RESEARCH ARTICLE

THE EFFECTIVENESS OF 'PAIN DIGITAL ACUPRESSURE (PDA)' IN REDUCING LABOR PAIN AND THE DURATION OF THE SECOND STAGE OF LABOR

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ABSTRACT

The maternal mortality rate in Indonesia is still the highest among Asian countries. One of the reasons is due to prolonged labor that is influenced by the anxiety and fear of the mother during labor. Anxiety and pain are very connected and influence each other. The pain will release the hormone that will disturb uterine contraction and increase the respiratory stimulation and decrease levels of CO_2 in mother and fetus. This will influence the wellness of both mother and fetus. The aim of this study is to quantify the effectiveness of Pain Digital Acupressure (PDA)in reducing labor pain and the length of the second stage during labor. PDA is a self-managed, non-invasive tool, based on electro-medical principles and does not disturb the labor process and can give the patient a feeling of comfort. The design is a quasi-experimental study involving 76 women during normal labor, (38in the Intervention group and 38 in the Control group) .The results shown there was a significant difference on the labor pain scale after using the PDA in the first, second and the third 30 minutes during latent stage labor compared with pain scale before using PDA (p: 0.000). The most effective period to use PDA was the first 30 minutes, which decreased pain by an average of1.79; and signifcant different with control group (p: 0,00). The use of PDA also reduced the length of the second stage of labor, (Intervention group: 14.36 minutes and Control group: 22.50 minutes, p=0.000). It is strongly recommended for women during labor to be offered PDA to modulate labor pain and the length of labor.

INTRODUCTION

As a health indicator, the maternal mortality rate remains high in Indonesia, in 2007 it was 228 per 100 000 live births. Even though the Infant Mortality Rate (IMR) decreased compared with 2002, the figure is still the highest among Asean countries (SDKI, 2007). The reasons for the high IMR are mostly due to hemorragia, eclampsia, post-partum complications, abortion, prolonged labor or distosia, embolism, and others (SDKI, 2007). The highest proportion of cases is due to prolonged labor or distosia, which happens during labor with anxious and fearful mothers. Fear and anxiety have a negative impact to the labor process as reported by Sercekus and Okumus (2009).

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They found that among 19 labors with fearful and anxious mothers,9 of them required surgical intervention. Anxiety as a predictor of pain during the labor process will influence the mothers' and babies' overall wellbeing (Lang, 2006). Furthermore, pain during labor will make mothers anxious and more fearful of the process therefore reinforcing a cycle of stress, fear, anxiety and pain during labor. Increases in cathecolamine and glucosteroid due to anxiety will cause a reduction in uterine muscle contraction, which will in turn disturb the labor process and prolong labor. However, contraction itself induces pain during labor and this will stimulate respiration in order to reduce the level of blood CO_2. This situation influences the oxygenation of the mother and baby and increases the risk of fetuses becoming hypoxic (Sercekus and Okumus, 2009). Pain also introduces variability in uterine muscle contraction thereby increasing the duration of laborand the risk to mother and baby, (Mander, 2003).

Clinical intervention in order to reduce the pain may or may not involve the use of medication. Patients usually prefer the non medication, because it would not harm the baby or mother, (Smith, 2011). Nursing care can take the form of supporting the mother to manage the pain on her own, (selfcare). One method of the pain management without the use of medication is to activate peripheral sensory receptors through touching, massage, reflexology, acupuncture, aromatherapy, trans-cutaneous electrical stimulation (TENS), water immersion and intradermal injection of sterilised water, (Habanananda, 2004). Some research studies have been published describing the use of acupressure to reduce pain during labor. Acupressure is a method to reduce pain by pressing or massaging certain anatomical points using finger pressure. Acupressure therapy can be used to relax muscles, improve blood circulation, reduce pain and increase the life energy power in the human body (Qi) in order to increase wellness, (Wong, 2011). Acupressure can also increase the blood circulation, the *yin* and *yang* balance and increase neuro-transmission that in turn will improve the normal functioning of the body, (Tournaire dan Yonneau, 2007).. Hjelmstedt (2010) found that through the use of acupressure in India, the pain during labor reduced in intensity in the intervention group and it was significantly different from control group who underwent standard intervention, ($p< 0.001$). Similar research has been reported by Lee, Chang and Kang (2004) in China about effects of pressure applied to the point SP6on pain during labor and the length of the labor process. The results showed that there was a significant difference in the intensity of pain before and after intervention ($p=0.012$), 30 minutes after intervention ($p=0.021$) and 60 minutes after intervention ($p=0.012$). The length of the labor process was also shorter in the acupressure group compared with the control group ($p=0.006$).

Despite evidence that acupressure has positive effects in reducing the pain during labor this form of intervention, applying acupressure to the mother's body during labor requires more time and qualified staff is not often used clinically. The most significant reasons are due to time and staff constraints. Few staff have been trained in acupressure techniques compared with the total number patients who would benefit, (Heni, 2012). It was concluded that in order to overcome the shortfall in the numbers of qualified acupressure staff, there was a need to develop a means of clinical intervention with the aid of a special instrument that can be operated by mothers' themselves. The preliminary study using a qualitative method by Heni, (2012) showed that women during labor feel fearful and anxious of labor pain before delivery. They need help to manage the labor pain and they need information on how to reduce the labor pain even if they have to do it by themselves. Based on those reasons, this study investigated the development of Pain Digital Acupressure (PDA) to reduce labor pain. Patients or their family can use the PDA at the onset of contractions as suggested by nursing theorist Dorothea Orem. She said that the aim of nursing care is to enable patients to fulfill their own needs by themselves, (self-care). Orem recommended that nurses work for patients so that they can help themselves, (Tomey and Alligood, 2006). The PDA that has been developed is a self-managed, non-invasive tool and does not disturb the labor process. This tool or instrument can give the patient a feeling of comfort including 'relief', 'ease' and 'transedence', as mention in the goal of nursing intervention (Kolcaba, 2003).

The aim of this study is to enhance nursing intervention using 'Pain Digital Acupressure (PDA)' and measure the effectiveness of PDA in reducing labor pain. Through the use of PDA as a new technology, the intention is to help women reduce labor pain which in turn will alleviate their health problem. The objectives are: 1) identify a suitable PDA with the required bio-electrical properties, 2) identify a suitable PDA with appropriate acupressure characteristics, 3) investigate the influence of PDA on uterine muscle contraction and the length of labor process in deer, 4) identify the effect of the chosen PDA on labor pain during first stage of labor and the length of second stage of labor in women.

Study literature

Understanding of the labor process

Labor is the process of delivering a baby and the placenta, membranes, and umbilical cord from the uterus to the vagina to the outside world.(Murray and Kinney, 2007:Reeder, Martin, Griffin, 2011).

Factors which influence the labor process:

- Intensity of uterine muscle contraction and the strength of mother to push out the baby.
- Passenger includes the fetus with their position, the size, and the placenta insertion.
- Passageway including the size and shape of the mothers' buttock, and the capability of muscle to make space for baby to be delivered.
- Psyche is a psychological situation of the mother. Increasing cathecolamine hormone due to anxiety and fear will disturb contractions and blood distribution to the placenta, (Murray and Kinney, 2007; Murray dan Huelsmann, 2009).
- The stages of labor according to Murray and Kinney, (2007); Reeder, Martin, Griffin, (2011) include:
- Stage 1 - begins from the onset of uterine contractions until full cervical dilatation. The length of the labor process in this stage is different between women experiencing their first delivery, (primiparous) and multiparous women. In primiparous women labor lasts around 8-10 hours, while in the multiparous women it lasts 6-7 hours. Stage 1 labor consists of three distinct phases:

Latent phase: from the cervical dilation 1-3 cm, in primiparous women it lasts 6-8 hours, while in multiparous women around 3-5 hours.

Active phase: with the cervical dilatation of 4-7 cm, in the primiparous this lasts 4-6 hours and in multiparous 2-4 hours with the intensity of muscle contractions moderate to strong.

Transition phase: with cervical dilatation 8-10 cm (or complete), high intensity of contractions, last a maximum of 3 hours in the primiparous.

- Stage 2 - starts from full cervical dilatation until delivery of the baby. In primiparous mothers this usually lasts between 30 minutes and 2 hours whereas inmultiparous cases, it is in the range 5-30 minutes.

- Stage 3 - starts from delivery of baby until delivery of placenta with an average length of 5-10 minutes.
- Stage 4 - is the end stage of labor and lasts around 1-2 hours.

(Murray and Kinney, 2007: Reeder, Martin, Griffin, 2011).

**Nursing intervention to reduce labor pain without medication**

People prefer this type of intervention because it is cheap, effective in reducing pain and non-invasive. These methods consist of relaxation techniques, stimulation of skin, hydrotherapy, and mental/psychological stimulation. One of the more effective skin stimulation methods during labor to reduce pain is to massage certain anatomical points; this technique is called 'acupressure', (Smith, 2011; Tournaire and Yonneau, 2007). Acupressure involves applying physical pressure using fingers, on different pressure points on the surface of the body to bring about relief through greater balance and circulation of fluids (blood, lymph) and metabolic energies in the body. When the acupressure points are stimulated the muscles will relax and the blood circulation will increase, and in turn will increase the energy power (Qi) that will help restore body function, (Wong, 2011; Alamsyah, 2011).

Acupressure points used during labor process:

- Point Cien Cing (Jianjing). Thispoint is in the shoulder directly under the ear, between two muscles or between neck scallop (cervical 7) and on the upper area of arm; this point will stimulate uterine contraction.
- Point BL 32 (Ce Liao). This point in located inside the 'dimples' formed by the ilio-scaral joint and is also used for local anesthetic.
- Point LI 4 (He Kuk). This point lies in the area between the thumb and forefinger (first and second metacarpal bones). This point is used to intensify uterine contractions. This method can be used during the second stage of the labor processand also when mother feels too tired to push during delivery.
- Point SP 6 (Sanyinjiao). This point is located on the inside of the leg, just above the ankle. It is located 3cm or four finger-widths superior to the highest peak of the ankle and deep pressure should be applied slightly behind the bone (tibia). This point is used to help cervical dilatation.
- Among these four points, the points LI4 and SP 6 are useful in helping to release the endorphin hormone, (Saputra dan Sudirman, 2009).

METHODOLOGY

This research led to the development of an instrument called Pain Digital Acupressure (PDA) that will be used by women during the labor process. Before it is used clinically, this PDA was tested on animal/lambs during the labor process to make sure that the device will not damage the baby or disturb the labor process. After a successful trial on deer, the PDA was then applied in a sample group of women during normal labor. The design is a quasi-experimental *pre-posttest with control group.*
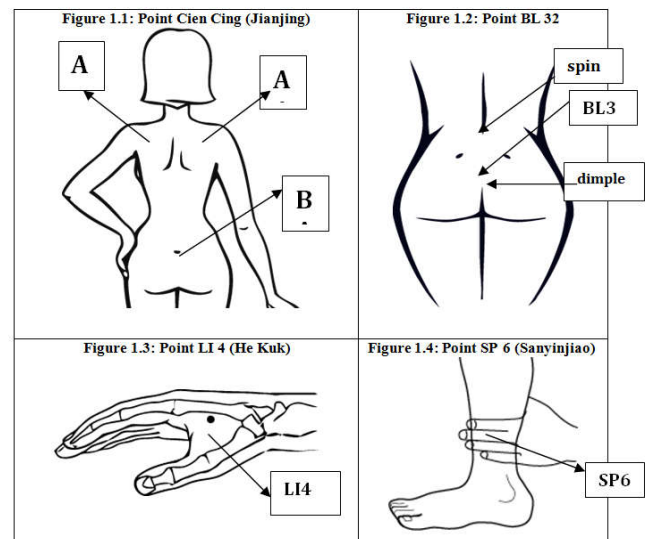
References: Wong, 2011; Alamsyah, 2010

Figure 1: Point of areas for labor pain.

Research Road Map

Stage one consist of two activities:

- Preparation stage to plan the development of the *Pain Digital Acupressure* device.
- Develop the instrument in the technical laboratory.
- Stage two involves the use of the PDA on deer during the labor process. It measures the uterine contractions and the length of labor process.
- Stage three involved the use of the PDA to measure the mothers' levels of pain during labor and the length of the second stage labor.

Ethical consideration

The Faculty of Nursing, University of Indonesia Ethics Committee, obtained the ethical approval; it is also approved by the District Helath Officer and Health Development & Politic District Office in Depok West Java. The animal trials has done based on the Helsinki Agreement 2004 about ethical consideration of animal in the deer/animal laboratory in Institute Technology Bogor West Java

Cohort description

For the animal group, researchers used three lambs in laboras the intervention group and three not in labor as the control group. The first three lambs were followed through the labor process with the PDA used at the point to reduce pain. Contractions were measured by using the contraction graph and the fetal heart rate. For the other three deer, contractions and fetal heart rate without PDA were measured. In the clinical setting, the sample size was 76 women experiencing normal labor. Thirty-eight women were in the intervention group (applying the PDA) and 38 women were involved in the control group (without PDA).

RESULTS AND DISCUSSION

Stage 1: Development of PDA

This stage began with the implementation of electro-medical principles as shown in Figure 2 below:

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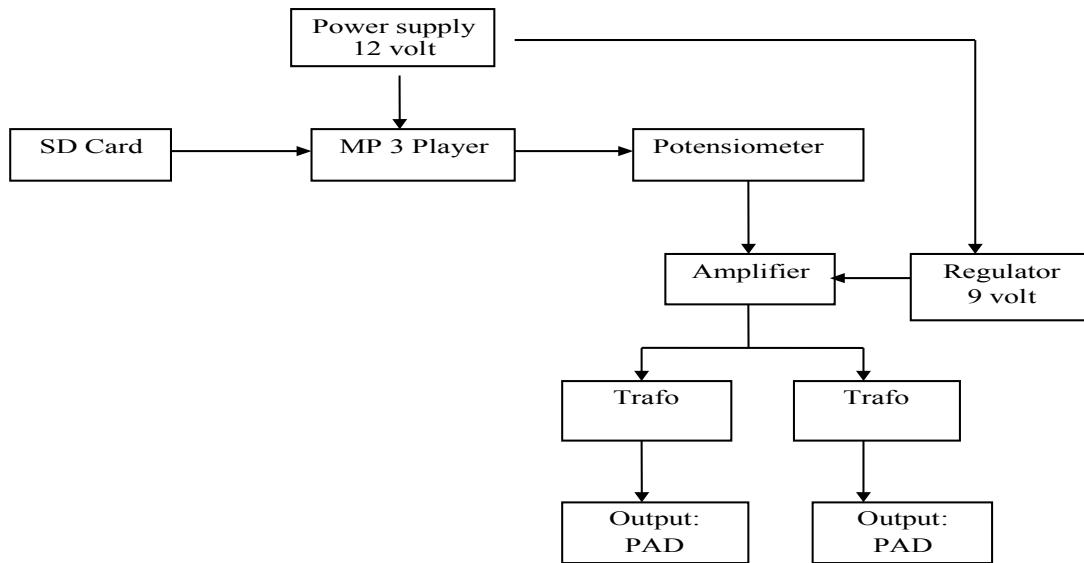
Gambar 5.1. Bloc Diagram alat *Pain Digital Acupressure* (PDA)

Figure 2. A Schematic diagram of Pain Digital Acupressure (PDA) device

Table 1. The frequency distribution of fetal heart rate and contraction of the deer (n = 6)

Variabel	Mean	SD
Foetal heart rate (FHR)	140 beats perminute (bpm)	7.85
Contraction	regular	
Frequency	5 x / 10 minutes	
Length of contraction		
Amplitude		
Length of labor process	5 minutes30 seconds	

Table 2. Patient demographics

Variable	Intervention group				Control group				p
	Mean	SD	N	%	Mean	SD	N	%	
Age	27.34	6.29			27.63	5.56			0.319
Gestational	39.24	2.12			39.03	1.33			0.728
Pregnancy status									
a. Primiparous			17	44.7			18	47.4	0.667
b. Multiparous			21	55.3			20	52.6	
Education									
Elementary school			12	31.6			8	21.1	0.805
Junior High			16	42.1			19	50.0	
Senior High			10	26.3			10	26.3	
Higher education			0	0			1	2.6	
Occupation									
a. Not working			37	97.4			36	94.7	
b. Working			1	2.6			2	5.3	0.244
Religion									
a. Islam			37	97.4			36	94.7	
b. Christian			1	2.6			2	5.3	0.244

Table 3: The dependency test of labor pain level before and after using the PDA in the intervention group during three separate interventions (n=38)

	Median (Min-Max)	Mean ± SD	Sig (2-tailed)
Pain level before 1st intervention	6.5 (4 – 9)	6.45 (1.132)	0.000
Pain level after 1st intervention	5 (2-8)	4.66 (1.381)	
Pain level before 2nd intervention	7 (5 – 10)	7.29 (1.183)	0.000
Pain level after 2nd intervention	6 (3 –8)	5.68 (1.297)	
Pain level before 3rd intervention	9 (6 – 10)	8.58 (1.130)	0.000
Pain level after 3rd intervention	8 (5 –10)	7.55 (1.408)	

Resultsfrom the animalstudy

The PDA was used on the animal during the labor process, the activity includes:

- Identify the points (Ming and Meng) in the 2nd and 3^{rd}Lumbar vertebrae of the lambs to apply the PDA pad.
- Identify the position of fundus of the uterus and the fetal heart rate.
- Cutting the hair around the acupressure points to apply the PDA pad.
- Identify the symptoms of Animal that in the labor stage for example restlessness, red vagina, mucous etc.
- Apply the PDA in place every 30 minutes during contraction and after 60 minutes, until the animal calfis delivered.
- Measurement was performed using a CTG (contraction graph) to measure the contractions and fetal heart rate

The result is shown in the table one. Table one shows that the use of PDA in the deer during the labor process does not disturb the labor process itself, as evidenced by the fact that FHR was normal 140 bpm and the contractions were normal, regular and strong. The time to delivery was quicker at an average of 5 minutes and 30 seconds, (normally around 30 minutes). The results of this study are similar to that found by Lee Chang Kang (2004) and confirms that acupressure shortens the labor process and decreases the pain experienced.

Stage 3

The results of the third stage were measured amongst women during normal labor. During the labor process, the respondents (women during normal labor) were divided into two groups (intervention and control group) the results are shown the table two. From Table 2,it is shown that the mean patient's age was 27.34 years in the intervention group and 27.63 in the control group. There is no significant difference between both groups (p= 0.319) this means that both groups are homogeneous. The mean gestational age in the intervention group was 39.24 weeks and 39.03 weeks in the control group. Again, there is no significant difference between both groups (p=0.728) and both groups are homogeneous. A similar situation was also apparent in the pregnancy status in both groups, the more prevalent pregnancy status were the multiparous women, (55.3% in the intervention group and 52.6% in the control group) and there was no significant difference between the groups (p= 0.728). Other variables such as education (p=0.805), occupation (p=0.244) and religion (p=0.244) were not significantly different or homogeneous between the intervention and control groups.

Based on *Wilcoxon* (2-tailed) statistical analysis, the results show that the significance values were0.000 ($α< 0.05$) in all three interventions. This suggests that the null hypothesis was rejected, and there is significant difference in labor pain levels before and after using PDA in the intervention group.

In order to measure the effectiveness of the PDA as a pain-reducing instrument, researchers also measured another group who did not use the PDA instrument (control group), and analyzed the differentiation delta labor pain intensity between both groups. The results are shown in the table four.

By using a *Mann Whitney* test (2-tailed), the results show the significance was 0.000 ($α< 0.05$) in all three interventions, so that it was concluded that the null hypothesis was rejected, and there is a significant difference of the delta labor pain intensity before and after using PDA between the intervention group and control groups. In addition, it was also investigated the difference in the duration of the labor process especially during 2nd stage of labor from full cervical effacement (10 cm) until baby was delivered. The results are shown in the table five. Table five shows that the mean duration of the 2nd stage of labor in the intervention group was 14.36 minutes, while in the control group it was 22.50 minutes, the significance value was 0.000. This suggests that there is a significant difference in the duration of 2nd stage labor between both groups, and this can be attributed to the use of the PDA instrument. The results of this study mirrors those found by Hamidzadeh (2012); Kashanian and Sahali (2010) who investigated manual intervention with acupressure. The results show that the length of the active phase and 2^{nd}stage in the labor process were shorter in the intervention group in contrast with the control group.

Conclusion

A Pain Digital Acupressure device has been developed that is compatible with the acupressure principles as well as electromagnetic principles. PDA type A (square wave, 30 Hz, amplitude 0.8 and volume two) is the most suitable PDA that will be used for the next phase of this research study. The pilot study performed on deer during labor shows that the PDA does not disturb the labor process or the fetal heart rate. The PDA was demonstrated to have shortened the length of the labor process in the deer. The PDA used by women during normal labor also gave positive results namely: reducing the labor pain level and intensity during labor process and reducing the length of the labor stage. It is recommended for women during labor to use the PDA instrument, which can be operated by them thus enabling self-care. The PDA instrument will be further refined through manufacturing processes to make it more ergonomic and user friendly.

Acknowledgments

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