

Cortisol Effect on Maternal Pain in the Labor Environmental Settings

¹Nanik Cahyati*, ²Fitri Nurhayati

^{1,2}*Department of Midwifery, School of Health Sciences Jenderal Achmad Yani,*

***Email: nanikcahyati3@gmail.com.**

Abstract

A safe and satisfactory birth experience depends on some degree of stress experienced by a woman giving birth. Fear and anxiety can disrupt the subtle neuro-hormonal influences that drive labor and birth, allowing for intervention at delivery and associated with greater potential risk to life for the well-being of women, infants and families. Setting the delivery environment is one of the non-pharmacological methods to divert attention from maternal pain. This study aims to determine the effect of cortisol hormone on maternal pain in the setting of labor environment. This research uses quasi experimental method of pre post test with control group design with 60 mothers in Self-Employment Midwife (in Bahasa Indonesia, it was abbreviated as BPM). Test statistical analysis using Mann-Whitney Test, T Test and Double Regression Test. The results obtained were: there was a difference of average pain between treatment and control group at T1 (4,97 vs 5,67; $p = 0,109$), and at T3 (8,27 vs 8,50; $p = 0,218$), whereas in T2 the mean pain of the treatment group was lower than in the control group (6.70 vs 7.30, $p = 0.039$). There was no effect of percentage increase of cortisol level with labor pain ($P > 0,05$). Conclusion of this research there was no effect of cortisol on maternal pain in labor environmental setting.

Keywords: Cortisol, maternal pain, labor environment

Introduction

Labor is an unforgettable woman's experience, and every woman wants a fun, healthy, and comfortable experience both during pregnancy and maternity. For most women in society, they want a natural childbirth without strong pain in their life. One of the factors that increase maternal stress is the physical environment of the delivery room; where most still apply a relatively physically visible (Susilowati, 2014, Jenkinson B, 2014).

Environment is the biggest factor in the healing process in the medical community, which is 40%. The physical environment affects 94% of the easy or difficult to give birth. The environment in labor affects the delivery process but unfortunately is still neglected and tends to provide fear, anxiety, boredom, and stress in pregnant women so as to interfere with subtle neuro-hormonal influences that encourage intervention at delivery and birth (Munro J, Jokinen M, 2012, Hadibowo C, Wardono P, 2014).

Stress is a physiological or psychological tension caused by a stimulus called a stressor that can be formed in a pain stressor. Stressor pain can cause painful sensations or painful disturbances or suppress feelings that can be physical and psychological. The mechanism of stress is characterized by increased secretion of Corticotropine Releasing Hormone (CRH), which acts as a regulator of a number of cortisol in the blood. CRH is secreted into the pituitary portal system which will secrete glucocorticoid hormone, one type of glucocorticoid hormone is cortisol. High levels of cortisol can suppress and increase susceptibility to the immune system. Macrophage lymphocyte cells play a role in the adaptive immune system, cortisol which is a stress hormone, contributes to the adaptive immune system (Kantasa, et. al., 2016).

The fear of birth incidence increased by 6% of all parturient and 8-22% of all reasons for caesarean section. The fear of spontaneous labor experienced primipara often comes from the psychological effects of one of them causing great pain at the time of childbirth, while fear of another delivery is the result of a previous history of uncomfortable labor. The physiological factors of labor pain are due to uterine contractions and cervical dilatation which in this case plays an important role during labor. Psychological factors such as stress due to pregnancy, will increase in the mother who will enter the maternity room and along with stressful situations of factors that affect the perception of pain during labor one of which the environment itself that can affect a

mother's experience of pain and tension so that will affect neuro hormone in the body. (Hadibowo C, Wardono P, 2014).

Fear and anxiety are psychological factors; which considered to be significantly effect the labor pain. Psychological factors in the form of anxiety to face labor have short-term and long-term consequences on both mother and fetus' health (Munro J, Jokinen M, 2012). From the above explanation, one of the main goals in providing intrapartum care is pain management during the delivery. The non-pharmacological approach to pain management includes various techniques that address not only the physical sensation of pain, but also seek to prevent suffering by increasing the psychoemotional and spiritual components of care. The ideal delivery environment is one for non-pharmacological therapy approaches by fostering a sense of comfort and privacy. It can help comfort and places to walk, bathe, and rest. Based on the above background, the authors are interested to conduct research on "Cortisol Effect on Maternal Pain in the Labor Environmental Settings".

Method

This research uses Quasi Experimental method, with Pre-Post Test Control Group Design on 60 first-stage maternal mothers. Pain assessment using Numerical Rating Scale (NRS) was performed three times: the first measurement (T1) by the time when the mother came to the BPM, second (T2) after 60 minutes in labor and third (T3) at opening 8-9 cm and all pain measurement not under His circumstances. Blood sampling for cortisol examination in the latent phase and 10 minutes of infant after birth. Test statistical analysis using Mann-Whitney Test, T-Test, and Double Regression.

Results

Table.1
Research Subjects Characteristics

Characteristics	Group				P Value*
	Intervention		Control		
	n	%	N	%	
1. Mother's Age (yr) :					1,000*
< 20	4	13,3	4	13,3	
20-35	26	86,7	26	86,7	
2. Educational Background:					0,107**
Basic (Primary – Junior High)	6	20	13	43,3	
Intermediate (Senior High)	17	56,7	14	46,7	
Advance (Higher Education)	7	23,3	3	10,0	

Annotation : *) Fisher Exact Test; **) Chi Square Test

Based on table 1, the results of statistical test differences in the characteristics of subjects based on age obtained p value = 1,000 and for education p = 0.107. The results of this test indicate that there is no significant difference ($p > 0.05$) between maternal characteristics in the intervention group and maternal mothers in the control group.

Table 2
Cortisol Levels Differences in the Intervention Group and Control Group

Cortisol (µgr/dl)	Group		p Value
	Intervention (n = 30)	Control (n = 30)	
Pre			0,988*
Mean (SD)	371,20 (121,84)	429,12 (245,55)	
Median	361,21	334,18	
Range	140,00 – 579,86	160,05 – 895,83	
Post			<0,001**
Mean (SD)	546,13 (167,04)	760,19 (263,85)	
Median	523,374	799,797	

Range	277,98 – 936,21	305,49 – 1259,89	
Increased cortisol (%)			0,007*
Mean (SD)	57,30 (55,87)	108,21 (85,86)	
Median	34,88	79,09	
Range	1,93 – 211,04	5,46 – 347,42	

Annotation: *) based on Mann –Whitney Test
 **) based on un-paired T Test

Table 2 presents the cortisol differences from both the measurement and the percentage of improvement. Appearance at the measurement of pre (latent phase) between the two groups did not show any significant difference ($p = 0,988$); whereas in post-measurement (10 min after infant birth) and percentage of improvement showed significant difference ($p < 0,05$). Increased cortisol (%) in the intervention group (57.3%) was lower when compared to the control group (108.21%).

Table 3
Pain Scores Differences in the Intervention Group and Control Group

Pain Score	Group		P Value ^{*)}
	Intervention (n = 30)	Group (n = 30)	
First NRS:			
Mean (SD)	4,97 (1,35)	5,67 (1,81)	0,109
Second NRS:			
Mean (SD)	6,70 (1,06)	7,30 (2,15)	*0,039
Third NRS:			
Mean (SD)	8,27 (1,28)	8,50 (1,80)	0,218
Pain Mean Score			
Mean (SD)	6,67 (0,922)	7,20 (1,562)	0,037

Annotation: *) based on Mann-Whitney Test;

Table 3 presents pain scores differences in both study groups from all three measures. In the first measurement of pain scores, both groups were not significant ($p = 0,109$) while in the measurement of both pain scores was significantly different when compared with control group ($P = 0.039$) while in the third median score the pain score in both groups was not significant ($p = 0,218$).

Table 4
**Cortisol Levels Effect and the Regulation of Labor Environment
 on Maternal Pain Score**

	Variable	CoefficientB	SE (B)	Coefficient Correlation	P Value
The initial model	The labor environment setting	0,152	0,445	0,082	0,573
	% Cortisol level rises	0,002	0,003	0,109	0,422
	The first pain score	0,311	0,136	0,327	0,020
Final model	The first pain score	0,288	0,119	0,304	0,018
	Permanent	6,923			-

Annotation: *) $r^2 = 9,2\%$.

Based on the results of the multiple regression analysis above, it appears that multivariable percentage of cortisol levels increase and the regulation of birth environment did not correlate significantly with maternal pain score (third measurement). From the final model, the

effect of pain score (first measurement) on the increase of maternal pain score (third measurement) is 9,2%, and the rest 90,8% are unexamined other factors.

Discussion

The subject characteristics seen in the study depicted on age and education level. The subject of this study is mostly aged 20-35 years, and the level of education pursued in this study is mostly high school. According to Swelling et.al, education and age in general may affect maternal psychosocials in addition to the preparation and expectation of labor to be lived.

From the research, there were no significant differences ($P > 0,05$), but post-baby measurement was significantly different ($p < 0,05$). This cortisol level increases during pregnancy and continues to increase until labor. In one study, cortisol levels in saliva during labor increased from $27.8 \pm 2.2 \text{ nmol / L}$ in the first stage of labor to $64.1 \pm 4.2 \text{ nmol / L}$ soon after birth placenta, followed by a decrease to $12.6 \pm 1.3 \text{ nmol / L}$ in the next 17 hours. However, the increase of cortisol (%) in the intervention group (57.3%) was lower when compared to the control group (108.2%), this was because the maternal cortisol levels were affected by two physiological mechanisms ie feto-uteroplacental and bone corticosteroid feedback behind negative stress response HPA-axis, this is what underlies the measurement of cortisol hormone as a biomarker of stress in humans. The cortisol examination may provide clues about the sensitivity of HPA-axis components during labor and manipulation justified through interventions to reduce psychophysiological stress during labor. In labor, maternal cortisol levels are affected by acute stress. Anxiety and excessive stress (distress) will cause hormone imbalance that causes stress response resulting in increased hormones catecholamine and cortisol (Buckley SJ, 2015).

Differences of pain scores in the treatment group with the control group at the first measurement (T1) were performed in the maternal mother at the time of the latent phase and newly entering the delivery environment. There was no difference in pain score between the treatment group and the control group ($P > 0.05$).

Maternal pain is the context of an individual woman formed from the process of physiology, psychology. According to Read (1994) stresses that the intensity of pain during labor is primarily related to emotional tension. The results of another study showed that women who first became pregnant experienced more severe sensory pain compared with the apparently mildly multipara pelvic pain during labor as a result of stimuli from the nociceptor in the vagina, vulva, perineum and rapid fetal decline. This indicates that the condition of the mother is in the same condition so that the pain score before treatment has the same value (Lowe NK, 2002, Labor S, 2008).

The second examination was performed when the mother had adapted 60 minutes with the environment in labor environment and the result showed that there was a significant difference with the result ($P = 0,039$). This shows that a physical environment has an effect on thinking, feeling, and human behavior. A designated environment in which space can provide stimuli (stimuli from outside) that can be responded by the human senses system (sight, hearing, taste, smell, and touch), where psychologically potentially form a perception that is not directly affect the emotional as well as human behavior.

Based on research conducted by Debrri entitled Relation Implementation of Elements of Interior Healing Environment at Inpatient Room in Reducing Stress, this research is one of proving that interior space has an influence on thinking, feeling, and human behavior. This stress condition is recognized by the patient can be minimized through the application of healing environment elements in the interior of the inpatient room. The concept of healing environment which is one of the concept of forming a maintenance environment that combines physical and psychological aspects of the patient in it which aims to accelerate the process of adaptation of the patient so that with the physical limitations of a patient can adapt quickly which affects the decrease of stress level. (Princess DH, Widihardjo, Wibisono A, 2013)

Based on a multivariable analysis the percentage increase in cortisol levels and the setting of birth environment did not correlate significantly with maternal pain score (third measurement). From the final model, the effect of pain score (first measurement) on the increase of maternal pain score (third measurement) is 9,2%, and the rest 90,8% are unexamined factors.

In this case the delivery environment gives a great effect on the mother of every individual require adaptation of new environment as in this research is labor environment. The process of labor has a great effect on comfort, anxiety, fear, the smoothness of labor and patient satisfaction so that stress in labor is defined as psychological stress, which is a combination of fear

and pain, experienced by women during childbirth itself affects a mother's experience of taste sick. By setting the environment with attention to 5 senses by giving the impression of a relaxed, cool and comfortable will affect the hormone endorphins so that pain can be overcome.

In the case of labor pain caused by the release of oxytocin, hypoxia (lack of oxygen) in the uterine muscle, uterine muscles contracting cervical stretching, tubal pull, ovaries and ligaments of uterine ligaments, uterine ischemia (decreased vascularization and oxygen deprivation in the area) from compression of the arteries supplying to the myometrium during uterine contractions, the pain at the onset of labor has not been too painful and is not always sensitive to opioids. The pain at the end of the first and second stage of labor is closer to birth, quite distinctive and easily localized within the vagina, rectum and perineum (Lowe NK, 2002, Labor S, 2008, Gupta S, 2006).

In the case cortisol also acts on the immune system and endogenous opioid system. Although these opioids come out within a few minutes, their initial function may only be to inhibit or modulate the release of cortisol.

An intravenous study of intravenous epinephrine to 10 women to reduce uterine contractions by 55% takes 2 minutes. In experimental studies with animals showed that the analgesic effect on them did not show up for 30 minutes after the pain (Buckley SJ, 2015, Dixon L, Skinner J, Foureur M, 2013).

It could be assumed that there is no correlation with the maternal response in response to the available physical environment, when responding to something happens because we get external stimuli received by the five senses. The total time required to respond to a stimulus is called reaction time. The reaction time of a person responds to a very fast stimulus of approximately 150-200 milliseconds but the adjustment to his environment depends on the level of adaptation of the person concerned in his environment. The level of adaptation is not only different from one human to another so that the function of experience but occurs due to differences in stimulation levels from time to time. The level of adaptation will occur shifting the tolerance threshold of a person to the stimulus environment continuously provide stimulation, then it will decrease standard and follow the will of the environment. (Sutalaksana IZ, 2006, Sarwono SW, 1992)

Besides, it is a subjective pain although the mechanism is unclear, even the brain structure that causes the perception is also unclear, the pain threshold of each individual is different, the pain threshold will come down when we feel tired, anxious, angry, depressed, scared and isolated. The ability of a person to manage the stress experienced (coping) is different, in this case adaptive coping pattern will facilitate someone overcome the pain and vice versa maladaptive coping pattern will make it difficult for someone to overcome the pain. Pain perception is influenced by subjective factors, so pain is fundamentally subjective experience (Fraser MD, Cooper AM, 2009, Kitahat LM, 1994).

This is supported by the study of Ye (2009) which states that mothers who have a good understanding of the birth process, the level of pain will be felt lighter than the mother who has poor understanding. A good understanding for mothers can reduce the fear and make mothers do not experience excessive tension. In theory, according to Caceres and Burn 2010, a good perception for the mother can also come because she is more focused on gratitude because it can experience the process of labor, whereas in mothers who have poor perception, the anxiety will be increased so that there is a cycle of pain – stress – pain and so on.

Conclusion

Our research shown that there is a difference in labor pain in the second measurement, 60 minutes after the mother's adaptation in labor environment. However, there is no correlation of cortisol level increase to labor pain in the delivery environment.

Acknowledgment

The funding of this study is excluded from private. Acknowledgments goes to Stikes Jenderal A. Yani Cimahi who has provided support to this research and to the Lab at the Faculty of Medicine Unpad and ITB interior design team who has assisted in the implementation of this research.

References

Buckley SJ. 2015. *Hormonal Physiology of Childbearing : Evidence and implications for women, babies, and maternity care*. Childbirth Connection a program national partnership for women and families.

- Dixon L, Skinner J, Foureur M. 2013. *The emotional and hormonal pathways of labour and birth: integrating mind, body and behaviour*. New Zealand College of Midwives.
- Fraser MD, Cooper AM. 2009. *Myles Buku Bahan Ajar kebidanan*. EGC.
- Gupta S, Kumar A, Singhal H. 2006. *Acute Pain - Labour Analgesia*. Indian J Anaeseth.
- Hadibowo C, Wardono P. 2014. *Perancangan Birth Center Dengan Pendekatan Cognitive Behavioral Therapy Di Bandung*. Jurnal Tingkat Sarjana bidang Senirupa dan Desa
- Jenkinson B, Josey N, Kruske S. 2014. *BirthSpace: An evidence-based guide to birth environment design*. Queensland Centre for Mothers & Babies, The University of Queensland.
- Kantansa, et.all. 2016. *Efek stressor rasa sakit renjatan listrik terhadap jumlah sel radang limfosit dan makrofag pada Gingiva Tikus Sapargues Dawley*. Vol 4. E-Journal Pustaka. Fakultas Kedokteran Gigi Universitas Jember.
- Kitahat LM. 1994. *Pain Pathways and Transmission*. Yale Journal Of Biology and Medicine
- Labor S. 2008. *The Pain of Labour*. www.sagepublication.scom.
- Lowe NK. 2002. *The nature of labor pain*. Am J Obstet Gynecol
- Melzack R. 1999. *From the gate to the neuromatrix*. International Association for the Study of Pain. Elsevier Science BV .
- Moayeddi M, Davis KD. 2013. *Theories of pain: from specificity to gate control*. J Neurophysiol, www.jn.org.
- Munro J, Jokinen M. 2012. *Evidence Based Guidelines for Midwifery-Led Care in Labour, Birth Environment*. The Royal College of Midwives.
- Oktavia NS, Gandamiharja S, Akbar IB. 2013. *Perbandingan Efek Musik Klasik Mozart dan Musik Tradisional Gamelan Jawa Terhadap Pengurangan Nyeri persalinan kala I Fase Aktif Pada Nulipara*. MKB
- Putri DH, Widihardjo, Wibisono A. 2013. *Relasi Penerapan Elemen Interior Healing Environment Pada Ruang Rawat Inap dalam Mereduksi Stress Psikis Pasien*. ITB J Vis Art & Des.
- Sarwono SW. 1992. *Psikologi lingkungan*. Jakarta.; PT Grasindo
- Susilowati E. Proceeding Book Workshop Nasional . 2014. *Upaya Menciptakan Kenyamanan pada Ibu Bersalinan melalui Setting tempat persalinan*. Magister Kebidanan Fakultas Kedokteran Universitas Padjajaran. Bandung.
- Sutalaksana IZ, Anggawisastra R, Tjakraatmadja JH. . 2006. *Teknik Perancangan Sistem Kerja*. ITB.