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INTERACTION BETWEEN CHRONIC STRESS AND LACTATION

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ABSTRACT

Chronic stress can be either due to many stressors or due to same stressor continuously for a prolonged period, which repeatedly activates autonomic nervous system and hypothalamic-pituitary-adrenal axis without relaxation response, resulting in persistent physiologic effects. Physiologic response causes malfunctioning of HPA axis to release excess cortisol, the principle stress hormone. Studies have shown that acute physical and mental stress can impair milk ejection reflex. If this occurs repeatedly during prolonged stress, it could reduce milk production by preventing full emptying of the breast at each feed. As the effects of chronic emotional stress on lactation are not known, this study was conducted to assess the relation between maternal chronic stress and lactation. Pregnant women were assessed for the level of stress with the help of Holmes and Rahe stress scale, 96 were selected for the study. Objective measurement was done by analyzing serum cortisol levels by electrochemiluminescence immunoassay. It was observed that among 96 subjects 36 (37.5%) were mildly stressed, 34 (35.41%) were moderately stressed and 26 (27.08%) were severely stressed. Serum cortisol levels were high in moderately stressed subjects when compared to mildly stressed subjects with $p< 0.05$. Also high levels of serum cortisol were observed in subjects with severe stress when compared to moderately stressed subjects with $p< 0.05$. Milk volumes were measured upto 5 days postpartum by test weighing method using digital weighing machine. Daily milk volumes were compared between mildly, moderately and severely stressed subjects. Gradual decrease in the mean milk volumes were recorded with $p< 0.05$. So chronic stress may hamper the lactation.

KEY WORDS : **Lactation, chronic stress, serum cortisol, milk volume.**

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INTRODUCTION

Human milk is a carefully engineered substance, has unique composition ideal for the growth and development of infants. Availability of mother's milk is conceivable only if lactation is sustained. To safeguard lactation, it is necessary to know the physiology of lactation, how to initiate and maintain maternal interest in breastfeeding particularly at the time of stress. The initiation of lactation/milk production is based on research conducted over the past 20 to 25 years.[1] Daly and Hartmann separated the onset of milk production into two phases, lactogenesis I (L-I) and lactogenesis II (L-II).[2,3] During mid-pregnancy the mammary gland gains the ability to secrete milk; L-I, but full milk secretion is inhibited by the high levels of oestrogen and progesterone yet the gland remains quiet and prepared to initiate lactation after birth.[4] L-II is the onset of copious milk production after parturition with a severe decline in the milk inhibiting hormones progesterone (in particular), oestrogen and placental lactogen, also simultaneous increase in concentration of prolactin from the anterior pituitary.[5] The initiation and maintenance of lactation require appropriate hormonal changes and maternal behavior. When lactation insufficiency cannot be explained with inadequate mammary development, it is routinely blamed on maternal stress. Depending on the duration of the stress, suppression of lactation may result from a decrease in milk synthesis or ejection. The prevalence of stress during pregnancy has been found to range from 6% to as high as 52.9% in developing countries.[6,7] Two potential mechanisms can be hypothesized for the relationship between stress and lactogenesis. First, maternal stress seems to interfere with the release of oxytocin, that is responsible for the milk ejection reflex. If the milk ejection reflex is impaired often, then the incomplete removal of milk from the breast eventually will lead to down-regulation of milk synthesis. Although milk removal is not necessary to trigger lactogenesis II, it may be related to the timing of onset of full milk production or the volume of milk produced.[8,9] Maternal stress affects levels of prolactin involved in lactation, but there is little evidence about this in humans. Second, a newborn who experienced stress during labor and delivery may be too weak or too sleepy to latch on and suckle effectively at the breast. Even if the lactational capacity of the mother is not compromised, this could lead to impaired lactogenesis if milk removal is not adequate. It may happen that the causal pathway between maternal stress and lactogenesis could be reversed i.e. mothers who experience delayed onset of milk production are likely to become stressed as a result. In observational studies it is often difficult to determine the relationship between cause and effect.[9] General references vary in their descriptions of the onset of L-II from two to three days, to four days up to even eight days postpartum.[4,8] Then the onset of L-II is categorised into the early onset of lactogenesis as less than 72 hours and delayed onset as more than 72 hours.[10] Animal studies have demonstrated suppression of lactation after exposure to certain types of stressful stimuli.[11] Most of these studies were performed during established lactation, not during lactogenesis. In humans the studies have examined whether maternal stress affects the milk ejection reflex or the amount of milk transferred during a feed. The first was a unique experiment by Newton and Newton in 1948, which involved three different types of distractions imposed during the first morning feed on a mother. Immersion of her feet in ice water for 10 sec of every 30 sec; verbal math problems, accompanied by mild electric shocks if the mother got the wrong answer or took too long in answering and intermittent pulling of the mother's big toes, causing sharp pain. Despite the fact that the study included only one woman, the novel design of the experiment provided useful information. Milk intake by the infant at the first morning feed was measured on 8 control days and 12 distraction days ie, 4 days for each of the three treatments. Milk intake on control days was quite consistent, ranging from 142 to 209 g (mean, 168 g).[12] These findings indicate the effect of acute stress on lactation. The effect of chronic stress on lactation is not known. As chronic stress is a state of on-going physiological arousal. This occurs when the body experiences several stressors or a single stressor continuously, that it does not have the ability or opportunity to activate the relaxation response.[13] Physiologic stress response involves activation of autonomic nervous system and HPA axis, which originate in brain.[14] With chronic stress both systems are repetitively activated, thus resulting in persistent physiologic effects.[15] Severe stress alters HPA axis, malfunctions negative feedback loop resulting in excess production of CRH from hypothalamus, which stimulates anterior pituitary for the systemic release of ACTH (adrenocorticotrophic hormone), which subsequently signals the adrenal glands to release glucocorticoids predominantly cortisol.[16,17] Serum cortisol levels gradually increase from 6 weeks to 40 weeks of pregnancy and a sharp rise may be noted two weeks before the onset of labor. Cortisol levels indicate the objective measure of chronic stress during pregnancy. High cortisol levels in pregnancy has been associated with adverse pregnancy outcomes like aborted fetus, delayed fetal growth [18,19] and may be on lactogenesis also. The study was conducted to assess the level of stress in 1st, 2nd and 3rd trimesters of pregnancy to correlate the interaction between chronic stress and cortisol in all the three trimesters of pregnancy, also relation between chronic stress and milk volume output.

MATERIAL AND METHODS

The study was conducted during the period 2012 - 2015 in Karimnagar, Telangana state. 96 pregnant women in the reproductive age (21-45 yrs) attending the antenatal clinic of Prathima institute of medical sciences were enrolled for the study. The study was designed and got approved by the ethical committee. The research protocol was explained to the participants, also their role in the study and were asked to sign the consent form if were willing to take part. A proforma was obtained consisting of clinical and other details of the pregnant women. Participants were assured that despite entering in the study they could withdraw any time they wished and their information would be kept confidential.

Inclusion criteria

Participants included were non-smokers, with no history of diabetes mellitus, with no h/o major endocrinal abnormalities.

Exclusion criteria

Pregnant women with the history of nonlactogenesis, with no intention to breastfeed were excluded from the study.

To measure stress according to the Holmes and Rahe Stress Scale, the number of "Life Change Units"(LCU) that apply to events in the past year of an individual's life were added and the final score gave a estimate of how stress affects health. Pregnant women at different age groups were assessed for the level of stress by asking questionnaire as per Holmes and Rahe stress scale and categorised into mildly, moderately, severely stressed groups.Mild stress; LCU<150, moderate stress; LUC150-299, severe stress; LCU≥ 300.Objective measurement was done by analyzing the serum cortisol levels in all the three trimesters of pregnancy. Blood samples(5-7ml) were collected by venipuncture between 8.30am – 10.30am with all sterile precautions, placed in evacuated tubes and then taken to laboratory in ice box, centrifuged at 1300xg for 20 min at 4ºC in a refrigerated table top centrifuge. Serum samples for hormone assays were frozen at -20ºC until analyzed. Elecsys cortisol reagent kit, Cat. No. 11875116 was used for Serum cortisol quantitative determination by electrochemiluminescence immunoassay (Roche Elecsys 1010/2010). Women were encouraged to express breast milk 8 times per day from day 1 to day 5 postpartum. Milk volumes(ml) were measured by test weighing method on digital weighing machine. Results were recorded and data analysis was done. The software SPSS16.0 was used for data analysis.

RESULTS

Table I

Stress levels in different age groups

Age groups (yrs)	Mildly stressed (<150)	Moderately stressed(150-299)	Severely stressed (>300)	Total
20 – 25	14	7	7	28
26 – 30	8	9	5	22
31 – 35	8	8	7	23
36 – 40	4	7	3	14
41 – 45	2	3	4	9
	36(37.5%)	34(35.41%)	26(27.08%)	96

Among 96 pregnant women 37.5% were with mild stress, 35.41% were with moderate stress and 27.08% were with severe stress.

Table II

Cortisols at different stress levels during pregnancy

	1st trimester	2nd trimester	3rd trimester
Mean cortisol in µg/dl with SD at stress<150, n=36	14.68±1.30	23.28±1.79	29.49±3.63
Mean cortisol in µg/dl with SD at stress 150-299, n=34	20.62±0.29	25.16±1.35	29.42±1.11
Mean cortisol in µg/dl with SD at stress >300, n=26	23.09±1.95	27.34±1.38	32.69 ± 0.47

The cortisol levels were significant with p≤ 0.05 when compared with controls (9.6 - 14.0 µg/dl).

Table III

Milk volumes (ml) from day1 to day 5 postpartum at different stress levels

	Mean, SD of milk vol in mild stress(< 150)	Mean, SD of milk vol in moderate stress(150-299)	Mean, SD of milk vol in severe stress(> 300)
Day 1	47.63 ± 3.33	43.60 ± 3.28	38.82 ± 4.89
Day 2	95.72 ± 5.38	85.89 ± 5.15	78.26 ± 7.51
Day 3	261.77 ± 17.57	172.81 ± 18.59	134.44 ± 16.13
Day 4	379.27 ± 14.29	294.54 ± 20.53	217.70 ± 49.22
Day 5	596.06 ± 16.81	409.83 ± 42.80	349.53 ± 39.38

Total of 96 pregnant women were included in the study group, in the age range of 21-45 yrs. It was observed that 36 (37.5%) women were in mild stress, 34 (35.41%) women were moderately stressed and 26 (27.08%) women were severely stressed (Table-I). The mean and SD of serum cortisol levels in nonpregnant women (controls) were 12.3±3.8 µg/dl. It was observed that mean cortisol levels were higher in moderately and severely stressed women than in the controls. It was observed that women of age group 21-25 yrs with <150 LCU were having almost normal or more than normal levels of cortisol. Women of age group 36-40 yrs were having very high levels of serum cortisol because of their declining reproductive age. It was observed that serum cortisol levels of stressed subjects were increased in 2nd trimester than that in 1st trimester, also reached to peak levels in 3rd trimester (Table-II). Milk volumes were reduced gradually (with p<0.05) in moderately and severely stressed women when compared with the milk volumes of mildly stressed women(Table-III). Lower milk volumes were observed in moderately stressed subjects when compared with milk volumes of mildly stressed subjects. Similarly milk volumes were still lower in severely stressed subjects when compared with the milk volumes of moderately stressed subjects. The milk volumes were significant with p≤ 0.05.

DISCUSSION

In our study it was observed that the milk volumes were significantly reduced in severely stressed women. The first study conducted by Newton and Newton in 1948, indicated that, the maternal acute stress suppresses the lactation.[12] Similar study by Feher, Berger etal, estimated the milk vol output from the mothers who gave birth prematurely.[20] They observed that the mothers were in stress and the milk volume was reduced when compared with the milk volumes of controls. So, lactation insufficiency can be because of maternal stress. These studies were conducted in women with acute stress. Our study is conducted in women with chronic stress. Chronic stress is a state of on-going physiological arousal. This occurs when the body experiences several stressors or a single stressor continuously for prolonged period, that it does not have the ability or opportunity to activate the relaxation response that leads to malfunctioning of HPA axis and so excess cortisol. This type of chronic stress response occurs may be because of our modern lifestyle, when everything from high-pressured jobs to loneliness to busy traffic can keep the body in a state of perceived threat and chronic stress ie, due to everyday stressors which are ignored or poorly managed. [13]

CONCLUSION

Human milk is the ideal food for infants because of its unique nutritional characteristics and with the benefits of human milk well recognized, it is necessary to focus attention on how to optimize lactation for the benefit of newborns and it is essential to bring awareness in population. Further research is required to gain a better understanding of the differential effects of stress on lactation.

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