THE JOURNAL OF
Obstetrics and Gynaecology Research

doi:10.1111/jog.13562 J. Obstet. Gynaecol. Res. Vol. 44, No. 4: 717–722, 2018

Effects of daytime versus night-time cesarean deliveries on Stage II lactogenesis

Gülşah İlhan[1], Fatma V. Atmaca[1], Ayşenur Çümen[1], Ali G. Zebitay[1], Emre S. Güngör[1] and Ayşe F. G. Karasu[2]

[1]Department of Obstetrics and Gynecology, Süleymaniye Women and Children's Health Training and Research Hospital and [2]Department of Obstetrics and Gynecology, Bezmi alem Vakıf University, Istanbul, Turkey

Abstract

Aim: The circadian timing system has a rhythm and one of the roles of this system is the mediation of hormonal and metabolic adaptations to lactation. This study was conducted to determine whether the time to stage II lactogenesis differed in women who underwent cesarean section (CS) in the daytime (DT) or night-time (NT).

Methods: This study was conducted at Süleymaniye Research and Education Hospital between June and December 2016. Two hundred and eighty-eight mothers who had a cesarean delivery and their healthy singleton neonates were included. Clinical and demographic data of the mothers and neonates, time of initiation of breastfeeding and time to stage II lactogenesis were analyzed according to DT or NT CS groups.

Results: There were no statistically significant differences in age, gravida, parity, body mass index, week of gestation at birth, postoperative hemoglobin level, cesarean indications, anesthesia type, previous history of breastfeeding, transfusion need, Apgar scores or birth weight-height of neonates between the DT and NT CS groups. While the time of initiation of breastfeeding did not differ statistically in terms of DT or NT CS groups, the time to stage II lactogenesis was significantly longer in the NT CS group.

Conclusions: NT cesarean delivery is a risk factor for the delayed onset of lactogenesis. The results of this study may be useful to clinical practitioners counseling mothers who undergo NT cesarean delivery.

Key words: breastfeeding, circadian system, lactation, stage II lactogenesis.

Introduction

Breastfeeding provides a ideal nutrition for the healthy development of newborns and infants.[1] It is also associated with many health benefits for mothers.[2,3] Agencies worldwide recommend breastfeeding during the first six months and mixed breastfeeding for up to two years.[4–6]

Human lactation is a complex phenomenon and involves two stages. Stage I lactogenesis is defined by the differentiation of mammary alveolar epithelial cells into specialized secretory cells that occurs during pregnancy. Stage II lactogenesis is the initiation of plentiful milk secretion.[7] Maternal perception of the milk 'coming in' is strongly correlated to stage II lactogenesis.[8–10] The perception of onset of stage II lactogenesis beyond 72 h postpartum is considered a delayed onset of lactogenesis.[10]

One of the conditions leading to the delayed onset of lactogenesis is delayed initiation of breastfeeding. Timely initiation of breastfeeding is defined as putting the newborn to the breast within 1 h of birth. Incidence rates of delayed onset stage II lactogenesis range from 17% to 44% in various populations.[11,12]

Lactogenesis is a function of finely arranged feedback mechanisms, which are potentially susceptible to

Received: July 28 2017.
Accepted: October 23 2017.

Correspondence: Gülşah İlhan MD, Department of Obstetrics and Gynecology, Süleymaniye Women and Children's Health, Training and Research Hospital, Balıklı caddesi, telsiz mahallesi, zeytinburnu, Istanbul, Turkey. Email: gulsah.keskin.84@hotmail.com

physical and psychological manipulations of the mother, infant or both. Mode of delivery is also a factor effecting lactogenesis and breastfeeding outcomes. It is thought that cesarean section may delay lactogenesis.[13]

The circadian rhythm is the physical, mental and behavioral changes that follow a roughly 24 h cycle, responding primarily to light and darkness in an organism's environment. This system functions to arrange human physiology when changes occur in an environment.[14] It has a rhythm and one of the roles of this system is the mediation of hormonal and metabolic adaptations to pregnancy and lactation.[14]

We hypothesized that sudden disruption of the maternal circadian rhythm alters hormones and metabolic adaptations and results in the delayed onset of stage II lactogenesis. Therefore, the present study was undertaken to determine whether the time to lactogenesis was different in women who underwent cesarean section (CS) in the daytime (DT) or nighttime (NT).

Methods

This prospective observational study was conducted at the Suleymaniye Research and Education Hospital in Istanbul between June and December 2016. Local ethics committee approval was granted (Institutional Review Board number: 87534341/771). Two hundred and eighty-eight mothers who underwent a cesarean delivery at this hospital and their healthy singleton neonates were included in the study.

The inclusion criteria were as follows: mothers who underwent CS between 34 and 40 weeks of gestation, carrying a single fetus, aged ≥ 18, who initiated breastfeeding, spoke Turkish and were not admitted to the adult intensive care unit. Exclusion criteria were: mothers with a known absolute contraindication to breastfeeding or those aged < 18 years old and unable to obtain parental consent. Mothers with a systemic illness, including diabetes, hypertension, hypothyroidism, hypopituitarism and polycystic ovarian syndrome, who had undergone breast injury-surgery and smokers were also excluded from the study. Written informed consent was obtained from all participants.

After cesarean delivery, all of the babies were roomed with their mothers and exclusively breastfed, which was initiated within the first hour of birth, as per baby friendly hospital policy. All of the mothers received information and practical instruction on how to breastfeed and the advantages of breastfeeding. They received support, encouragement and supervision of breastfeeding techniques and good latching. Each patient was visited within the first 24 h after delivery by an obstetrics and gynecology assistant and a brief questionnaire was administered. The mothers were asked about the time of initiation of breastfeeding and the sensation of milk coming in (time to stage II lactogenesis). The sensation of milk coming in was described as a tingling or prickly feeling in the breast, dripping from the contralateral breast, gulping by the baby and milk running from the baby's mouth.[14] Clinical and demographic data of the mothers including gravida, parity, age, body mass index (BMI), week of gestation at birth, previous history of breastfeeding, postoperative hemoglobin level (g/dL), cesarean indication (elective/emergency), anesthesia type (spinal/general anesthesia) and data including Apgar scores, birth weight and height of neonates, time of initiation of breastfeeding and time to lactogenesis were recorded and analyzed according to DT or NT CS groups.

Gravida was defined as the number of pregnancies and parity was defined as the number of previous deliveries. Anesthesia types included spinal or general anesthesia. Elective cesarean delivery was defined as a planned operation and performed when the patient was not in an active delivery, whereas the remaining CS were defined as emergency. The time to stage II lactogenesis was defined as the number of hours between delivery and the time that each mother first observed the signs of a surge in milk production. A previous history of breastfeeding was calculated by summing the total breastfeeding period (months).

Patients who underwent CS were allocated into two groups: DT and NT. Istanbul is a city in Turkey located in the northern hemisphere at the intersection of the 41st parallel and the 29th meridian. During the study period, CS time was evaluated according to sunrise and sunset times and classified as DT or NT CS.

Statistical analysis

IBM SPSS version 22.0 was used for statistical analysis. Descriptive data were expressed as mean ± standard deviation. Differences in normally distributed continuous variables were evaluated using the Student's *t*-test. The Mann–Whitney *U* test was used for abnormally distributed data. Chi-square and Fisher's exact

tests were used to compare qualitative data. $P < 0.05$ was considered statistically significant.

Results

This study included 288 mothers who breastfed their babies and had a cesarean delivery. Seventy-three (25.34%) primiparous and 215 (74.66%) multiparous mothers were included in the study. The age range of the sample was 18–43 years, while the average age was 28.33 ± 5.37 . Gravida ranged from 1 to 6, with a mean of 2.44 ± 1.20. Parity ranged from 0 to 4, with a mean of 1.35 ± 1.11 (Table 1).

There were no statistically significant differences in age, gravida, parity, BMI, week of gestation at birth, postoperative hemoglobin level (g/dL), cesarean indication (elective/emergency), anesthesia type (spinal/general anesthesia), previous history of breastfeeding or need for transfusion between the groups ($P > 0.05$) (Table 1). There were also no statistically significant differences in Apgar scores or birth weight and height of neonates between the groups ($P > 0.05$) (Table 2).

While time of initiation of breastfeeding did not differ statistically between the groups ($P > 0.05$), the time to lactogenesis was statistically significantly higher in the NT CS group ($P < 0.01$) (Table 3). Regarding the time of breastfeeding initiation, 169 (58.68%) mothers initiated breastfeeding immediately within 1 h following delivery, while 26 (9.02%) initiated breastfeeding at the first hour following their delivery. The remaining 93 (32.29%) mothers initiated breastfeeding after 1 h. Lactogenesis occurred within 1 h in 159 (55.20%) women, while the longest time to lactogenesis was 24 h.

Of 288 cases, 156 (54.16%) were emergent cesarean deliveries and 132 (45.84%) were performed electively. Most of the elective CS were indicated because of previous cesareans ($n = 93$, 70.45%), while most of the emergent CS were indicated because of previous CS in active labor. There were no statistically significant differences in cesarean indications between the groups ($P > 0.05$). The time to stage II lactogenesis was significantly longer for emergency CS (2.65 ± 4.65) than elective (2.60 ± 3.43) CS ($P < 0.01$).

Discussion

This study was carried out in an industrialized area of Turkey where cesarean delivery rates are high and demonstrated that NT cesarean deliveries are negatively associated with lactogenesis time.

The effects of breastfeeding on maternal-infant health include reduced gastrointestinal diseases, respiratory illness, better cognitive development for infants, reduced risk of postpartum depression, breast and ovarian cancer in mothers, type II diabetes and obesity in both mothers and infants.[2,3,15] Economic benefits have also been documented.[16] Adults who were breastfed are less likely to be overweight or obese and perform better on intelligence tests.[3,15] The timing of breastfeeding is also crucial. Approximately 7.7% and 19.1% of all neonatal deaths may be avoided with universal initiation of breastfeeding within the first day and first hour of life, respectively.[17] Timely

Table 1 Demographic features of the DT and NT groups

Features		DT ($n = 228$)	NT ($n = 60$)	P
		Mean ± SD (median)	Mean ± SD (median)	
Age		28.60 ± 5.37	27.28 ± 5.28	0.091†
BMI		30.28 ± 3.01	29.66 ± 2.94	0.150†
Gestational week		38.31 ± 1.71	37.99 ± 2.30	0.316†
Gravida		2.48 ± 1.13 (2)	2.28 ± 1.45 (2)	0.064‡
Parity		1.41 ± 1.08 (1)	1.13 ± 1.19 (1)	0.059‡
Breastfeeding history (month)		21.23 ± 13.23 (18)	19.17 ± 15.38 (12)	0.253‡
Hb level (g/dL)		0.62 ± 0.77	0.81 ± 0.91	0.100†
Features		n (%)	n (%)	
Cesarean indication	Elective	103 (45.2%)	29 (48.3%)	0.662§
	Emergency	125 (54.8%)	31 (51.7%)	
Anesthesia type	Spinal	194 (85.1%)	48 (80%)	0.338§
	General	34 (14.9%)	12 (20%)	

†Student's t- test; ‡Mann–Whitney U test; §Ki-Kare test. BMI, Body mass index; DT, daytime; Hb, Hemoglobin; NT, night-time; SD, standard deviation.

Table 2 Comparison of neonatal features according to group

Neonatal feature	DT (n = 228)		NT (n = 60)	P
	Mean ± SD (median)		Mean ± SD (median)	
Apgar score (1 min)	7.99 ± 0.93		7.68 ± 1.20	0.065†
Apgar score (5 min)	7.28 ± 2.90		7.70 ± 2.16	0.219†
Birth weight (gm)	2608.9 ± 299.1		2526.7 ± 312.4	0.061†
Height (cm)	49.56 ± 2.15		48.67 ± 3.84	0.085†
Neonatal feature		n (%)	n (%)	
Need for postoperative transfusion	(−)	226 (99.1%)	60 (100%)	1.000‡
	(+)	2 (0.9%)	0 (0%)	

†Student's *t*-test; ‡Fisher's exact test. DT, daytime; NT, night-time; SD, standard deviation.

Table 3 Initiation of breastfeeding and stage II lactogenesis time according to group

	DT (n = 228)	NT (n = 60)	P
	Mean ± SD (median)	Mean ± SD (median)	
Initiation of breastfeeding (h)	2.11 ± 4.76 (1)	2.21 ± 3.83 (1)	0.139
Stage II lactogenesis time (h)	1.46 ± 0.62 (1)	4.23 ± 4.83 (3)	0.001*

*P < 0.01; Mann–Whitney U test. DT, daytime; NT, night-time; SD, standard deviation.

initiation of breastfeeding can help to prevent neonatal death caused by infection, such as sepsis, pneumonia and diarrhea.[18,19]

Implementation of the country's national strategy for infant and young child feeding, the baby-friendly hospital initiative, is encouraged and our hospital is certified. Our recommendations involve timely initiation of breastfeeding, exclusive breastfeeding for the six months and continued breastfeeding up to the age of two years.[20,21] In our hospital, the standard protocol is immediate skin-to-skin contact and the initiation of breastfeeding in the delivery room, although this may be difficult after CS. After delivery, the infant is triaged to the regular nursery, while the mother is transferred to her room. The mothers receive information and practical instruction on how to breastfeed and the advantages of breastfeeding.

The circadian system is the physical, mental and behavioral changes that follow a 24 h cycle in response primarily to light and darkness in an organism's environment. Mediation of the hormonal and metabolic adaptations to pregnancy and lactation is one of the roles of the circadian timing system. Onset of stage II lactogenesis also requires coordinated changes in metabolism and hormones to initiate plentiful milk production.[14]

Thus, we hypothesized that acute disruption of the maternal circadian timing system (NT CS) alters the metabolism and hormones and results in the delayed onset of stage II lactogenesis. Light, activity, eating at night and sleep disturbances are well characterized chronodisruptors. These chronodisruptors have also been associated with hormonal and metabolic alterations during pregnancy and inadequate breastfeeding outcomes. In our study, the time to stage II lactogenesis was statistically significantly longer in the NT CS group. Circadian misalignment, as a consequence of an interrupted sleep cycle, sleep deprivation and exposure to light at night, may be the leading cause of delayed onset of stage II lactogenesis in the NT CS group.

Gestational age at delivery, parity, maternal education, mode and place of delivery, type of delivery attendant and prenatal and postpartum counseling about breastfeeding are reported to be among factors affecting the practice of timely initiation of breastfeeding.[22–24] Our study group consisted of women aged 18–43 years who had cesarean deliveries. All patients underwent CS at the same hospital. The week of gestation at birth, place of delivery and mode of delivery did not differ between the groups and all women received postpartum counseling about breastfeeding. The majority (67.70%) of the mothers initiated breastfeeding within the first hour of their delivery.

Time to onset of stage II lactogenesis varies widely, with reports ranging from the first hours after parturition to beyond day 7 postpartum. The perception of onset of stage II lactogenesis beyond 72 h postpartum is considered a delayed onset of lactogenesis.[10] Risk factors associated with delayed onset of stage II

lactogenesis include CS; primiparity; maternal obesity; delayed first breastfeeding episode; stress; pain; systemic illness, including diabetes, hypertension, hypothyroidism, hypopituitarism and Polycystic ovarian syndrome; breast injury/surgery; and smoking.[25] Other risk factors include longer duration of labor and elevated cortisol concentrations in both the mother and fetus.[10,26] In our study, all women underwent CS. There were no statistically significant differences in age, gravida, parity or BMI of the mothers between the groups ($P > 0.05$). The time to initiation of breastfeeding also did not differ statistically between the groups. Women with systemic disorders that might interfere with lactogenesis were excluded. In the present study, none of the mothers experienced lactogenesis beyond 72 h, but the time to stage II lactogenesis was significantly longer in the NT CS group.

Studies assessing milk production in the first few days after delivery according to infant weight have shown that the results are parallel to the mother's sensation of milk 'coming in'.[27,28] In our study, the mothers' experience, although less exact as a research tool, was very useful in practice.

It is well known that lactogenesis and breastfeeding outcomes are dependent on the mode of infant delivery. Published data indicate emergency CS in particular can have a marked negative effect on breastfeeding during the early postpartum period.[29] In our study, the time to lactogenesis II was significantly longer in emergency CS compared to elective CS; however, there was no significant difference in the number of emergency CS between the groups. In Turkey, some operations, including CS, are performed at patient request during the night shift for a small donation to the hospital; this is why some elective CS are performed at NT.

Although interesting findings were obtained in the present study, physiological parameters, including hormonal levels, sympathetic/parasympathetic dominance and blood sugar levels were not available to explain our observations. Seasonal, socioeconomic and regional factors also seem to affect the time to lactogenesis. Our study population all lived in Istanbul and had similar socioeconomic backgrounds. The study was performed between June and December 2016, a period that covers summer, autumn and winter. Our primary goal was to compare the day-night effects on the time to stage II lactogenesis. The effect of seasonal factors on time to stage II lactogenesis may be considered another limitation of the study.

The most striking result of this study is that NT CS is a risk factor for the delayed onset of lactogenesis. As many of the external factors that disrupt circadian rhythm are modifiable, interventions to eliminate the chronodisruptors should be considered. Clinicians can plan elective CS in DT. Indications for NT CS should be limited to emergency cases. Clinical practitioners can use the results of this study to assist in the counseling of breastfeeding mothers who have undergone NT CS in compulsory situations.

Acknowledgment

We thank Dr Mehmet Ilhan for assistance with English language.

Disclosure

The authors report no conflict of interest.

Author contributions

All authors have read and approved the final version of the manuscript.

References

1. World Health Organization, UNICEF, USAID, AED, UCDAVIS, IFPRI. *Indicators for Assessing Infant and Young Child Feeding Practices Part III: Country Profiles*. Geneva: WHO, 2008.
2. Ip S, Chung M, Raman G *et al*. Breastfeeding and maternal and infant health outcomes in developed countries. *Evid Rep Technol Assess (Full Rep)* 2007; **153**: 1–186.
3. World Health Organization. 10 facts on breastfeeding. 2015. [Cited 16 Jan 2016.] Available from URL: www.who.int/topics/breastfeeding/en
4. Cattaneo A. Protection, promotion and support of breastfeeding in Europe: A blueprint for action. 2004. EU Project contract N. SPC. 2002359. Trieste, Italy: European Commission, IRCCS Burlo Garofolo, WHO Collaborating Centre for Maternal and Child Health.
5. Public Health Agency of Canada. Protecting, promoting and supporting breastfeeding: A practical workbook for community-based programs. 2014. [Cited 13 Jan 2016.] Available from URL: www.publichealth.gc.ca/breastfeeding
6. World Health Organization. Global strategy for infant and young child feeding. the optimal duration of exclusive breastfeeding, WHA55 A55/15. Geneva: WHO. 2001 [Cited 16 Jan 2016.] http://www.who.int/nutrition/topics/infantfeeding_recommendation/en/
7. Pang WW, Hartmann PE. Initiation of human lactation: Secretory differentiation and secretory activation. *J Mammary Gland Biol Neoplasia* 2007; **12**: 211–221.

8. Chapman DJ, Perez-Escamilla R. Maternal perception of the onset of lactation is a valid, public health indicator of lactogenesis stage II. *J Nutr* 2000; **130**: 2972–2980.
9. Chen DC, Nommsen-Rivers L, Dewey KG, Lönnerdal B. Stress during labor and delivery and early lactation performance. *Am J Clin Nutr* 1998; **68**: 335–344.
10. Dewey KG, Nommsen-Rivers LA, Heinig MJ, Cohen RJ. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatrics* 2003; **112**: 607–619.
11. Matias SL, Nommsen-Rivers LA, Creed-Kanashiro H, Dewey KG. Risk factors for early lactation problems among Peruvian primiparous mothers. *Matern Child Nutr* 2010; **6**: 120–133.
12. Nommsen-Rivers LA, Chantry CJ, Peerson JM, Cohen RJ, Dewey KG. Delayed onset of lactogenesis among first-time mothers is related to maternal obesity and factors associated with ineffective breastfeeding. *Am J Clin Nutr* 2010; **92**: 574–584.
13. Evans KC, Evans RG, Royal R, Esterman AJ, James SL. Effect of caesarean section on breast milk transfer to the normal term newborn over the first week of life. *Arch Dis Child Fetal Neonatal Ed* 2003; **88**: F380–F382.
14. Fu M, Zhang L, Ahmed A *et al.* Does circadian disruption play a role in the metabolic-hormonal link to delayed lactogenesis II? *Front Nutr* 2015; **2**: 1–13.
15. Neville MC, Anderson SM, McManaman JL *et al*. Lactation and neonatal nutrition: Defining and refining the critical questions. *J Mammary Gland Biol Neoplasia* 2012; **17**: 167–188.
16. Association of Women's Health, Obstetric, and Neonatal Nurses (AWHONN). Breastfeeding [Position statement]. *J Obstet Gynecol Neonatal Nurs* 2015; **44**: 145–150.
17. Mullany LC, Katz J, Li YM *et al*. Breastfeeding patterns, time to initiation, and mortality risk among newborns in southern Nepal. *J Nutr* 2008; **138**: 599–603.
18. Lawn JE, Kerber K, Enweronu, Laryea C, Massee Bateman O. Newborn survival in low resource settings: Are we delivering? *BJOG* 2009; **116**: 49–59.
19. Alive and Thrive. Insight: Impact of early initiation of exclusive breastfeeding on newborn deaths. 2010. A&T Technical Brief. Issue 1. Washington DC: A&T.
20. Federal Ministry of Health Family Health Department Ethiopia. National strategy for infant and young child feeding. 2004. AED, USAID, WHO, UNICEF.
21. World Health Organization, UNICEF. *Global Strategy for Infant and Young Child Feeding*. Geneva: WHO, 2003.
22. Al-Kohji S, Said HA, Selim NA. Breastfeeding practice and determinants among Arab mothers in Qatar. *Saudi Med J* 2012; **33**: 436–443.
23. Berhe H. *Determinants of breastfeeding practice among mothers of children aged less than 24 months attending governmental maternal and child health clinics in Mekelle Town, Northern Ethiopia*. Addis Ababa: University Electronic Library, 2011.
24. Gladius Jennifer H, Muthukuma K. A cross-sectional descriptive study was to estimate the prevalence of the early initiation and exclusive breast feeding in the rural health training centre of a medical college in Tamilnadu, Southern India. *J Clin Diagn Res* 2012; **6**: 1514–1517.
25. Hurst NM. Recognizing and treating delayed or failed lactogenesis II. *J Midwifery Womens Health* 2007; **52**: 588–594.
26. Chapman DJ, Pérez-Escamilla R. Does delayed perception of the onset of lactation shorten breastfeeding duration? *J Hum Lact* 1999; **15**: 107–111.
27. Houston MF, Howie PW, McNeilly AS. Factors affecting the duration of breast feeding: 1. Measurement of breast milk intake in the first week of life. *Early Hum Dev* 1983; **8**: 49–54.
28. Neville MC. Regulation of mammary development and lactation. In: Neifert MR Neville MC (ed). *Lactation, Physiology, Nutrition, and Breast-Feeding*. New York: Plenum Press, 1983; 112.
29. Perez-Escamilla R, Maulen Radovan I, Dewey KG. The association between caesarean delivery and breastfeeding outcomes among Mexican women. *Am J Public health* 1996; **86** (6): 832–836.