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Original Article

Observational Study of Fetal Monitoring in Different Maternal Positions at More Than 3600 Masl Huancavelica, 2021

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Abstract *- This research aims to determine the effect of maternal left lateral decubitus and Fowler positions on electronic fetal monitoring at more than 3600 Masl-Huancavelica, 2021. Method: the research was pre-experimental, prospective, and longitudinal analytical; the level of research is explanatory; normality was evaluated with the Shapiro-Wilk statistician and statistical analysis with the Wilcoxon signed-rank test sample: 35 pregnant women between 32 and 42 weeks. Each one underwent two NST of 20 minutes (LLD and Fowler). Results: the average age was 25 years old and a mean of 37.26 weeks of gestational age; 37.1% were primigravida, 42.9% second gestation and 20% multiple gestations; in the NST in the LLD position, it was found: that 91.4% reactivity, 8.6% non-reactive, there were no pathological, while in the Fowler position: 74.3% presented reactivity, 20.0% non-reactive and 5.7% pathological. The baseline in LLD was 136.06, compared to 139.31 in Fowler. The mean of variability and accelerations was 10.51 and 4.49 in LLD and 9.63 and 3.43 in Fowler; few NSTs were identified with mild variable decelerations of 0.34 and 0.09, and fetal movements were 13.11 and 10.40, respectively. There is a significant difference in the baseline, showing less in LLD ("p" value 0.000). Conclusions: The LLD position shows better results than the non-stress test; a significant difference has been found in the baseline, while the variability, acceleration and movements are similar in both positions with a significance of 0.05.*

Keywords *- Non-Stress Test (NST), Left Lateral Decubitus position (LLD), Fowler's position, Fetal Heart Rate (FHR).*

1. Introduction

Continuous external electronic fetal monitoring is one of the maternal tests with the greatest feasibility of developing to monitor the adequate oxygenation of the fetus and thus avoid hypoxia and asphyxia, which generate damage to the central nervous system of the fetus. Standardizing monitoring processes and maternal position during fetal monitoring can improve the specificity of cardiotocographic records, helping to reduce cerebral palsy [1]. Maternal position for antepartum monitoring varies among hospitals and evaluators. Determining the best position can improve monitoring guidelines. Electronic fetal monitoring is the most widely used method to assess fetal condition, either during pregnancy or childbirth [2]. Likewise, the non-stress test (NST) is one of the prenatal tests that is performed after 28 weeks of gestation in order to assess fetal well-being through the assessment of the elements of the fetal heart rate (FHR) and fetal movements [3].

The NST is based on the evaluation of the functioning of the fetal autorhythmic atrial pacemaker, which causes to be variations from beat to beat, produced by the autonomic nervous system originating in the brain stem of the fetus [4]; likewise, these variations and the adequate functioning will show itself generating cardiac accelerations that constitute fetal reactivity. The autonomic nervous system has two branches (sympathetic and parasympathetic), which have opposite influences on the fetal heartbeat. On the other hand, the balance of these two nervous systems results in the FHR at rest and basal variability [4],[5]. During fetal development, the sympathetic nervous system develops much faster than the parasympathetic nervous system, which occurs during the third trimester. In this sense, with advancing gestational age, there is a gradual decrease in the basal fetal heart rate [7] and an increase in the frequency of the accelerations together with the amplitude above the initial value [7],[8].

There is some research that recommends the semi-fowler position to perform an NST since it could reduce the need for prolonged monitoring [10] while others the left lateral decubitus position because, in this position, a higher fetal heart rate would occur, increased accelerations and fetal movement, in this position the maternal-placental circulation improves; therefore it should have better results in the elements of the fetal heart rate [11]–[13].

Standardizing the maternal position during NST is necessary to improve its sensitivity in diagnosing fetuses with hypoxia. Using any position leads to prolonged tests and increased costs. Therefore, it is important to determine the effect of LLD and FOWLER positions on fetal heart rate. The main objective of this research is to find the results of different positions of the fetus in the mothers of Huancavelica located at more than 3600 masl.

Currently, there is controversy about the maternal position at the time of performing electronic fetal monitoring since, in most cases, these are performed according to the experience of health personnel. In this sense, the present research work will reinforce and establish bases to continue with the investigations that contribute to standardizing the maternal position now of performing electronic fetal monitoring and, at the same time, reduce the variations in practice between health care providers since the decisions will be ordered. In the same way, these results will be an important reference for future research.

2. State of Art

Nathan et al. [10], in the research “The relationship of maternal position to the results of brief nonstress tests: a randomized clinical trial”, 2000. Its objective was to determine if the maternal position (left lateral decubitus position versus semi-fowler position) had any effect on the results of the test without stress during a shorter period (10 minutes): a randomized comparative study whose population consisted of 108 pregnant women between 32 and 42 weeks. They found that both nonstress test sequence and position were significant and independent factors related to nonstress test reactivity; they also found that tests performed with the patient in the semi-fowler's position were more likely to have reactive results. They concluded that the semi-fowler position is a position to perform a non-stress test in a brief period. Using this position could decrease the need for prolonged monitoring, leading to a more effective evaluation in the time of evaluating patients at risk.

Cito et al. [14], in the research “Maternal position during the non-stress test and fetal heart rate patterns”, 2005. The study examined how maternal position during non-stress tests at different gestation weeks affects fetal heart rate patterns. They performed 1055 NST in 368 pregnant women, divided into recumbent, sitting, and walking groups. Fetal heart rate differed based on gestational age and maternal position. The most common position was reclining, followed by sitting and walking. The duration of the test decreased significantly in sitting or walking. Fetal movements were greater in the recumbent position. The baseline did not vary with maternal position. They concluded that two orders of factors affect the NST: the gestational age at which the test is performed and the maternal position assumed during the test.

Alus et al. [12], in their research “The effects of different maternal positions on the non-stress test: an experimental study”, 2007, Turkey. It aimed to determine the effects of different maternal postures on non-stress test results and mothers' preferences for positions involved; an experimental study with four randomly assigned positions: supine, left lateral, semi-fowler and sitting where its sample consisted of 408 pregnant women, the average age of the participants was 27 years old, and the average gestational age was 36 weeks. They found significant differences ($P < 0.05$) between the 4 four groups; they found that the semi-fowler position gave the highest fetal reactivity, followed by the sitting position, left lateral decubitus, and supine showed the least fetal reactivity. They concluded that the supine position produces the least nonreactivity, along with physical complaints such as back pain and shortness of breath.

Stone et al. [13], in their research “Effect of maternal position on fetal behavioral state and heart rate variability in healthy late gestation pregnancy”, 2017. Aimed to evaluate the effects of different maternal positions on Fetal Behavioral States (FBS) in healthy late-gestation pregnancies under controlled conditions; its population consisted of 29 pregnant women who had continuous fetal ECG recordings under standardized conditions in four randomly assigned positions (left lateral, right lateral, supine, and semi-recumbent). They found a significant association between maternal position and mean fetal heart rate; heart rate variability measures were reduced in both the semi-recumbent and supine positions. On the other hand, in late gestation healthy gestation, maternal position affects FBS and heart rate variability. They concluded that fetal adaptations to maternal positions might produce mild hypoxic stress.

Ibrahim et al. [11], in their research “The effect of different positions during the non-stress test on maternal hemodynamic parameters, satisfaction, and fetal cardiotocographic patterns”, Saudi Arabia, 2021. It aimed to investigate the effect of different maternal positions during NST on the fetal cardiotocographic pattern, a quasi-experimental study where its sample consisted of 118 pregnant women in the third trimester. They found a higher fetal heart rate, increased accelerations, and fetal movement in the left lateral position, followed by the semi-fowler position compared to the supine position, with statistically significant differences. On the other hand, they did not observe statistically significant differences ($P > 0.05$) regarding the fetal heart rate variability and the NST reactivity in the three positions. They concluded that the left lateral and semi-fowler positions were associated with a more favorable cardiotocographic pattern than the supine position.

Mucuk et al. [15], in their research "The effect of different positions during a non-stress test on maternal hemodynamic parameters, satisfaction, and fetal cardiotocographic patterns", Saudi Arabia, 2021. It aimed to investigate the effect of different maternal positions during NST on the fetal cardiotocographic pattern, a quasi-experimental study where its sample consisted of 118 pregnant women in the third trimester. He found that there was a higher fetal heart rate, increased accelerations, and fetal movement in the left lateral position, followed by the semi-fowler position compared to the supine position, with statistically significant differences. On the other hand, they did not observe statistically significant differences ($P > 0.05$) regarding the fetal heart rate variability and the NST reactivity in the three positions. They concluded that the left lateral and semi-fowler positions were associated with a more favorable cardiotocographic pattern than the supine position.

3. Conceptual Basis

3.1. Fetal Circulation

The fetal cardiovascular system is adapted to deliver highly oxygenated blood to the brain and heart while diverting it from the lungs. Biochemical and anatomical factors contribute to this system, including vaso-regulatory agents and four specialized derivations [16]. On the other hand, the fetus's oxygen supply depends on oxygen content in the blood, flow velocity in the uterine and umbilical arteries and the diffusing capacity of the placenta [17].

Fetal shunts divert oxygenated blood to the systemic circulation; shunt deoxygenated blood away from the lungs. The umbilical vein carries blood to the liver; ductus venosus allows for bypassing hepatic circulation. [18]. Blood from the lower body enters the right atrium and bypasses the left atrium through the foramen ovale. This oxygenated blood passes through the left ventricle and is pumped to the carotid and coronary arteries [16]. The rest of the blood flow from the inferior vena cava mixes with desaturated blood from the superior vena cava, which first enters the right ventricle through the tricuspid valve and subsequently enters the pulmonary artery [19]. In cases of hypoxia, the fetus redistributes its blood flow, favoring vital organs such as the heart, brain and adrenal glands [17], [20].

3.2. Fetal Heart Rate

The cardiovascular system is one of the organs that function in embryogenesis; blood begins to circulate towards the end of the third week of gestation [21]. The fetal heart becomes vital for the distribution of oxygen and nutrients since the passive diffusion of oxygen becomes insufficient for the distribution of oxygen and nutrients [22], [23].

The onset of the first heartbeat begins on the 22nd day of gestation, followed by active fetal blood circulation at the end of the 4th week [21], [22]. Using transvaginal ultrasound, the heartbeat is observed at 4.5 to 5 weeks of gestation, with a Doppler ultrasound from week 10 and a standard stethoscope from 16 weeks [3]. Normal FHR values range between 110 and 160 beats per minute (bpm) [3], [24], [25]. However, there is still no consensus on the normal fetal heart rate, as current international guidelines recommend different baseline FHR ranges from 110 to 150 beats per minute (bpm) or 110 to 160 bpm.

3.3. Classification

Classification of Dr. Caldeyro Barcia:

- Normal fetal heart rate: fetal heartbeat greater than or equal to 120 and less than 150
- Weak tachycardia: Fetal heartbeat greater than or equal to 150 and less than 160.
- Moderate tachycardia: Fetal heartbeat greater than or equal to 160 and less than 180.
- Marked tachycardia: fetal heartbeat greater than or equal to 180.
- Weak bradycardia: Fetal heartbeat greater than or equal to 110 and less than 120.
- Marked bradycardia: Fetal heartbeat less than 110.

Dr. Hon's Rating:

- Normal fetal heart rate: fetal heartbeat greater than or equal to 120 and less than 160.
- Moderate tachycardia: Fetal heartbeat greater than or equal to 160 and less than 180.
- Marked tachycardia: fetal heartbeat greater than or equal to 180.
- Moderate bradycardia: Fetal heartbeat greater than or equal to 100 and less than 120.
- Marked bradycardia: Fetal heartbeat less than 100.

NICHD Classification (2008): Normal fetal heart rate, a fetal heartbeat between 110 and 160 and tachycardia, a fetal heartbeat greater than 160.

3.4. Fetal Heart Rate Patterns

There are four elements or parameters of the fetal heart rate, which are: baseline, variability, acceleration and deceleration [26]-[29].

3.4.1. Baseline

It is the average FHR recorded in 10 minutes at maternal rest, excluding accelerations and decelerations. Preterm fetuses tend to have values at the upper limit of this range and post-term fetuses at the lower limit [28], [29]. Normal values range from 110 to 160 bpm [25], [29]. Abnormal baseline patterns are:

- Tachycardia (> 160 bpm) is considered moderate when the duration is less than 30 minutes and severe when it exceeds 30 minutes.

- Bradycardia (< 110 bpm) is considered moderate when the beats oscillate between 110 and 100 bpm; and severe when it is less than 100 bpm.

In the case of fetal tachycardia, the presence of fever in the mother, chorioamnionitis, and fetal hypoxia should be ruled out. While in fetal bradycardia, severe fetal hypoxia, post-maturity, and hypothermia must be ruled out [28], [29].

3.4.2. Variability

Fetal heart rate variability refers to beat-to-beat oscillations recorded for 10 minutes, indicating oxygenation of the CNS and myocardium. Normal values range from 6-25 bpm [28], [29]. Abnormal patterns of variability are:

- Absent: In these cases, there are no apparent oscillations or fluctuations in the FHR that last 10 minutes or more.
- Saltatory: it is considered greater than 25 bpm, persistent for 10 minutes or more.
- Sinusoidal pattern: it is the undulating record with a cycle frequency of 3-5 bpm that persists for 20 minutes or more.

In absent variability, the presence of fetal sleep and prematurity should be ruled out. Likewise, in all three cases, the presence of fetal hypoxia must be ruled out [28], [29]

On the other hand, the International Federation of Gynecology and Obstetrics (FIGO) classifies variability as follows—different amplitude levels for fetal heart rate (FHR) and their corresponding descriptions. An absent FHR has a rate of less than 3 beats per minute and an undetectable amplitude. A minimum FHR has an amplitude of 5 beats per minute or less. A moderate, normal FHR has an amplitude ranging from 6 to 25 beats per minute. Finally, a marked, severe or saltatory pattern FHR has an amplitude greater than 25 beats per minute.

3.4.3. Accelerations

These are abrupt and transient increases in the FHR above the baseline with an amplitude of 15 beats and a duration greater than 15 seconds without exceeding 10 minutes [3], [28], [29].

Types of fetal accelerations include non-periodic, which is a response to fetal movements and assessed in the non-stress test (NST), periodic, which occurs with uterine contractions; and compensatory, which precedes decelerations. Prolonged accelerations last 2-9 minutes, and those greater than 10 minutes result in baseline changes [28], [29].

3.4.4. Decelerations

These are transitory falls or decreases in the fetal heart rate of 15 beats per minute below the baseline with a duration of 15 seconds and no longer than 10 minutes [3], [28], [29]. It is called a prolonged deceleration when the decrease of 15 bpm or more lasts from 2 to 9 minutes, while the baseline change is the decrease in FHR for more than 10 minutes [28], [29].

- Early deceleration: it is the gradual, transient, and low amplitude drop with respect to the baseline. These coincide with the beginning and end of the uterine contraction. It is attributed to a vagal compression reflex of the fetal head in the birth canal [28], [29].
- Late Decelerations: These are FHR drops that begin after the contraction peak, presenting a delay, both in its onset and in its peak, greater than 20 seconds [3], [28], [29].
- Variable decelerations: They can appear at any time during the trace; their amplitude and duration become highly variable, which justifies their name [3].

On the other hand, Fetal movement starts from the 7th week and becomes more complex towards the end of pregnancy. Primiparous women perceive it around 18-20 weeks, and multiparous women around 16-18 weeks. [30]. Fetal movement can be quantified using the Cardiff, Sadovsky, or Rayburn method, involving counting movements during a specific period [28]-[32]. Decreased fetal movement can signal a deteriorating fetal state but does not always mean imminent fetal death. Factors such as maternal activity, position, and medication can also influence perception [32].

3.5. Body Positions

Body positions are postures used by health personnel to examine, treat, and prevent injuries resulting from immobility in bedridden patients. Measures like accessory placement and covering sheets vary with each position. In the supine position, the patient is lying on his back. Its legs are extended, and its arms are aligned along the body. The body plane is parallel to the ground plane [34], [47]. Supine position in pregnancy compresses the aorta, causing low blood pressure, pulse pressure, and worsened lung function.

In prone decubitus, the plane of the body is parallel to the ground; the patient is lying on their abdomen and chest. Head turned laterally. The legs are extended, and the arms are also extended along the body. In lateral decubitus (fig.1), the patient lies on the side, with extended legs and arms parallel to the body for greater stability [35].

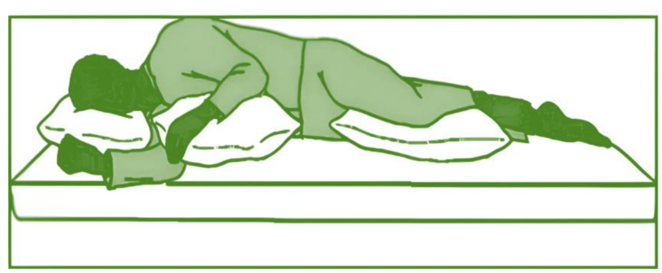

Fig. 1 Lateral decubitus position

3.6. Special Positions

The Fowler position (fig.2) has the patient semi-sitting with their head raised at 45º to 60º, with two variants. Sims, Like lateral decubitus but with the lower arm back, upper hip and knee flexed, and head turned. Gynecological, supine with legs in stirrups. Trendelenburg: supine with the body inclined 45º Morestin, body inclined with head higher. Genupectoral, prone with hips up. Roser, supine with head hanging out of bed [34,47].

Fig. 2 Fowler position

3.7. Electronic Fetal Monitoring

Hon, Caldeyro-Barcia, and Hammacher developed consistent methods for fetal monitoring in the 1950s, leading to the first commercial monitor in 1968. The term electronic fetal monitoring became popular in English-speaking countries, while cardiotocography became the preferred term by FIGO in 2015 [36].

Cardiotocography records fetal heart rate and uterine activity via ultrasound. The NST assesses fetal well-being in the third trimester [4]. It consists of external monitoring of FHR and fetal movements in the absence of uterine activity. This test serves to determine the fetal status during the period in which it is performed [26]. According to the Antepartum Electronic Fetal Monitoring Care Procedure Guide, cardiotocographic characteristics should be assessed in 20 minutes, and these can be extended from 40 to 90 minutes before concluding with the diagnosis [27], [28], [48].

The NST tries to assess the fetal respiratory reserve and identify those fetuses that are in a compromised situation. It is based on the fact that the FHR of the non-acidotic and neurologically intact fetus will react with transient accelerations to fetal movements since it reflects the state of oxygenation of the fetal brain [41], [42]. In a test in which adequate variability (> 5 bpm) is found, fetal movements present, which are accompanied by accelerations (of at least 15 beats lasting at least 15 seconds) and absence of decelerations is considered normal [26], [39]-[43].

In the results, the Hospital Cayetano Heredia uses antepartum electronic fetal monitoring with reactive, non-reactive, and non-reassuring patterns. Reactive NST includes two increments of 15 beats over 20 minutes, non-reactive NST is evaluated for 45-90 minutes, and non-reassuring patterns are characterized by alterations in baseline or variability with acceleration. Spanish Society of Gynecology and Obstetrics interprets the results of NST tracing based on reactive, non-reactive, normal, suspicious, and pathological patterns [40].

The obstetric behavior according to the NST pattern

- Reactive: indicates fetal well-being; the test will be repeated in 3-7 days, depending on the cause that led to its performance. However, regarding the safety margin of the test, it is one week since usually, except in acute processes, placental deterioration is usually slow and progressive.
- Non-reactive: a stress test must be performed; this pattern can be shown in periods of fetal rest, prematurity, and maternal treatment with sedatives or hypnotics. To rule out a false positive, the fetus will be externally stimulated (fetal mobilization, vibroacoustic stimulation) and continue recording for another 15 to 20 minutes.
- Pathological: other studies will be carried out, among them the Doppler study, biophysical profile, or contraction stress test, although, in the case of the abnormal pattern, it is possible to directly choose to terminate the pregnancy based on the gestational age and the criteria that allowed it to be qualified it as such [26].

The principal complication that occurs during pregnancy is inferior vena cava syndrome, which compresses the vena cava and aorta, causing hypotension, tachycardia, and dyspnea. Management involves LLD positioning, hydration, and correction of the cause. The Poseiro effect is an asymptomatic regional hypotension caused by the compression of the aorta and iliac arteries during pregnancy and labor, which affects the fetal heart rate [3], [48].

The hypothesis for the study suggests that the maternal positions of LLD and Fowler can have an impact on electronic fetal monitoring. The general hypothesis is that these positions influence the monitoring, while the specific hypotheses provide further details. The first specific hypothesis states a difference in the FHR baseline between Fowler's position and left lateral decubitus. The second hypothesis suggests a difference in FHR variability between these positions. The third hypothesis states a difference in FHR accelerations, while the fourth hypothesis suggests a difference in fetal movements between Fowler's position and left lateral decubitus. Overall, the study aims to investigate the impact of these maternal positions on electronic fetal monitoring.

4. Methodology and Results

The department of Huancavelica presents a rugged and abrupt geography, where there are several altitude floors, from 1,950 meters above sea level in its valleys, up to 5,000 meters above sea level. The research was conducted in the district capital of Huancavelica, which is located at 3,680 meters above sea level. The type of research is pre-experimental, prospective, analytical, and longitudinal [44]. Our pre-experimental research prospectively observed pregnant women placed in different positions to compare fetal heart rate measurements. [45]. The level of research is explanatory [46]. The research design is pre-experimental, with two factors: left lateral decubitus position and semi-fowler.

Each pregnant woman was monitored in both positions; the starting position was randomized. The population consisted of all pregnant women from 32 to 42 weeks of pregnancy who attended the health facility. The sample consisted of all the pregnant women who attended the health facility from September 1st to October 30th, 2021. The sampling was to the investigator's criteria that to be admitted. The pregnant women had to meet certain characteristics: being ≥ 32 and ≤ 42 weeks of pregnancy by RUF or ultrasound of the 1st trimester, agreeing to participate in the study and being pregnant women with pathologies that affect the maternal-placental circulation such as asthma, COVID-19, silicosis, tuberculosis was not considered part of the study, pneumonia, gestational hypertension, preeclampsia, chronic hypertension, chronic hypertension with added preeclampsia, diabetes, IUGR, oligohydramnios, polyhydramnios, hyperthyroidism, pregnant women medicated for mental health problems, preterm labor threat, febrile syndrome, multiple pregnancies, great multi pregnancies (≥ 4 pregnancies).

An electronic fetal monitor of the Bistos brand, model BT350 FETAL MONITOR, was used. We used Fisher's test to evaluate the non-stress test. A structured observation instrument was used to evaluate the four elements of fetal heart rate and fetal movements.

4.1. Data Process

1. Permission was requested from the Ascension Health Center to conduct our project in this establishment and to use the environment and fetal monitor.
2. The objective population of our study was identified through the nominal registry of pregnant women and active epidemiological surveillance.
3. The sample was identified by reviewing the medical records and verifying the inclusion and exclusion criteria.
4. For the sampling, telephone calls and home visits were made to the pregnant women, informing them about the research and inviting them to participate in the study.
5. Informed consent was given to them so that their participation could be evaluated.
6. 72 hours after the first contact, we contacted the pregnant women again to find out the answer about participation in the research.
7. Once they gave us the signed informed consent, the date and time for the procedure were scheduled.
8. NST procedure:
   - 8.1 The pregnant woman was received, and we identified ourselves.
   - 8.2 We asked the patient for her perinatal card and signed informed consent.
   - 8.3 We verify the data and corroborate the gestational age.
   - 8.4 We provide brief, clear, and concise information to the patient about the procedure to be performed; Likewise, we clarify any doubts of the patient regarding it.
   - 8.5 Glucose (chocolate wanta) was given to the patient 30 minutes before starting the NST.
   - 8.6 The patient was allowed to rest for 30 minutes before starting the NST.
   - 8.7 After 30 minutes, we ask the patient to urinate.
   - 8.8 An anamnesis aimed at fetal health was performed.
   - 8.9 We wash our hands.
   - 8.10 Maternal vital functions were taken (blood pressure, heart rate, respiratory rate, and temperature)
   - 8.11 We registered the patient in the fetal monitor, recording her name and surname.
   - 8.12 We place the patient on the stretcher and perform the Leopold maneuvers.
   - 8.13 We place the cardiotransducer with gel in the highest focus of the fetus's heartbeat and fix it with elastic bands.
   - 8.14 We place the tocodynamometer approximately 8 cm from the uterine fundus and fix it with an elastic band.
   - 8.15 We calibrate the equipment to the basal tone of the uterus (8-12 mmHg.).
   - 8.16 The position with which the pregnant woman would start was drawn to control the bias of her position.
   - 8.17 We started the layout with the position that had to start in the draw for 20 minutes.
   - 8.18 After 20 minutes, we finish the route.
   - 8.19 We change position and start a new route for 20 minutes.
   - 8.20 Once the 20 minutes had elapsed, we finished the tracing and proceeded to remove the transducers.
   - 8.21 In cases of loss of focus, we started the tracing again in the position that was lost.
   - 8.22 We read and interpreted the cardiotocographic variables.
   - 8.23 We describe the events that occurred during the patient's stay in the data collection form.

9. The obstetrician on duty was shown the tracings, and at the same time, we reported the events that occurred during the procedure to leave the cardiotocographic record finally.
10. In cases where there was no reactivity, the obstetrician on duty was informed immediately, and the treatment was continued with prior authorization. It should be noted that no external stimulation was performed in any of the tracings.

4.2. Data Analysis Techniques and Processing

The Microsoft Office Excel 2010 spreadsheet and the SPSS V25 package were used for data processing and analysis.

The statistician selected to get the normality of the data was Shapiro-Wilk, and for hypothesis testing, the Wilcoxon signed rank test.

Table 1. Operationalization of variable

Independent Variable	Conceptual Definition	Operacional Definition	Dimensions	Indicators	Value	Type of variable
Maternal Position	Indicates the body's position in space and has the purpose of keeping the body in balance during dynamic movements and stasis.	These are the positions that the pregnant woman can adopt to promote physiological well-being; during electronic fetal monitoring within 20 minutes.	Maternal characteristics	Age in years	Numerical	Numerical Discrete
				Gestational age	Numerical	Numerical Discrete
			Left lateral decubitus	Angle of the surface of the stretcher to the head at 180 degrees.	Numerical	Numerical Discrete
			Fowler	Angle of the surface of the stretcher to the head at 45 degrees.	Numerical	Numerical Discrete
Gestational Age	It is the number of weeks that exist between the first day of the last normal menstruation and the current date or the date of childbirth.	It is the age of the fetus, counted from the date of the last menstrual period of the pregnancy to the date on which the non-stress test was performed.	Preterm	≥ 32 weeks to < 37 weeks	Numerical	Numerical Discrete
			At term	≥ 37 weeks and < 41 weeks	Numerical	Numerical Discrete
Fetal Heart Rate	They are the fetal beats that occur minute by minute. Its normal values range between 110 and 160 bpm and can vary between 5 and 26 beats per minute. This rate may change as the fetus responds to intrauterine conditions.	It controls the fetal heart rate by determining its parameters in different positions through the cardiotocograph.	Baseline	Average of the fetal heart rate in 20 minutes	Numerical	Numerical Discrete
			Variability	Amplitude of the fetal heart rate in 1 minute	Numerical	Numerical Discrete
			Accelerations	Number of accelerations in 20 minutes	Numerical	Numerical Discrete
			Decelerations	Number of decelerations in 20 minutes	Numerical	Numerical Discrete

Table 2. Maternal age and gestational age of participating pregnant women

Variables Statistics	Statistical value	
	Age of the pregnant woman	Gestational age in weeks
Pregnant women	35	35
Mean	25	37.26
Median	25	37
Mode	26	36
Standard Deviation	5.866	2.267
Minimum	16	32
Maximum	41	42

Table 3. Obstetric characteristics of the participating pregnant women

Variables	Values		
	N	%	% Accum.
Number of pregnancies			
Primigravida	13	37.1	37.1
Second gestation	15	42.9	80
Multiple gestations	7	20	100
Parity			
Nullipara	15	42.9	42.9
Primipara	14	40	82.9
Multipara	6	17.1	100

Table 4. Results of the Non.Stress test by left lateral decubitus and position at more than 3600masl- Huancavelica, 2021

Results	Non-Stress Test			
	Test Result in LLD		Test Result in Fowler	
	Frequency	Percentage	Frequency	Percentage
Pathological	0	0.0%	2	5.7%
Non-Reactive	3	8.6%	7	20.0%
Reactive	32	91.4%	26	74.3%
Total	35	100.0%	35	100.0%

In Table 1, we observe that the pregnant women are, on average, 25 years old; the age that most appeared was 26, the minimum age was 16, and the maximum was 41 years old; at the time of monitoring, on average, pregnant women had 37.26 weeks of pregnancy, the most frequent gestational age was 36 weeks, the minimum was 32, and the maximum 42 weeks, likewise, 50% of pregnant women have a gestational age less than or equal to 37 weeks.

In Table 2: it is observed that according to the number of pregnancies, there is 13 primigravida that makeup 37.1%, 15 second gestations that make up 42.9% and 7 multipregnancies that make up 20% of the sample; according to parity, it is observed that 42.9% are nulliparous [16], 40% are primiparous [15] and 17.1% are multiparous [7].

In Table 3: it is observed that according to the number of pregnancies, there are 37.1% (13) Primigravida, 42.9% (15) Second gestation and 20% (7) Multiple gestation; according to parity, it is observed that 42.9% (15) are nulliparous, 40% (14) are primiparous and 17.1% (6) are multiparous.

Table 4 shows the results of the NST of 35 pregnant women who underwent it in both positions, obtaining the following: in the left lateral decubitus position, no pathological results were observed, 8.6% were non-reactive, and 91.4% presented reactivity, while in the Fowler position, 2 NSTs were pathological (5.7%), 7 NSTs with non-reactive results (20.0%) and 26 NSTs with reactive results (74.3%). In addition, the fetal status of the pathological results was monitored through ultrasound and Apgar at birth, finding physiological fetal status.

In Table 5, the average baseline FHR in the LLD position is 136.06, compared to 139.31 in the Fowler position, being higher in this position; likewise, the mean of the variability and accelerations is 10.51 and 4.49 in the LLD position, and 9.63 and 3.43 in the Fowler position. About decelerations, the mean is lower in the Fowler position at 0.09, compared to the LLD position at 0.34. In the end, the average fetal movements were 13.11 in LLD and 10.40 in Fowler.

Table 5. Comparison of the elements of the fetal heart rate in the left lateral decubitus maternal vs Fowler position at more than 3600 masl – huancavelica, 2021

Elements of the FHR, in LLD and FOWLER	N	Mean	Mean Error	Median	Mode	Standard Deviation	Variance	Range	min	max
Baseline in LLD	35	136.06	1.384	135	130	8.189	67.055	38	122	160
Baseline in Fowler	35	139.3	1.269	138	138	7.51	56.339	34	128	162
Variab. in LLD	35	10.51	0.548	10	10	3.239	10.492	13	5	18
Variab. in Fowler	35	9.63	0.721	9	10	4.264	18.182	23	3	26
Acceleration in LLD	35	4.49	0.461	4	8	2.726	7.434	9	0	9
Acceleration in Fowler	35	3.43	0.427	3	3	2.524	6.37	10	0	10
Desac. in LLD	35	0.34	0.1	0	0	0.591	0.35	2	0	2
Desac. in Fowler	35	0.09	0.048	0	0	0.284	0.081	1	0	1
Mov. Fetals in LLD	35	13.11	1.505	11	7	8.904	79.281	32	1	33
Mov. Fetals in Fowler	35	10.4	1.253	10	1[a]	7.413	54.953	32	1	33

Table 6. Effect of material left lateral cecubitus and fowler positions on fetal heart rate elements at more than 3600 masl – Huancavelica,2021

Variable	Values			
	Baseline in Fowler - Baseline in LLD	Variability in Fowler - Variability in LLD	Accelerations in Fowler - Accelerations in LLD	Fetal Movement in Fowler - Fetal Movement in LLD
Z	-3,509b	-1,824c	-1,808c	-1,255c
Sig. Asymptotic (bilateral)	0.000	0.068	0.071	0.209

The effects of maternal positions on fetal rate can be seen in Table 6. From this table, it can be deduced that regarding the baseline, the “p” value is 0.000 < 0.05. therefore, the alternate hypothesis is accepted; There is a difference in the FHR baseline between the Fowler position and the left lateral decubitus position, showing less in LLD, which we affirm assuming an error of 5%.

In variability, the "p" value is 0.068 > 0.05; therefore, the null hypothesis is not rejected; that is: There is no difference in FHR variability between the Fowler position and the left lateral decubitus position.

In accelerations, the "p" value is 0.071 > 0.05; therefore, the null hypothesis is not rejected; that is to say: There is no difference in FHR accelerations between the Fowler position and left lateral decubitus.

In fetal movements, the "p" value is 0.209 > 0.05. Therefore, the null hypothesis is not rejected: There is no difference in fetal movements between the Fowler position and left lateral decubitus.

5. Discussion

One of the most used tests of fetal well-being in health establishments is the NST, which is performed routinely from 28 weeks of pregnancy or in the event of an alarm finding on intermittent auscultation; it has a high specificity (90%) to detect healthy fetuses in normal pregnant women, even reaching 99% in pregnant women with pathology. However, its sensitivity is low, between 45% to 50%. This could be due to operator error since different techniques have been observed when performing the continuous recording of the FHR, for example, the positions adopted by the pregnant woman [14].

The participants reported ages from 16 to 41 years old; on average, they were 25 years old; the range of gestational age was between 32 to 42 weeks of gestation, on average 37.26 weeks; the gestational age at which the NST was performed was to avoid nonreactivity biases that occur more frequently in extremely preterm infants, taking into account that fetal reactivity appears at 24 weeks of pregnancy. The autonomic nervous system regulates FHR better as it matures. Likewise, Nathan et al. [10] conducted a study like ours in the same range of gestational ages. On the other hand, Alus et al. [12], in their research, found the mean age of the participants to be 27 years old and the mean gestational age to be 36 weeks, different from our study.

Regarding the obstetric characteristics of the pregnant women who participated, 37.1% were primigravida, 42.9% were second gestation, and 20% were multiple gestations; Regarding parity, 42.9% were nulliparous, 40% primiparous, and 17.1% multiparous; no studies have been found in which the number of pregnancies or maternal parity influences FHR.

In the non-stress test, better results were obtained in the LLD position compared to the Fowler position, finding fetal reactivity 91.4% vs 74.3%, non-reactive 8.3% vs 20%, pathological 0% vs 5.7%, completely opposite to the one identified by Nathan et al. [10], those who reported more reactivity in the semi-fowler position despite the very short period (10 minutes). The situation makes these two positions controversial; however, Ibrahim et al. [11] found better FHR parameters in LLD, similar to our study.

When comparing the means of the parameters of the fetal heart rate in continuous recordings of 20 minutes in each position (LLD and Fowler), the baseline was lower in LLD, the variability, accelerations, decelerations, and movements was slightly higher in LLD; the decelerations found were type III or mild variables that occurred in less than 30% with respect to uterine contractions.

When analyzing the difference of each one of the elements of the FHR, a significant difference was found in the baseline, being lower in the LLD position, with a p = 0.000; while the variability, accelerations and fetal movements remained similar in both positions, which does not coincide with the results of the study carried out by Ibrahim et al. [11], who found a higher baseline in the LLD position, semi-fowler. On the other hand, Mucuk et al. [15] found a significant difference in fetal heart rate, accelerations and fetal movements, being higher in LLD, except for variability; the difference with our study is that the fetal heart rate is lower in the LLD position, and the coincidence is that we found no difference in variability.

It is found that the LLD shows better results in the fetal evaluation and the diagnosis of the NST; physiologically, it is coherent because, in the position of the abdominal vessels, the inferior vena cava and the abdominal aorta are left free, guaranteeing a good maternal and placental circulation, which also guarantees the provision of oxygen in the intervillous space of the placenta so that it can be given to the fetus.

6. Conclusion and Future Work

On average, the participating pregnant women were 25 years old, and the mean gestational age was 37.26 weeks. The pregnant women who participated were mostly primiparous and second gestation. Therefore, their parity was nulliparous and primiparous. The result of non-stress tests had better results in the left lateral decubitus position than Fowler's.

A significant difference was found in the baseline between the LLD and Fowler position, showing lower LLD (p-value of 0.000), while in variability, accelerations, decelerations and fetal movements, no difference was found. The LLD position shows better results in electronic fetal monitoring than the Fowler position.

Further research on antepartum electronic fetal monitoring is needed as information is limited. The health sector should prioritize placing pregnant women in the LLD position for monitoring to save time. Educate pregnant individuals on the importance of electronic fetal monitoring to avoid refusal due to misinformation. The Universidad Nacional de Huancavelica-EP Obstetrics should conduct a larger and longer study.

Ethical Considerations

The present study has the approval of the ethics committee of the University of Sciences and Humanities and the National University of Huancavelica, each participant agreed to their participation by means of an informed consent and each participant was given a copy of it.

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