

Aerobic Exercise and Its Effect on Oxytocin Level and Labor Progression

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Abstract. Nowadays, Obstetrical management has turned into active management. Aerobic exercise has already been performed by pregnant women and recommended by the American College of Obstetrics and Gynecology. It is known to have many benefits for labor progress and could decreased cesarean section and assisted vaginal delivery rate. This might be caused by the increase of endogenous oxytocin level. This is an experimental study involving 40 patients in Hasan Sadikin General Hospital, Awi Bitung Islamic Hospital and Kota Bandung District Hospital that met the inclusion criteria and divided into 2 groups: a group that performed aerobic exercise regularly and the other who did not. The characteristic of the subject (age, gestational age and body birth weight) showed no significant differences between two groups. Between two groups, there were significant association on mode of delivery and length of active phase of labor and the percentage of plasma oxytocin level. There was no significant association between the two groups in duration of the first stage, second stage and oxytocin level with the length of aerobic exercises. This study concluded that regular aerobic exercise in pregnant woman increases oxytocin level and improve labor progress.

1. Introduction

The maternal mortality rate in Indonesia based on Indonesian Demographic and Health Survey in 2012 was 359 in 100.000 live births. This is far from target of the Millennium Development Goals (MDGs) which is 102 in 100.000 live births. Around 90% of maternal mortality was caused by postpartum bleeding, infection, prolonged labor and complication of unsafe abortion.[1, 2]. In fact, maternal death during labor is preventable. Conversion of obstetrical to active management is being executed to reduce maternal and neonatal mortality.

Labor process is a complex interaction between maternal, fetal or placental factors. The smooth delivery process requires changes from the quiescence to contracted uterus. This uterine contraction has to be strong and coordinated. The uterine contraction will produce cervical dilatation and engagement for the labor to be occurred smoothly. Labor process is a physiological process that involved hormonal influences. Two main hormones that contribute in initiation of these process are oxytocin and prostaglandin.

Uterine contraction happened as an interaction between actin and myosin light chain kinase.[3] This enzyme activated when it conjoined with Calmoduline and Calcium. Calcium is released from sarcoplasmic reticulum cells and inhibited by progesterone, cyclic adenosine monophosphate, isoproterenol and promoted by oxytocin, prostaglandin and acetylcholine.[4] Oxytocin effect that increased calcium releasing will activate light chain kinase enzyme and later will induce myometrial



contraction.[5] It is concluded that oxytocin have an important effect in normal parturition process. With this process, maternal neonatal mortality and morbidity hopefully can be reduced.

Aerobic activity has become an integral part of a woman's daily life. Some of pregnant woman will continue their usual activities, but most of them will leave them. This phenomenon happened because of traditional superstition in the society, that afraid of musculoskeletal injury, abdominal trauma, disorder of fetal growth from the aerobic activities.[6-8] American College of Obstetrics and Gynecologist has recommended activity of pregnant woman at term will effect in increase of parturition quality. Aerobic activity for 30 – 60 minutes in 3 – 5 days a week can increase the pelvic musculoskeletal that can reduce birth canal trauma during labor. Continuous and rhythmic activity such as walking, jogging or static bicycle is recommended.[6, 9]

In 2008, Cochrane collaboration showed that there was a significant association between aerobic activity with the remarkable progression in the first and the second stage of labor. This brings out the idea that aerobic activity is recommended for pregnant woman in remarkable condition. Therefore the complication and risk factor of pregnancy has to be well recognized.[10] Aerobic activity that has been mainly practiced and even recommended by ACOG, give more benefit in progression of labor and ultimately reduce the incidence of cesarean section and operative vaginal delivery. This might be influenced by plasma oxytocin level. Developed countries had studied and done aerobic activity during parturition. But this study is not yet conducted in Indonesia.

2. Method

The study was conducted on April until September 2010. From 40 pregnant women who came to the Hasan Sadikin Hospital, Awi Bitung Hospital and Ujung Berung District Hospitals. The samples were then divided into pregnant women who has performed aerobic activity and has not performed aerobic activity.

The inclusion criteria are pregnant women, singleton, and head presentation, 32-34 weeks pregnancy, without any medical complication, no harmful obstetric complications, mother height > 150 cm, and estimated fetal weight < 4000 g and normal maternal body mass index. Exclusion criteria are not follow > 20% aerobic activity program, any medical or obstetrical disorders, admit in parturient with cervical opening > 3-4 cm.

The determination of the samples carried out by statistical calculation by confidence interval 95% ($Z\alpha = 1.96$) and test power of 90% ($Z\beta = 1.28$). Based on the calculation, sample size was increased to 20 per group. Control group was pregnant women 32-34 weeks of pregnancy, chosen by matching time of labor based on maternal age.

3. Result

From our research, there was a significant difference between initial and later plasma oxytocin level in pregnant women who has performed aerobic activity. A large percentage increase in oxytocin levels in pregnant women who has performed aerobic activity amounted to 80.2%, while in pregnant women who did aerobic activity amounted to 13.2%. The difference between two group was significant ($p=0,038$).

Table 1. Labor Progress Based on First Stage Active Phase Duration in Aerobic Activity Group and Without Aerobic Activity Group

Duration of Labor	Aerobic Activity (n=20)	Without Activity (n=20)	Aerobic	Significance
First stage (hours)				
X (SD)	6.1 (1.1)	9.1 (2.2)		$Z_{M-W} = 4.214$
Median	6	9		$P < 0.001$
Range	5-9	6-12		

In this study we found that in pregnant women who did aerobic in the first stage active phase of labor was shorter ($Z_{m-w} = 4.214$ $p < 0.05$). Most of pregnant women who did aerobic activities had spontaneous delivery and none of this group had C-section due to failed oxytocin induction compared to other group. There is a significant correlation between delivery method with aerobic activities ($p < 0.05$).

Table 2. Delivery Method in Aerobic Activity Group and Without Aerobic Activity Group

Delivery Method	Aerobic Activity (n=20)	Without Aerobic Activity (n=20)
Spontaneous Delivery	18	9
Oxytocin Augmentation	1	4
Vacuum Extraction	1	3
C-section due to Failed of Oxytocin Drip	0	4

4. Discussion

Oxytocin is an extremely potent uterotonic and important in increasing uterine contractions in phase two but not proven to initiate the delivery. The hormone oxytocin and prostaglandin known as an uterotonic have some role in labor initiation. Increased levels of oxytocin and prostaglandins occurs in 2nd stage of delivery by increasing the hormone receptors on the myometrial contractions and cervical dilation.

In early pregnancy, oxytocin levels is low because of the estrogen and progesterone ratio is also low. At the end of pregnancy, estrogen will be produced in high amounts by the placenta, which increases the sensitivity of the uterine muscle to oxytocin.

During pregnancy, oxytocin in blood plasma increases with gestational age. The release of endogenous oxytocin is enhanced by labor, cervix, vagina and breast stimulation, estrogen that flows in blood vessel, increased osmolality/plasma, low liquid volume in blood circulation, and physical stress that will induce oxytocin production. [3]

Delivery start at 2nd stage, from the onset until cervical fully dilated at 10 cm. At 2nd stage active phase, the velocity of cervical dilation was 1, 2 cm/ hour in primipara, and 1, 5 cm/ hour in multipara. We consider the dystocia, when the velocity of cervical dilation was less than 0, 5 cm/ hour during 2 hour, or there was no progression of labor and no descendant of fetal head during two hours observation. In this study, we will evaluate a progression of labor from the type of delivery, duration of 2nd and 3rd stage of labor. A dystocia can happen during a delivery, and will determine the next step of management.

Fitzpatrick and Dawood research's, mentioned that the highest levels of oxytocin was obtained at the time of expulsion of the baby's head, and the current maximum uterine contractions oxytocin levels between 20-200 pmol.[11]. In pregnant women who has performed aerobic activity, Shelley et al

mentioned that physical activity will lead to body stress and improve circulation of heart and blood vessels that will provide a stimulus to the posterior pituitary to secrete oxytocin.

Table 1 showed the comparison between levels of oxytocin before, after and percentage changes between groups who do aerobic activity and exercise. It was shown that the initial levels of oxytocin has no significant difference with $p = 0.758$ ($p\text{-value} > 0.05$). After the treatments, it showed significant difference $p = 0.04$. In pregnant women who perform aerobic activity, a higher levels of oxytocin than those who did aerobic activity showed. Comparison of oxytocin levels before and after treatment in aerobic activity group was statistically significant by the Wilcoxon test with $Z_w = 3.305$, $p = 0.01$ ($p < 0.05$). In the group that did aerobic activity also means $Z_w = 3.084$, $p = 0.02$ ($p < 0.05$). It is concluded that the effect of aerobic activity will increase oxytocin levels. It reinforces the previous research and have a positive effect in increasing plasma levels of oxytocin in the group that did aerobic activity.

Changes may be significant if the maternal weight is increased. Increased body weight will caused pressure on joints in the pelvic area and the knee until it reaches 100%. [6-8] During pregnancy, hormonal abnormalities can induce greater laxity of the joints to the symphysis pubis softening for accommodation of labor. [7, 8] Uterine activity shows minimal and insignificant changes obtained in research Aerobic exercise while pregnant will increase your heart rate and cardiac output. During the exercise, blood is redirected from internal organs including uterus for supplying the muscle contraction. [8, 9]

Influence of aerobic exercise for pregnant being an interesting thing for the last of decade for examined. Aerobic exercise during pregnancy and occurs adaptation on pulmonary system. In pregnant women increase tidal volume light reaches 50% and oxygen consumption was assumed as a result of fetal oxygen demand. [12]. Research proved none of side effects that accompany the fetus when the mother underwent an aerobic activity. [13, 14]

Aerobic activity has become women's daily life. Many women who have undergone regular aerobic activity before or after getting pregnant as an effort to improve health while pregnant. Objective data on the influence of maternal aerobic exercise to the mother, fetus and her own very limited and sometimes the results of empirical data shows some similarities and contradictory.

Arthal, et al. study showed that duration of labor was shorter in women who did exercise during pregnancy compared with who did no exercise. [15] In 2008 Cochrane stated that there is a significant relationship between aerobic activity with the smooth process of the first stage of labor and acceleration of the second stage. [10] Cooling study found the average duration of the active phase in the group that did aerobic activity during pregnancy was 7.2 ± 2.5 hours compare with the group that did aerobic activity that is 9.2 ± 4.3 hours. [16]

In a study of 876 pregnant women in Pennsylvania and New York, easier childbirth was documented in women done regular exercise compared with who do not exercise at all [17-19]. Sofoewan O, found that the incidence of prolonged labor in primigravidas substantially smaller grouped was 1.9% of pregnant women who do physical activity and 15.1% in the control group ($p = 0.0031$). Prolong second stage of labor was also significantly shorter than those who do not do physical activity. [18] Supratmaja showed that women whose physical activity did the second stage of labor activity shorter than women who do not do physical activity (8.96 ± 4.20 versus 12.87 ± 6.71 min, $p = 0.00154$). [18]

This study indicates that aerobic activity in pregnant women give better effect than pregnant women who did aerobic activity. This is consistent with previous studies that get in the group aerobic activity during pregnancy was comparable to the control group were able to speed up the duration of the first stage and second stage of labor.

Fox et al. obtained correlation between physical nulliparous activity with increasing number of spontaneous labor and decreased the incidence of cesarean section. [20] Lawani, et al concluded that pregnant women with aerobic activity decreased operative obstetrics action and increased spontaneous delivery compared with not doing aerobic activity. [21] This study support Cochrane theory by the presence of a decrease in the incidence of cesarean section in pregnant women who perform aerobic activities. [10] From this study, it was found that from 20 people who do aerobic activity, 18 are

undergoing spontaneous labor (90%). Meanwhile, from 20 people who do not do aerobic activity, only 9 cases of spontaneous delivery occurred (45%). Statistical analysis showed that there is a relationship between route of labor with aerobic activity for pregnant women significantly with $p = 0.020$. Increasing the percentage of spontaneous delivery were significant and pressing either the incidence of operative vaginal delivery and abdominal delivery.

Chi square test at 95% confidence level indicates that there is no significant relationship between prolong 1st stage active phase of the second stage to prolonged exercise aerobic activity with significance values, respectively $p = 0.086$ and $p = 1.0$.

Other factors that influence labor are calcium level and vitamin D. Recent studies showed correlation between vitamin D deficiency with adverse pregnancy outcomes such as preeclampsia, gestational diabetes, small for gestational age neonates [22-24] and increased risk of caesarean section.[25].

References

- [1] Saifuddin 2005 *Upaya safe motherhood and making pregnancy safer, in bunga rampai obstetri dan ginekologi sosial* Jakarta: Yayasan Bina Pustaka Sarwono Prawiroharjo
- [2] WHO Safe Motherhood. 2005.
- [3] Cunningham, F., William obstetrics. 2005, Mc Graw - Hill: London.
- [4] Firdaus F, 2004 *Perbandingan efektivitas oksitosin injeksi intramuskular dengan oksitosin intravena umbilikal sebagai profilaksis perdarahan pasca salin, in Obstetric and Gynecology* Bandung: Universitas Padjadjaran
- [5] Thornton S, Davison J M and Baylis P H 1988 Plasma oxytocin during third stage of labour: comparison of natural and active management *BMJ* **297** (6642), 167-169
- [6] Hatch M C, Shu X O, McLean D E, Levin B, Begg M, Reuss L and Susser M 1993 Maternal exercise during pregnancy, physical fitness, and fetal growth. *American journal of epidemiology* **137** (10), 1105-1114
- [7] Artal, R., A comparison of cardiopulmonary adaptation to exercise in pregnancy at sea level and altitude *Am J Obstet Gynecol*, 1995. 172: p. 1170-180.
- [8] Paisley, T., E. Joy, and R. Price, Exercise during pregnancy : A practical approach. *Current Sports Medicine Reproduction*, 2003. 2: p. 325-30.
- [9] Wang, T. and B. Apgar, Exercise during pregnancy. *American Family Physician*, 1989: p. 1-9.
- [10] Kramer, M., Aerobic exercise for women during pregnancy. *Cochrane Database System Review*, 2004(4).
- [11] Muchtar, A., Oksitosin, in *Farmakologi dan terapi*, S. Gan, Editor. 1991, PT. Intermasa: Jakarta. p. 288-96.
- [12] Wolfe, L. and M. Mottola, Validation of guidelines for aerobic exercise in pregnancy, in *Decision making and outcomes in sports rehabilitation* K. DA and B. JV, Editors. 2000, Churchill Livingstone New York. p. 205 -22.
- [13] Dye, T., Recent studies in the epidemiologic assessment of physical activity, fetal growth, and preterm delivery : a narative review. *Clinical Obstetric and Gynecology*, 2003. 46(2): p. 415-22.
- [14] Leet, T. and L. Flick, Effect of exercise on birthweight *Clinical Obstetric and Gynecology*, 2003. 46(2): p. 423 - 31.
- [15] Artal, R. and M. O'toole, Guidelines of the American College of Obstetricians and Gynecologist for exercise during pregnancy and the postpartum period. *British Journal Sports Medicine*, 2003. 37: p. 6-12.
- [16] Collings, C., L. Curet, and J. Mullin, Maternal and fetal responses to a maternal aerobic exercise program. *Am J Obstet Gynecol*, 1983. 186: p. 142-49.
- [17] Artal, R. and C. Sherman, Exercise during pregnancy: safe and beneficial for most *Physical Spot Medicine*, 1999. 27(8): p. 51 - 75.
- [18] Supriatmaja, I. and T. Suwardewa, Pengaruh senam hamil terhadap persalinan kala satu dan kala

dua. 2005.

- [19] Kennelly, M., Feta heart rate response to strenuous maternal exercise: not a predictor of fetal distress. *Am J Obstet Gynecol*, 2002. 187(3): p. 811-17.
- [20] Fox, N., S. Geiber, and S. Chasen, Physical and sexual activity during pregnancy with the onset of labor and mode of delivery on multiparous women. *International Journal Gynecology and Obstetric*, 2008. 1528.
- [21] Lawani, M., Effect of antenatal gymnastics on childbirthL a study on 50 sedentary women in the Republic of Benim during the second and third quaters of pregnancy *Sante*, 2003. 13(4): p. 235 - 41.
- [22] Zhang, C., Maternal plasma 25-hydroxyvitamin D concentrations and the risk for gestational diabetes mellitus. *PLoS One*, 2008. 3(11): p. e3753.
- [23] Bodnar, L.M., Maternal vitamin D deficiency increases the risk of preeclampsia. *J Clin Endocrinol Metab*, 2007. 92(9): p. 3517-522.
- [24] Bodnar, L.M., Maternal serum 25-hydroxyvitamin D concentrations are associated with small-for-gestational age births in white women. *J Nutr*, 2010. 140(5): p. 999-006.
- [25] Merewood, A., Association between vitamin D deficiency and primary cesarean section. *J Clin Endocrinol Metab*, 2009. 94(3): p. 940-5.