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Effects of Types of Anesthesia on Neurobehavioral Response and Apgar Score in Neonates Delivered with Cesarean Section in Dilla University Referral Hospital

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Abstract

Background: Neonatal outcomes are affected by types of anesthesia and perioperative patient cares. Studies showed that neonatal neurobehavioral response and Apgar score were better in mothers who gave birth under spinal anesthesia than general anesthesia. But studies were inadequate locally and this study compared neonatal neurobehavioral response and Apgar score in mothers who undergo caesarean section.

Objective: The main objective of the study was to compare Neonatal neurobehavioral response and Apgar score in neonates delivered with caesarean section under spinal *vs.* General anesthesia.

Methods and materials: After approval from institutional review Board (IRB) of Dilla University, we studied 200 consecutive babies delivered with caesarean section under spinal and General Anesthesia from ASA I&II term pregnant mother in Dilla University Teaching and referral Hospital. Prospective effectiveness study design was employed. Mothers were randomly allocated in two equal groups 60 patients each by lottery method after informed consent.

Result: There was a significant mean difference between the two groups on mean Intraoperative systolic blood pressure. More women who received spinal anesthesia had lower intraoperative systolic blood pressure as compared to women who received general anesthesia (P<0.05). Neonatal Neurologic Adaptive capacity score at 15 minutes were better in spinal as compared to General Anesthesia. There were significant association between types of Anesthesia with the majority of the tests in 15 minute and 2 hrs period. But Neonatal Neurologic Adaptive capacity score at 24 hrs didn't show significant Association.

Conclusion: Spinal Anesthesia is associated with good neonatal outcomes even in emergency caesarean section with non-touching rapid sequence spinal anesthesia technique. General anesthesia should be preserved for cases contra indicated with spinal anesthesia.

Keywords: Apgar score; Neurologic adaptive capacity score; Anesthesia; Neonate

Introduction

Caesarean section is a procedure where by a baby is delivered through an incision on the abdominal wall and intact uterus of the mother under General or Spinal Anesthesia. It is usually life-saving and reserves the health of the mother and her baby [1,2].

General anaesthesia refers to the loss of ability to perceive pain associated with loss of consciousness produced by intravenous or inhalation anesthetic agents. For caesarean section, this involves the use of thiopentone for induction, tracheal intubation facilitated by suxamethonium, positive-pressure ventilation of the lungs with pre-oxygen plus a volatile agent, and a muscle relaxant [1].

Regional anaesthesia (spinal) refers to the use of local anaesthetic solutions to produce circumscribed areas of loss of sensation. This type of regional anaesthesia used for caesarean section involves the infiltration of a local anaesthetic agent directly into the subarachnoid space [1].

General and Regional Anesthesia for caesarean section are not ideal as each has benefits and risk to foetus. But the aim of clinician is to select the method which is harmless and most comfortable for the mother, least depressant to the new born [2].

Spinal anesthesia affects neonates either by decreasing uteroplacental perfusion secondary to sympathetic blocked induced hypotension or intratecally administered Opioids with local anesthetics that depress the respiratory center and end up with asphyxia and acidosis [3].

The outcome of Neonates delivered by Caesarean section is depending on preoperative maternal and neonatal condition, intraoperative management and postoperative care. Effective neonatal resuscitation with qualified resuscitator and adequate equipment must be provided and the Apgar score in the first minute and fifth minute and arterial oxygen saturation with pulse oximeter (89-94%) will signify adequate resuscitation minimal or no respiratory depression [4].

Incidence of Neonatal Mortality

The assessment of anaesthesia-related mortality has been employed since so many years back and defined as death of patients under, or following anesthesia within twenty four hours under the care of anesthetist [5].

Unlike other studies conducted in different parts of the world [2,4,6-27] incidence of neonatal death was reported only in one study, there were four deaths in general anesthesia and zero in spinal anesthesia [28].

Determinants of Neonatal Morbidity

Anesthesia related morbidity is any complication that could occur in patients under or following anesthesia under the care of anesthetist within twenty four hours and they are related with preoperative patient condition, intraoperative management and postoperative care [5].

Neonatal Neurobehavioral Response

Apgar sore assess the need for neonatal resuscitation and intraoperative anesthetic drugs effects are not easily appreciated [28]. As a result, the anesthesiologist and neonatologist discover new methods of assessment besides Apgar score. The neurologic and Adaptive capacity score is the one being employed because of its simplicity and feasibility.

According to a study conducted in America, the neonatal neurologic and Adaptive capacity score was much lower in babies delivered under general anesthesia than spinal anesthesia [7]. But a study conducted in Thailand showed Neonatal Adaptive Capacity Score in babies born either Spinal or general anesthesia had no significant difference [25].

Neonatal Intensive Care Unit (NICU) Admission and Hospital Stay

The factors contributing for long duration of hospital stay and NICU admission varies with preoperative maternal and neonatal condition, types of anesthesia administered intraoperative management and postoperative care.

According to an observational study conducted in Pakistan, babies delivered under general anesthesia had long duration of hospital stay and required neonatal Intensive care Unit Admission [22].

A study conducted in Turkey showed that neonatal ICU admission had no significant difference in mothers who received either spinal or general anesthesia [10].

According to another study conducted in Italy, rates of neonatal admission and need for oxygen ventilation were higher in babies delivered under general anesthesia. But the overall neonatal outcomes were not significant [24].

Apgar Score

The immediate neonatal outcome is usually measured with a tool called Apgar score in the first minute and fifth minutes after delivery.

According to different literatures, the first and fifth Apgar scores were better in neonates delivered under spinal anesthesia as compared to general anesthesia [4,6,8,10,12,14,16-19,21-25]. However, in other studies the fifth minute Apgar score didn't show significant different between the groups [2,11,13,15].

A study conducted in Ethiopia showed that neonatal outcomes were affected by uterine incision to delivery time. Neonates delivered in uterine incision to baby out less than three minute had better Apgar score [6].

During review of the literature, we found out many clinical trials and observational studies comparing neonatal outcomes delivered with caesarean section. However, still there are controversies on selection of types of anesthesia and effects of each on neonatal outcomes. Besides, there are no studies in Ethiopia comparing neonatal outcomes delivered with caesarean section in clinical trial or prospective observational study.

Apgar score is employed to confirm the need for resuscitation of the baby. However, Apgar score doesn't confirm effects of maternal preoperative and intraoperative administered drugs on neonatal neurologic effects. Anesthesiologists and pediatricians used different techniques to assess neurobehavioral response of neonates delivered with caesarean section. Neurologic and Adaptive capacity score is the recent techniques employed by Anesthesiologists. There were many clinical trials and observational studies conducted to assess the Apgar score of neonates delivered with caesarean section [4,6,8,10,12,14,17-25]. These studies showed that babies delivered under spinal anesthesia had better outcomes as compared to general anesthesia. Though studies conducted on effects of types of anesthesia to Neurobehavioral response of neonates were scarce worldwide, they showed that babies delivered under General anesthesia had low neurobehavioral response than Spinal anesthesia groups [2,7,13,16].

Methods and Materials

After approval from institutional review Board (IRB) of Dilla University, we studied 200 consecutive babies delivered with cesarean section under spinal and General Anesthesia from ASA I&II term pregnant mother in Dilla University Teaching and referral Hospital. Prospective effectiveness study design was employed. Mothers were randomly allocated in two equal groups 60 patients each by lottery method after informed consent. Mothers with spinal Anesthesia group was preloaded with 1-1.5 litres of crystalloids before spinal Anesthesia and Spinal Anesthesia was given with 2-2.5 ml of 0.5% bupivacaine in sitting position with strict aseptic technique. General Anesthesia was induced with rapid sequence induction with 3.5 mg/kg of thiopental and 1-2 mg/kg succinylcholine. General Anesthesia was maintained with 1-1.5 v% halothane, 0.1 mg/kg of vecronium and 1.5-2 mg/kg of Pethdine.

Data collection method and measurement of variables

Data were collected using a pre-tested structured questionnaire. The trained data collectors managed the data in intraoperative and postoperative period who were not responsible for the anesthetic management for that particular subject.

Preoperatively, the socio-demographic characteristics, ASA status, preoperative hematocrit and blood pressure were taken. Intraoperatively, the maternal blood pressure was taken every three minutes until delivery of the baby and the induction to delivery time also recorded. Just after delivery, the first and the fifth minute Apgar scores were recorded. The Apgar score was assessed with a standard table format which contains five parameters (Table 1) [10].

Sign	0	1	2
Appearance	Blue and pale	Body pink, extremities blue	Completely pink
Pulse rate	Absent	Bellow 100	Above 100
Grimace	No response	Grimace	Cry
Activity	No movement	Some flexion of extremities	Active movement
Respiration	Absent	Shallow and irregular	Deep and regular, strong cry

Table 1: Apgar scoring table.

Postoperatively, the baby was sent to ward along with his/her mother and the neurobehavioral response of the baby was assessed with Neonatal neurologic and Adaptive capacity score at 15 minutes, 2 and 24 hrs. The Neonatal Neurologic and Adaptive capacity score contains five assessment areas i.e. adaptive capacity, Active tone, Passive tone, primary reflexes and general neurologic status. Each criterion was given a score of 0 for absent or abnormal, 1 for slightly abnormal and 2 for normal and the maximum score will be 40 (Table 2) [26].

		0	1	2	Total score
Adaptive Capacity	Response to sound	Absent	Mild	Vigorous	
	Habituation to sound	Absent	7-12 stimuli	<6 stimuli	
	Response to light	Absent	Mild		
	Habituation to light	absent	7-12 stimuli	<6 stimuli	
	Consolability	Absent	Difficult	Easy	
Total					
Passive tone	Scarf sign	Encircles the neck	Elbow slightly passes midline	Elbow dose not reach midline	
	Recoil of elbow	Absent	Slow and weak	Brisky and reproducible	
	Popliteal angle	>110°	100-110°	<90°	
	Recoil of lower limb	Absent	Slow and weak	Brisky and reproducible	
Total					
Active tone	Active contraction of neck flexor	Absent/abnormal	Difficult	Good, head is maintained in the axis of the body	
	Active contraction of neck extensor	Absent or abnormal	Difficult	Good, head is maintained in the axis of the body	
	Palmar grasp	Absent	Weak	Excellent: reproducible	
	Response to traction (following Palmar grasp	Absent	Lifts part of the body weight	Lifts all body weight	
	Supporting reaction (upright position)	Absent	Incomplete transitory	Strong; lifts all body weight	
Total					
Primary reflexes	Automatic walking	Absent	Difficult to obtain	Perfect ; reproducible	
	Moro reflex	Absent	Weak; incomplete	Perfect	
	Sucking	Absent	Weak	Perfect : synchronous with swallowing	
Total					
General Assessment	Alertness	Coma	Lethargy	Normal	
	Crying	Absent	Weak	Normal	
	Motor activity	Absent /excessive	Weak	Normal	

Total			
Grand total			

Table 2: NACS scoring table.

Data processing and analysis

Chi square test and odds ratio were used to determine the association between hypothesized independent and dependent variables. Finally, multivariate analysis was used to control possible confounders and identify independent predictor of Neurobehavioral response and Apgar score.

Results

A total of 200 Neonates delivered with caesarean section from a term pregnant women were followed perioperatively for twenty and the response rate of the participants were hundred percent.

Socio-demographic characteristics

Data on maternal age, weight, height, Body Mass Index, and neonatal weight were summarized in Table 3.

Variables	Spinal anesthesia (n=100)	General anesthesia (n=100)	P value
Age (year)	23.21 ± 50	22.61 ± 5	0.414
Weight (Kg)	66.22 ± 12	63.5 ± 10	0.115
Height (cm)	162.02 ± 6.7	162.78 ± 4.5	0.351
BMI (kg/m^2)	23.21 ± 5.4	22.61 ± 4.8	0.414
Neonatal weight (g)	3556.2 ± 596	3295.9 ± 455	0.422
Data were stated as mean ± SD, BMI: Body Mass Index.			

Table 3: Socio-demographic Characteristics.

Maternal preoperative Characteristics

Data on maternal preoperative hematocrit, previous cesarean section and qualification of the anesthetist who provided anesthesia were shown in Table 4.

Variables	Spinal anesthesia (n=100)	General anesthesia (n=100)	P value
Preoperative SBP	122.10 ± 9.13	122.05 ± 14	0.798
PHCT	39.22 ± 4.77	38.39 ± 3.9	0.18
Previous C/S	24/100	15/100	0.108
Data were described as mean ± SD and number. SBP: systolic Blood Pressure. PHCT: preoperative Hematocrit.			

Table 4: preoperative maternal characteristics.

Intraoperative maternal characteristics

There was a significant mean difference between the two groups on mean Intraoperative systolic blood pressure. More women who received spinal anesthesia had lower intraoperative systolic blood pressure as compared to women who received general anesthesia (P<0.05). Severe reduction in blood pressure decreased placental perfusion which results in fetal acidosis and asphyxia. However, neonates delivered from spinal anesthesia with lower blood pressure and Normal blood pressure didn't show any difference (Table 5).

Variables	Spinal anesthesia (n=100)	General anesthesia (n=100)	P value
Base line	122.10 ± 9.13	122.05 ± 14	0.798
3rd minute	117.60 ± 12.23	119.53 ± 14	0.301
6th minute	102.20 ± 11.59	114.35 ± 19.78	0.000*
9th minute	97.8 ± 11.69	111.40 ± 19.12	0.000*
12th minute	100.32 ± 9.44	122.55 ± 14.95	0.000*
15th minute	103 ± 20.72	115.95 ± 12.06	0.000*
PACU entry	116.65 ± 14.98	117.19 ± 10.40	0.768
*Significant at P<0.05; Data were described as mean ± SD, PACU: Post Anesthetic Care Unit.			

Table 5: intraoperative maternal systolic blood Pressure (mmHg).

Neonatal characteristics

There was no neonatal death in this study. The number of neonates required resuscitation was higher in general anesthesia, 24/100 and 14/10 respectively. But the mean difference was not significant (P>0.071) (Figure 1).

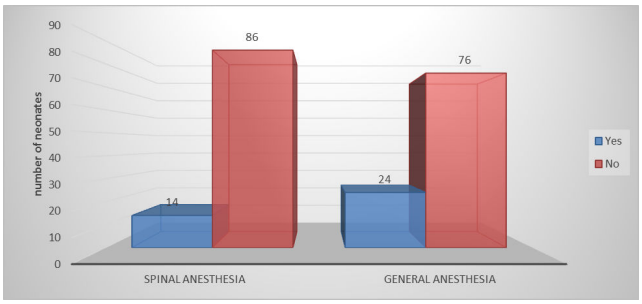

Figure 1: need of resuscitation.

Apgar score

There were significant mean difference on the mean first and fifth minute Apgar score (P<0.05). The Apgar score of neonates in the first minute less than seven was lower in general Anesthesia as compared to spinal anesthesia. Thirty one neonates from hundred had lower first minute Apgar score less than seven in General Anesthesia when compared to spinal Anesthesia groups which was only eleven neonates from hundred with lower first minute Apgar score less than seven (Table 6).

Variables	Spinal anesthesia (n=100)	General anesthesia (n=100)	P value
First minute Apgar	7.57 ± 0.96	7.13 ± 1.22	0.005*
Fifth minute Apgar	8.7 ± 0.67	8.34 ± 0.95	0.002*
Apgar score <7	11/100	31/100	0.001*
Apgar score >7	89/100	69/100	0.001*
Neonatal $Psao_2$	91.63 ± 4.43	91.52	0.24
Hospitalization	2.99 ± 0.86	3.05 ± 0.93	0.637

*Significant at P<0.05; Data were expressed as mean ± SD and number. PACU: Post Anesthetic Care Unit, $Psao_2$: percutaneous arterial oxygen saturation.

Table 6: Apgar score, neonatal oxygen saturation and duration of Hospitalization.

Neurologic adaptive capacity score

Neonates delivered under General and spinal Anesthesia was assessed with Neurologic Adaptive Capacity score to determine the effect of Anesthetic drug on neonatal immediate outcomes in 15 minute, 2 hrs and 24 hrs.

Neonates delivered under spinal anesthesia had highest score in 15 minutes when compared to babies delivered under General Anesthesia. There were significant association between types of anesthesia with the majority of the tests especially in 15 minute and 2 hrs period. However, there was no significant difference in 24 hrs assessment (Table 7).

	15 minutes			2 hrs			24 hrs		
Parameters	SA	GA	P value	SA	GA	P value	SA	GA	P value
Adaptive Capacity									
Response to sound	63	37	0.000**	74	56	0.008*	99	97	0.312
Habituation to sound	65	40	0.001**	76	57	0.006*	99	97	0.508
Response to light	73	54	0.020*	84	66	0.013*	99	97	0.508
Habituation to light	81	64	0.026*	88	72	0.018*	100	97	0.218
Consolability	57	53	0.045*	66	65	0.126	100	97	0.218
Passive tone									
Scarf sign	52	34	0.026*	64	53	0.127	100	96	0.13
Recoil of elbow	56	50	0.421	66	64	0.397	100	97	0.218
Popliteal angle	62	49	0.104	71	62	0.224	100	96	0.13
Recoil of lower limb	67	47	0.005*	79	61	0.010*	99	97	0.508
Active									
Neck flexion	66	38	0.000**	78	55	0.002*	100	97	0.246
Neck extension	64	35	0.000**	76	54	0.004*	100	97	0.246
Palmar grasp	73	59	0.076*	83	70	0.071	99	97	0.508
Palmar traction	45	29	0.026*	58	49	0.315	99	96	0.359
Supporting reaction	43	23	0.002**	57	46	0.088	99	96	0.359
Primary reflexes									
Automatic walking	44	26	0.028*	58	48	0.44	99	96	0.359
Moro reflex	59	38	0.008*	72	57	0.082	99	98	0.561
Suckling	72	65	0.287	82	74	0.172	99	98	0.561
General assessment									

Alertness	95	88	0.076	97	91	0.074	100	99	0.316
Crying	94	88	0.138	96	92	0.234	100	99	0.316
Motor activity	91	81	0.048*	94	87	0.091	100	98	0.155
*significant (0.001<P<0.05), ** very significant (p<0.001) , GA: General Anesthesia, SA: spinal Anesthesia, P: p-value									

Table 7: Number of Neonates who scored highest score in each item of Neurologic Adaptive Capacity Score after caesarean section under spinal and general Anesthesia, Dilla University Referral Hospital, Ethiopia, 2016.

Determinants of neonatal Apgar scores

To determine the predictor of lower Apgar score, bivariate and Multivariate logistic regression was conducted and the results was described below (Table 8).

Neonates born under General Anesthesia were more likely to have higher figures of Apgar score less than seven when compared to spinal anesthesia, (AOR=0.275, 95% CI=[0.129, 0.285]).

Neonates born with greater than three minutes from uterine incision to baby out were half times more likely to be asphyxiated (AOR=0.453, 95% CI= [0.224, 0.917]) as compared to babies born with less than three minutes from uterine incision to baby out.

Variables	Apgar Score at first minute		COR, 95% CI	AOR, 95% CI
	<7 N (%)	>7 N (%)		
Neonatal weight (kg)				
<3	19 (33.33)	38 (66.67)	0.383 (0.183, 0.779)*	0.383 (0.183, 0.779)*
>3	23 (16.08)	120 (83.92)	1	1
Type of anesthesia				
General	31 (31)	69 (69)	0.275 (0.129, 0.285)*	0.275 (0.129, 0.285)*
Spinal	11 (11)	89 (89)	1	1
Total fluid Requirement (ml)				
<1500	16 (38.09)	26 (61.91)	1	1
>1500	41 (25.95)	117 (65.05)	0.569 (0.278, 1.17)	0.569 (0.278, 1.17)
Time from skin incision To uterine incision (min)				
<3	32 (76.19)	10 (23.81)	1	1
>3	73 (46.20)	85 (53.80)	3.73 (1.72, 8.09)*	0.268 (0.124, 0.583)*
Time from uterine incision To baby out (min)				
<3	27 (64.29)	15 (35.71)	1	1
>3	71 (44.94)	87 (55.06)	2.206 (1.09, 4.46)*	0.453 (0.224, 0.917)*
*Significant at P<0.05, results were expressed in number and percent. COR: Crude Odd Ratio; AOR: Adjusted Odd Ratio; CI: Confidence Interval.				

Table 8: Determinates of first minute Apgar score (n=200).

Discussion

The mean Apgar score at first minute was lower in neonates delivered under general Anesthesia when compared to spinal Anesthesia groups. This study is in line with many studies conducted elsewhere [2,10,11,13,17,18,20,21,24]. However, the mean fifth minute Apgar score didn't show significant mean difference in these studies. But a study conducted other areas showed a significant mean difference at first and fifth minute [6,12,23,25].

In this study Neonatal Neurologic Adaptive Capacity Score in the 15 minute and 2 hrs time were higher in neonates delivered under spinal Anesthesia when compared to General Anesthesia. This study finding is in line with a study conducted in America [7]. However, the 24 hrs Neurologic Adaptive capacity score didn't show significant different. This significant difference in the first couple of hours might be due to

lipid soluble intravenous drugs passing through the placenta and depress the neonate for some time. But a study conducted in Thailand didn't show significant difference between the groups on Neonatal neurologic Adaptive Capacity score [25].

A systemic review and meta-analysis on effects of types of anesthesia on maternal and neonatal outcomes also showed that neonatal Neurologic Adaptive Capacity Score didn't significant different (P>0.4) [2].

Neonatal resuscitation and intensive care Admission is higher in babies delivered under general Anesthesia as compared to Spinal Anesthesia but there was no significant mean difference (p>0.071). This study finding is in line with a study conducted in Turkey in which neonatal Intensive care Admission was 5 *vs.* 6 for spinal and general anesthesia respectively [10].

Another study in Turkey also showed that respiratory support didn't show any significant association (P>1) [22].

A study conducted in America showed that immediate neonatal intensive care Admission didn't have any significant difference. However, a study conducted in Pakistan showed that there were higher number of neonatal Admission in general anesthesia when compared to spinal Anesthesia, [28] *vs.* 6 respectively, P<0.001. These discrepancies might be due to longer induction delivery time with potent lipid soluble intravenous agents and/or more emergency cases with fetal distress in the sample of a study conducted in Pakistan.

Greater induction to delivery time is associated with low Apgar score. This study is in line with a study conducted in Gondar University.

Conclusion

The findings in this study revealed that the mean first minute and fifth minute Apgar score is much better in babies delivered under spinal Anesthesia when compared to general Anesthesia.

Apgar score less than seven at first minute was better in neonates delivered under spinal anesthesia. Neonatal Apgar score had a significant association with induction delivery time.

Neonatal Neurologic Adaptive Capacity Score was higher in neonates delivered under Spinal Anesthesia in 15 minute and 2 hrs when compared to General Anesthesia.

The neonatal respiratory support and Neonatal Intensive care Admission didn't show any significant difference between the groups.

Overall, spinal Anesthesia is associated with minimal neonatal outcomes even in emergency caesarean section with non-touching rapid sequence spinal anesthesia technique. General anesthesia should be preserved for cases contra indicated with spinal anesthesia.

Competing Interest

All authors declare that they have no conflict of interest associated with the publication of this manuscript.

Authors' Contribution

Semagn Mekonnen conceived and designed the study and collected data in the field, performed analysis, interpretation of data, and draft the manuscript. Kokeb Desta involved in the design, analysis, and interpretation of data and the critical review of the manuscript.

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