Uterine Electrical Activity During First Stage of Labor

Authors
Tecky Afifah Santy Amartha[1]*, Suryono Suryono[2], Melyana Nurul Widyawati[1], Syarief Thaufik Hidayat[3], Suryati Kumorowulan[1]

[1]Magister Applied Midwifery, Postgraduate Program of Politeknik Kesehatan Kemenkes Semarang, Semarang, Indonesia
[2]Instrumentation and Electronic Laboratory, Physic Department, Faculty of Science and Mathematics, Diponegoro University, Semarang, Indonesia
[3]Medical Staff Group of Obstery Gynecology Departement, Dr. Kariadi Hospital, Semarang, Indonesia
*Coressponding Author
Tecky Afifah Santy Amartha
Email: *tecky.afifah@gmail.com*

Abstract
Palpation tecnique still used today, studies have shown that this technique is uneffective for measuring uterine contractions during labor. Electromyogram (EMG) with surface electrodes is a non-invasive tool that can be used to monitor uterine activity in labor with more objective and accurate result. The aim of this study was to explain the uterus electrical activity during first stage of labor. This is a prospective observational of 10 singleton deliveries. Maternal contractions monitored using 3-channel surface electrodes of the EMG. Recording was done from begining until complete servix dillatation every 30 minutes for 10 minutes. Recordings are then calculated the average frequency, duration, interval, and the action potentials. Ten random data sequence was piked by data normalization and presented in a trend. The results showed the frequency, duration and action potential experiencing a rising trend approaching second stage of labor, with average respectively (3.65 ± 0.89) time/10 minutes, (67.40 ± 27.03) second and (62.82 ± 29.12) mV. But in the frequency and action potential decreased at the end of first stage of labor. The duration of the contraction was significantly decreased approached second stage of labor with average (3.79 ± 1.18) menutes. Changes in uterus activity was a natural mechanism during labor in the mother's body to adjust physiological conditions of the mother and fetus in the womb to be through normal birth process.
Keywords: *Uterine Contraction, Uterine electricity, First stage of labor, Electromyography.*

Introduction

In Indonesia there are still obstacles in efforts to reduce maternal mortality. Among them are poor quality of health care antenatal, delivery and postpartum. One woman dies every hour during childbirth or due to pregnancy-related causes.[1]

Monitoring during labor and after delivery, including the use of partographs is still not optimal. Partograf is used as a tool for making clinical decisions, relating to early recognition of possible complications and choosing the most appropriate action.[2] Uterine contractions as one

of the main factors affecting childbirth are of the utmost importance to be monitored during labor to identify complications in labor.

Dystocia in labor may be caused by contraction abnormalities. By closely monitoring the contractions, medical personnel can be used to perform early detection of contraction disorders such as uterine inertia, hypertonic contractions, hypotonic, and incoordinate uterine action that may result in latent and active phases in the first stage of labor. The resulting consequences of this in the mother is the occurrence of intrapartum infection, uterine rupture, fistula formation, pelvic floor muscle injury. Whereas in the fetus may lead to caput succedaneum and fetal head molasses may even result in skull fracture if labor management is not performed well.[2]

Palpation techniques in Indonesia are still used by birth attendants as a method of measuring uterine contractions in labor. Clinically the measurements with palpation are less useful and to date the measurement of uterine contractions is done by placing the palms on the fundus area then calculated and recorded the frequency, interval, and duration. Previous research has found that measurements by palpation are ineffective and inaccurate, requiring more accurate measurement methods.[3]

Previous studies have measured electrical voltages due to uterine contractions by Uterine Electromyography using an ECG-like surface electrode which is a more simple, accurate, and risk-free measure of his or her own.[4] EMG is a method for evaluating muscles based on the detection of muscle electrical activity.[5]

The EMG signal burst responsible for uterine contractions is seen in clear temporal correspondence with the toxin output (TOCO) simultaneously. However, TOCO can only measure the degree of contraction and (coarse and inaccurate) contraction amplitude. The uterine EMG signal, can be analyzed by a number of advanced mathematical methods to determine prolong electrochemical readiness of the myometrium for labor.[6] Several previous studies

also examined the electrical activity, but about uterine electrical activity during the period of pregnancy.[7] In addition, previous studies examined uterine electrical activity as a predictor of preterm labor.[8] By using EMG, it is expected that the measurement and monitoring of uterine contractions in labor can be performed optimally with more objective and valid results. Based on the description, then in this research will be measured uterine electrical activity in the first stage of labor.

Method

This is an observational prospective study. The samples in this study were 10 normal maternity women at Ngesrep Public Health Center who fulfilled the inclusion criteria, namely: normal maternal women both primipara and multipara, have entered labor satge marked by dilatation and cervical leveling and adequate contraction at least 2 times in 10 min with duration>20 second, pregnancy at delivery>37 weeks and <42 weeks, age range 20-35 years, healthy mother, and willing to be respondent. Mothers consume / obtain uterotonica, have sensitive or allergic skin, there is injury in mother's abdomen, delivery time> 24 hours or old labor, premature rupture of membranes will be excluded from the research.

Table 1 Characteristics of respondent

Characteristics		Min	Max	Mean±SD	n (%)
Maternal age (year)		18	32	25,60±3,75	
Parity		1	3	1,80±0,63	
Gestational age (week)		37,71	40,71	38,98±1,04	
FH (cm)		30	34	32,10±1,37	
BMI (Kg/m^2)		22,48	35,79	28,05±3,72	
Second stage duration (minute)		10	55	30,70±17,48	
Birthweight (gram)		2750	3600	3135±279	
Sex	Male				5 (50)
	Female				5 (50)

*FH: Fundus Height; BMI: Body Mass Index;

This research has got certificate of research worthiness from Health Research Ethics Commission of Poltekkes Semarang with number: 001KEPK / Poltekkes-Smg / EC / 2017.

Respondents meeting the inclusion criteria were fitted with 1 electrode at the fundus parallel to the umbilicus and 1 electrode above parallel to the umbilicus. 1 electrode is placed on the right side

of the mother's abdomen as a ground, each at a distance of 3-5 cm from the umbilicus.[9] Recording of uterine electrical activity is performed on every 10 minute contraction made every 30 minutes until complete cervical opening used EMG by miliVolt (mV) unit. If in the implementation there are mothers who experience complications or childbirth to be pathologic as the mother should be in the operation Sectio cesarea (SC) it will be issued as a sample (Drop out). The results that appear newly created trends in the results of each measurement results.

Result and Discussion

Table 2 Distribution of average data on uterine electrical activity during first stage of labor

Variable	Min	Max	Mean±SD
Frequency (x/10 minute)	1,80	4,80	3,65±0,89
Duration (second)	37,92	127,00	67,40±27,03
Interval (minute)	2,45	5,83	3,79±1,18
Potential action (mV)	36,48	137,28	62,82±29,12

Frequency of Uterine Contraction

The frequency of uterine contractions in labor in the first stage of labor has a tendency to increase but decrease before the second stage of labor. The average maximum frequency occurring in the first stage of labor is 4.57 times/10 minutes, and the minimum average frequency is 2.80 times / 10 minutes.
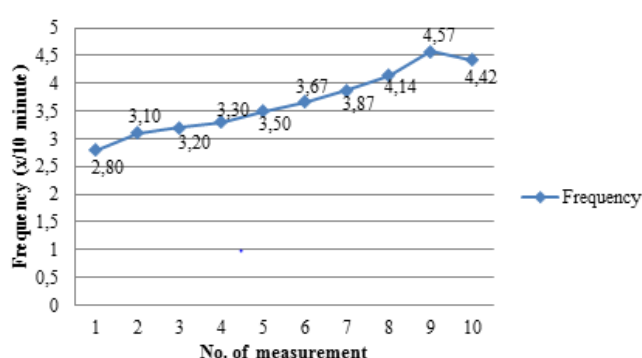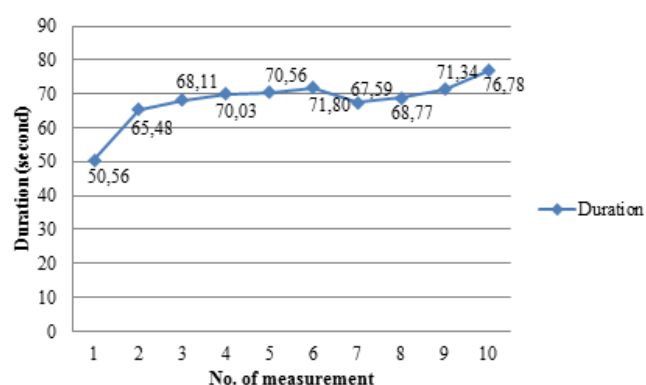

Fig. 1 Frequency trend of Uterine contraction during first stage of labor

This corresponds to the sub phase of the active phase of the first stage of labor, namely acceleration (acceleration), maximal dilatation, and deceleration (deceleration).[10] Previous studies have found that in the latent phase normal labor is recorded only one contraction for 8.2 minutes of control. At the end of the latent phase, it increases to 3 contractions in 8.2 minutes. The amount of contraction did not change by about 4 contractions for 8.2 minutes during the active phase of labor.[11] The uterine sync becomes stronger and shows a strong contraction rhythm in labor, so the contractions become more frequent.[12] This increased contraction rhythm is influenced by the hormone oxytocin which is the main initiator of contractions in labor. Oxytocin is released from the mother's pituitary gland regularly resulting in a synchronized uterine contraction.[13]

Duration ofUterine Contraction

The duration of uterine contractions in The first stage of labor labor fluctuated but has a tendency to increase before the second stage of labor. The average duration of the longest contraction in The first stage of labor was 76.78 seconds, while the shortest duration was 50.56 seconds.

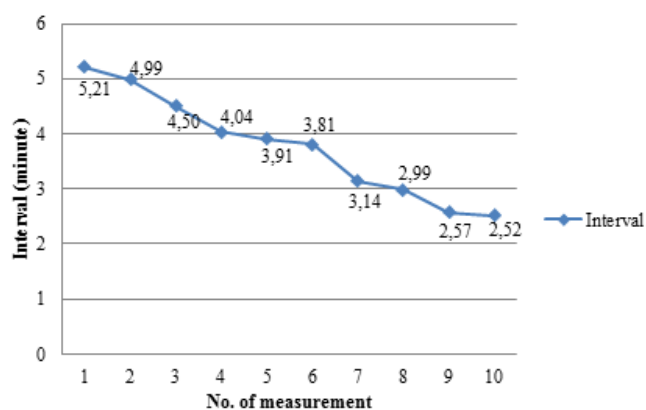**Fig. 2** Duration trend of uterine contraction during first stage of labor

Fluctuations in the duration of contraction can be considered as feedback received by the uterus from the process of decreasing the lower part of the fetus so that the uterus may alter its ability to work in accordance with the condition of the fetus in the womb.[14] The duration of contraction will affect the opening of the cervix, the strain on the cervix occurs due to myometrial contraction. At the time of contraction occurs hydrostatic pressure of amniotic fluid and intrauterine pressure rises

and causes the cervix to become flat (effacement) and open (dilatation).[15]

There is a difference in the observed duration of contraction based on the increase in pressure measured by TOCO, palpation of the abdomen, and the pain felt by the mother. Measurements of contraction using TOCO showed contraction at the end of labor for 2.5 minutes, whereas from the measurement using abdominal palpation method, the duration of contraction occurred for 1.5 minutes.[16] Compared with the pain felt by the mother during contractions lasts only 45 seconds. A common mistake is to intervene for uterine inertia in the laboring mother when labor has not yet begun (false labor).[2] Especially in multigravida that often occurs despite the insufficient contraction. This makes healthcare workers make early diagnosis inpartu which resulted in the waiting period of labor progress will also progress. The result is the occurrence of a diagnostic error with a prolonged labor. As a consequence, maternity will get a prolonged labor handling that is not actually needed.

Interval ofUterine Contraction

The interval of uterine contractions in the first stage of labor has a tendency to shorten near second stage og labor with the longest interval average being 5.21 minutes and the shortest interval average is 2.52 minutes.
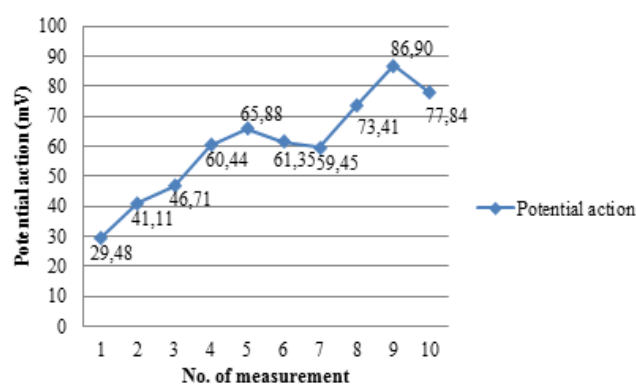

Fig. 3 Interval trend of uterine contraction during first stage of labor

The contraction interval shows the depolarization phase or the resting phase in uterine contractions.

The period of relaxation between contractions is essential for the well-being of the fetus. Hypoxemia in the fetus may occur if contractions occur continuously as they may interfere with uteroplacental blood flow.[10] Intramiometrial pressure is usually the same as maternal artery pressure when the amnionic pressure in the uterus reaches 40 mmHg, but it should be remembered that intramiometrial pressure is 2-3 times the pressure amnion in the uterus. As the contractions ease the flow of blood through the spiral artery continues and at the end of the contraction the blood flow returns to normal. Based on this it can be imagined the danger of oxygen supply being disconnected at each peak of contraction. If the inter-contraction interval shows a very short time, indicating a lack of fetal time to supply oxygen again, then contraction may be a threat to the fetus.[17]

Potential Action of Uterine Contraction

The average potential action on the first stage of labor labor fluctuates but has a tendency to increase, there is a decrease of action potential in the middle of the first stage of labor and before the complete opening. The highest average potential action on the first stage of labor contractions in this study was 86.90 mV and the lowest average action potential was 29.48 mV.

Fig. 4 Potential action trend of uterine contraction during first stage of labor

The result of trend of action potential in this research is in line with previous research using electrical uterine myography monitoring (EUM)

in active phase labor by using micro watt second unit, uterine electrical activity during labor has tendency to increase but decrease at the end of first stage of labor.[18] Intrauterine pressure increases in the active phase of labor that affects the lower segment of the uterus to stretch so that cervical dilatation occurs and the fetus may descend to the pelvic door. This power decreases when the complete cervical clearance goal has been reached and the fetus has entered the pelvic door. The next phase is the phase of fetal discharge which in this phase is the most important is the pressure of the abdomen. Abdominal muscle is an important factor for increasing intraabdominal pressure during the second stage of labor. Pregnant women are encouraged to use abdominal muscles to help release the fetus. Increased pressure on the abdomen is a physiological function (such as defecation). The action of these muscles is related to the reflexes that occur due to stretching of certain muscle receptors. When the lower part of the fetus reaches the pelvic floor it triggers the receptor to transmit afferent impulses through the cervical nerves to the medulla, thus stimulating the motor neurons responsible for abdominal contractions. Although triggered by reflexes, the impetus of maternal forces is important to predict the success of labor.[19]

Conclussion

The frequency trends of uterine contractions in labor in the first stage of labor have a tendency to increase but decrease before the second stage of labor. Trend duration of uterine contractions in The first stage of labor labor fluctuated but has a tendency to increase before the second stage of labor. The trending interval of uterine contractions in The first stage of labor labor experiences a shortening tendency near The fsecond stage of labor. The average potential action trends in The first stage of labor labor fluctuate but tend to increase, there is a decrease in action potential in mid-first stage of labor and ahead of complete opening.

References

1. Unicef Indonesia. Ringkasan Kajian: Kesehatan Ibu dan Anak. 2012.
2. Saifudin, A.B. Ilmu Kebidanan Sarwono Prawiroharjo. PT Bina Pustaka Sarwono Prawiroharjo: Jakarta. 2009: 288-294.
3. Arrabal, P.P. dan Nagey, D.A. Is manual palpation ofuterine contractions accurate? Am J Obstet Gynecol, 1996;174(1): 217-9.
4. Cohen, W. Uterine Electromyography. Pregnant Women Can Soon Benefit from Research at Jamaica Hospital. 2003.
5. Gamet, D. dan Fokapu, O. Electromyography. Encyclopedia of Biomedical Engineering. Informa Healthcare USA. 2008.
6. Garfield, R.E., Maner, W.L. Physiology and Electrical Activity of Uterine Contractions. Semin Cell Dev Biol. 2007:18(3): 289-295.
7. Lammers, W.J.E.P. The Electrical Activities of the Uterus During Pregnancy. Reproductive Sciences 20(2). 2013;182-189.
8. Verdenik, I., Pajntar, M., Leskosek, B. Uterine electrical activity as predictor of preterm birth in woman with preterm contractions. European Journal of Obstetric and Gynecology and Reproductive Biology 95 (2001) 149-153.
9. Vasak et al. Uterine Electromyography for identification of first-stage labor arrest in term nulliparous women with spontaneous onset of labor. Am J Obstet Gynecol, 2013; 209-232.e1-8.
10. Cunningham, F.G., Leveno, K.J, Bloom, S.L., Hauth, J.C., Rouse, D.J., Spong, C.Y. Obstetri Williams. Ed 23. Vol 1. EGC: Jakarta. 2013.
11. Vrhovec, J and Lebar, A.M. An Uterine Electromyographic Activity as a Measure of Labor Progression, Applications of EMG in Clinical and Sport Medicine, Dr. Catriona Steele (Ed.), InTech, 2012.

12. Moslem, B., Khalil, M., Diab, M.O., Marque, C. Detrenden fluctuation analysis uterine electromyography. 978-1-4244-7000-6/11. IEEE. 2011.

13. Dixon, L., Skinner, J., Foureur, M. The emotional and hormonal pathways of labour and birth: integrating mind, body and behavior. New Zeland Collage of Midwives Journal 48. 2013.15-23.

14. Zagami, S.E., Golmakani, N., Saadatjoo, S.A.R., Ghomian, N., Baghbani, B. The shape of uterine contractions and labor progress in spontaneous active labor. Iran J Med Sci. 2015; Vol 40, No 2.

15. Sofian, Amru. Rustam Mochtar Sinopsis Obstetri. Jilid 1. EGC: Jakarta. 2012: 65; 71.

16. Failey, D.H. Lecture Notes. Obstetrics and Gynaecology. 2nd Ed. 2004: 162.

17. Hughey. Electronic Fetal Heart Monitoring. Brookside Associates. 2014. Available at http://www.brooksidepress.org/Products/ Military_OBGYN/Textbook/LaborandDelivery/electronic_fetal_heart_monitoring.htm

18. Hiersch, L., Salzer, L., Aviram, A., Haroush, A.B., Ashwal, E., Yogev Y. Factors affecting uterine electrical activity during the active phase of labor prior to rupture of membranes. J Matern Fetal Neonatal Med. 2014.

19. Olivera, B.D.R., Andrade, A.D., Lemos, A., Brito, V.C., Pedrosa, M.L., Silva, T.N.S. Abdominal muscle electrical activity during labor expulsive stage: a cross-sectional study. Rev Bras Fisioter. 2011;15(6):445-51.

.