

**RESEARCH PAPER.****HANDHELD DOPPLER VERSUS PINARD FETAL STETHOSCOPE FOR INTERMITTENT MONITORING OF FETAL HEART RATE DURING THE SECOND STAGE OF LABOUR**

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**Abstract**

Perinatal mortality is a good indicator to assess the quality of intrapartum health care system. Ultimate goal of antepartum and intrapartum health care services is achieving a satisfactory perinatal outcome. An analytical cross-sectional study was conducted among 423 pregnant women who were admitted for delivery at the labour room, Teaching Hospital Jaffna. Term singleton pregnancies with cephalic presentation were included. Mothers with medical disorders, complicated pregnancies, previous history of antepartum hemorrhages and past sections were excluded. Interviewer administered structured data collection sheet was applied for data collection. Mean age of the study participants was 27.97 years (SD=5.72 years). Foetal heart rate abnormalities were not detected among 63.3% of the study participants (N=269). Pinard foetal stethoscope was used first to detect abnormalities of 17.9% (N=28) of the participants with foetal abnormalities. Handled Doppler machine was used to detect first foetal abnormalities in 28.2% of the study participants (N=44). In 84 participants (53.8%) foetal abnormalities were detected at the first time by both methods. Significantly higher percentage of participants were detected by the handled Doppler machine than the pinard foetal stethoscope ( $z=2.159$ ;  $p<0.05$ ). In 53.3% of the (N=84) mothers with complicated deliveries, foetal heart rate abnormalities were detected at the first time by both methods. Identification of foetal heart rate abnormalities by both methods significantly indicated the risk of proceeding to a complicated delivery (OR=2.508: 95% CI=1.230 - 5.115). Using the handled Doppler method for foetal heart rate monitoring is more effective than using the traditional pinard stethoscope. Predictions gathered by using both pinard foetal stethoscope and the Doppler method were more accurate. Interruption of the physiological child birth process can be detected beforehand with a higher probability by intrapartum foetal monitoring.

**Key words:** Pinard Stethoscope, Doppler, Heart rate

## Introduction

Globally more than 130 million live births occur during a single year<sup>(1,2)</sup>. But unfortunately 8 million of them do not live to celebrate their first birthday<sup>(1,3)</sup>. In Sri Lanka 360,000-400,000 live births occur during one year and 11/1000 of these live births end up as perinatal deaths<sup>(4,5)</sup>. Perinatal death is basically defined as delivering a dead foetus by a pregnant mother with a gestational age more than 28 weeks or death of a neonate during the first seven days of life that is in the early neonatal period<sup>(1,6)</sup>. Perinatal mortality is a good indicator to assess the quality of intrapartum health care system of a particular country or an institution which provides health care facilities<sup>(7)</sup>. Ultimate goal of antepartum and intrapartum health care services is achieving a satisfactory perinatal outcome<sup>(8)</sup>. Delivery of a live non asphyxiated baby and discharging both mother and the new born without any complication are expected in achieving a good perinatal outcome<sup>(9)</sup>. Preparation of pregnant women for an uncomplicated satisfactory perinatal outcome is done during the antenatal care<sup>(10,11)</sup>. Facilitating the child birth after onset of labour in order to proceed without any complication or to minimize complications is done during the Intrapartum care<sup>(12)</sup>. One of the main challenges of intrapartum care includes proper monitoring of foetal wellbeing<sup>(13)</sup>. This task is more complicated with the uncomfortable situation of the mother during child birth<sup>(12,14,15)</sup>.

If this difficult situation is not properly managed delivering of the baby with complications such as birth asphyxia, obstructed labour, meconium aspiration or death of the infant within the uterus or inside the birth canal could occur<sup>(16,17)</sup>. Intrapartum hypoxia is identified as the third most

common cause of neonatal deaths around the world<sup>(18)</sup>. Estimated number of neonatal deaths which occur due to intrapartum hypoxia around the world is 660,000<sup>(1,19)</sup>. In addition to that 414,000 neonates are left out with residual disability state annually<sup>(6)</sup>. More than one million intrauterine deaths are estimated in developing countries<sup>(20,21)</sup>. The stillbirth prevalence is high in areas of very low quality obstetric and neonatal care<sup>(22)</sup>. It is essential to monitor physiological parameters of foetus during the intrapartum period to achieve a reduction of perinatal mortality<sup>(23)</sup>. Foetal heart rate monitoring is a well-accepted procedure to ensure foetal wellbeing during the intrapartum period<sup>(24)</sup>. In routine clinical practice foetal heart rate monitoring is done by midwives in the labour room with the help of Pinard foetal stethoscope<sup>(25)</sup>. Foetal heart rate monitoring should be combined with quick and rational management with measures of neonatal resuscitation and necessary assistance for delivery<sup>(26)</sup>.

## Methodology

Analytical cross-sectional study was conducted in labour room of obstetric unit at Teaching Hospital Jaffna. All the admissions to the obstetric unit in the study setting were used as the sampling frame. 423 participants were recruited. Singleton pregnancies with cephalic presentation, POA between 37 to 41 weeks. Normal FHR and CTG at the time of admission were included within active phase of first stage of Labour. Multiple Gestations, Abnormal presentation of foetus, Oligohydroamniosis. Abnormal antenatal CTG, Pre eclampsia, Ante partum and Intra partum Haemorrhages, Past section and pre-term labours were excluded from the study.

Data collection was started at the antenatal ward and subsequently in the labour room. Two midwives were allocated for a single patient. One monitored the fetal heart rate using a Pinard while the other midwife monitored the fetal heart rate by using the Doppler machine. Foetal heart rate was measured at every ten minutes during the Passive descent phase of second stage of labour. During the active expulsive phase of the second stage of labour, foetal heart rate was measured at every five minutes. All the measurements were taken just after the uterine contractions. Doppler measurement was taken prior to the manual Pinard

stethoscope. These two methods of foetal heart rate monitoring were applied for the same patient by two allocated midwives. Measurements of those two midwives were mutually exclusive from each other. When anyone detected an abnormality it was confirmed by using Cardiotocography (CTG). CTG was interpreted as normal, suspicious or abnormal. According to the unit labour room protocols, further management was done. Normal vaginal delivery, instrumental delivery or Emergency Lower Segment Cesarean Section (LSCS) were the procedures done. The details were entered in to a printed pre tested data collection sheet.

**Table 1; Distribution of age and parity of the participants**

	Number(N)	Percentage (%)	
<b>Age</b>			
<20	46	10.8	
21-25	113	26.6	<b>X<sup>2</sup>=68.4 P&lt;0.001</b>
26-30	118	27.8	
31-35	107	25.2	
>36	41	9.6	
<b>Parity</b>			
1	238	56.0	<b>X<sup>2</sup>=320.61 P&lt;0.001</b>
2	146	34.4	
3	35	8.2	
≥4	6	1.4	
<b>Total</b>	<b>425</b>	<b>100</b>	

More than 40 years old mothers and teenagers were among the study participants. Minimum reported age was 17 years and the maximum reported age was 43 years (Mean =27.97: SD=5.72). Study participants were described in five age categories and distribution of study participants among these age categories was significant ( $X^2=68.4$ : $p<0.001$ ). Majority of the study participants represented the 21 to 30 years age group (N=231:54.35%). Majority of

them were primi gravidae mothers (N=238:56.0%). Distribution of the study participants according to the parity was significant ( $X^2=320.6$ : $p<001$ ). (Table 1) Abnormalities were not detected among 63.3% of the study participants (N=269). Pinard foetal stethoscope was used first to detect abnormalities of 17.9% (N=28) of the participants with foetal heart rate abnormalities.

**Table 2; Distribution of event detection rate**

<b>Detected event</b>	<b>Number (N)</b>	<b>Percentage (%)</b>	
Uneventful	269	63.3	
<b>Method of detection</b>			
First detected Only Pinard	28	17.9	Z=2.159
Only Doppler	44	28.2	P<0.05
Both methods	78	53.8	

The Doppler study done at the same moment appeared normal. Handled Doppler machine was used to detect first foetal heart rate abnormalities in 28.2% of the study participants (N=44). In 84 participants (53.8%) foetal heart rate abnormalities were detected at the first time by both methods. When considered individually, significantly

higher percentage of participants were detected by the handled Doppler machine than the pinard foetal stethoscope ( $z=2.159; p<0.05$ ). (Table 2) Majority of the participants had experienced delivery of live non-asphyxiated baby at the end of the labour (N=313:73.6%).

**Table 3: Distribution of Ultimate result of the labour**

<b>Outcome</b>	<b>Number(N)</b>	<b>Percentage (%)</b>
LNA Baby delivered	313	73.6
EM / LSCS	22	5.1
Meconium Stained Liquor	63	14.8
Birth Asphyxia	8	1.8
SCBU admissions	12	2.8
Other	07	1.6
<b>Total</b>	<b>425</b>	<b>100</b>

22 participants had undergone Emergency Cesarean section due to labour complications (5.1%). All of these complications were detected by the pinard or Doppler methods during labour by health care workers. None of the participants experienced intrauterine deaths. (Table 3) Mean duration of labour was

significantly different between primi mothers and multiparous mothers ( $p<0.05$ ). Participants whose labour was augmented had experienced prolong labour than who went for delivery without induction ( $p<0.05$ ). (Table 4)

**Table 4; Distribution of duration of labour**

		<b>Mean</b>	<b>P value</b>
<b>Parity</b>	Primi gravidae	8.66	<0.001
	Multigravida	4.21	
<b>Labor Augmentation</b>	Labour induction	6.73	<0.001
	Without induction	5.79	
<b>Maternal Age</b>	Age > 30 years	6.61	0.095
	Age < 30 years	5.87	

**Table 5; Association of foetal heart rate monitoring methods and complicated labour outcome**

Abnormality detection	LNA Baby	Delivery with Complication	Total
Not detected by any methods	269	-	269
Detected by any/both methods	45	111	156
Pinard Only	28	-	28
Doppler only	-	44	44
Both	17	67	84

In 14.33% (N=45) of the mothers who had a healthy live birth without any obstacle, doppler or pinard stethoscope detected foetal heart rate abnormalities. 111 participants in the study sample delivered their newborns with complications. All those participants were detected with foetal heart rate abnormalities either with both methods or with a single method during the period of labour. Not detecting a foetal heart rate abnormality during labour was identified as a positive factor for proceeding with a live non asphyxiated baby delivery. Although a foetal heart rate abnormality was detected for the

first time by the pinard stethoscope, all those participants delivered live non asphyxiated babies without any complication. However foetal heart rate abnormalities were detected in all the mothers who experienced complicated deliveries by the handled Doppler method. In 17 mothers foetal heart rate abnormalities were detected for the first time by both methods, but they delivered live non asphyxiated babies without any complication. 67 mothers who had complicated deliveries were detected with foetal heart rate abnormalities by both methods. (Table 5)

**Table 6; Distribution of combined application of foetal heart rate monitoring tools and labour outcome**

	Adverse Outcome	LNA Baby	Total
<b>Test Results</b>			
Both test positive	67	17	84
Both test negative	44	28	72
<b>Total</b>	111	45	156

*Odds Ratio = 2.508: 95% Confidence Interval =1.230 - 5.115*

In 53.3% of the (N=84) mothers with complicated deliveries, foetal heart rate abnormalities were detected at the first time by both methods. According to these results, identification of foetal heart rate

abnormalities by both methods significantly indicates the risk of proceeding to a complicated delivery (OR=2.508: 95% CI =1.230 - 5.115).(Table 6)

**Discussion**

Valaries Smith et al, after a systematic review in 2012, has concluded that electronic fetal monitoring in the labour room should be studied in detail. Findings of the present study accompany with those recommendations. It showed clearly a successfulness by using the handed Doppler machine for electronic fetal monitoring during the study. There were no uncomplicated deliveries, from whom were being detected as abnormalities by electronic foetal monitoring. Sinclair et al in his study conducted in 2001, has concluded that for a

safe birth CTG monitoring is not mandatory. But according to our study findings the requirement of CTG cannot be excluded. Munro et al in 2002, according to his study has concluded that maternal anxiety is generated by using EFM and that gives rise to use of pain relief methods. This aspect was not considered during the present study. If pharmacological pain relief methods are being used, complicated child deliveries can be expected. This will generate an extra service burden.

According to Maude et al in 2014, intermittent auscultations can improve the labour outcome by 12%, when compared to foetal condition monitoring by using a CTG alone. Present study also accompanies the advantages of this intermittent monitoring methods. In the study sample all the complicated deliveries were predicted either by the handed Doppler or the Pinard stethoscope.

According to the randomized controlled trial that has done by Vintzileos et al, it is clear that reducing the perinatal mortality is positively associated with the electronic foetal monitoring. Even though there were no comparative findings to this present study,

majority of those who had undergone electronic foetal monitoring had surgical interventions. On the other hand, Vintzileos also mentioned that mothers who had undergone electronic foetal monitoring had more Emergency LSCS. In the present study every mother who had an emergency LSCS had been detected as having a FHR abnormality during the 1<sup>st</sup> stage of labour by using a handed Doppler initially.

The advantages of handed Doppler is shown by a comparison study with a study sample of 1255 full termed singleton pregnancies which was studied by Mohammad Nyomi. According to them there was a well identifiable association between the electronic foetal monitoring and perinatal morbidity and mortality outcomes. They have recommended to promote ultrasound foetal heart rate monitoring in the developing countries. Yet recommending ultrasound monitoring techniques and procedures in a country such as Sri Lanka could be practically difficult. Therefore, it is clear that combined use of the Pinard stethoscope and the electronic foetal monitoring technique is much appropriate according to the present study findings.

The main objective of labour is to have a live and healthy off spring. Whether labour is a completely natural process there can be various pathophysiological complications during the process. Yet due to the advanced technology and implementation of various strategies of modern medicine we have been able to minimize those complications.

Fetal distress is a dangerous notifiable complication which can occur during labour process. Fetal distress is considered as the lowering of foetal heart rate than the normal level or increasing than the normal when fetus is ready to be delivered. There are two

main ways to detect foetal distress which are being used in labour rooms. Those methods are first, CTG and secondly, listening to the fetal heart rate. Yet the CTG is practically difficult to use continuously or use in small time intervals frequently. So more readily and widely used method is monitoring fetal heart rate. The more traditional way is listening to the FHR using a Pinard stethoscope. But now there is a handed Doppler machine which is commonly used. According to this study findings all the participants who were detected as having a fetal heart rate abnormality, only by using a Pinard stethoscope, had an uncomplicated delivery. So, a hypothesis can be postulated as there is a false red-light sign when using a Pinard measurement. All the participants who were diagnosed as having a fetal heart rate abnormality, initially by using a Doppler machine had complicated delivery which favours the above hypothesis. Even though above all, there were participants who had live non asphyxiated baby deliveries as well as complicated deliveries, who were diagnosed of having fetal heart rate abnormalities by using both methods. Majority showed complicated deliveries. So it is indicated that, these methods can be used as a prediction for complicated delivery, yet the accuracy of these methods are to be evaluated further.

On the other hand, from the mothers who were detected as having FHR abnormalities, only 22(14.1%) had undergone emergency LSCS. This implicates that from the mothers who were diagnosed of having fetal HR abnormalities, majority had undergone normal vaginal delivery. But precautions can be taken for those complications which were assumed. So it is practical and more accurate to take decisions by using both methods to diagnose, than depending on stethoscope findings only.

Handed Doppler machine is a smaller device when compared to the Pinard stethoscope, also much easier to use. Yet it should be used much more carefully because it is not durable as the Pinard stethoscope. Also handed Doppler machine does not cause subjective variations when it comes to measure an abnormality in FHR as in the Pinard stethoscope. This means that the measurements taken by the Pinard will totally depend on the person who is using it. When using the handed Doppler machine this can be prevented. But more accurate way to come for a diagnoses is, using both strategies in a parallel way.

It could be difficult to adopt to a digital method, for health care professionals who have been using the Pinard for a longer time period. Daily usage of Handed Doppler machine could be unpopular due to several implications such as maintenance difficulties as it is an electronic device and requires application of trans-conducting gel on subjects. However, using any method to predict complications during delivery is highly advantageous as taking precautions are invaluable. Handed Doppler is not an expensive device comparatively, also does not need much more complex training. When it comes to taking measurements, handed Doppler does not cause subjective variations. Because of that, promoting use of handed Doppler in Sri Lankan labour rooms is clearly advantageous. But the Pinard stethoscope which is used at present, should not be removed as combining of both methods for the assessment will give a better prediction for early detection. Also, it does not cause technical difficulties when both methods are used simultaneously.

### **Conclusions**

Predictions gathered by using both pinard foetal stethoscope and the Doppler method

are more accurate. Further studies should be conducted regarding the use of handled Doppler monitoring method as a highly sensitive and diagnostic test during the intrapartum period. Future attention should

be focused on studying the diagnostic test accuracy of foetal heart rate monitoring methods to predict all the perinatal adverse events.

## Reference

1. World Health Organization. Neonatal and perinatal Mortality, country, global and regional approach. Geneva; 2006. 75 p.
2. Haub C, Kaneda T. 2014 World Population Data Sheet. Popul Ref Bur. 2014;August:20.
3. Rutstein SO. Factors associated with trends in infant and child mortality in developing countries during the 1990s. Bull World Health Organ. 2000;78(10):1256–70.
4. Statistics D of C and. Census and population and Housing 2012 [Internet]. Colombo; 2012. Available from: [http://www.statistics.gov.lk/Gender/Statistics/Tables/Population/Pop\\_1.02.pdf](http://www.statistics.gov.lk/Gender/Statistics/Tables/Population/Pop_1.02.pdf)
5. Family Health Bureau. Annual Report on Family Health, Sri Lanka 2014. Colombo; 2014.
6. Ahearne CE. Short and long term prognosis in perinatal asphyxia: An update. World J Clin Pediatr [Internet]. 2016;5(1):67. Available from: <http://www.wjgnet.com/2219-2808/full/v5/i1/67.htm>
7. Spector JM, Agrawal P, Kodkany B, Lipsitz S, Lashoher A, Dziekan G, et al. Improving quality of care for maternal and newborn health: Prospective pilot study of the who safe childbirth checklist program. PLoS One. 2012;7(5).
8. Bureau M of H& FH. National strategic plan on maternal and newborn health 2012-2016. Colombo;
9. Health M of. Health service delivery: strengthening of maternal health services. srilanka. 2008.
10. Lumbiganon P, Lapaiboon M, Glumetzoglu M, Zousa JP, taneepa Nichkul S RP. Method of delivery and pregnancy out comes in Asia: The global survey on maternal and perinatal health. Lancet. 2010;375:490–9.
11. Hemachandra N, editor. Maternal Care Package : A guide to ffield care workers. Colombo: Family Health Beureu; 2011.
12. RANZCOG. Intrapartum fetal surveillance. RANZCOG Clinical guideline. 2014. 68 p.
13. Vardhan S, Bhattacharyya TK, Kathpalia SK, Kochar SPS. Intrapartum electronic foetal monitoring: Does it lead or mislead? Med J Armed Forces India. 2006;62(1):51–5.
14. Haverkamp AD, Thompson HE, McFee JG, Cetrulo C. The evaluation of continuous fetal heart rate monitoring in high-risk pregnancy. Am J Obstet Gynecol. 1976 Jun;125(3):310–20.
- 15.A\_Randomized\_Trial\_of\_Intrapartum\_Electronic\_Fetal.1.pdf.
16. Medical A, July AJ. Risk factor of birth asphyxia. 2016;(August).
17. Pmnch. Every Newborn Action Plan. Vol. 2014. 2014.
18. Rafique A, Akram M, Khan RA, Fakhar-UI-Zaman M. Birth Asphyxia -Clinical Experience and Immediate



- Outcomes. *J Rawalpindi Med Coll* [Internet]. 2017;21(1):20–2. Available from: [http://www.journalrmc.com/volumes/06\\_Birth Asphyxia Clinical Experience and Immediate Outcomes.pdf](http://www.journalrmc.com/volumes/06_Birth%20Asphyxia%20Clinical%20Experience%20and%20Immediate%20Outcomes.pdf)
19. Lee ACC, Mullany LC, Tielsch JM, Katz J, Khattry SK, LeClerq SC, et al. Risk factors for neonatal mortality due to birth asphyxia in southern Nepal: a prospective, community-based cohort study. *Pediatrics* [Internet]. 2008;121(5):e1381-90. Available from: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2377391&tool=pmcentrez&rendertype=abstract>
20. Franck LS. Some Pain , Some Gain : Reflections on the Past Two Decades of Neonatal Pain Research and Treatment. 2002;21(5):37–41.
21. World Health Organisation (WHO). Making Every Baby Count : audit and review of stillbirths and neonatal deaths. *WHO Libr Cat Data*. 2016;(August):144.
22. World Health Organization. The WHO application of ICD-10 to deaths during the perinatal period. 2016;1–88.
23. Sarno AP, Ock Ahn M, Brar HS, Phelan JP, Platt LD. Intrapartum Doppler velocimetry, amniotic fluid volume, and fetal heart rate as predictors of subsequent fetal distress: I. An initial report. *Am J Obstet Gynecol* [Internet]. 1989;161(6, Part 1):1508–14. Available from: <http://www.sciencedirect.com/science/article/pii/0002937889909149>
24. Smith V, Begley CM, Clarke M, Devane D. Professionals' views of fetal monitoring during labour: a systematic review and thematic analysis. *BMC Pregnancy Childbirth* [Internet]. 2012 Dec 27;12:166. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3549751/>
25. Maeda K. Fetal Heart Rate Monitoring. *Heal Med Informatics* [Internet]. 2014;5(1):1–2. Available from: <http://www.springerlink.com/index/10.1007/978-3-642-70358-4>
26. Alfirevic Z, Devane D, Gyte GML, Cuthbert A. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour. *Cochrane Database Syst Rev*. 2017;2017(2).