Original Article

Effects of different anesthetic techniques on neurologic and adaptation capacity in newborn with elective cesarean section

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Abstract

Background: Neurologic and Adaptive Capacity Scoring (NACS) has been introduced as a screening test for diagnosis of central nervous system depression due to intrapartum drugs on the neonate. This test can show neurological and behavioral changes even in the presence of a normal Apgar score. NACS has 20 indicators, each indicator allocating to itself the score zero, one or two. The aim of this study was to compare the effects of different anesthetic techniques on the NACS values.

Materials and Methods: This study was performed as a randomized, single-blind clinical trial on 75 infants born with elective cesarean in Shahid Beheshti Hospital, Isfahan. Simple Sampling method was carried out and the information was gathered by questionnaires. Anesthetic techniques included general, spinal or epidural anesthesia. NACS score was assessed at 15th min, 2 and 24 h after birth and then the anesthesia technique was recorded in the questionnaire. NACS score 35 or above was considered normal and 34 or less was abnormal.

Results: In the present study, no significant correlation was found between the anesthesia techniques and NACS score. The mean NACS at 15 min after birthin the general, spinal and epidural groups were 33.5 ± 2.2, 33.0 ± 4.4 and 33.7 ± 1.6 respectively ($P = 0.703$).

Conclusion: All three anesthetic techniques have identical effects on neurological and compatibility capacity of neonates born with elective cesarean; so, this could necessarily be a base to recommend the three methods equally.

Key Words: Anesthetic, caesarean, neurological and adaptive capacity scoring, Newborn

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INTRODUCTION

Neurological and adaptive capacity scoring (NACS) has been applied as a measuring tool for diagnosis of depression in central nervous system resulting from the effects of drugs used in neonates.

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In a study, NACS was indicated as a screening test for diagnosis of depression in central nervous system resulting from the drug's effects in mature infants and also for distinguishing it from the effects following birth trauma and perinatal asphyxia. NACS has 20 indicators each of which can allocate to itself one of the scores zero, one or two. This index evaluates five general areas in infants including:

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(1) Adaptive capacity (2) passive tone (3) active tone (4) primary reflex and (5) general observation. Scores between 35 and 40 would be considered normal and score 34 or under it shown probable problems in infants.[1] Researches showed that this test is able to demonstrate the neurological and behavioral changes even in the presence of normal Apgar coefficient.[1-3]

The effect of smoking, drug abuse, sex and birth weight on the neuro-behavioral (NB) status of the infant have been confirmed.[4-7] Furthermore, there are studies on the effects of factors related to anesthesia affecting the NB function of infants; so that in a study on newborns in elective cesarean section, the results indicate that in general anesthesia with thiopental sodium or ketamine compared with spinal anesthesia with tetracaine, they had lower early neonatal NB scale (ENNS) score. Although thiopental sodium had a lower score comparing with ketamine, there was no significant difference.[2]

Furthermore, in a study, it was found that epidural anesthesia in mothers of infants with risky conditions, has more benefits comparing general anesthesia regarding the NB condition of the infants.[8] It was found in another study that in the neonates born with cesarean by general anesthesia using thiopental and Enflurane, the NACS score was less than epidural or spinal anesthesia. NACS score in epidural anesthesia was also below the spinal.[3]

In one study, using Lidocaine, Bupivacaine and Chloroprocaine as intra-epidural showed no adverse effects on the ENNS of the infants,[9] whereas in another study, epidural anesthesia with Lidocaine, compared with Bupivacaine had lower scores considering NB conditions.[10] Furthermore, a study has revealed that general anesthesia with desfluranecompared with sevoflurane lead to higher NACS score than in infants born by cesarean.[11]

With respect to the conflicting results in some studies, the difference in the measuring instrument of NB condition, shortage of sample volume in some studies and lack of any comprehensive study comparing different anesthesia techniques and newer anesthesia drugs, this study was carried out with the aim of determining the effect of three anesthetic methods including general anesthesia using thiopental and Isoflurane, spinal anesthesia using lidocaine 5% and epidural anesthesia using Lidocaine 2% on the NACS score as a test with proved validity, reliability and sensitivity[1,2,12] in infants born cesarean.

MATERIALS AND METHODS

After study approval by the Ethics Committee of the Isfahan University of Medical Sciences, this randomized, single-blind clinical trial was performed on 75 infants born with elective cesarean in ShahidBeheshti Hospital, Isfahan from the fall to the winter of 2011.

Inclusion criteria included grade one and two of American Society of Anesthesiologists physical status in mothers and lack of fetal distress, the absence of any high-risk pregnancy, not receiving any narcotic or sedative before surgery, absence of placental abnormalities, newborns weighing 2500 g or more, gestational age between 42 and 38 weeks, maternal age between 35 and 20 years, the mother's height between 155 and 175 cm and the weight between 60 and 90 kg.

Exclusion criteria included the death-birth, meconium staining, congenital malformations, maternal difficult intubation, unusual bleeding and maternal hypotension and any change in surgery plan andanesthesia.

The number of samples in each group was obtained as many as 25 people. Z195% confidence level was 1.96 and Z2 power coefficient of the test was 80%.

After obtaining informed consent from the mothers going to the operating room, they were randomly assigned into three groups using random-number table in the following way.

Group A: General anesthesia with the use of sodium thiopental 5 mg/kg and the amount of succinylcholine 1.5 mg/kg as anesthetic induction agents, then the use of 1.2-0.8 MAC Isoflurane, nitrous oxide and oxygen with 50% proportion and mechanical ventilation with a tidal volume of 10 ml/kg and respiration rate of 10 times/min was considered as the following factor of anesthesia

Group B: Consisted of spinal anesthesia using 1.8 ml of 5% Hyperbaric Lidocaine in the space between vertebrae L4-L3 or L5-L4 in a sitting position

Group C: Consisted of epidural anesthesia using 2% Lidocaine 20 ml solution using a needle into the space between the vertebrae L4-L3 or L5-L4 in a sitting position.

All patients during operation and before delivery received one liter of Ringer's solution and uterine displacement to the left until expulsion moment of the fetus was performed in all patients. All patients undergoing general anesthesia were under electrocardiographic (ECG) monitoring, pulse oximetry, non-invasive blood pressure (NIBP) and $EtCO_2$.The patients undergoing regional anesthesia were only under ECG monitoring, pulse oximetry and NIBP.The patient's blood pressure and pulse rate was measured and recorded after putting on bed and before the anesthesia induction as the "Base" of blood pressure and pulse rate and in case of the lowering of the mean arterial blood pressure during anesthetic induction to umbilical cord clamping (during uterine incision) to below 30% of the base value, medical interventions including changing positions, fluid resuscitation and vasopressor administration was performed, but the patient was excluded from the study.

Also in case of lowering SPO2 <90% or changes in EtCO2 to <35 or >45 mmHg, the cases were recorded in the questionnaire, but such patients were excluded from the study.

Also, information about the baby including birth weight, sex, gestational age and fetal position in the uterus were recorded in the questionnaires. After birth, the baby was dried using standard way and was kept under control. The Apgar's score of minute one and five and also NACS score of 15^{th} min and 2^{nd} and 24^{th} h after birth were determined and recorded in the questionnaire by a learned nurse who was unaware about the grouping of the patients. The NACS Details are shown in Appendix 1.[1]

Induction of anesthesia using the three methods mentioned was conducted by an anesthesiologist. Information gathering and filling out the questionnaires were also performed by a collaborator who was also unaware of the patients' division. NACS score of 35 or above was considered normal and a score of 34 or less was considered abnormal.

Data were analyzed using SPSS software. For comparison between the three groups, one-way ANOVA (one way ANOVA) and variance analysis was used. The Chi-square test was used to compare the distribution of frequencies and $P < 0.05$ were considered as significant.

RESULTS

This study included 80 cesarean born infants, but 3 of them due to weighing <2500 g and maternal hypotension were excluded from the study. The study was continued by 77 neonates; 26 infants in Group A, 25 in Group B and 26 in Group C [Figure 1].

The demographic characteristics and mothers' feature are listed in Table 1.

Underlying conditions were considered as hyperthyroidism, diabetes, low platelet count and rheumatoid arthritis, respectively included in 6.5%,

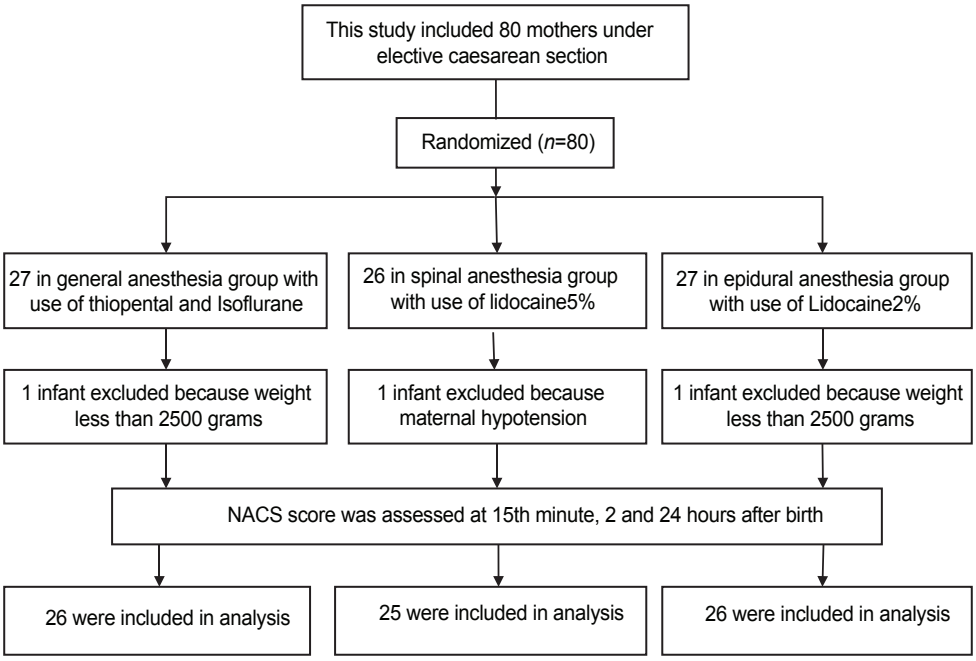

Figure 1: Flow diagram of enrolled study patients

6.5% and 1.3% of mothers. The demographic and neonatal factors are listed in Table 2.

NACS scores at different times of the infants in the three groups are shown in Table 3.

Variance analysis test showed that at all times, the mean NACS in the three groups were not significantly different ($P > 0.05$). ANOVA and following Duncan test showed that the average pulse at the incision time of the uterine was higher in group A than in Groups B and C ($P < 0.05$), but there was no difference between Groups B and C ($P < 0.05$). Also, the mean arterial pressure at the time of uterine incision was higher in Group A than in Group C and it was in turn higher in Group C than Group B ($P < 0.05$). Also, the mean interval between the anesthesia operation and the fetus expulsion in Group C was more than Group B and in Group B was more than Group A ($P < 0.05$).

DISCUSSION

The general aim of this study was to compare the effect of three different anesthetic techniques on neurologic and adaptation capacity of elective cesarean born neonates. Based on the results from this study, the three studied groups were not significantly different in terms of the variables related to mother and infants. So the disturbing effect of the above factors is neutral in this study and the obtained results are most probably related to the anesthesia technique.

Significant difference in mean arterial pressure and heart rate during uterine incision and the average interval between induction of anesthesia and birth can be related to the nature of anesthesia which makes it impossible to create integration between groups in this regard. So, spinal and epidural anesthesia through blocking sympathetic system and activity of some heart reflexes lead to hypertension and bradycardia that this condition is more intense in case of spinal anesthesia than epidural. Also, in general anesthesia the induction of anesthesia in the mother is carried out after perp and derpwhich reduces the interval between induction of anesthesia and fetus expulsion to the least. After the spinal anesthesia following blocking, vapidity is quickly spread, but due to perp and derp in mother after spinal block the time interval between spinal anesthesia and fetus expulsion is more than general anesthesia. In epidural anesthesia compared with spinal anesthesia due to the rather slow spread of vapidity, the interval is increased even more.[13] So

Table 1: Demographic characteristics and mother's feature (mean±SD)

Variable	Group			*P*
	General anesthesia (*n*=26)	Spinal anesthesia (*n*=25)	Epidural anesthesia (*n*=26)	
Mean age (year)	28.9±2.9	29.3±4.1	27.8±5.3	0.424
Mean weight (kg)	77.0±7.1	76.0±9.6	75.5±5.6	0.819
Mean BMI (kg/m^2)	29.7±2.6	28.7±2.8	28.6±1.6	0.186
Mean height (cm)	160.8±4.1	162.3±5.3	162.7±3.9	0.306
Mean gravity (time)	2.0±0.9	1.8±0.8	1.7±0.7	0.497
ASAII/ASAI (person)	22/4	19/6	24/2	0.265
No underlying disease (person)	22	19	24	0.290
Mean arterial blood pressure before anesthesia (mmHg)	96.9±6.6	99.8±8.1	95.3±6.7	0.086
Mean pulse rate before anesthesia (number in minute)	99.8±19.0	104.0±16.9	97.0±8.0	0.250
Mean arterial blood pressure during uterine incision (mmHg)	105.5±15.4	83.6±14.8	92.3±6.1	0.000
Mean pulse rate during uterine incision (number in minute)	111.8±18.5	100.1±24.0	95.5±8.0	0.005
Mean interval from anesthesia to birth (min)	3.6±1.1	5.7±2.3	19.7±1.6	0.000
Mean interval from uterine incision to birth (second)	56.3±25.1	74.7±51.5	76.0±34.2	0.127

SD: Standard deviation, BMI: Body mass index; ASAII/ASAI: Physical status, American society of anesthesiologist

Table 2: Demographic factors and the characteristics of the infant (mean±SD)

Variable	Group			*P*
	General anesthesia (*n*=26)	Spinal anesthesia (*n*=25)	Epidural anesthesia (*n*=26)	
Mean gestational age (week)	38.5±0.5	38.7±0.6	39.2±0.7	0.293
Mean weight (g)	3208.4±373.7	3240.0±318.7	3392.3±475.7	0.209
Sex: boy/girl (person)	11-15	14-11	14-12	0.389
Fetus position: Cephalic/bridge/transverse (person)	25-1-0	24-1-0	23-2-1	0.605
Apgar mean at the 1st min	9.0±0.0	8.8±0.4	8.5±0.6	0.345
Apgar mean at the 5th min	10.0±0.0	9.9±0.2	9.5±0.6	0.482

SD: Standard deviation

Table 3: Mean NACS at different times in the three groups of infants (mean±SD)

Variable	Group			*P*
	General anesthesia (*n*=26)	Epidural anesthesia (*n*=26)	Spinal anesthesia (*n*=25)	
15 min	33.5±2.2	33.0±4.4	33.7±1.6	0.703
2 h	35.8±1.3	35.3±3.5	35.4±1.3	0.719
24 h	36.5±0.9	36.5±1.6	36.8±1.7	0.732

SD: Standard deviation, NACS: Neurologic and adaptive capacity scoring

the anesthesia technique and its physiologic nature can express the difference between these three groups regarding the mean arterial pressure and pulse rate at the time of uterine incision and time interval between induction of anesthesia and fetus expulsion. In a study by Hodgkinson, *et al*. in 1978 on 150 elective caesarian born infants, they concluded that using general anesthesia with thiopental sodium or ketamine comparing spinal anesthesia with Tetracaine, the ENNS score (early NB scale) were lower. Though having lower scores than ketamine, thiopental sodium administration showed no significant difference between them.[2]The differences in the results of this study and the study performed by Hodgkinson can be due to different test evaluations and type of drugs used in general and spinal anesthesia. In this study, NACS is used as a test which its validity and reliability has already been demonstrated.[3-14]

In a study by Abboud, *et al*. in 1985 on 52 pregnant women, they showed that in babies born with caesarian using general anesthesia with the use of thiopental, Tubocurarineand Enflurane, the NACS score was lower than the epidural or spinal anesthesia with Tetracaine and Chloroprocaine. Also in epidural anesthesia, the NACS score was lower than the spinal anesthesia.[3] The differing results of this study and our study could be found in sample size and the type of drugs used in the research. In our study of succinylcholine, isoflurane and spinal lidocaine was used instead of tubocurarine, enfluran, tetracaine and chloroprocaine. Contradicting results in different studies is reported to be in relation with different anesthesia techniques or even different anesthetic drugs in one study.[1,10,15] Although it apparently seems that the amount of fetus exposure to different anesthetic drugs during cesarean in general anesthesia is more than epidural anesthesia, but the results of this study showed that maintaining physiologic conditions in mother and infant during cesarean, avoiding drastic changes in hemodynamic of acid-base, oxygenation and ventilation have a greater impact on the prevention of NB changes that may be created in newborns. If the above conditions are provided for mother and baby, it seems that the effect of anesthesia techniques or various drugs can have a minor impact on the NB condition of the baby.

Limitations of this study include the lack of possibility to measure the plasma level of drugs in the umbilical cord blood after passing the placenta-blood barrier and also the lack of enough acquaintance with exact method of evaluating newborns using NACS at the beginning of the study due to the extensive nature of the research which this problem was to a great extent obviated by providing more information to the nurse and explaining to her how to deal with problems. So, the general conclusion could be that regarding the results of this study, using each of the three anesthesia techniques including general, spinal and epidural anesthesia have similar effects on the neurologic and adaptability capacity of the elective cesarean infants. As a consequence, all three techniques could be used equally based on the necessary conditions and condition of the mother.

Moreover, regarding the results of this study, it is suggested to further researchers to investigate the NB condition of the babies when the mother is faced with problems or in the case of fetus risky conditions such acidosis or bradycardia.

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Appendix 1: Neurologic and adaptive capacity scores

Neurologic and adaptive capacity scores	0	1	2
Adaptive capacity			
Response to sound	Absent	Mild	Vigorous
Habituation to sound	Absent	7-12 stimuli	<6 stimuli
Response to light	Absent	Mild	Brist blink
Habituation to light	Absent	7-12 stimuli	<6 stimuli
Consolability	Absent	Difficult	Easy
Passive tone			
Scarf sign	Encircles the neck	Elbow slightly passes midline	Elbow does not reach midline
Recoil of elbows	Absent	Slow weak	Brisk reproductible
Popliteal angle	>110	100-110	<90
Recoil of lower limbs	Absent	Slow weak	Brisk reproductible
Active tone			
Active contraction of neck flexors	Absent	Difficult	Good
Active contraction of neck extensors	Absent	Difficult	Good
Palmar grasp	Absent	Weak	Excellent
Response to traction	Absent	Lifts part of the body weight	Lifts all of the body weight
Supporting reaction	Absent	Incomplete	Strong
Primary reflexes			
Automatic walking	Absent	Difficult to obtain	Perfect
Moro reflex	Absent	Weak	Perfect
Sucking	Absent	Weak	Perfect
General assessment			
Alertness	Coma	Lethargy	Normal
Crying	Absent	Weak	Normal
Motor activity	Absent	Diminished	Normal