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SEZERYAN DOĞUMUN YENİDOĞAN GENEL HAREKETLERİ ÜZERİNE ETKİSİNİN İNCELENMESİ

Investigation of the Effects of Cesarean Section on General Movements of the Newborn

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ÖZ

GİRİŞ ve AMAÇ: Bu çalışmanın amacı, Sezaryen (S) doğum sırasında kullanılan anestezik maddelerin doğum sonrası ilk 48 saat içinde sağlıklı, tam zamanlı doğan bebeklerin genel hareket (GMs) kaliteleri üzerine olan etkisini araştırmaktır. Ayrıca doğum şekline göre anne ve bebeğe ait peri-prenatal koşulları, bu koşullarla GMs motor Optimalite Skorları arasındaki ilişkiyi incelemektir.

YÖNTEM ve GEREÇLER: Çalışmaya herhangi bir risk içermeyen gebelik ve intrauterin sürecinin ardından 37- 40 haftayı tamamlayarak komplikasyonsuz bir doğum sonucunda doğan 60 tam zamanlı doğan bebek ve anneleri dahil edildi. Bebekler doğum şekillerine göre 30 Normal Spontan Vajinal Yol (NSVY) ve 30 elektif S ile doğan bebekler olarak sınıflandırıldı. GMs motor Optimalite Skorları bebeklerin video görüntüleri üzerinden spontan hareketlerinin GMs Detaylandırılmış Motor Optimalite Analizi ile puanlandırılmasıyla belirlendi. Ayrıca, doğum şekline göre bebeklerin GMs motor optimalite skorları ile gebelik, doğum ve yeni doğana ait optimalite değerlendirmeleri arasındaki ilişki incelendi. Pre-perinatal koşullar doğum şekline göre karşılaştırıldı.

BULGULAR: NSVY ile doğan bebeklerin ilk 48 saat içindeki motor optimalite skorlarının S ile doğan bebeklerden daha yüksek olduğu bulundu ($p<0.05$). NSVY ve S grubundaki annelerin gebelik koşulları ve yenidoğanın fizyolojik sağlık hali açısından optimaliteleri arasında fark olmadığı görüldü ($p>0.05$). Doğum optimalitesi NSVY ile doğumda S dan daha yüksek bulundu ($p<0.05$). Doğum şekline göre bebeklerin motor optimaliteleri ile peri-prenatal koşulları arasında ilişki görülmedi.

TARTIŞMA ve SONUÇ: Sezeryan doğum sırasında kullanılan anestezik maddeler doğumdan sonraki ilk 48 saatte yeni doğanın nörodavranışsal durumunu etkilemektedir.

Anahtar Kelimeler: Yeni doğan nörodavranış, Prechtl, genel hareketler, anestezi, sezeryan, vajinal doğum.

ABSTRACT

INTRODUCTION: This study aimed to analyse the effect of anaesthetics used during Caesarean Section (CS) on the General Movements (GMs),quality of healthy full-term infants in the postnatal first 48 hours, the peri-prenatal conditions of mothers and infants, and the relationship between these conditions and GMs motor Optimality Scores (OS) according to type of birth.

METHODS: This study included 60 term infants born without any birth complications after completing 37–40 weeks of non-risky pregnancy and intrauterine process, along with their mothers. The infants were allocated as 30 of them born by Normal Spontaneous Vaginal Delivery (NSVD) and 30 of them born by elective CS. Infants' GMs were assessed in detail in the first 48 hours using Prechtl's Method; this assessment yielded their OS. The relationship between infants' GMs motor OS and pregnancy, birth, and infants' optimality assessments was examined, and pre-perinatal conditions were compared according to type of birth.

RESULTS: Motor OS in the first 48 hours were higher for infants born by NSDV than for those born by CS ($p<0.05$). No difference was found between mothers' pregnancy conditions and neonates' physiological health optimality in the two groups ($p>0.05$). Birth optimality was higher in NSVD group than in CS group ($p<0.05$). No relationship was found between infants' motor optimality and peri-prenatal conditions according to type of birth.

DISCUSSION and CONCLUSION: Anaesthetics used during CS affect infants' neurobehavioral status in the postnatal first 48 hours.

Keywords: Infant neurobehavior, Prechtl, general movements, anaesthesia, caesarean, vaginal delivery

INTRODUCTION

The increase in rates of Caesarean Section (CS) over the past decades, particularly have led to increased research and concern among healthcare professionals, governments, policy-makers, scientists and clinicians (1).

According to the Organization for Economic Cooperation and Development (OECD) 2015 report, CS rates have increased with the average rising from 20% in 2000 to 28% in 2015. In 2015, CS rates were lowest in Nordic countries (Iceland, Finland, Sweden and Norway), Israel and the Netherlands. They were highest in Turkey, Mexico and Chile, CS rate for Turkey was 53.1% (2). The CS-related maternal mortality ratio is 4–8:10.000, which is 26 times greater than that for vaginal delivery. The increased frequency of CS and its high cost put a great burden on national economies. In addition, the CS procedure poses many risks for the mother and the baby (3). Currently, epidural and spinal anaesthesia are the most frequently employed regional anaesthesia methods during childbirth. Although spinal anaesthesia has a minimal effect on fetal blood flow, maternal hypotension caused by spinal anaesthesia affects both mothers and babies; if it lasts too long, it may result in bradycardia. Moreover, spinal and epidural anaesthesia administered for CS requires high doses of anaesthetics, which may be transferred to placenta and affect the fetus—and thereby the neonate (4). Bupivacaine and levobupivacaine are frequently used in epidural and spinal anaesthesia. Both of these anaesthetics are known to be transferred to the placenta; however, levobupivacaine, the levo-counterpart of bupivacaine, is as effective as bupivacaine but less toxic (4). Low-dose administration of novel anaesthetics, such as ropivacaine and levobupivacaine, and also local anaesthetics-opioid combinations are reported to have fewer effects on neonates compared with traditional epidural analgesia (5). However, it is still crucial to analyse the neurobehavioral effects of these anaesthetics on neonates.

The Prechtl Analysis is one of the most frequently used tests to evaluate the fetus and the neonatal at the earliest term. Prechtl Analysis is an observational method that evaluates the spontaneous complex movement patterns emerging on the head, arms, and legs of the fetus and neonates and thereby determines neurological dysfunctions. It is an important tool for evaluation of the integration of central nervous system. These complex and variable movements are called general movements (GMs). If the nervous system is impaired, GMs lose their complexity and variability and become monotonous and weak (6,7). The optimality concept in the Prechtl Analysis evaluates the quality of GMs in detail and scores motor optimality. Pre-perinatal conditions along with neurological conditions and obstetric history of the infants can also be assessed with the optimality concept (8-10).

The present study aimed to compare neonates born by caesarean section and normal spontaneous vaginal delivery (NSVD) in terms of quality of movement within the first 48 hours after delivery; to investigate the effects of anaesthetics used during CS on neonates' general movements; and to

determine the relationship of GM motor optimality scores with mother-, infant- and birth-related optimality scores.

MATERIAL and METHODS

This randomised controlled study included 72 mothers and neonates who received services at the Neonate Department of a tertiary care center. Although evaluations of all mothers were completed, 12 neonates and their mothers were excluded from the study because the neonates were not able to be kept awake or still. This study included 60 term neonates (30 NSVD and 30 elective CS) who have completed 37 to 40 weeks' gestation and were delivered with no complications upon completion of a risk-free pregnancy and intrauterine term. Of the neonates, 28 (46.7%) were male and 32 (53.3%) were female. Mothers and neonates who needed urgent medical care and cases who needed central block anaesthesia during NSVD were excluded from the study. The cases that required emergency intervention, needed central block anaesthesia during NSVD, twins, or multiple births were also excluded from the study.

All patients' consents were obtained to access their hospital records and to video record the babies. The study was approved by the Non-Entrepreneurial Clinical Research Ethics Board of Hacettepe University (LUT 12/33-10).

All CS participants in this study received spinal anaesthesia and bupivacaine + fentanyl; levobupivacaine + sufentanil were used as local anaesthetics. The neonatal and maternal demographic information of the cases included in this study were recorded.

Assessment of Peri-Prenatal Optimal Conditions: Prof. Heinz Prechtl[8] formulated a list to determine the most optimal and desirable conditions for the representation and comprehensive explanation of the pre-perinatal conditions of mother, fetus, and placenta. This list was included in this study as the Prechtl's Optimality Assessment Forms used for the pregnancy, birth, and neonatal periods.

These forms were:

1) Pregnancy Optimality Assessment: examines pregnancy through 8 items for social aspects, 12 items for previous pregnancy history, and 25 items for current pregnancy (ANNEX 1);

2) Birth Optimality Assessment: examines birth conditions through 21 items (ANNEX 2); and

3) Neonatal Optimality Assessment: examines the clinical and medical conditions of the infant using 26 items (ANNEX 3).

The pregnancy optimality assessment was made by directly asking to the mothers through face-to-face interviews, and the birth and neonatal optimality assessments were made by reviewing the information in the patient files. Optimal and non-optimal answers were scored as "1" and "0", respectively (8-10).

The maximum optimal scores are 45 for pregnancy, 21 for birth, and 26 for the conditions of the neonatal infant.

Motor Optimality Assessment: *Recording Spontaneous Movements (GMs):* Within the first 48 hours after birth (0–1day), the infants' spontaneous movements were video recorded without any external stimulation, starting from the moment when their physiological status became stable.

During video recording, neonates were kept in a supine position and were either in their diapers only or in a thin bodysuit not covering their extremities. The camera was fixed using a tripod and set to cover the entire bed. Five- to ten-minute video clips were recorded from the mid-sagittal line, involving at least 3 spontaneous GM series (7).

Detailed analysis of the quality of the general movements (The GM Trust, 1997): The video records were assessed by a researcher who was blinded to the infants' type of birth and compared the records with the golden standard videos showing all features of the GMs. The Preterm, Term, Early Postterm Period General Movement Detailed Scoring Form was used for scoring. To assess the infants' movements, scoring was performed according to eight criteria: speed, character, amplitude, sequence, range in space, fluency and elegance, onset and off set, and subtle distal movements. The movements were scored as 2 for optimal level and 1 for non-optimal level considering the golden standard movement features (10-12). The optimal-level GMs movements were scored as 2 if they were normal, variable, and complex. The GM movement characteristics were scored as follows: 1) 2 if they were at full angle and variable and 1 if they were at acute or wide angles; 2) 2 if they were slow and 1 if they were fast or monotonous; 3) 2 if they were complex and variable and 1 if they were cramped, loose, fluctuant, tremorous, or weak; 4) 2 if their sequence was variable and 1 if they were synchronized, disorganized, monotonous GMs repeated in the same order and did not include the other parts of the body; 5) 2 if their range in space was variable and 1 if it was on a single plane; 6) 2 if they included rotations and were fluent and 1 if the included few or many rotations and were not fluent; 7) 2 if they started as smooth and soft and 1 if they started as sudden or fluctuating; 8) 2 if they had variations including subtle distal movements and hand and finger movements, and 1 if there were few finger movements, the hands were made fists, or the finger movements were synchronized or opened and closed with the same repetition.

An infant meeting the optimality conditions for all GMs parameters could obtain a maximum score of 16 (11,12).

When a deterioration occurs in the development of nerve system, the GMs lose their normal complexity and variability and some movement features are observed; these are defined as abnormal GMs. The quality of GMs observed from the term to the postterm second month are categorized as normal, abnormal, poor repertoire, chaotic, cramped-synchronized (7,13).

Abnormal GMs categorization is as follows:

1. *Poor Repertoire GMs (PR):* Movement series are monotonous. The movements are not as complex as in normal GMs. They are indicated by "PR" in the assessment (7).
2. *Cramp-Synchronized GMs (CS):* Movements are rigid and lack the smoothness and fluency of normal GMs. All extremity and body muscles simultaneously strain and relax. They are indicated by "CS" in the assessment (7).
3. *Chaotic GMs (Ch):* The movements in all extremities are seen as wide-amplitude, non-fluent, complex and irregular. They are sudden and sharp. They are indicated by "Ch" in the assessment (7).
4. *Hypokinesia (H):* The one-hour video record includes very few movements, which are not enough to assess movement quality. They are indicated by "H" in the assessment (7).

Statistical analysis:We used SPSS 15.0 software for Windows (SPSS Inc., Chicago, IL, USA) for all statistical analyses. Analyses were all univariable. Student's *t*-test was used to compare medians, and Pearson's correlation coefficient was used for measuring association. All tests used a significance level of 0.05.

RESULTS

There was no significant difference between groups in terms of demographic data of mothers and the neonates, neonatal and natal variables, and neonates' 1 min and 5 min Apgar scores (Table I)

Table I. Neonatal and Maternal Demographic Characteristics (X ± SD)

	CS Group n=30	NSVD Group n=30	Significance	
Characteristics	X ± SD	X ± SD	*t*	p
Birth Weight (kg.)	3.26 ± 0.38	3.20 ± 0.40	0.62	0.53
Birth Length (cm.)	50.30 ± 1.47	49.90 ± 1.45	1.24	0.22
Head Circumference (cm.)	34.72 ± 1.00	34.43 ± 1.12	1.53	0.13
Gestational Age (week)	38.43 ± 1.00	38.97 ± 0.92	-2.06	0.44
Apgar 1 min	7.47 ± 0.86	7.13 ± 0.51	1.83	0.07
Apgar 5 min	9.20 ± 0.48	9.07 ± 0.25	1.34	0.18
Maternal Age (year)	26.93 ± 5.65	25.70 ± 5.88	0.83	0.41
Number of Pregnancy (Parity)	2.13 ± 0.9	1.87 ± 0.97	1,102	0.27

p>0.05 Values are mean ± SD. There was no significant difference between the groups on the Student's t-test; CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery; SD: Standard Deviation

Comparison of the Motor Optimality Scores of the Infants in the NSVD and CS Groups

Of the infants in both groups, 8 (26.7%) showed normal movements (N) and the others (73.3%) showed poor repertoire (PR) movements (Table II).

Table II. Comparison of the GMs of the Infants by Groups

	N		PR	
	n	%	n	%
NSVD	8	26.7	22	73.3
CS	8	26.7	22	73.3

CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery; N: Normal PR: Poor Repertuar

The quality of movements of the infants born by normal delivery in the first 48 hours were higher than those in the infants born by caesarean section, according to their motor OS. Although both of the groups were video-recorded in the first 48 hours, the times of video recording were later for the CS group than those for the NSVD group (Table III).

Table III. Comparison of the Groups in terms of the Infants' Motor Optimality and Assessment Age

	CS Group n = 30	NSVD Group n = 30	The Significance Test for the Difference between Two Averages	
Characteristics	X ± SD	X ± SD	*T*	P
GMs Motor OS	11.53 ± 2.85	13.27 ± 2.59	-2.47	0.02*
Postnatal Age (hour)	26.98 ± 12.75	17.53 ± 7.78	3.46	0.00*

**p < 0.05; CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery; SD: Standard Deviation; OS: Optimality Score*

It was observed that the infants in the CS group lost optimality in terms of sequence, (76.7%), fluency and elegance (66.7%), and character of the movements (63.3%); and those in the NSVD group lost optimality in terms of a decrease in subtle distal movements (53.3%), fluency and elegance (50%), and sequence (40%) of the movements. The movements' onset and offset, amplitude and range in space were at an optimal level in the NSVD group; the difference was significant (Table IV).

Table IV. Assessment of the Motor Optimality Variables in the Groups

Motor Optimality Variables	NSVD Group (n=30)				CS Group (n=30)			
	Optimal Score (2)		Non-optimal Score (1)		Optimal Score (2)		Non-optimal Score (1)	
	N	%	n	%	n	%	N	%
Amplitude	24	80	6	20	16	53.3	14	46.7
Speed	21	70	9	30	15	50	15	50
Character of the Movement	20	66.7	10	33.3	11	36.7	19	63.3
Sequencing	18	60	12	40	7	23.3	23	76.7
Spatial Sectors of the Movements	22	73.3	8	26.7	14	46.7	16	53.3
Fluency and Elegance	15	50	15	50	10	33.3	20	66.7
Onset and Offset	28	93.3	2	6.7	20	66.7	10	33.3
Subtle Distal Movements	14	46.7	16	53.3	14	46.7	16	53.3

CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery

No difference was found between the pregnancy conditions of the mothers in the two groups. The childbirth optimal condition scores of the normal delivery group was statistically significantly higher than that of the caesarean group. The neonatal optimality conditions of the infants were also equal and at a maximum level (Table V).

Table V. Comparison of the Groups in terms of Pregnancy, Birth, and Neonatal Optimality Scores

	CS Group n=30	NSVD Group n=30	The Significance Test for the Difference between Two Averages	
Characteristics	X ± SD	X ± SD	t	P
Total Pregnancy OS	33.50 ± 4.77	32.80 ± 5.92	0.48	0,633
Social Pregnancy	5.43 ± 1.22	5.63 ± 1.10	-0.67	0.50
Previous Pregnancy	7.20 ± 3.99	6.10 ± 5.36	0.90	0.37
Pregnancy Index	20.93 ± 1.66	21.17 ± 1.20	-0.46	0.64
Birth OS	14.80 ± 1.37	16.90 ± 1.45	-12.64	0.00*
Neonatal OS	26 ± 0.00	26 ± 0.00	0	1.00

**p < 0.05; CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery; OS: Optimality Score*

Analysis of the Correlation between Motor Optimality and Pre-Perinatal Conditions

No relationship was found between the motor optimality scores and infants' weight, pregnancy optimality (social pregnancy, previous pregnancy and pregnancy index), and birth optimality scores of the two groups (Table VI).

Table VI. Analysis of the Relationship of Motor Optimality with Pregnancy and Birth Optimality of the CS and NSVD Groups

	CS Group n=30		NSVD Group n=30	
Variables	Pearson Correlation	Motor OS	Pearson Correlation	Motor OS
Social Pregnancy	R	0.17	r	0.01
	P	0.37	p	0.95
Previous Pregnancy	R	0.03	r	0.10
	P	0.86	p	0.59
Pregnancy Index	R	-0.26	r	-0.32
	P	0.16	p	0.09
Birth Optimality	R	-0.02	r	-0.20
	P	0.93	p	0.30

CS: Caesarean Section; NSVD: Normal Spontaneous Vaginal Delivery; OS: Optimality Score

DISCUSSION

This study aimed to determine whether or not CS and the anaesthetic substances used in CS affect the infants' nerve system. Unlike previous studies, this study compared the infants born by NSVD without spinal anaesthesia with the infants born by CS with spinal anaesthesia. The higher Optimality Scores (OS) of the infants born by NSVD than those of the infants born by CS suggest that this difference is caused by anaesthesia. Most of the infants, both those in the NSVD group and those in the CS group, showed poor repertoire movements according to their GMs motor OS. Ploegstra et al. analysed the difference between the OS of the infants born by vaginal delivery and caesarean section with spinal anaesthesia and found that the type of birth did not affect the GMs of the infants (14). As Einspieler et al., Prechtl, Ploegstra et al. have reported, abnormal GMs can be observed even in healthy full-term infants within the first week due to physiological variables (11,13,14). It was reported that GMs were similarly abnormal on the postnatal first, second, and third days (no statistical significance); however, they began to normalize on the second or third day and become normal on the fifth to seventh days

(14). Based on these findings, poor repertoire GMs are not unusual for the healthy full-term infants in the present study.

No difference was found between the pregnancy, birth, and neonatal OS of the mothers and infants in the CS and NSVD groups in this study. In addition, no difference was found between the obstetric optimality of the infants in both groups because this study included the infants without any complications under neonatal and prenatal conditions. Furthermore, the fact that no relationship was found between the GMs motor OS and pregnancy and birth OS of the infants in both groups supports the above-mentioned finding.

The mothers in both groups were under similar pregnancy optimality conditions. The mothers in the CS group had been led to caesarean section due to their previous caesarean section, although they had met the optimal conditions during their pregnancy. The frequency of caesarean section is known to increase in parallel with the number of the subsequent pregnancy (15-17). However, many studies have reported that the majority of pregnant women having caesarean section are aged between 20 and 29 (16-17). In the present study, the average ages of the mothers having CS and NSVD were 26.93 ± 5.65 and 25.70 ± 5.88, respectively.

The quality of movement of the term infants in the CS and NSVD groups who were born without any complications were compared, and the optimality scores of the neonates were found at a maximum and similar level in both groups. This showed that the infants in both groups met the physiological health criteria at an equal and maximum level.

The duration of hospital stay was shorter for the mothers and infants in the NSVD group (17,18). The reason for assessing the infants born by NSVD earlier than the infants born by CS was related to the time of discharge of the mothers and infants from the hospital and was because the infants born by CS could not be assessed in the first 24 hours due to drowsiness and agitation, which was observed during the study but could not be statistically indicated.

The studies in the literature that explored the relationship between the mothers' and infants' OS and GMs findings generally examined the results of different neurological status or types of birth. No studies were found on the type of birth and GMs scores of infants in relation to anaesthesia. The effects of anaesthetic substances on neonates were analysed in many studies, which generally compared the form of anaesthesia and the effects of anaesthetic substances on infants and mothers. In such studies, neonatal neurobehavioral status was investigated using tools such as Brazelton Neonatal Behavioral Assessment Scale (BNBAS), The Early Neonatal Neurobehavioral Scale (ENNS), and Neurologic and Adaptive Capacity Scoring System (NACS) (19-22).

Abboud et al. compared the effects of general and regional anaesthesia on neonates, assessed the neonates born with general anaesthesia at the fifteenth minute and second hour postnatal, and found that their primary reflexes, active-passive tonuses, and Adaptive Capacity Scores were lower. However, those authors found no difference between the groups at the end of 24 hours postnatal

(21,23). On the other hand, the studies on the effect of regional anaesthesia and the specific anaesthetic substances on neonates did not show an effect that altered their neurobehavioral status as neonates (25,26).

In the present study, the neurobehavioral status of the infants born by normal spontaneous vaginal delivery and caesarean section, accepted as optimal, was evaluated using the Prechtl Analysis. Although the infants showed the same distribution when categorized as normal and PR, The GMs scores of the infants born by CS with regional anaesthesia was lower than that of the infants born by NSVD. The total GM scores of the infants born by NSVD without regional anaesthesia were not optimal; however, the anaesthetic substances used during the birth of the infants born by CS with regional anaesthesia were found to more negatively affect the physiological stability and optimal quality of movement of the infants within the first 48 hours.

Limitation of Study: Determination of whether or in how much time the qualities of movement were aligned with each other through the assessment records on the following days was particularly important for showing the effect of caesarean section on the neonates' movements in the present study. However, this could not be concluded due to the short duration of hospital stay of the mothers and infants, which is a limitation of this study.

Conclusion: The stimulability of infants is known to be less on the postnatal first two days after caesarean section.[27,29] Although the GMs assessment in this study was based on the spontaneous movements of the infants without applying any external stimulus, the anaesthetic substances given to the mothers affected the infants and suppressed their central nerve system, thereby causing the GMs motor OS of these infants to be lower, which supports the above-mentioned fact. The negative effects of the CS and anaesthesia on the movements of the infants within the first 48 hours, and the optimal effect of the NSVD on the infants were shown once again in this study.

The short- and long-term effects of anaesthesia on mothers and infants should be examined from different perspectives and using different methods through long-term follow-ups. The higher GMs OS of healthy full-term infants born by NSVD in this study than that of the infants born by CS shows that positive effects of NSVD on the infants. Therefore, health policies should be established to encourage normal delivery where possible.

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