and neuraxial anesthesia, such as spinal anesthesia, epidural anesthesia, and spinal and epidural combination anesthesia.^{4,5,6,7}

General anesthesia is used for emergency conditions, including fetal distress, tetanic uterine contractions, placental abruption, umbilical cord prolapse, and patients refusing regional anesthesia.^{4,6,7} The advantages of general anesthesia are speedy onset, control over the airway and ventilation, comfort for mothers who fears needles or surgery, and less likelihood of developing hypotension when using regional anesthesia. However, general anesthesia has disadvantages, such as aspiration risk and endotracheal intubation failure.^{4,6,7} Various techniques and general anesthetic drugs used for caesarean section include intravenous anesthetics, such as propofol, thiopental, ketamine, and etomidate, and inhalation anesthetics such as halothane, nitrous oxide, enflurane, isoflurane, desflurane, and sevoflurane. Among the various general anesthetic drugs, the most widely used general anesthetic inhalation is sevoflurane, desflurane, and isoflurane, as opposed to nitrous oxide.^{6,7,8} Sevoflurane is an inhalation anesthetic with a low partition coefficient, fast induction, and rapid awakening of anesthesia, which makes it easy to adjust the depth of anesthesia by lowering the blood pressure to a lower level than the level obtained by other inhalation anesthetics.^{4,6,7,8} Volatile anesthetics such as sevoflurane can cross

the placental barrier, causing sedation of the unborn fetus and depress the respiratory system.^{5,9}

Regional anesthesia has become the preferred technique because general anesthesia carries a greater risk of maternal morbidity and mortality. Spinal anesthesia is the first choice for planned and emergency caesarean section patients.^{4,7,8,9} The advantages of using spinal anesthesia over epidural or combined spinal-epidural anesthesia are that the onset is faster and predictable, can produce a complete block, and has no potential for systemic severe drug toxicity because the anesthetic dose used is minimal.⁴ Complications that occur in spinal anesthesia are hypotension, post-dural puncture (spinal headache), and hematoma.¹⁰ The decrease in blood pressure in spinal anesthesia is caused by the sympathetic blockade, which inhibits sympathetic nerve output and reduces the systemic vascular resistance, triggering vasodilation in the blocked area and a decrease in cardiac output.^{4,11} The reduction in blood pressure by spinal anesthesia is more significant than the decrease in blood pressure under general anesthesia because in spinal anesthesia, the enhanced level of sensory blockade produces a lot of autonomic blockades, which lead to vasodilation and resulting in a decrease in blood pressure.¹² The reduction in blood pressure can cause a decrease in uteroplacental blood flow, which eventually may reduce the Apgar score and cause impaired uteroplacental perfusion that leads to a lower pH of the umbilical artery blood and causes acidosis in the fetus.^{5,13}

The Apgar score is a tool for assessing the clinical status of newborns in the first and fifth minutes. The Apgar score consists of five examination components, namely: (1) Appearance, (2) Pulse, (3) Grimace, (4) Activity, and (5) Respiration. The Apgar score is useful for conveying information about the clinical status of a newborn and is a predictor of neonatal morbidity and resuscitation response.

Factors that influence the Apgar score are gestational age, congenital malformations, and the effect of anesthesia used during cesarean section.^{14,15} The general purpose of this study was to compare the Apgar scores of newborns delivered through cesarean section under general anesthesia with sevoflurane and spinal anesthesia with bupivacaine based on the influence of these anesthetics on uterine blood flow and penetration of drugs through the placental barrier.

METHODS AND SUBJECT

This was a cross-sectional analytic retrospective study conducted at the Melinda Mother and Child Hospital (RSIA) Bandung using medical records of patients who underwent cesarean section from August to November 2021. The inclusion criteria in this study were singleton pregnancy, healthy mother, and healthy fetus, while the exclusion criteria were spinal anesthesia contraindications and twin pregnancy. The sample size of this study was 40 and these samples were recruited using the consecutive sampling approach by recruiting all patients who met the inclusion and exclusion criteria consecutively. The subjects in this study were divided into two groups: first group and the second group, each consisting of 20 patients. The first group was a group of patients who underwent cesarean section using general anesthesia with sevoflurane and the second group was a group of patients who underwent cesarean section using spinal anesthesia with bupivacaine. The Ethics Commission has approved this research under an ethical clearance number: 001/SKEP/KM/RSIAM/X/2021 and a research permit from RSIA Melinda was obtained to collect the medical record data. Data processing was carried out using one of the statistical software, and the results were presented in tabular form and explained through narratives.

RESULTS AND DISCUSSION

This study was conducted at the Melinda Mother and Child Hospital Bandung from September 2021 to November 2021 using medical record data. The subjects were patients who underwent cesarean section and were given general anesthesia with sevoflurane or spinal anesthesia with bupivacaine. Based on medical record data, there were 40 patients that met the inclusion criteria, consisting of 20 samples of the general anesthetic group using sevoflurane and 20 samples of the spinal anesthetic group using bupivacaine.

Patient General Characteristics

Data on general characteristics of patients collected in this study were age, weight, and height. The frequency distribution of the characteristics of the subjects can be seen in table 1. The average age of patients who underwent cesarean section in the general anesthesia group with sevoflurane was 31.45 ± 4.15 year old while for the spinal anesthesia group using bupivacaine, the average age was 31.65 ± 4.80 year old. Based on the results of the statistical calculations, there was no significant difference between the two groups ($p=0.889$). The average weight of patients who underwent cesarean section under general anesthesia with sevoflurane was 77.43 ± 9.97 kg and 71.80 ± 11.67 kg in patients who underwent cesarean section under spinal anesthesia with bupivacaine. Based on the statistical results, there was no significant difference in the body weight of the two groups ($p=0.109$). The average height of the subjects in the general anesthesia group with sevoflurane was 161.60 ± 5.47 cm, and in the spinal anesthetic group with bupivacaine, the average height was 160.00 ± 4.79 cm. Statistically, there was no significant difference in the height of the two groups ($p=0.331$). Based on the general characteristic data in this study, the two study groups were relatively homogeneous as research sample.

Table 1. Subject General Characteristics

Characteristics	Type of Anesthesia				P-Value
	GA Sevoflurane		SA Bupivacaine		
	Mean	SD	Mean	SD	
Age (year)	31,45	4,15	31,65	4,80	0,889*
Weight (kg)	77,43	9,97	71,80	11,67	0,109*
Height (cm)	161,60	5,47	160,00	4,79	0,331*

Average Apgar Score of Newborns from Cesarean Section Patients

The distribution of the average Apgar scores of patients underwent cesarean section under general anesthesia and spinal anesthesia at the 1st and 5th minutes can be seen in Table 2. The Apgar score at the first minute in this study was 8.90 ± 0.45 in the general anesthetic Sevoflurane group, while the first-minute Apgar score in the spinal bupivacaine group was 8.70 ± 0.47 . The results of this study showed that there was no statistically significant difference between the two ($p = 0.054$). The fifth minute Apgar score after the baby was born in the sevoflurane general anesthesia group was 8.70 ± 0.47 , while in the bupivacaine spinal anesthetic group, it was recorded at 9.75 ± 0.41 and no statistical significant difference in the fifth minute Apgar score in both groups ($p=0.708$). The results of this study are not in line with a study conducted at Prof. R. D Kandou General Hospital Manado in 2012 that suggested a significant difference between the 1st minute and 5th minute Apgar scores with the spinal anesthesia group has a higher Apgar scores compared to the general anesthesia group.¹⁶

This study's results align with a study conducted at the Melinda Mother and Child Hospital Bandung in 2015, explaining that there was no significant difference ($p=0.33$) in the anesthesia group. However, at the fifth minute Apgar score, there was a very significant difference ($p=0, 00$) in the spinal anesthesia group, and the Apgar score was higher in the spinal anesthesia group compared to the general anesthesia group.¹⁷ The results of this study are also

supported by a previous study conducted at the Al-Ihsan Hospital Bandung in 2019, showing that both the 1st-minute Apgar score and the 5th-minute Apgar score does not present any significant difference.¹⁸ In the group of patients using local anesthesia, the Apgar score was higher than that of general anesthesia. One theory stated that the volatile general anesthetic sevoflurane can cross the placenta quickly and can cause respiratory depression in the neonates. It causes anesthetic agents, such as sevoflurane, to be used in emergency cesarean sections because the level of sevoflurane that crosses the placenta is insufficient to cause depression in neonates. However, sevoflurane can cause a decrease in blood pressure, which affects the decrease in the blood flow in the uteroplacental circulatory system, which can affect the Apgar score in neonates.⁵

The difference in the results of this study is thought to be caused by several factors, one of which is the use of general anesthetic drugs and spinal anesthetic drugs. General anesthesia has the disadvantage that it crosses the placental barrier, causing the baby to be exposed to the effects of anesthesia and will cause the neonate to experience respiratory depression and sedation, which may eventually affect the Apgar score.⁵ Based on the theory that the use of general anesthetic doses with minimal doses (<1 MAC) will cause minimal depression in neonates, this study is not in line with the theory because there is no hypoxia and depression in neonates; hence, the anesthetics does not affect the oxygenation in neonates, which is reflected in the score. There was no significant difference

between the Apgar and general anesthesia groups.⁴ With spinal anesthesia, there will be a sympathetic blockade that inhibits sympathetic nerve output, resulting in a decrease in systemic vascular resistance and vasodilation in the blocked area and causing a decrease in venous return, cardiac output, and uteroplacental perfusion. A decrease in uteroplacental perfusion will cause complications in the neonate, namely neonatal hypoxia, which will affect the

Apgar score, but the decrease in blood pressure can be prevented by giving co-loading crystalloids and vasopressors.

In this study, it was shown that there was no decrease in uteroplacental perfusion that interfered with oxygenation in neonates. Furthermore, it was one of the factors that caused no difference in Apgar scores in the spinal anesthesia and general anesthesia groups.^{5,11,12}

Table 2 Comparison of Apgar Score

Apgar Score	Type of Anesthesia				P-Value
	GA Sevoflurane		SA Bupivacaine		
	Mean	SD	Mean	SD	
1 minute after delivery	8,90	0,45	8,70	0,47	0,054
5 minutes after delivery	9,70	0,47	9,75	0,41	0,708

Average Blood Pressure

This study also measured the vital signs of patients after general anesthesia and spinal anesthesia by measuring the vital signs every five minutes until the twentieth minute, where the results are available in table 3. The measurement of the average blood pressure in patients after anesthesia in both groups demonstrated that there was a significant difference in the mean systolic blood pressure between the cesarean section patients under general anesthesia and those who underwent caesarean section under spinal anesthesia at the 1st minute after induction of anesthesia ($p=0.009$) and the 20th minute ($p=0.012$). In diastolic blood pressure, there was a significant difference between the general anesthesia group and spinal anesthesia group at 10 minutes (0.029), 15 minutes ($p=0.002$), and 20 minutes ($p=0.002$).

The results obtained in this study are supported by data from research conducted by Dr. Hasan Sadikin General Hospital Bandung, Indonesia, in 2014

that stated no significant difference between cesarean patients with general anesthesia and those with spinal anesthesia. In this study, it is explained that the decrease in blood pressure, both systolic blood pressure and diastolic blood pressure, were observed, especially in patients who had cesarean section using spinal anesthesia. Similar results were also obtained in a study conducted at The Melinda Mother and Child hospital Bandung in 2015, and there were significant changes in systolic blood pressure and diastolic pressure in a group of patients with a cesarean section using spinal anesthesia and general anesthesia.^{17,19}

In our study, it can be seen that there is a decrease in systolic and diastolic blood pressure in the group of patients using spinal anesthesia. This data is supported by the theory that the decreased blood pressure in spinal anesthesia is due to sympathetic blockade. This sympathetic blockade will inhibit the sympathetic nerve expenditure, resulting in a decrease in systemic vascular

resistance, vasodilation in the blocked area, and a decrease in cardiac output. Decreased blood pressure during spinal anesthesia will cause a decrease in uteroplacental blood flow that will lead to impaired uteroplacental perfusion, which can affect the Apgar score.^{11,12}

The theory also shows that volatile anesthetics, such as sevoflurane, can cause a decrease in maternal blood pressure, which leads to a decrease in uterine blood flow and uterine contractility; thus, special care must be taken when using general anesthesia sevoflurane by measuring blood pressure.⁵ In this study, although there was a statistically significant difference in the two anesthetic groups' average spinal blood pressure and diastolic pressure, it did not affect blood pressure clinically because the decrease in blood pressure in both groups was still within normal limits. Hence, it did not cause hypotension in the two groups.

Average Mean Arterial Pressure (MAP)

Based on the results of the study presented in table 3, there is a significant difference in the mean MAP between the general anesthesia and spinal anesthesia groups at 10 minutes ($p = 0.012$), 15 minutes ($p = 0.012$), and 15 minutes ($p = 0.012$). = 0.018), and the 20 minutes ($p = 0.000$). The results showed that the decrease in MAP in the bupivacaine spinal anesthesia group was greater than the decrease in MAP in the general anesthetic sevoflurane group. This follows the theory that spinal anesthesia-induced effect on blood pressure is due to sympathetic blockade through changes in systemic vascular resistance and cardiac output. The inhibition of sympathetic nerve expenditure causes a decrease in systemic vascular resistance and cardiac output, resulting in the decrease in mean arterial pressure (MAP).¹¹

Average Heart Rate

The distribution of the heart rate for patients who underwent cesarean section under general anesthesia and spinal anesthesia from minute 0 to minute 20 can be seen in table 3, which shows that based on the results of statistical tests, there is a significant difference in the average heart rate between the two groups at the 1st minute after induction of anesthesia ($p=0.010$), and 5th minute after the induction of anesthesia ($p=0.005$). Results of this study showed an increase in the heart rate of the general anesthesia group in the beginning and then a decrease in the 5th minute. In spinal anesthesia, the heart rate decreased and then stabilized. Many factors can cause the increase in the group of general anesthesia with sevoflurane. For example, one factor that increases heart rate in the general anesthetic group in the first minute after induction is linked to intubation as this action causes a sympathetic activation response that will then lead to increased catecholamine release.⁴

This study's results align with the theory that general anesthesia sevoflurane does not cause too much emphasis on myocardial contractility; thus, no change identified in pulse rate in the group receiving general anesthesia with sevoflurane.⁴ However, the results of this study are not in line with the theory which stated that in sevoflurane there is no change in heart rate, but some inhaled general anesthetic agents, such as desflurane and isoflurane, cause sympathetic stimulation, which will cause tachycardia and hypertension during induction.²⁰ The decrease in heart rate in this study follows the theory, which stated that a decrease in cardiac output and systemic vascular resistance produced by sympathetic blockade of spinal anesthesia plays a role in the decrease in heart rate during spinal anesthesia.¹¹

Average Oxygen Saturation (SpO₂)

The distribution of the average SpO₂ of cesarean section patients with general anesthesia and spinal anesthesia from the 0th minute to the 20th minute can be seen in table 3. Based on the results of the statistical tests, there is a significant difference in the average SpO₂ between the cesarean section patients with general

anesthesia and those under spinal anesthesia from 1 minute after induction of anesthesia until 20 minutes ($p < 0.05$). Although there was a significant difference in oxygen saturation between the two groups, it did not give any clinical effect because there was no hypoxia in both group; thus, it did not affect the Apgar score.

Table 3. Comparison of the Average Vital Signs of Cesarean Section Patients by Type of Anesthetic Technique

Vital Sign	Anesthesia				P-Value
	GA Sevoflurane		SA Bupivacaine		
	Mean	SD	Mean	SD	
Blood Pressure (mmHg)					
SBP Pre Induction	125,65	14,97	123,35	14,25	0,622*
SBP 1 minute after induction	137,05	29,06	117,85	11,83	0,009*
SBP 5 minute after induction	111,45	17,37	107,15	18,04	0,447*
SBP 10 minute after induction	122,30	14,35	113,90	13,84	0,252*
SBP 15 minute after induction	116,11	11,58	109,05	10,60	0,054*
SBP 20 minute after induction	121,92	13,08	111,21	9,19	0,012*
DBP Pre Induction	74,75	12,26	73,75	9,11	0,771*
DBP 1 minute after induction	77,05	18,72	65,65	16,53	0,120**
DBP 5 minute after induction	62,45	10,58	57,80	10,00	0,161*
DBP 10 minute after induction	68,10	13,25	59,45	6,13	0,029**
DBP 15 minute after induction	66,89	9,97	58,45	5,82	0,002*
DBP 20 minute after induction	69,42	11,11	58,37	5,71	0,002**
MAP Pre Induction	94,05	12,98	92,40	9,95	0,654*
MAP 1 minute after induction	98,05	21,66	87,65	8,43	0,053*
MAP 5 minute after induction	83,20	13,74	77,10	12,83	0,155*
MAP 10 minute after induction	89,50	12,64	80,40	8,81	0,012*
MAP 15 minute after induction	85,37	9,92	78,90	6,06	0,018*
MAP 20 minute after induction	90,08	9,89	79,16	5,33	0,000*
Heart Rate (x/minute)					
HR Pre induction	84,00	12,77	91,45	14,37	0,091*
HR 1 minute after induction	102,35	15,49	89,75	13,91	0,010*
HR 5 minute after induction	77,30	13,03	93,60	20,36	0,005*
HR 10 minute after induction	84,00	12,81	90,60	20,20	0,225*
HR 15 minute after induction	81,74	13,43	84,20	13,87	0,577*
HR 20 minute after induction	80,42	10,46	86,16	9,61	0,128*
SpO₂ (%)					
SpO ₂ pre induction	97,10	9,27	97,19	9,03	0,907
SpO ₂ 1 minute after induction	96,50	9,35	97,38	9,30	0,004
SpO ₂ 5 minute after induction	96,30	9,32	97,81	9,36	0,000
SpO ₂ 10 minute after induction	96,50	8,93	97,67	8,90	0,000
SpO ₂ 15 minute after induction	95,74	10,92	97,62	10,68	0,000
SpO ₂ 20 minute after induction	95,33	11,84	97,65	9,35	0,005

Note: * independent t-test, **Mann-Whitney; signifikan ($p < 0,05$); SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure, HR = heart rate; SpO₂ = oxygen peripheral saturation

CONCLUSION

No difference is observed in the Apgar scores between infants born under sevoflurane general anesthesia and bupivacaine spinal anesthesia. Both anesthetic groups performed well on the Apgar score.

ACKNOWLEDGEMENTS

We would like to acknowledge the examiners and other parties that have provided constructive inputs and suggestions for the research and manuscript writing.

DECLARATION OF INTERESTS

Authors declare no conflict of interest

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