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Comparison between autonomic nervous activity of women in the sitting and supine position on the first postpartum day

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Summary

Purpose of investigation: To investigate the differences in autonomic nervous activity of women in the sitting and supine positions. *Materials and Methods:* Autonomic nervous activity (high frequency (HF) and low frequency (LF) (ratio LF/HF) and vital signs of 42 women were determined on the first postpartum day. *Results:* In both primiparous and multiparous women, HR was significantly lower in the supine than in the sitting position ($p < 0.001$). Primiparous women showed higher HF in the supine than in the sitting position, whereas in multiparous women, HF was significantly higher in the sitting than in the supine position ($p < 0.05$). LF/HF was significantly higher in the sitting than in the supine position in primiparous women ($p < 0.001$). *Conclusion:* Significant differences between the sitting and supine postures may be due to differences in hemodynamics. Furthermore, in multiparous women, there is a possible absence of autonomic nervous balance on the first postpartum day.

Key words: Autonomic nervous activity; Postpartum women; Posture; Vital signs.

Introduction

Autonomic nervous activities are substantially influenced by factors including diet, exercise, sleep, posture, as well as stress [1]. Fukai *et al.* [2] stated that parasympathetic activity and the coefficient of variation of R-R interval increase significantly in the somnolent condition. Moreover, recently, it has become possible to assess autonomic nervous activities non-invasively through spectral analysis of heart rate (HR) variability (HRV). This analysis has helped to clarify many issues including the actual condition of autonomic nervous activities and mutual influences and relationships of the environment and/or factors of the component systems.

Autonomic nervous activities of women are intensively influenced by changes in the levels of endocrine hormones. During the menstrual cycle, estrogen increases the parasympathetic tone and progesterone reduces the parasympathetic tone [3]. In addition, during the gestation/intrapartum period in which female hormone levels change considerably, steroid hormones (estrogen and progesterone) influence the changes in autonomic nervous activities during pregnancy [4]. Women in their puerperal period are also indicated to possibly have an unstable condition and/or confusion in their sympathetic nerve system owing to a sharp decrease in progesterone caused by afterbirth [5].

Women in the postpartum period in the process of recovery generally have poor clinical significance unless they have any particular abnormality [6]; the autonomic nervous activities of women in the early postpartum period have not been discussed sufficiently. There is a study by Izumi *et al.* [7] on women in the postpartum period, but they included women within six months and seven to 12 months after childbirth, not women in the early postpartum period. Hence, only a few studies have focused on women in the early postpartum period. For example, Nakakita *et al.* [8] indicated the factors influencing autonomic nervous activities of women in the early postpartum period; they showed that not only female sex hormones, but also inexperience in child rearing and physical symptoms caused by pain after delivery can greatly influence the activities. The author mentioned that autonomic nervous activities on the first postpartum day in particular are likely to be unstable compared to that observed in the first to third day postpartum period [8]. Moreover, the author reported that autonomic nervous activities change differently in multiparous and primiparous women in the early postpartum period, indicating that delivery experience influences their autonomic nervous activities [9]. According to a study by Mizuno *et al.* [10] who investigated the autonomic nervous activities of women in the 35th week of pregnancy, early postpartum period, and after one month, no significant difference was detected in the sympathetic activity of the normal postpartum women between 35 weeks of pregnancy and early time/one month after childbirth, whereas the parasympathetic activity of postpartum women with mental stress tended to be enhanced on the first postpartum day. However, as the autonomic nervous activities of women in the early postpartum period are being accumulated currently, the actual status re-

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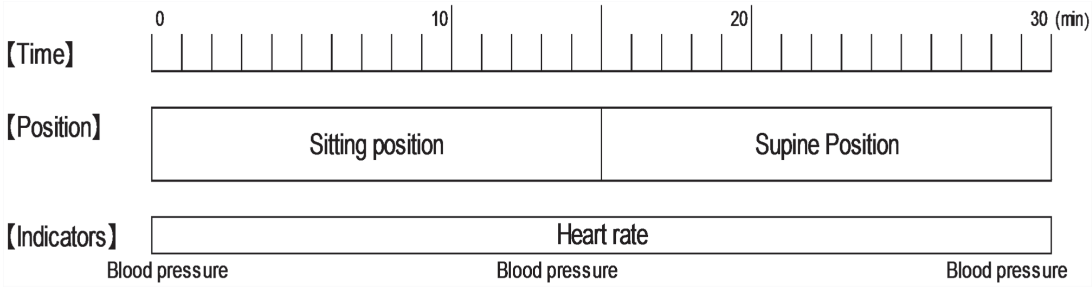

Figure 1. — Experimental protocol.

mains unknown.

Hayashi *et al.* [1] stated that autonomic nervous activities are remarkably influenced by posture; therefore, the posture change from the supine position, in which the parasympathetic nerve is predominant, to the standing position results in sympathetic nerve predominance. The present author suspects that posture-dependent changes in autonomic nervous activities are remarkable in the early postpartum period because endocrine hormones are elevated and women spend a lengthy time sitting for lactation and guidance after childbirth, among other factors in the early postpartum period.

This study aimed to examine the differences in hemodynamics and autonomic nervous activities depending on the posture by determining bloodless capture of the activities and blood pressure (BP) in the sitting and supine positions in primiparous and multiparous women on the first postpartum day, as autonomic nervous activities are substantially influenced by endocrine hormones. Because preceding studies have revealed differences in autonomic nervous activities considering the experience of delivery, the results of primiparous and multiparous women have been reported separately.

Materials and Methods

This was an experimental/investigational study with a cross-sectional design. The participants were women on the first postpartum day after normal delivery who were admitted to the Department of Obstetrics and Gynecology. The inclusion criterion included being a Japanese postpartum woman who was breastfeeding her healthy child. The exclusion criteria were the presence of any cardiovascular disease, mental disease, and/or other complication likely to affect assessment results, more than 500 ml of bleeding, and cesarean section.

The study included women from used a single center, i.e., an obstetrics and gynecology clinic located in Kanagawa Prefecture. The data collection period was four months between the end of April and the end of August 2010.

HR, the ratio of low frequency to high frequency (LF/HF), HF, and BP were measured. Data of HR, HF, and LF/HF were analyzed online by recording the HRV using an HR meter and via a spectral analysis program, MemCalc. HF was analyzed after logarithmic transformation ($\log_{10}$) because of the high individual difference and variation in the distribution of frequency domain. BP was measured by using a vital sign monitor and automated blood manometer.

Analytical methods for HRV included the analysis of total HRV (time domain) and a methodology in which frequency components of chronotropism of HR were subjected to spectral analysis (frequency domain) [11, 12]. The spectral analysis used for HRV in this study is highly useful because it can separately assess sympathetic and parasympathetic activities [12]. HF represents the function of the parasympathetic nerve on the heart, whereas LF/HF was used as an index of the function of the sympathetic nerve [1, 13-15].

Avoiding the time immediately after meals and after a shower, which are likely to affect autonomic nervous activities, data were collected between 1 pm and 5 pm in which the room temperature was set between 24°C and 28°C.

Data from participants in the sitting position were collected for 15 minutes. Following this, the participants maintained the supine position for 15 minutes for data collection (Figure 1). Data for five minutes, i.e., between five and ten minutes after start of the collection, were likely to be relatively stable and adopted in both the postures. Because the amplitude of the HF component is independently influenced by the respiratory rate due to the activity level of the vagus nerve on the heart [14], the participants underwent a practice for breath control in advance, in which they controlled their respiratory rate at 15 breaths/min by using an electronic metronome.

SPSS Statistics 22 software was used for statistical analysis. Sitting and supine BP, HR, HF, and LF/HF were analyzed by using the paired *t*-test.

The patients were provided with written and oral explanations regarding the purpose of the study, that inclusion in the study was arbitrary, and that they would not have any disadvantage in their other care even if they refused to participate in the study, that they could cancel participation during the study, and that their privacy would be guaranteed. They were informed that the data they provided would not be used for any other purposes than the study, and that it would be destroyed after completion of the study; however, they were informed that their anonymized data would be presented at academic conference(s). Thereafter, they provided written informed consent. This study protocol was approved by the Research Ethics Review Committee of Graduate School of Health Management, Keio University.

Results

The baseline characteristics of the participants are shown in Table 1. Tables 2 and 3 show the differences in hemodynamics and autonomic nervous activities between the sitting and supine positions in primiparous and multiparous women.

Table 1. — *Participant characteristics.*

		Primiparous (n = 18)	Multiparous (n = 24)
Age (years)		30.6 ± 4.8	32.5 ± 4.3
Time required for delivery (minutes)		723.7 ± 340.4	251.0 ± 184.3
Baby's birth weight (grams)		3069.2 ± 236.6	3081.7 ± 266.7
Amount of bleeding (grams)		257.3 ± 104.3	220.2 ± 104.2
Episiotomy	Yes	18 (100%)	20 (83.3%)
	No	0 (0%)	4 (16.7%)

Table 2. — *Physiological indices of the primiparous group (n = 18).*

	Sitting position	Supine position	*t*-value	*p*-value
Heart rate (b.p.m)	76.3 ± 9.0	70.4 ± 8.6	4.418	<0.0001
HF ($msec^2$)	2.40 ± 0.39	2.49 ± 0.42	-0.929	0.366
LF/HF ($msec^2$)	1.18 ± 0.19	1.03 ± 0.16	5.056	<0.0001
Systolic blood pressure (mmHg)	110.1 ± 11.1	107.3 ± 11.3	1.704	0.107
Diastolic blood pressure (mmHg)	65.2 ± 9.1	63.4 ± 9.7	1.120	0.278

HF: high frequency, LF: low frequency.

Table 3. — *Physiological indices of the multiparous group (n = 24).*

	Sitting position	Supine position	*t*-value	*p*-value
Heart rate (b.p.m)	70.2 ± 9.6	66.3 ± 9.5	4.251	<0.0001
HF ($msec^2$)	2.74 ± 0.32	2.53 ± 0.48	2.644	0.015
LF/HF ($msec^2$)	1.06 ± 0.09	1.00 ± 0.14	2.012	0.057
Systolic blood pressure (mmHg)	107.7 ± 9.5	108.0 ± 12.0	-0.131	0.897
Diastolic blood pressure (mmHg)	63.6 ± 8.9	63.4 ± 8.6	-0.925	0.365

HF: high frequency, LF: low frequency.

The mean sitting HR was significantly different ($p < 0.0001$) in both primiparous and multiparous women. The HF value of multiparous women was significantly higher in the sitting than in the supine position ($p < 0.05$). The HF of primiparous women was higher in the supine than in the sitting position, but no significant difference was detected.

The mean $\log_{10}$ LF/HF of primiparous women was significantly higher in the sitting than in the supine position ($p < 0.001$). The mean $\log_{10}$ LF/HF of multiparous women was also higher in the sitting than in the supine position, similar to that observed in primiparous women, although the difference was not significant. Both systolic and diastolic BPs of primiparous as well as multiparous women in the sitting and supine positions were not significantly different.

Discussion

In this study, a comparison of the sitting and supine positions showed a significant difference in HR, HF, and LF/HF. This is partly consistent with the results obtained in the study by Kamidate *et al.* [16] in which the HR was elevated, LF/HF was increased, and HF was decreased in the sitting position. Hence, in this study, it was confirmed that postural change caused a visible change in autonomic nervous activities through a change in hemodynamics even in women in the early postpartum period.

HR was significantly lower in the supine than in the sitting position in both primiparous and multiparous women. This is probably because of the decrease in the cardiac output due to decline in venous return caused by the influence of gravity attributable to the sitting position [17]. Moreover, HF of primiparous women was lower in the sitting position although no significant difference was detected, whereas LF/HF showed a significant increase in the sitting position compared to the supine position. In addition, regarding BP, although no significant difference was detected, both systolic and diastolic BPs were higher in the sitting position than in the supine position. Kamidate *et al.* [16] stated that sitting up and the subsequent drop of the lower thighs from the supine position are mild stresses on the body through stimulation of the autonomic nerves. In the present study as well, the results of the primiparous women demonstrated that the sitting position was a mild stress compared to the supine position. However, among multiparous women, although no significant difference was detected, LF/HF was higher in the sitting position than in the supine position, whereas HF showed a significant increase in the sitting position compared to the supine position. In addition, little difference was seen in their BPs between the sitting and supine positions.

The supine position results in parasympathetic nerve predominance [1,13]. Ichiba *et al.* [18] reported that parasympathetic activity was predominant in the semi-Fowler's position compared to the upright sitting position, and the semi-Fowler's position was useful as a relaxation position in their study among healthy university students. In addition, a study to verify the effect of back massages on women in the early postpartum period also indicated a relaxation effect of supine resting [19]. Thus, the study obtained a different result for HF of multiparous women compared to those of preceding studies as well as primiparous women in this study. However, this is probably owing to the data collection method in which data were collected by unifying the experimental environment and conditions for both primiparous and multiparous women. Therefore, there may be an obstetrical reason that has yet to be clarified. Moreover, because the number of participants is small in this study, it is necessary to confirm whether these results by accumulating more data. If the same results as the present study are obtained, an examination of why only HF of multiparous women shows a different result will be necessary in the future. Thus, considering the results of the present study and the preceding studies, the sympathetic and parasympathetic activities seem to be suppressed and enhanced, respectively, in a more intensive manner in the supine position than in the sitting position in women in the early postpartum period, similar to that observed in normal female adults. The present author believes that the results of this study are a valuable basic resource for conducting studies and for interventions in women in the early postpartum period.

Conclusion

This study examined differences in the autonomic nervous activities and hemodynamics depending on the posture of women in the early postpartum period, and revealed the following: 1) in women in the early postpartum period, sympathetic and parasympathetic activities are suppressed and enhanced, respectively, in a more intensive manner in the supine position than in the sitting position, as seen in general adults, and a significant difference was seen in BP between the postures and 2) the results regarding HF of multiparous women were different from those of preceding studies, as well as those of primiparous women in this study.

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