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Comparative Study of Intermittent Auscultation and Continuous Electronic Monitoring of Labor in Low-Risk Pregnant Women in Four Hospitals in Douala (Cameroon)

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Abstract

Introduction: Monitoring fetal heart rate during labor allows for the early detection of anomalies and proactive intervention before complications arise. In our context, two types of monitoring are practiced: electronic and manual. However, electronic monitoring faces the challenge of the availability of cardiotocographs in operational-level healthcare facilities. A few intermediate-level healthcare structures are equipped with this tool. **Objective:** Our objective was to evaluate the impact of the type of labor monitoring on maternal and fetal outcomes in the maternity wards of Douala hospitals. **Materials and Methods:** We conducted a 5-month longitudinal observational study with an analytic component in 4 hospitals at different reference levels. The study exhaustively included parturients whose active labor phase was continuously monitored in these hospitals and whose fetuses were alive. Both the mothers and newborns were followed up to the second postpartum day. Statistical analyses were performed using SPSS software version 28.0. The chi-square test was used to compare quantitative variables, with a significance threshold set at $p < 0.05$. **Results:** During the study period, we recorded 498 deliveries, with 195 monitored by cardiotocography and 303 by fetal Doppler. The study population had an average age of 29.5 ± 5.8 years. All women were educated, and 53.4% had higher education levels. Multiparous women represented 47% of the study population, with an average parity of 1.4 ± 1.3. In total, 52% of the

women had attended at least four prenatal consultations, and 75.5% were full-term. Regarding the mode of delivery, we found a cesarean rate of 21.5% for electronic monitoring compared to 6.2% for manual monitoring; 97.4% of women with pathological tracings underwent cesarean sections, compared to 100% of women with abnormal fetal heart rate patterns. The prevalence of neonatal asphyxia was 5.6% (11/195) in the electronic monitoring group and 6.3% (19/303) in the manual monitoring group. Three-quarters of neonatal deaths due to asphyxia occurred in the group that received manual monitoring. **Conclusion:** Although the rate of cesarean deliveries is higher with electronic monitoring, neonatal outcomes are better, with lower neonatal mortality, even though a higher rate of neonatal asphyxia was diagnosed compared to manual monitoring.

Keywords

Intermittent Auscultation, Continuous Monitoring, Labor, Low-Risk Pregnancies, Maternal-Fetal Outcomes

1. Introduction

Monitoring labor involves all the measures taken to ensure the smooth progress of labor, with the aim of preventing maternal-fetal morbidity and mortality. Neonatal deaths related to intra-partum issues account for 10% of deaths among children under five years old [1] [2]. There are several methods for fetal monitoring during labor, including continuous or intermittent electronic monitoring via cardiotocography and intermittent auscultation using a Pinard fetal stethoscope or a fetal Doppler [3]. Effective fetal monitoring during labor can prevent obstetric complications by timely indicating the need for a cesarean or instrumental delivery. Since 2010, the American College of Obstetricians and Gynecologists (ACOG) has recommended intermittent monitoring for low-risk women [4]. However, manual monitoring does not allow for the objective identification of certain fetal heart rate (FHR) anomalies, because there are no tracings. Since the introduction of cardiotocography (CTG), some authors have noted an increase in cesarean rates without a reduction in neonatal morbidity and mortality [4]-[6]. Studies indicate that there is not always a correlation between the diagnosis of acute fetal asphyxia made by cardiotocography and the newborn's condition at birth following a cesarean. Due to these discrepancies, the American College of Obstetricians and Gynecologists prefers to use the term "non-reassuring fetal status" rather than acute fetal asphyxia when indicating the need for an emergency cesarean delivery [7]. This helps justify the lack of correlation between the diagnosis of acute fetal asphyxia and a good APGAR score at birth. Although a cesarean is a mode of delivery similar to vaginal delivery, it remains a surgical procedure that increases maternal morbidity. The WHO recommends that for quality obstetric care, the cesarean rate should be between 10% - 15% for all indications combined [8]. In Cameroon, both types of monitoring are practiced. We aim to assess the impact

of the two types of monitoring on maternal and fetal outcomes in four maternity hospitals in the city of Douala.

2. Methodology

2.1. Type of Study

We conducted a longitudinal observational study with an analytic component.

2.2. Study Location

The study was carried out in four maternity hospitals in the city of Douala: the General Hospital of Douala, Laquintinie Hospital, and the District Hospitals of Cité des Palmiers and Logbaba. All these sites were chosen based on the number of parturients and the availability of monitoring types. It should be noted that the two District Hospitals did not have cardiotocographs.

2.3. Study Period

The study took place from January to May 2025.

2.4. Study Population

Our study focused on parturients, postpartum women, and their newborns.

a. Inclusion Criteria

We included:

1) Any postpartum woman who gave consent and had a term ≥ 37 weeks of gestation (WG).

2) Any single pregnancy with the fetus in a cephalic presentation.

3) Newborns of women meeting the first two inclusion criteria.

b. Exclusion Criteria

1) Parturients who were not monitored (arrived at full dilation or referred from another health facility).

2) Parturients with an indication for elective cesarean section.

3) Parturients without current pathology.

4) Parturients with intrauterine fetal death.

2.5. Sampling

We conducted consecutive sampling of all eligible women presenting during the study period who met the inclusion criteria. The sample size was calculated using Lorentz's formula:

Neonatal asphyxia was defined as an Apgar score below 7 at the 5th minute of life.

$$N = \left[T \times P(1-P)\right] / M^2$$

where:

N is the minimum required sample size.

T is the confidence interval at 95%, which is T = 1.96.

P is the prevalence of the cesarean rate for acute fetal asphyxia at the General Hospital of Douala: 17% [9].

M is the margin of error at 5%.

For a minimum sample size N, the numericable application yields:

$$N = (1.96)\times(1.96)\times(0.17)\times(1-0.17)(0.05)\times(0.05) = 216.8$$

Thus, N = 217 cases.

3. Procedure

After obtaining informed consent from each woman, we collected data from the survey form completed by the parturients and postpartum women. This included information related to their identification and pregnancy monitoring. Based on their medical records, we then completed data on labor monitoring (partogram and fetal heart rate (FHR) recordings, and the newborn's condition at birth). In the neonatology unit, we recorded the progress of the newborns who had been transferred there with an Apgar score of less than 7 at the 5th minute until the second day of life. After collecting the data, we divided the postpartum women into two groups based on the type of FHR monitoring they received: manual monitoring (in district hospitals) versus electronic monitoring (at the General Hospital or Laquintinie Hospital). It is important to specify that, during electronic monitoring, patients with cardiac rhythm anomalies were divided into two groups: those with suspicious tracings, where one parameter was atypical, and those with pathological tracings, where all parameters were irregular. In the manual monitoring group, parturients were classified as having either abnormal or normal auscultation, as no tracings were available.

4. Results

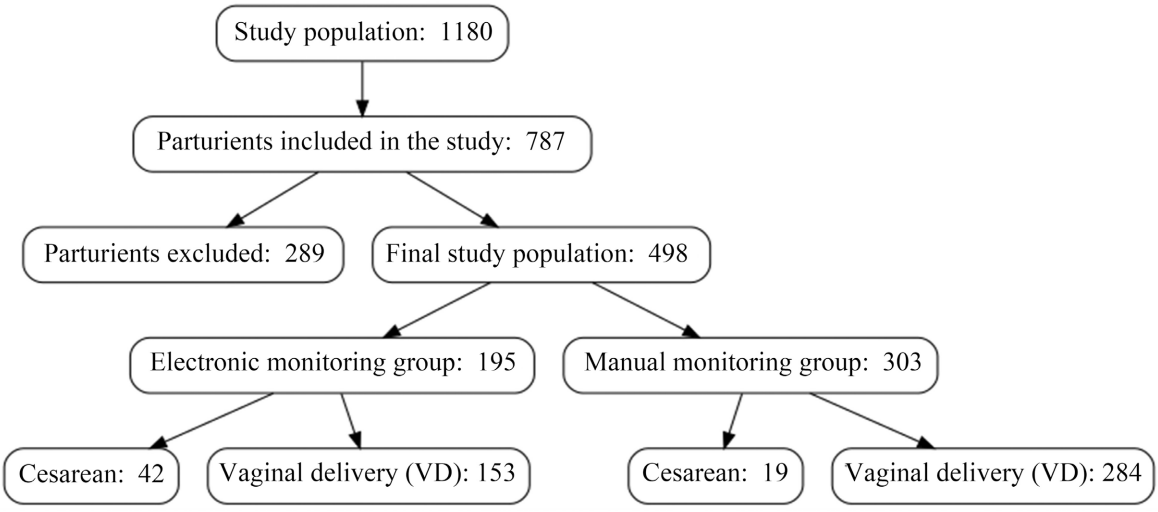

Figure 1. Flow diagram.

During our study, we recorded 1,180 deliveries across the four hospitals. We

initially included 787 postpartum women, and after applying the exclusion criteria, we retained 498. In this population, we recorded 195 deliveries with electronic monitoring, including 42 cesarean sections (21.5%) and 153 vaginal deliveries. For deliveries with manual monitoring, we registered 303, including 19 cesarean sections (6.2%) and 284 vaginal deliveries. For the entire study population, a total of 61 cesarean sections were performed and 437 vaginal deliveries. The flowchart below shows the details of our sample selection (Figure 1).

4.1. Sociodemographic and Clinical Characteristics of the Postpartum Women

The average age of the patients was 29 ± 5.8 years, with a minimum age of 15 and a maximum of 45 years. More than half of the patients were single (68.3%). About one-third of the patients were employed in the private sector (29.3%), followed by pupils and students (22.3%). A proportion of 2.2% of the women were HIV-positive. Regarding parity, the majority of the pregnant women had fewer than 3 children (primiparous 47.4%, nulliparous 31.1%). Concerning their prenatal care, 55% had between 4 to 7 prenatal visits. Three-quarters of the patients went into labor between 37 and 40 weeks of gestation, and the rest between 40 and 41 weeks. The predominant pregnancy-related pathologies were malaria and preeclampsia.

4.2. Labor Monitoring Methods in the Four Maternities

4.2.1. Population Distribution According to Hospitals and Type of Monitoring

In the two district hospitals, monitoring was exclusively manual. At the General Hospital of Douala, it was exclusively electronic. At Laquintinie Hospital, we had both types of monitoring (Table 1).

Table 1. Distribution by hospitals and type of monitoring.

Hospitals	Electronic		Manual	
District Hospital of the City of Palms	0	0.0	180	100.0
District Hospital of Logbaba	0	0.0	116	100.0
General Hospital of Douala	82	100.0	0	0.0
Laquintinie Hospital of Douala	113	94.2	7	5.8
Total	**195**	**39.2**	**303**	**60.8**

4.2.2. Population Distribution Based on Mode of Delivery and Variations in Monitoring Types

Electronic monitoring highlighted suspicious and pathological anomalies in the fetal heart rate, which almost invariably led to an indication for a cesarean section. Manual auscultation detected fewer anomalies compared to electronic monitoring (Tables 2-4).

Table 2. Modes of delivery according to variations in monitoring types.

	Electronic Monitoring							
	Cesarean section		AVB		OR	IC (95%)		P value
Normal tracing	0	0.0	140	100.0	-	-	-	-
Pathological tracing	37	97.4	1	2.6	1.810	1.119	8.124	0.013*
Suspicious tracing	5	29.4	12	70.6	0.330	0.091	3.527	0.743
	Manual Monitoring							
Abnormal auscultation	14	4.6%	0	0.0	-	-	-	-
Normal auscultation	-	0.0	289	95.4	-	-	-	-

Electronic monitoring enabled early detection of fetal heart rate anomalies. It appears that the frequency of cesarean indications for non-reassuring fetal status is very high in cases of electronic monitoring. Thus, there is an overestimation of fetal asphyxia, as ¾ of the newborns showed good recovery by the fifth minute.

Table 3. Cesarean section and Apgar at the fifth minute.

Type of Monitoring	**Apgar < 7**		**Apgar > 7**		**OR**	**IC (95%)**		**P value**
	n	**%**	**n**	**%**		**BI**	**BS**	
Electronic Monitoring	11	26.2	31	73.8	**0.358**	**0.172**	**0.822**	**0.000***
Manual Monitoring	2	10.5	19	89.5	0.514	0.098	7.775	0.088

The intermittent nature and lack of tracings in manual monitoring hinder the early detection of fetal heart rate anomalies. When anomalies do occur, most are revealed late, at a severe stage. Although there is no statistically significant link between vaginal delivery and the occurrence of neonatal asphyxia, it is observed that babies born vaginally and monitored manually during labor tend to have poor extra-uterine adaptation after 5 minutes of life.

Table 4. Vaginal delivery and Apgar at the fifth minute.

Type of Monitoring	**Apgar < 7**		**Apgar > 7**		**OR**	**IC (95%)**		**P value**
	n	**%**	**n**	**%**		**BI**	**BS**	

Continued

Electronic Monitoring	9	5.5	144	94.1	2.816	0.772	1.640	0.552
Manual Monitoring	19	6.7	265	93.3	3.151	0.180	14.222	0.609

4.3. Pronostic Fœtal Fetal Prognosis

We observed more neonatal deaths in the manual monitoring group. There were no neonatal seizures in either group (Table 5).

Table 5. Neonatal complications based on type of monitoring.

Neonatal Complications	Electronic Monitoring		Manual Monitoring		OR	IC		p-value
	n	%	n	%		BI	BS	
Resuscitation	6	66.7	3	33.3	0.857	0.091	8.075	0.893
Neonatal admission for low APGAR	20	45.5	18	54.5	0.448	0.042	4.736	0.504
Seizures	0	0.0	0	0.0	-	-	-	-
Deaths	1	25.0	3	75.0	0.506	0.094	5.470	0.280

4.4. Evaluation of the Predictive Values of Tracings

We found that a normal CTG is reassuring (few false negatives). The negative predictive value of a suspicious or pathological tracing remains strong, which sufficiently explains the unnecessary interventions due to the overestimation of acute fetal asphyxia diagnoses (Table 6).

Table 6. Evaluation of the predictive values of abnormal tracings (Suspicious and Pathological).

Fetal Heart Rate Recording	Specificity [IC 95%]	Sensitivity [IC 95%]	VPP [IC 95%]	VPN [IC 95%]
Pathological + Suspicious Tracing	98.7% [98.2 - 100]	13.6% [7.9 - 16.9]	89.6% [78.5 - 100]	65.7% [61.7 - 69.7]
Normal Tracing	98.2% [96.3 - 99.9]	7.3% [3.2 - 9.7]	88.9% [75.3 - 100]	40.4% [39.4 - 44.0]

5. Discussion

The average age of the respondents was 29.53 ± 5.8 years, with extremes ranging from 15 to 45 years, and the mode falling within the 25 to 35-year interval. It should be noted that this age range corresponds to the peak of fertility in Cameroon, according to the EDS-MICS 2018 [10]. These results are similar to those found by the teams of Mwansa *et al.* in Congo in 2019, and Yakini *et al.* in Burkina

Faso in 2023 [3] [11]. The increasing trend of later first-time childbirth and having fewer children can be attributed to the growing educational attainment of young girls. The rising level of education among young girls today justifies the later age at first childbirth and the tendency to have fewer children. Furthermore, young women are increasingly informed about the necessity of birth control through the promotion of family planning. It is noted that most pregnant women had regular prenatal visits, ranging from about 4 to 8 visits, which can be attributed to the fact that our study was conducted in urban areas where referral hospitals and maternal and child health policies are accessible and applicable.

Our findings highlight a paradox: electronic monitoring is associated with a higher cesarean rate and more frequent diagnosis of neonatal asphyxia, yet with lower neonatal mortality. This can be explained by the low specificity of CTG, which tends to over-diagnose non-reassuring fetal status and therefore leads to more interventions, including cesareans, even in less severe cases. However, this increased vigilance seems to prevent fatal outcomes in the most critical situations. Thus, CTG, despite its limitations, remains a valuable tool for reducing neonatal mortality in low-resource settings.

We selected four hospitals, among which two district hospitals practiced 100% manual monitoring using a Doppler. Cardiotocography was always used at the General Hospital. However, despite being available at Laquintinie Hospital, it was not used systematically since it was not included in the delivery kit, requiring additional fees. According to the Quebec National Institute of Public Health (INSPQ), intermittent auscultation is less expensive, associated with fewer interventions (cesareans, instrumental deliveries, epidurals), while having an equivalent neonatal risk compared to electronic fetal monitoring [12]. Electronic monitoring (CTG) is widely used for high-risk pregnancies, but its systematic use in low-risk cases does not reduce mortality and increases the cesarean rate [13]. In our resource-limited context, manual monitoring is suitable due to its lower cost, but it faces challenges due to the shortage of healthcare personnel in maternity wards, especially in healthcare facilities at the operational level that are overburdened with patients. The inclusion of electronic surveillance through cardiotocography in the delivery kit, on one hand, will strengthen maternal-fetal monitoring. On the other hand, it will alleviate understaffed medical teams, as manual monitoring is entirely dependent on staff who must regularly attend to the women in labor for auscultation. In view of this analysis, the use of CTG in low-risk populations would also play an important role in preventing obstetric complications because the issues encountered are not always inherent to the clinical profile of the patients (pregnancy-related pathologies, history of uterine scars, etc.).

The cesarean rate was three times higher with electronic monitoring compared to manual monitoring. CTG is associated with a higher rate of cesarean sections, often due to false positives of fetal anomalies. However, studies are controversial. For instance, Mwansa *et al.* in Congo in 2019 found similar cesarean rates regardless of the monitoring method, at 29% and 26% for CTG and intermittent auscultation, respectively [14].

In our study, manually monitored cases showed more babies with poor extra-uterine adaptation (APGAR < 7 at the 5th minute) following vaginal delivery. This finding supports our research hypothesis that cardiotocography could help address fetal complications during labor by timely indicating a cesarean delivery, particularly since the neonatal death rate was three times higher with manual monitoring. This paradox has multiple factors, including:

1) The quality of applying manual monitoring: it can be effective if well applied. However, in our context, staff is often understaffed, especially at night or in rural areas. The recommended monitoring interval (every 15 to 30 minutes in the first stage, every 5 minutes in the second stage) is not respected. Sometimes, there is a lack of training to detect fetal cardiac anomalies early. Tools (Pinard fetoscope, Doppler) may be absent, broken, or shared among several patients. The result is that fetal anomalies are either undetected or detected too late [15].

2) Delays in care even if an anomaly is detected: obstetric decisions are delayed (absence of oxytocin, stockouts of antibiotics…). There is a delay or impossibility of accessing a cesarean section in cases of non-reassuring fetal status. Often, inter-hospital transfers are long or inaccessible. Consequently, the effectiveness of manual monitoring is theoretical, as no immediate action is possible [16].

3) The technical limitations of manual monitoring, even under the best conditions: transient or late decelerations are not always perceived. The absence of tracings for analyzing and interpreting anomalies, unlike CTG which records data, means intermittent auscultation relies entirely on the subjective interpretation of the caregiver [17].

4) Aggravating systemic factors: such as late access to maternity care (delays in consultation or transport), lack of neonatal resuscitation care in case of distress at birth, insufficient infrastructure (no electricity, no available operating rooms in rural hospitals, often in urban areas too) [18].

According to the Cochrane systematic review, compared to intermittent auscultation, continuous cardiotocography showed no significant improvement in the overall perinatal mortality rate (relative risk (RR) 0.86, 95% confidence interval (CI) 0.59 to 1.23, N = 33,513, 11 trials, low-quality evidence) [4].

6. Conclusion

The effectiveness based on intermittent auscultation largely depends on the training, supervision, and compliance of the staff. It is not the manual monitoring itself that is less effective, but rather the conditions under which it is applied in resource-limited countries. These include factors related to human resources (understaffing, workload, insufficient training), technical means (obsolete or improperly used equipment), and infrastructure (delayed decision-making, limited access to cesareans, absence of a neonatal intensive care unit). CTG, on the other hand, allows for early detection of anomalies. Considering the obstacles encountered in practicing intermittent auscultation, it would help strengthen maternal-fetal monitoring by systematically including it in the delivery kit in our healthcare facilities.

This is especially important at the operational level, which is the base of the health pyramid and the cornerstone of the health system. However, CTG increases the rate of avoidable cesareans, highlighting the necessity to correlate other parameters to assist in the decision-making regarding fetal extraction.

Conflicts of Interest

The authors declare no conflicts of interest.

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