Obstetrics and Gynecology International

Human Pregnancy and Parturition Clinical Management

Guest Editors: Faustino R. Pérez-López, Sean C. Blackwell, Edmund F. Funai, Shi-Wen Jiang, Marc J. N. C. Keirse, and Liliana S. Voto

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Editorial Board

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Editorial

Human Pregnancy and Parturition Clinical Management

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Pregnancy and parturition are major events in human life. The health care providers' mission of antenatal care is to treat conditions that may alter development and health of the embryo and fetus. In consequence, birth and parturition represent a challenge for the adaptation to a new environment. Birth conditions may vary in relation to healthcare facilities, prenatal care, and educational and economical conditions. A major challenge for those assisting human birth is to properly and timely identify mothers and fetuses at risk for complications. Globalization of information disseminated through mass media and the Internet has revealed the huge inequalities that women suffer during pregnancy and parturition. Healthiness among mothers and their children is a critical indicator of health status of the world's population as well as the health outcome of future generations.

Online scientific publications have increased during the last years as alternatives to conventional journals. Publications with the "online open access" modality are based on two aspects: (1) a peer-review system similar to that used for centuries in the Western World science and (2) publication cost is covered by the authors. Submission of a scientific contribution is generally performed seeking the highest impact possible. In order to compete with traditional journals, those online have to transverse a long journey in order to be evaluated by the scientific community and the appropriate organizations and to achieve an impact factor. These scenarios give rise to a Darwinian natural selection-like process in which final destination of a given contribution will depend on its intrinsic quality. Affecting this process are the autoevaluation of the authors and the rigor and editorial criteria of a given journal. Although not always true, higher impact journals receive contributions with higher quality whereas those with low or no impact factor the contrary.

For the occasion of this issue of *Obstetrics and Gynecology International,* 17 papers were submitted to the peer-review process. Publication criteria were not guided by any specific recommendation. It was based on the individual editors' expertise and experience and assessment of the reports received from independent referees. As a product of the review process, the readers will find 5 accepted contributions from different origin addressing several issues of human pregnancy and parturition management.

An international group of researchers (M. L. Kamb et al.) in their paper "*A Road Map for the Global Elimination of Congenital Syphilis*" review the problem of congenital syphilis and its impact over perinatal deaths. It was estimated that untreated syphilis in the world causes a similar or even higher mortality than HIV.

Researchers from The Netherlands (M. P. G. C. Vinken et al.) present in their paper "*Nifedipine-Induced Changes in the Electrohysterogram of Preterm Contractions: Feasibility in Clinical Practice*" a clinical study regarding the use of the electrohysterogram to monitor uterine contractions in women with preterm labor managed with nifedipine.

Stillbirths and neonatal deaths are major issues in the care of pregnant women, especially in developing countries. Researchers affiliated to different Norwegian Institutions (A. Jammeh et al.) in their paper "*Jammeh et al. Stillbirths in Rural Hospitals in The Gambia: A Cross-Sectional Retrospective Study*" performed a cross-sectional retrospective study of stillbirth in rural Gambia.

Authors from Ecuador and Spain (D. Salazar-Pousada et al.) in their paper "*Salazar-Pousada et al. Depressive Symptoms and Resilience among Pregnant Adolescents: A Case-Control Study*" present a comparative controlled study to determine resilience and depressive status among pregnant adolescents and compare them to young pregnant adults in their 20s.

And finally, authors from the United States (A. W. Ayres and S. K. Pugh) in their paper "*Ayres and Pugh. Ex Utero Intrapartum Treatment for Fetal Oropharyngeal Cyst*" report on an oropharyngeal cyst compromising fetal airway which was managed with an ex utero intrapartum treatment procedure. Fetoplacental circulation was maintained until the fetal airway was secured.

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Review Article

A Road Map for the Global Elimination of Congenital Syphilis

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Congenital syphilis is the oldest recognized congenital infection, and continues to account for extensive global perinatal morbidity and mortality today. Serious adverse pregnancy outcomes caused by maternal syphilis infection are prevented with screening early in pregnancy and prompt treatment of women testing positive. Intramuscular penicillin, an inexpensive antibiotic on the essential medicine list of nations all over the world, effectively cures infection and prevents congenital syphilis. In fact, at a cost of $11–15 per disability adjusted life year (DALY) averted, maternal syphilis screening and treatment is among the most cost-effective public health interventions in existence. Yet implementation of this basic public health intervention is sporadic in countries with highest congenital syphilis burden. We discuss the global burden of this devastating disease, current progress and ongoing challenges for its elimination in countries with highest prevalence, and next steps in ensuring a world free of preventable perinatal deaths caused by syphilis.

1. Introduction

Mother-to-child transmission of syphilis, that is, congenital syphilis, has been documented since the 15th century [1], yet continues today to cause substantial perinatal morbidity. If left untreated, maternal syphilis infection will, in up to 80% of pregnancies, lead to severely adverse pregnancy outcomes including stillbirth, premature birth, neonatal death, or congenital infection in the newborn [2]. In light of continuing perinatal mortality caused by syphilis and the high cost-effectiveness of antenatal screening and treatment as an intervention package [3], in 2007 the World Health Organization (WHO) launched a global initiative for the elimination of congenital syphilis. In subsequent analyses, WHO has estimated that, were ten countries with high antenatal syphilis burden allowed to focus efforts in strengthening existing maternal and child health (MCH) systems infrastructure to ensure universal maternal syphilis screening coupled with prompt treatment, an investment of only $3 to 4 million dollars per year over five years could substantially reduce this global perinatal scourge. In addition to these resources, elimination of congenital syphilis requires a combined commitment of governments and other partners in order to mount an effective and sustained response. The global elimination of congenital syphilis can greatly support current global efforts, including those outlined in the Millennium Development Goals of reducing child mortality, improving maternal health, and combating HIV, malaria and other infectious diseases.

2. Global Burden of Congenital Syphilis

Globally just over 2 million pregnant women test positive for syphilis each year, comprising 1.5 percent of all pregnancies worldwide [9, 10]. *Treponema pallidum*, the bacteria causing syphilis, is able to traverse the placenta early in pregnancy and lead to fetal exposure; however, fetal compromise is generally not manifested until later in the second or third trimesters with maturation of the fetal immune system [2]. Cohort studies have been consistent in finding that

Table 1: Adverse pregnancy outcomes due to maternal syphilis.

Outcome	Harmon [4] ($N = 1001$)	Ingraham [5] ($N = 302$)	Rabut [6] ($N = 722$)	McDermott [7] ($N = 436$)	Watson-Jones [8] ($N = 100$)
Stillbirth	17%	22%	36%	46%	25%
Neonatal Death	23%	12%		35%	NA
Prematurity or low birth weight	NA	NA	NA	NA	25%
Infected Infant	21%	33%	NA	NA	NA
Any adverse outcome	61%	67%	36%	81%	49%

NA = Data not assessed.

substantial proportions (40–81 percent) of syphilis-exposed fetuses are severely affected, with stillbirth neonatal death being the most significant consequences (Table 1) [4–8]. A smaller but substantial proportion of untreated maternal infections results in congenital infection in newborn infants, often manifested by premature birth, low birth weight, and failure to thrive. Among surviving infants, visceral involvement is common, as are fever, rashes, blindness, and a variety of typical skeletal and dental abnormalities [1].

The World Health Organization (WHO) estimates that globally the majority of maternal syphilis infections are untreated and of sufficiently high-titer (RPR $\geq 1:8$) to cause significant fetal exposure to *T. pallidum*. This situation results in an estimated 692,100 to 1.53 million adverse pregnancy outcomes each year caused by syphilis (Table 2) [8, 11–13]. Approximately 650,000 of these pregnancy complications result in perinatal deaths (i.e., deaths occurring from 22 weeks gestation through the first 7 days of life). Thus, untreated maternal syphilis is believed to have at least similar mortality, if not higher, than other important infections during pregnancy such as HIV (estimated to cause 250,000–290,000 perinatal deaths globally) [14] neonatal tetanus (200,000 perinatal deaths), or malaria in pregnancy (200,000 perinatal deaths) [13]. Globally, untreated maternal syphilis infection accounts for up to one quarter of all stillbirths and 11% of neonatal deaths, with most of these perinatal deaths occurring in developing settings with moderate or high antenatal syphilis prevalence and weak health systems [15].

Table 2: Estimated global burden of congenital syphilis cases.

Proportion of seropositive women with:	Watson-Jones [8, 11]	Schulz [12]	WHO [13]
Untreated syphilis	95%*	100%	100%
High serologic titer ($\geq 1:8$)	73%	—	—
Adverse pregnancy outcome due to syphilis**	49%	65%	75%
Global Annual No. of Congenital Syphilis Cases	692,100	1,323,900	1,527,600

Note that all assumptions based on WHO estimate of 2,036,753 pregnant women with syphilis [9].
*not included in the original Watson-Jones model; **includes late fetal loss, perinatal death, prematurity/low birth weight, neonatal infection.

3. Situation: Health Services Delivery Now

Adverse pregnancy outcomes caused by syphilis can be almost entirely averted through early identification of maternal infections through antenatal screening programmes, and prompt treatment of women with positive tests with a single dose of long acting penicillin prior to 24 weeks gestation [16]. Maternal syphilis screening and treatment are recognized as part of essential antenatal services [17], and almost all nations already have existing policies recommending universal syphilis screening during pregnancy [18]. However, implementation of the policy is weak in many settings, particularly in countries with highest disease burden.

High-burden countries have reported numerous barriers that limit effective screening and treatment as part of basic antenatal health services [19]. Access to early antenatal clinical (ANC) services, especially prior to 24 weeks gestation, is still limited in many parts of the world, and particularly in sub-Saharan African nations where a third of women either receive care later in pregnancy or do not receive care at all [17]. Health providers, particularly those in lower-level health facilities, may be unaware of the burden of congenital syphilis or the need to identify and treat early in pregnancy, and thus may not prioritize syphilis screening for the first antenatal visit. Syphilis diagnosis can be complicated and usually requires serologic screening with nontreponemal (e.g., RPR) or treponemal (e.g., TPHA) tests, and ideally both. While RPR tests, measuring active infection, are relatively simple and inexpensive, they require basic laboratory capacity, trained technical staff, and ongoing quality control systems. Unfortunately many lower-level facilities providing antenatal services have *no* laboratory access, thus testing is often simply not done at all. In antenatal facilities with access to laboratories able to conduct RPR tests (typically district level or higher facilities), women must often go to a separate site for testing, incurring additional transportation costs and waiting time above the basic antenatal visit. Additionally, women are often asked to pay for the tests themselves, a substantial barrier for many women [17, 20–23].

Even in places that could feasibly provide testing routinely, further systems level issues such as stockouts of critical commodities and inadequate numbers or distribution of clinical or laboratory providers can limit testing. Also, for women with positive tests, treatment can be delayed when results are not provided in a timely fashion, or

when treatment is difficult to access. Women with positive screening tests may not learn about positive results until a later clinic visit, and are often asked to travel to another site for treatment—for which they often, again, have to pay themselves. Furthermore, while most programmes collect data on maternal screening, few collect data on provision or timing of treatment, and thus programmes may be unaware of their deficiencies in providing prompt and appropriate treatment [22, 23]. Another increasingly reported barrier that limits programme coverage and effectiveness is the provision of disease-specific antenatal care. In some settings women are required to attend different clinics for basic ANC services, HIV testing and prevention of mother to child transmission services (PMTCT), and malaria prevention and treatment, for example [23].

4. WHO Initiative for the Global Elimination of Congenital Syphilis

4.1. Rationale and Strategy. Taking into consideration the current challenges to congenital syphilis prevention, WHO has outlined a strategic plan of action for the global elimination of congenital syphilis [20] as a public health problem. Given difficulties in diagnosing and monitoring syphilis-related complications, the specific goal of this elimination effort is to prevent transmission of syphilis from mother to child. This can be achieved by strengthening antenatal care programmes to ensure that all women receive early antenatal care which includes universal syphilis screening, prompt and appropriate treatment, and counselling on how to prevent infection. Additionally, recommendations that partners of infected women are treated (reducing reinfection) and that all neonates born to infected mothers are treated will help reduce congenital syphilis in live borne infants.

WHO has also outlined a series of guiding principles upon which the global congenital syphilis elimination strategy was developed: *country-driven* to adapt to local needs; *integrated* to ensure that the effort strengthens existing STI, HIV, prenatal, and maternal and newborn health services; *rights-based* to ensure that all individuals have the knowledge to participate in decision-making about their health and access to high-quality care, and *collaborative* so that government bodies, donors, and communities work together to optimize use of scarce resources.

At a country level, WHO outlined a strategy consisting of four pillars with corresponding specific objectives of actions to be undertaken (Figure 1). The pillars are the following:

(1) ensure advocacy and sustained political commitment for a successful health initiative,

(2) increase access to, and quality of, maternal and newborn health services,

(3) screen and treat pregnant women and partners, and

(4) establish surveillance, monitoring, and evaluation systems.

The global initiative emphasizes that congenital syphilis elimination can contribute directly to three of the Millennium Development Goals (MDGs) by reducing child mortality (MDG4) through reductions in perinatal deaths and low-birth-weight infants; improving maternal health (MDG5) through reductions in late fetal losses and stillbirths and through a decreased burden of syphilis in pregnant women, and combating HIV/AIDS, malaria and other diseases (MDG6) through combined, systematic screening for HIV and syphilis in pregnancy with an emphasis on strengthening antenatal and postpartum health systems.

4.2. Measuring National and Local Programme Progress and Impact. Although some countries routinely monitor reports of congenital syphilis as a routine part of public health reporting, in general, case reporting of congenital syphilis is problematic as its definitive diagnosis is not easy. To address this, a WHO-led working group has identified a set of outcome and process indicators that together are feasible measures of programme progress and impact on congenital syphilis elimination. Monitoring the proportion of stillbirths attributable to syphilis was identified by the working group as the most promising outcome indicator, and it was recommended that a target for nations should be that "the proportion of stillbirths attributable to syphilis in the mother be less than 2 percent."

The stillbirth target of 2 percent was chosen because stillbirth is both the most common and most severe outcome caused by untreated maternal syphilis. Among women with active syphilis, 17 to 40 percent of pregnancies result in stillbirth, and the risk of stillbirth has been reported as ten to 18 times the background rate of stillbirth (approximately 2 percent) [4–8]. In settings with moderate to high maternal syphilis prevalence, congenital syphilis has been reported to account for more than 20 percent of all stillbirths (i.e., attributable fraction) [7, 8]. The 2 percent target was chosen as both an aspirational benchmark and one that, historically, was able to be achieved in settings adopting universal syphilis screening in pregnant women and prompt treatment of those testing positive [5, 6].

Three critical process indicators were also identified to monitor programme progress, all involving collection of local data. These are (1) the proportion of women tested for syphilis at their first antenatal care visit, (2) the proportion of pregnant women with a positive test for syphilis, and (3) the proportion of positive women treated for syphilis, ideally by 24 weeks. These few process indicators, along with currently collected indicators on estimated number of pregnancies and coverage of antenatal screening, potentially allow countries to calculate a summary process indicator that estimates overall programme effectiveness, that is "the estimated proportion of all syphilis-positive pregnant women treated by 24 weeks of gestational age." This indicator is important for countries to ascertain since treatment sufficiently early in pregnancy (prior to 24 to 28 weeks) is necessary to avert the adverse effects of syphilis in pregnancy in most situations [8].

5. Call to Action: An Investment Case for Eliminating Congenital Syphilis

In order to raise funds for the goal of eliminating congenital syphilis, WHO and its partners have developed

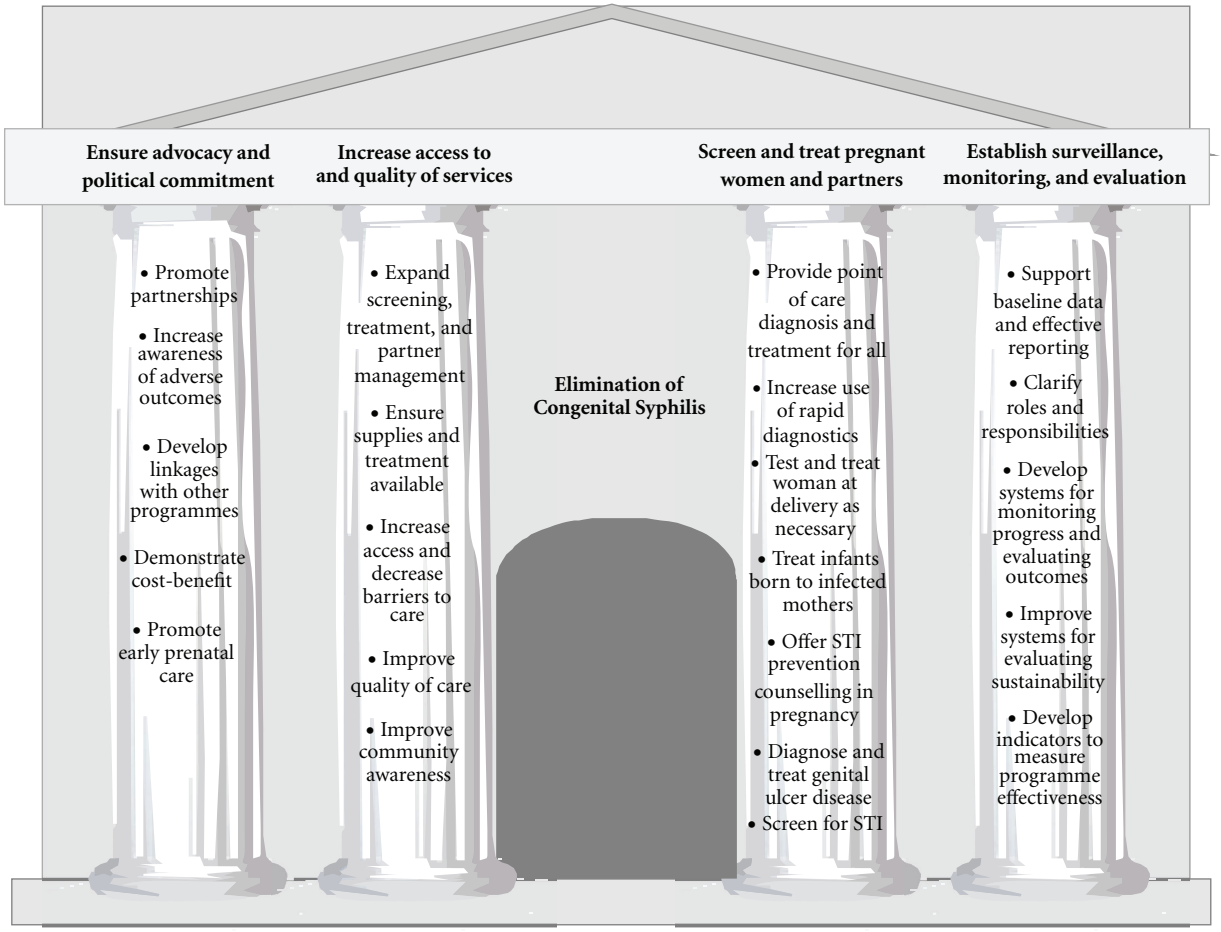

Figure 1: The four pillar strategy for elimination Congenital Syphilis.

an Investment Case for resource mobilization and to raise awareness of the issue and the proposed solutions. Cost calculations within the Investment Case have highlighted the significant DALY burden associated with untreated syphilis in pregnant women and have demonstrated how this DALY burden disproportionately affects people in low- and middle-income countries. The Investment Case shows how the elimination of congenital syphilis is a relatively "easy win" for programmes in affected countries as the intervention is relatively simple, highly cost-effective, technically feasible, and already politically acceptable (as demonstrated by consistent policies already in existence). Moreover, the Investment Case stresses that elimination of congenital syphilis is timely for countries that are aiming to reach their Millennium Development Goal commitments by 2015.

6. Next Steps

With sufficient resources, several additional areas can be better addressed to ensure that public health efforts aimed at the global elimination of congenital syphilis are effective, sustainable, and support overall MCH systems strengthening.

6.1. Addressing Barriers and Ensuring Sustainability of Programmes. As noted, a number of barriers currently exist that limit maternal syphilis screening and treatment efforts in developing world settings. Despite this situation, evidence based on current programmes supports that many of these barriers can be effectively countered if resources and efforts focus on antenatal health systems strengthening [22, 23]. An important component of the global initiative to eliminate congenital syphilis is that it promotes maternal syphilis screening and treatment as part of basic antenatal health services, thus is framed as a means of strengthening overall MCH systems rather than only battling congenital syphilis. In its promotion of early antenatal care with the recommended basic package of health services, the initiative intervenes against a range of preventable causes of perinatal morbidity and mortality. Similarly, in promoting integration of ANC service delivery through strategies such as incorporating integrated professional training and curricula for health care providers, coordinating distribution systems for critical commodities around ANC services, or integrating data systems monitoring, the initiative supports building capacity for improved antenatal outcomes overall.

Health service research studies have identified that another means of ensuring sustainability of programmes is through decentralization of laboratory services, such as provision of same day testing and treatment through rapid point-of-care tests [17, 20–23]. Several such tests that are heat stable, easy to use, and low cost ($0.19–0.99 per test) have been found to be sensitive and specific in very basic clinic settings [21, 22]. Use of such point-of-care tests ensures women with positive results are treated as early as possible, minimizing loss to followup and maximizing the potential to avert pregnancy complications. Currently available point-of-care syphilis tests are all treponemal tests, identifying any prior infection (even previously treated cases) as opposed to active infection. This can result in overtreatment of women whose prior infections were already treated. Nonetheless, studies conducted in antenatal settings lacking sufficient laboratory capacity for RPR testing have found introduction of point-of-care tests greatly enhanced screening rates [22–24], was acceptable and had negligible risks for women [23, 24], and was highly cost-effective even taking into account some overtreatment [24].

Another commonly reported barrier has been a requirement that screening and treatment costs are borne by the patient. Provision of free-of-charge or low-cost testing and treatment through government programmes has proven important in some settings to ensure the highest risk women are effectively screened and, if positive, treated [23]. This policy has been found to support health worker's ability to provide syphilis screening as a routine part of antenatal care, solidifying the habit of universal screening, also important in sustainability [23].

An especially difficult barrier to surmount in many settings is ensuring adequate human resources. In particular, shortfalls in clinical faculty and the absence of training and student mentoring opportunities can complicate strategies for eliminating congenital syphilis. As a result, medical, nursing and midwifery trainees not only lack updated professional curricula and learning materials (e.g., on rapid, point-of-care treponemal tests and syphilis treatment algorithms) but also lack practical experience. Addressing this requires the inclusion of current curricula and protocols within pre-service education as well as taking opportunities to observe and provide holistic antenatal care in which syphilis prevention and treatment are incorporated into service delivery. Equally important is engaging national accreditation and credentialing bodies in efforts focused on the elimination of congenital syphilis. An additional opportunity for influencing provider practice is through partnering with global professional associations, such as, the International Federation of Gynecology and Obstetrics (FIGO), the International Confederation of Midwives (ICM) and the International Council of Nurses (ICN). Such organizations are vested in advancing global standards of care within their respective profession and can greatly influence syphilis prevention (and its appropriate adaptation) in high-burden countries.

6.2. Health Systems Strengthening. Supporting the creation of strong, sustainable health systems that are responsive, efficient and equitable is now recognized as a key component of improving health for all [25–27]. The 2005 "Paris Declaration on Aid Effectiveness" emphasizes such health systems strengthening through local ownership (of the intervention), support of local health systems, harmonization of donor investment (thereby avoiding duplication), results measurement, and agreement of mutual accountability for attainment of development objectives [28]. Similar with other health initiatives, WHO has addressed this in some detail in the four pillar strategy identified for the global initiative for the elimination of congenital syphilis [20].

However, an inherent challenge lies in striking an appropriate balance between achieving programme and disease-specific goals while at the same time ensuring long-term sustainability through well-functioning and adequately-resourced health systems. This challenge also provides an opportunity in that investments that strengthen health systems can be leveraged to ensure that, in nations with high perinatal morbidity, congenital syphilis interventions are part of the comprehensive MCH systems strengthening efforts. Similarly, partnering with other global health initiatives such as the Global Fund (To Fight AIDS, Tuberculosis and Malaria) [25] and the President's Emergency Plan for AIDS Relief (PEPFAR) [26] can help support congenital syphilis interventions that are provided to the same at-risk population. The shared goals of improved infant and maternal health encompass the areas of service delivery, healthy workforce development, information needs, medical products and technologies, financing, leadership, and governance [27].

7. Summary

Untreated maternal syphilis infection continues to account for large numbers of perinatal deaths worldwide, primarily in nations with moderate to high community prevalence of syphilis and weak health systems. These perinatal deaths are preventable with sufficiently early antenatal syphilis screening and prompt treatment of women testing positive. This highly cost-effective intervention has been demonstrated to be successfully achieved in several high-burden settings through strengthening current health systems. Now—in the context of Millennium Development Goals aimed at promoting infant health and averting preventable deaths—is a prime opportunity to address this old disease through promoting stronger antenatal health systems.

The 2007 WHO initiative for the global elimination of congenital syphilis provides a framework for this effort. The monitoring and evaluation plan developed with support from representatives of high-burden nations provides a means of ensuring progress and accountability through enhancing existing data systems. In addition, the Investment Case developed by WHO and partners offers a potential to identify the resources needed to achieve congenital syphilis elimination over the next five years in ten of the world's highest burden countries. Evaluations of current programmes have helped identify several of the existing barriers to current maternal syphilis screening and treatment efforts as well as potential solutions to address them. Key among these

is a need to support overall health systems strengthening. Now remains the important step of bringing this effort to fruition through integration with other programmes, often disease-specific efforts, aimed at reducing maternal and infant morbidity and mortality. Effective partnerships, provider training, and empowerment can help support this critical process aimed at improving overall infant health.

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Clinical Study

Nifedipine-Induced Changes in the Electrohysterogram of Preterm Contractions: Feasibility in Clinical Practice

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Objective. Evaluating changes in the power spectral density (PSD) peak frequency of the electrohysterogram (EHG) caused by nifedipine in women with preterm contractions. *Methods*. Calculation of the PSD peak frequency in EHG contraction bursts at different times of nifedipine treatment in women in gestational age 24 to 32 weeks with contractions. *Results*. A significant ($P < .05$) decrease of PSD peak frequency between EHG signals measured before and 15 minutes after administration of nifedipine. A significant ($P < .05$) decrease in PSD peak frequency comparing signals recorded within 24 hours after administration of nifedipine to signals 1 day after tocolytic treatment. A higher average PSD peak frequency for patients delivering within 1 week than that for patients delivering after 1 week from nifedipine treatment ($P > .05$). *Conclusions*. EHG signal analysis has great potential for quantitative monitoring of uterine contractions. Treatment with nifedipine leads to a shift to lower PSD peak frequency in the EHG signal.

1. Introduction

Preterm birth is the leading cause of perinatal mortality and morbidity and accounts for approximately half of preterm births [1]. Although the management of threatened preterm labor by tocolytic therapy can prolong gestation [2], effectiveness of tocolytic agents depends on early introduction of therapy [1]. Some risk factors for preterm delivery have been identified, but available prediction methods exhibit poor diagnostic value for detecting preterm labor at an early stage [3–5].

When evaluating women with preterm contractions, the clinicians' daily dilemma is to differentiate between physiological uterine activity and contractions leading to preterm delivery. Monitoring uterine contractions may provide important prognostic information during pregnancy and parturition. No method is currently available for non-invasive monitoring and quantification of uterine contractions [3–5].

It is well established that uterine contractions are the result of the electrical activity propagation through the uterine muscle cells [6, 7]. The electrohysterogram (EHG) is a direct measure of the myometrium electrical activity and it can be measured noninvasively by electrodes positioned on the maternal abdomen [8–10]. The EHG is characterized by intermittent "bursts" of action potentials and each burst corresponds to a mechanical contraction of the uterus. The uterus is quiescent during pregnancy. However, as the delivery time approaches, the uterine electrical activity becomes increasingly synchronous [11].

Some typical changes have been observed in the EHG properties during preterm and term delivery [12–15]. In particular, the shifting of the EHG signal energy to higher frequency as delivery approaches is the most experienced phenomenon observed in the literature [11–14, 16]. In particular, the peak frequency, that is, the frequency corresponding to the maximum of the EHG signal power spectral density (PSD), is the EHG parameter that is most commonly tested [17].

As uterine preterm contractions are the most frequently recognized precursor of preterm delivery, inhibiting contractions (tocolysis) has been the focus of therapeutic approaches for prevention of preterm birth.

As the delivery time approaches, the number of cell gap junctions and voltage-dependant calcium channels increases and form an electrical syncytium leading to an increased uterine activity [18]. Currently, nifedipine, which directly blocks the calcium channel, would be in fact the first choice tocolytic agent to postpone delivery [2, 19]. Nifedipine is reported to be highly effective [2]; however, no placebo-controlled trials were performed and nifedipine is not registered for use as a tocolytic agent [20]. In some rare cases, serious maternal side effects are reported due to overdosage of nifedipine [21]. Therefore, more evidence is needed about the efficacy and safety of this drug for the inhibition of labor.

The aims of this study are (1) providing further insight into the use of the electrohysterogram (EHG) for monitoring uterine electrical contractions in preterm labor; (2) evaluating the nifedipine-induced changes in PSD peak frequency in women with preterm contractions.

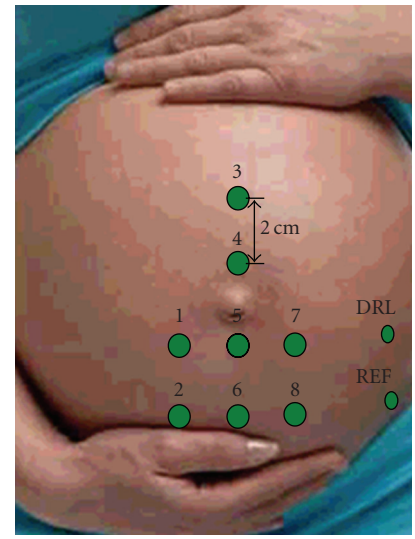

Figure 1: Electrode position and numbering on the abdomen. Prior to electrode positioning, the half length of the uterus was measured. The interelectrode distance was 2 cm for all electrodes. Ref = reference electrode, DRL = ground electrode.

2. Material and Methods

Data were collected at the Máxima Medical Center, a tertiary care teaching hospital. The study was approved by the medical ethical committee of the hospital. All participating women signed an informed consent.

2.1. EHG Signal Recording. The EHG was recorded by eight disposable contact Ag-AgCl electrodes (2 cm interelectrode distance) placed on the abdomen as shown in Figure 1. Prior to electrode attachment the skin was prepared by gentle rubbing with fine abrasive paper. A reference electrode was placed on the left hip. In order to obtain an efficient rejection of the electromagnetic interference, a driven-right-leg ground electrode and actively shielded cables were employed. The EHG signals were recorded and digitized at 1000 Hz, 20 bit resolution, by an M-PAQ amplifier (Maastricht Instruments Ltd., the Netherlands); a 16-channel system for physiological measurements with programmable gain and sampling frequency.

All included patients received nifedipine. For each patient, the EHG was recorded twice, before and after giving nifedipine. The period of each recording varied between 20 and 100 minutes per patient. A conventional tocogram was simultaneously recorded for medical prescription. The use of the tocogram was not specifically required for the study, but was employed for confirming the EHG contraction detection.

2.2. EHG Signal Processing. In order to improve the signal quality, seven bipolar signals were obtained by subtraction of the signal recorded at electrode five (Figure 1). The recorded signals where then visually inspected to assess the signal quality. If judged of good quality, all seven channels were used for further processing.

Additional noise due to respiration, maternal electrocardiogram, and skeletal electromyogram caused by abdominal muscle contraction was removed by band-pass filtering between 0.34 Hz and 1 Hz [16]. To this end, a four-order band-pass Butterworth filter was employed. The signal was then downsampled up to 20 Hz. The down-sampling was made possible by the low frequency content of the signal and reduced significantly the computational time. Contraction bursts of EHG activity were detected on the EHG signal by the method described in [22] and validated by comparison with the simultaneously recorded tocogram.

Similarly to many previous studies on the prediction of pre-term labor by electrohysterography, the power spectral density (PSD) was calculated on each bipolar signal by computing the Fast Fourier Transform (FFT) [8, 12, 16, 18]. Only signal segments within the detected EHG electrical contraction burst were used and no information derived from the quiescent period between contractions was analyzed.

The PSD was separately calculated for three contraction bursts during the first period of measurement, before treatment, and three contraction bursts during the second period of measurement, after treatment. The frequency at which the PSD was maximum, that is, the peak frequency (f_P), was singled-out. For each channel, the values of f_P were averaged over the three recorded bursts of electrical activity. Average and standard deviation of resulting f_P for the different periods of recording were then analyzed and compared.

2.3. Study Population. The study protocol has been carried out in addition to the general used procedures for threatened preterm labor.

Women admitted to the hospital for spontaneous preterm contractions, at risk for extreme preterm delivery,

Table 1: Study population characteristics.

Pt	Age	GA[1] at first EHG recording	Pregnancy	BMI[2]	Cervical dilatation (cm)	Cervical length (cm)	PPROM[3]	UTI[4]	Nifedipine-recording-interval (hours)	Delivery < 1wk
1	29	24 + 1	Singleton	22.3	1	3.1	No	No	4	No
2	34	28 + 0	Singleton	27.8	1	2.3	No	No	9	No
3	32	25 + 4	Singleton	28.0	0	1.6	No	No	10	No
4	29	30 + 4	Twin	22.5	1	1.9	No	Yes	8	Yes
5	29	31 + 2	Twin	21.6	1	2.0	Yes	Yes	5	Yes
6	28	29 + 5	Twin	27.3	1	2.2	No	Yes	0	No
7	34	25 + 6	Twin	23.4	2	2.6	Yes	Yes	0	No
8	34	31 + 1	Singleton	25.1	1	ntb	No	Yes	0	Yes

[1] = gestational age
[2] = body mas index
[3] = preterm prelabor rupture of membranes
[4] = urinary tract infection.

that is, gestational age between 24th and 32nd weeks, were included in the study.

Exclusion criteria were age under 18 years, body mass index above 30, cervical dilatation over 3 cm. Additionally were excluded from the study those pregnancies complicated by pre-eclampsia or HELLP syndrome, placenta praevia, fetal anomalies or maternal trauma precipitating the symptoms.

Immediately after admission to the hospital, patients were assessed by a clinician in order to evaluate the risk of preterm delivery. The criteria for preterm labor were regular contractions at a rate of 4 in 20 minutes or 8 in 1 hour with at least one of the following: progressive effacement or dilatation of the cervix over time or dilatation of the cervix greater than or equal to 2.0 cm. If they were judged to be at risk, they were treated according to the hospital guidelines following the national guideline for tocolysis of the Dutch Association for Obstetrics and Gynecology [23].

Three primiparous and five multiparous women attending the hospital for preterm contractions underwent multichannel EHG recording. The mean gestational age on admission was 28.2 ± 2.8 weeks.

All singleton pregnancies received nifedipine oros 120 mg daily for the first 48 hours. After that, the dosage was lowered gradually over a 4-day period.

The two twin gestations received nifedipine oros 90 mg as the maximum dosage in order to decrease the risk of acute lung oedema [24]. Before giving nifedipine oros, in all pregnancies a load up dose with nifedipine 20 or 40 mg was given. betamethasone for fetal lung maturation was given to 7 patients, in the other patient betamethasone was already completed in the referring hospital.

Three different analyses were done by comparing the PSD peak frequency among different patient groups. The first comparison (three subjects, Group 1) was done between the value of f_P derived from EHG signals recorded before (Subgroup 1.1) and 15 minutes after administration of nifedipine (Subgroup 1.2). For those patients who already started nifedepine treatment in the referring hospital before the first EHG measurement session (three subjects, Group2), the comparison was done between the first measurement, that is, within 24 hours after starting nifedipine oros 9 (Subgroup 2.1), and one day after finishing the tocolytic treatment (Subgroup 2.2). After the effects of betamethasone were expected to be occurred, that is, 48 hours after the first injection, tocolytic treatment was finished in a cutback plan over a 4-day period. The third analysis included all patients (Group3) and aimed at a retrospective comparison of the f_P measured within 24 hours after starting treatment with nifedipine on women who delivered within one week (Subgroup 3.1) and the f_P measured within 24 hours after starting treatment with nifedipine on women who delivered after more than one week (removed: from the EHG measurement) (Subgroup 3.2).

Of the included patients, five women were diagnosed with lower urinary tract infection at 2–4 days before attending the hospital and four of them were still being treated with antibiotics when nifedipine was given.

Patient's characteristics are summarized in Table 1.

2.4. Statistical Analysis. Sigma-Stat software (SPPS Inc, Chicago, IL) was implemented for statistical comparison of groups. The PSD peak frequencies in all channels for every single patient and all separate bursts were considered for analysis.

Statistical analysis was performed using a 2-tailed *t*-student. A P value of less than .05 was considered statistically significant.

3. Results

In all patients, the uterine contractions detected by the EHG signal analysis corresponded to the uterine mechanical activity as recorded by tocodynamometer. In Figure 2 an example of these typical recordings is given for one patient

In general, the peak frequency as well as the uterine activity decreased in all patients after treatment with nifedipine (Table 2).

Table 2: Shift of PSD peak frequency.

Group 1[1]	Before nifedipine (Subgroup 1.1)	15 minutes after nifedipine (subgroup 1.2)	*P*-value
PDS peak frequency (Hz)	0.367 ± 0.061	0.340 ± 0.040	
	0.415 ± 0.046	0.375 ± 0.051	
	0.424 ± 0.079	0.405 ± 0.021	
Mean	0.402 ± 0.025	0. 373 ± 0.026	.043*
Group 2[2]	Within 24 hours after starting nifedipine (subgroup 2.1)	1 day after finishing nifedipine (subgroup 2.2)	*P*-value
PDS peak frequency (Hz)	0.390 ± 0.035	0.371 ± 0.058	
	0.436 ± 0.046	0.403 ± 0.074	
	0.434 ± 0.047	0.403 ± 0.041	
Mean	0.42 ± 0.021	0.392 ± 0.015	.024*
Group 3[3]	Patients delivering after 1 week after start nifedipine (subgroup 3.1)	Patients delivering within 1 week after start nifedipine (subgroup 3.2)	*P*-value
PDS peak frequency (Hz)	0.340 ± 0.040	0.407 ± 0.065	
	0.375 ± 0.051	0.380 ± 0.055	
	0.405 ± 0.021	0.434 ± 0.047	
	0.436 ± 0.046		
	0.390 ± 0.035		
Mean	0.389 ± 0.031	0.407 ± 0.022	.458**

[1] = patient 1–3 (Table 1)
[2] = patient 4–6 (Table 1)
[3] = patient 1–8 (Table 1)
*calculation by 2-tailed paired student *t* test
**calculation by 2-tailed unpaired student *t*-test.

In three patients (Group 1), the EHG signal was recorded before (62 bursts analyzed in total) and 15 minutes (time expected that effect of nifedipine will occur) after administration of nifedipine (53 bursts analyzed in total). As shown in Table 2 (group 1), averaging the results in these three patients, a significant 7.2% ($P < .05$) decrease in PSD peak frequency was observed (Figure 3).

In three other patients (Group 2), a comparison was made between the EHG signal recorded within 24 hours after starting treatment with nifedipine (56 bursts analyzed in total) and the EHG signal recorded 1 day after finishing tocolytic treatment after the 6-day period of treatment (63 bursts analyzed in total). Also in this case, a significant ($P < .05$) decrease in PSD peak frequency was observed in all patients (Table 2, Group 2). On average, the PSD peak frequency decreased of 6.7%.

Finally, from the eight patients in which the EHG was recorded (Group 3), three patients delivered within 1 week after treatment with nifedipine (Subgroup 3.2). Frequency analysis of the signals recorded from these patients (3 patients, 56 bursts analyzed in total), to those patients delivering after more than 1 week (Subgroup 3.2, 5 patients, 98 bursts analyzed in total), showed, on average, a higher f_P for Subgroup 3.1 as shown in Table 2. However, the significance of this difference was poor ($P = .46$).

4. Discussion

The devices and methods currently used for predicting preterm delivery, such as vaginal examination, tocodynamometer, fetal fibronectin, and ultrasound measurement of cervical length, do not provide accurate diagnosis or prediction of preterm labor [25]. Intrauterine pressure catheters are reliable but limited by their invasiveness and the need for ruptured membranes. External uterine monitors, such as tocodynamometers, are uncomfortable, inaccurate, and depend on the personal interpretation of the examiner. Biological tests, such as fetal fibronectin, can be used as a prognostic marker, although with poor positive predictive values [5]. Even cervical length changes may not be an accurate indicator of true labor, as a large percentage of women with established cervical change do not deliver preterm even without tocolytic treatment [26].

As current methods are not capable of discriminating contractions, most obstetricians either treat all patients having preterm contractions or wait for cervical change. Delay in the diagnosis of preterm labor may result in a lower efficacy of tocolytic drugs [27, 28], while giving tocolysis to all patients exhibiting uterine activity is not free of risks for mother and fetus [21, 28, 29].

Uterine contractions are the direct consequence of the generation and propagation of electrical activity at the

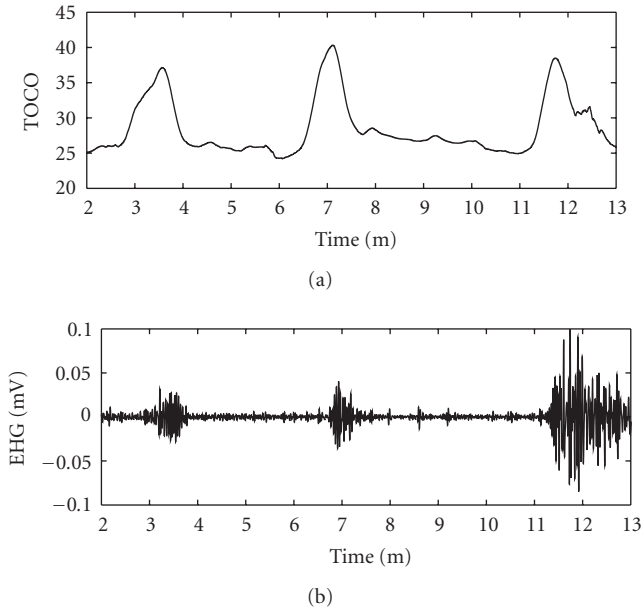

Figure 2: Tocographic and EHG recording of a patient with preterm uterine contractions. The figure shows an example of the temporal correlation between the uterine electrical and mechanical activity.

myometrium [6, 7]. It has been demonstrated that the EHG signal recorded on the skin surface is representative of the electrical activity initiating the mechanical contraction of the uterus [7]. Being a measure of the first cause of a contraction, the EHG signal is potentially the best predictor of delivery. Furthermore, it is noninvasively and can therefore be employed for both singleton and multiple gestations during pregnancy and delivery.

For the prediction of labor by electrohysterography previous studies mainly focused on the analysis of the frequency properties of the EHG signal [8, 9, 14, 15].

There is general agreement that the peak frequency derived from the PSD of the signal increases as the measurement-to-delivery time interval decreases [13, 16]. In particular, Buhimschi et al. [12] detected a significant shift from low to high PSD peak frequency in nonlaboring preterm patients as compared to laboring preterm patients. Doret et al. [11] performed a study in rats and showed the PSD peak frequency to be the earliest change to occur in the EHG signal as preterm delivery approached.

The shift of the EHG signal spectral content to higher frequencies can be explained by the underlying physiology. The frequency of action potentials within a burst is, in fact, a direct measure of the rate of the depolarization/repolarization process in the myometrial cells, a process governed by calcium ion-influx across ion channels [30]. When modifications in the ion channels of the myometrial cell plasma membrane initiate labor, the uterus becomes more excitable [30, 31], the signal propagation distance and contraction strength increase, and, as a result, higher frequencies within bursts of activity [13, 16] are expected.

Nifedipine is a calcium channel blocker. Therefore, it can be expected to act directly on the propagation of uterine activity. Lower frequencies within the EHG bursts after tocolytics can be associated to a lower level of electrical activity propagation and, ultimately, to the effectiveness of the treatment. The majority of tocolytic agents attempt to paralyze the myometrium, without addressing the root stimulus of preterm labor in a cause-specific way. Conversely, nifedipine acts by inhibiting the influx of calcium ions through the cell membrane and the release of intracellular calcium from the sarcoplasmatic reticulum. As a result, a decrease in intracellular free calcium occurs and leads to the inhibition of myosin light-chain kinase-mediated phosphorylation, which is calcium-dependant, and inducing a relaxation of the myometrium [32].

Moreover, nifedipine can be a preferable treatment for patients at risk for preterm delivery because it can be administered by oral route at any gestational age and severe side effects are reported to be very rare [20].

In the present study, the PSD peak frequency decreased in all patients after treatment with nifedipine, also for those patients close to delivery. The same results were obtained by analyzing the EHG signal of patients who were recorded within 24 hours of first treatment compared to their EHG signal after end of treatment.

A disadvantage of this study is that there is no control group. However, all of the patients we included in the study were at high risk for delivering very preterm.

The PSD f_P tendency highlighted in the present study suggests that nifedipine can be an effective tocolytic agent for inhibiting electrical activity propagation and therefore the effectiveness of uterine contraction when occurring preterm. In this case, the ultimate goal is in fact delaying the delivery in order to allow medical intervention or, in the most desirable case, to reach the term of pregnancy.

In the present study, three patients delivered in 1 week, even if they had been treated with nifedipine. All these women had an asymptomatic urinary tract infection. It is well established that treatment with antibiotics is associated with prevention of preterm birth [33]. In our study, four of the five patients were treated with antibiotics and two of them did not deliver within one week. The effectiveness of tocolytics in the presence of urinary tract infections needs further to be defined.

The reason of the failure of tocolytics in preventing preterm delivery is still an unsolved issue for gynecologists. However, it has been suggested that the effectiveness of tocolytics is highly dependent on early initiation of the therapy. Therefore, timely recognition of the process leading to the delivery is fundamental. Garfield et al. [18] and Linhart et al. [26] demonstrated, in fact, that parturition is a two-step process consisting of a conditioning (preparatory) phase, followed by active labor. During the conditioning phase, there is a progression of uterine contractility from an inactive to an active state. In the myometrium, the preparatory process involves changes in transduction mechanisms and the synthesis of several new proteins. At some point of the conditioning step, the process becomes irreversible and leads to active labor and, ultimately, to delivery [18]. It is known

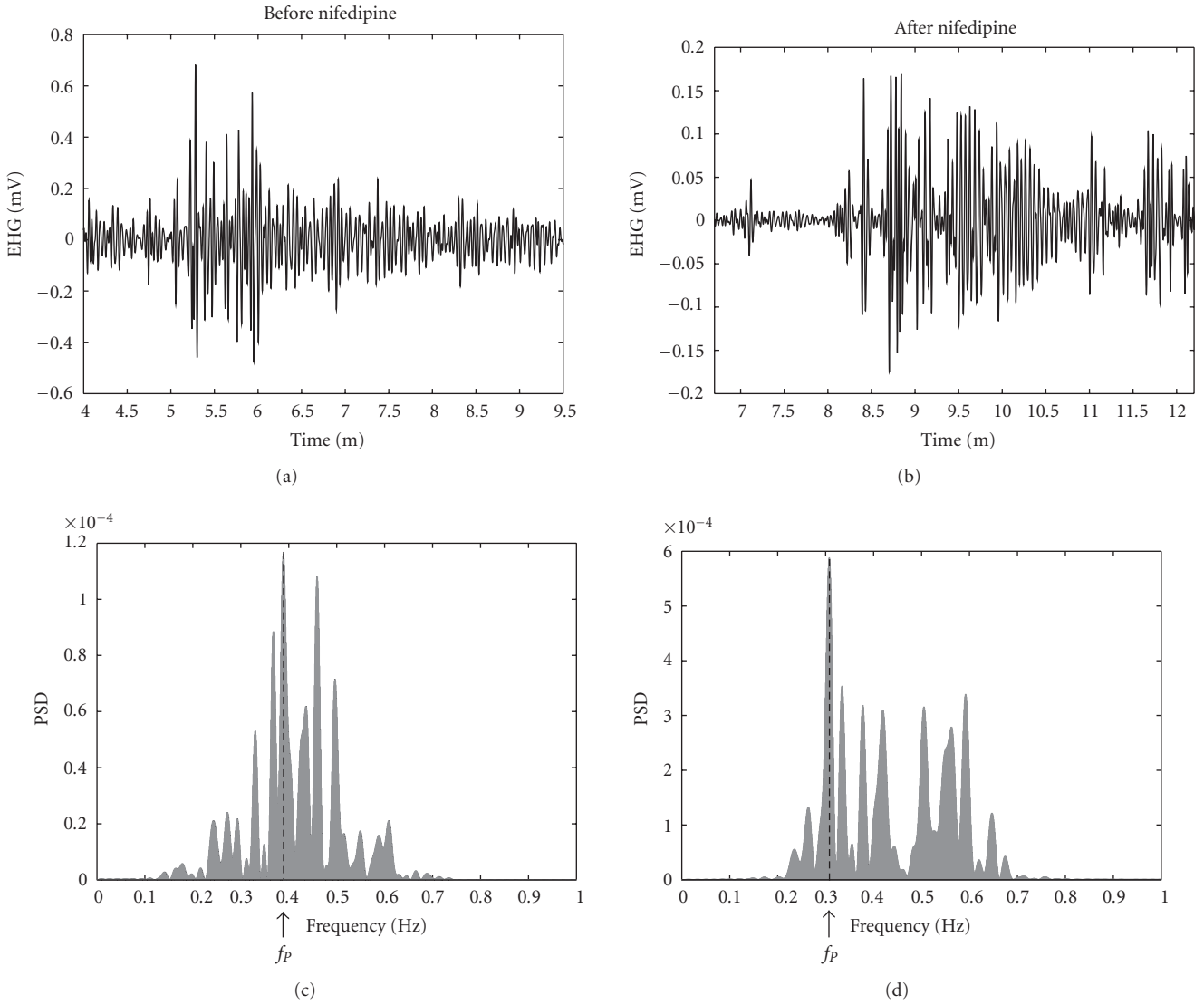

Figure 3: Example of preprocessed EHG signal (upper plot) before (left) and after (right) nifedipine treatment. The corresponding power spectral densities before (left) and after (right) nifedipine treatment are depicted in the bottom part of the figure with an indication of the peak frequency f_P.

that agents used to intervene in labor may be of greatest value during the preparatory phase in the progression to delivery [1]. Therefore, it could be suggested that the women in this study who failed to respond to therapy were treated too late and that during the EHG recording, an irreversible change to the active phase of labor might already have occurred.

On average, the women who did not respond to the therapy and delivered within one week from the measurement showed a higher f_P than the other patients. However, not all patients within one week from delivery showed higher f_P than the rest; finding a cut-off value for an accurate classification of the two populations was therefore not possible. Due to the limited size of the study population, these preliminary results, even if obtained by analyzing a large number of bursts, might be affected by the different treatment-to-measurement time.

We showed that the PSD peak frequency decreased in all women after treatment with nifedipine, although, due to the small number of women in the study and variable times of EHG recording (in five of the eight women, EHG recordings could only be made after the start of nifedipine treatment), this could not be linked with a significant increase in time to delivery.

Previous studies on a more extended database on animals and women not treated with tocolytics concluded that the peak frequency derived from the PSD of the EHG signal increases as the measurement-to-delivery interval decreases [17]. Noticeably, these conclusions were also mostly derived by mean differences for all the patients. However, ultimately, due to a poor significance of the difference, a cut-off value of peak frequency has not been found yet. Therefore, further studies are required in order to develop methods that can

reliably differentiate the uterine status of labor. Longitudinal studies in pregnant women could support the determination of the EHG properties related to the electrophysiological process leading to preterm labor. Further research on the differentiation of the uterine electrical activity in the non-prepared state before labor and the active state of labor would be necessary; objective criteria to evaluate the state of the uterine preparedness for labor can in fact improve management of preterm labor.

5. Conclusion

In this study, the efficacy of nifedipine as a tocolytic drug on the uterine activity was evaluated by monitoring and analysis of the EHG signal. Treatment with nifedipine leads to a statistically significant shift to lower PDS peak frequency in the EHG. As the PDS peak frequency is expected to rise when delivery approaches, from these preliminary results, it could be concluded that nifedipine is an effective tocolytic agent for suppressing preterm contractions. However, further studies are needed to relate the decrease in the myometrium electrical activity to the physiological effects leading to the effectiveness of the tocolitic treatment.

Even with accurate tocolysis, some patients do not respond to therapy and preterm delivery cannot not be inhibited. In these patients, an irreversible change to the active phase of labor has probably occurred. As tocolytic agents may be more effective during certain periods in the progression to delivery, it is important to develop methods that could reliably diagnose the risk of preterm birth at early stages.

This study confirmed that the EHG signal analysis is a reliable technique for non-invasive monitoring the uterine contraction and has great potential for predicting labor, especially for patients at high risk for preterm delivery. However, considering also the previous literature on the topic, our results suggest that the analysis of the EHG signal frequency alone may not provide a universal cut-off value for assessing whether the irreversible process leading to labor has already started or not. Since the spreading of the electrical activity through the myometrium is the first cause of labor, the analysis of the EHG signal propagation, for example, in terms of direction and velocity [34–36], might provide an important contribution to the development of methods that can objectively evaluate the state of the uterine preparedness for labor and to identify the patients at risk for preterm labor.

Contribution to Authorship

Maartje P. G. C. Vinken worked on conception and design of data, acquisition of data, and analysis and interpretation of data; C. Rabotti on analysis and interpretation of data, critical revision of article; M. Mischi on critical revision of article and statistical analysis; Judith O. E. H. van and G. S. Oei on the critical revision of article.

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Research Article

Stillbirths in Rural Hospitals in The Gambia: A Cross-Sectional Retrospective Study

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Objective. We determined the stillbirth rate and associated factors among women who delivered in rural hospitals in The Gambia. *Method*. A cross-sectional retrospective case review of all deliveries between July and December 2008 was undertaken. Maternity records were reviewed and abstracted of the mother's demographic characteristics, obstetric complications and foetal outcome. *Main Outcome Measure*: The stillbirth rate was calculated as deaths per 1000 births. *Results*. The hospital-based stillbirth rate was high, 156 (95% CI 138–174) per 1000 births. Of the 1,519 deliveries, there were 237 stillbirths of which 137 (57.8%) were fresh. Severe obstetric complication, birth weight <2500 g, caesarean section delivery, and referral from a peripheral health facility were highly significantly associated with higher stillbirth rates, OR = 6.68 (95% CI 3.84–11.62), 4.47 (95% CI 3.04–6.59), 4.35 (95% CI 2.46–7.69), and 3.82 (95% CI 2.24–6.51), respectively. Half (50%) of the women with stillbirths had no antenatal care OR = 4. 46(95% CI 0.84–23.43). *Conclusion*. We observed an unacceptably high stillbirth rate in this study. As most of the stillbirths were fresh, improved intrapartum care supported by emergency transport services and skilled personnel could positively impact on perinatal outcomes in rural hospitals in The Gambia.

1. Introduction

Stillbirths and neonatal deaths remain a huge challenge in the care of pregnant women, especially in developing countries [1]. Over 3.3 million stillbirths and more than 3 million early neonatal deaths occur every year. A vast majority (98%) takes place in developing countries where stillbirths represent over half of the perinatal deaths [2]. Complications during pregnancy and child birth are known to be closely associated with high stillbirth and perinatal mortality rate [3]. Perinatal mortality and stillbirth rates are important indicators of the quality of antenatal and obstetric care in a community [4]. Despite an important indicator stillbirths are invisible in global policy and programme priorities. They are usually not captured in local data collecting systems [2, 5]. Lack of a well-defined programme agenda, coupled with the lack of data, and social invisibility, deter action and investments for stillbirth prevention and reduction [2].

Being cognizant of the distribution of stillbirths (fresh and macerated) and deaths within the immediate postpartum period may help to detect shortcomings in the quality of antenatal and obstetric care given to the pregnant woman, hence prioritize appropriate intervention programmes [6]. Data on the frequency and distribution of these adverse births outcomes are important for planning maternal and child health services in developing countries [7]. As a drive to achieve the Millennium Development Goals (MDGs), the Government of The Gambia developed a national road map to accelerate the reduction of maternal and newborn morbidity and mortality [8]. However, this strategy remains

a challenge due to weak health system, gross shortage of skilled human resource, and inadequate access to emergency obstetric care. The aim of this study was to determine the frequency/rate of stillbirths and its associated socio-demographic and medical factors in two rural referral hospitals in The Gambia. To our knowledge no previous study has assessed the frequency of stillbirths in The Gambia.

2. Materials and Methods

2.1. Study Setting and Design. A cross-sectional retrospective study was carried out at Bansang General Hospital and Armed Forces Provisional Ruling Council (AFPRC) Hospital. These hospitals are located in the North and South bank of The Gambia, respectively, in two different health regions. Comprehensive EOC is available most of the time, mainly provided by Cuban Medical doctors. There is no Gambian medical doctor or obstetrician in any of these hospitals. The first class of medical doctors educated in The Gambia completed their education in 2007. The two hospitals serve a population of nearly 600,000 and are referral points for nearly 30 peripheral health centres and or dispensaries. Basic EOC is not available at any of these peripheral health centres. Thus, women in either the North Bank or South Bank with obstetric complications are referred to Bansang or AFPRC hospitals. Most of these women are referred during labour. The Government of The Gambia has adopted the primary health care (PHC) strategy to make health care more accessible to the rural population. Villages with more than 400 inhabitants have resident traditional birth attendants (TBA) who have eight weeks formal training in antenatal, intrapartum and postpartum care of the mother and child. These TBAs are being supervised by a community health nurse (CHN) who is in charge of a cluster of villages. Antenatal care is provided by mobile reproductive and child health clinics from the health centres and the two hospitals.

2.2. Study Population. We used data from hospital records on all women who gave birth at or after 28 completed weeks of gestation from 1st July 2008 to 31st December 2008. Data was abstracted from maternity case notes, admission, and delivery registers. Midwives or doctors attending a birth complete a standardised form to be filled in upon admission and immediately after delivery. The form contains important information about maternal health and complications during pregnancy and the intrapartum period. It also contains information about the newborn. A precoded case abstraction questionnaire was used. Data abstraction was done by the principal investigator and assisted by research assistants, mainly midwives.

2.3. Variables. The main outcome measure was stillbirth rate calculated as deaths per 1000 births. The eligibility criteria was based on the World Health Organization's (WHOs) international comparison of viability; that is birth weight of ≥1000 g and or born at ≥28 weeks of gestation. Thus, we defined stillbirth as death in the uterus of an infant at ≥28 weeks of gestation or ≥1000 g. It was classified as fresh when the baby was born with an intact skin suggesting that the death occurred during labour (less than 12 hours before delivery). A macerated stillbirth was defined when there was sign of degeneration suggesting the death having occurred more than 12–24 hours before labour. We also recorded early neonatal deaths defined as death of the newborn baby within the first twelve hours of birth. During this period all the live born babies and their mothers were still under observation in the hospital. Due to early discharge from hospital (twelve hours after delivery) and a retrospective study design, information on live-births who might have died at home within seven days of birth was not known. Due to low number and great uncertainty these results were not included in the tables.

For each birth, demographic and obstetric explanatory factors were captured. The demographic variables included maternal age in years, categorized in three groups: <20 (reference), 20–34, and ≥35. Parity coded as primiparous (0), 1–3 previous deliveries, ≥4 previous deliveries, area of residence (PHC village or non-PHC village). Obstetric factors included the following: admission status of the mother (booked or referred), antenatal care attendance for present pregnancy coded as no or yes, mode of delivery (spontaneous vaginal, assisted vaginal (breech), and caesarean section), presence of severe obstetric complication which included one or more of the following: prelabour rupture of membranes preterm, hypertensive pregnancy disorders (pre-eclampsia and eclampsia), antepartum haemorrhage comprising (placenta previa and abruption placenta), cephalopelvic disproportion (CPD), prolonged or obstructed labour, severe anaemia (haemoglobin level <9 g/dL). Foetal characteristic was birth weight <2500 g and ≥2500 g.

A total of 1,849 maternity admissions were recorded during the six months period. We excluded 224 (12.2%) who had not delivered. Twenty-one births were further excluded due to missing information on the vital status and birth weight, and 25 who weighed less than 1000 g. We also excluded 60 deliveries that occurred before reaching the hospital. The final data set for this analysis was 1,519. The Ethics Committee of Norway and the Joint Gambia Government and Medical Research Council Review board approved the study. Permission to carry out the study was achieved from the Ministry of Health of The Gambia and the chief executive officers of Bansang and AFPRC hospitals.

2.4. Statistical Analysis. All 1,519 institutional births were included in the analysis. Frequency analysis and cross-tabulations were used to determine the frequency and percentage of stillbirth and early neonatal mortality. Overall, stillbirth was calculated as a proportion of all births while early neonatal mortality was presented as a proportion of live births. Fresh and macerated stillbirths were calculated as a proportion of stillbirths. Multiple births were initially excluded, but repeating the analysis including multiple births the stillbirth rate remained largely unchanged. Thus we decided to maintain multiple births in the analyses. Univariate association between covariates and stillbirths were assessed with chi-square test or Fisher's exact test as appropriate. All P-values were two-sided and a value of 0.05

was considered statistically significant. Finally all covariates were included in a multivariate logistic regression model to determine significant factor associated with stillbirth. All statistical analysis was done with Software Package for Social Sciences (SPSS) for Windows version 16.0 (SPSS Inc, Chicago, II, USA).

3. Results

The total number of deliveries over the six months period was 1,519. Of these, 237 were stillbirths, representing a stillbirth rate of 156 (95% CI 138–174) per 1000 births. Of the 237 recorded stillbirths, 137 (57.8%) were fresh stillbirth. We recorded 6 early hospital neonatal deaths giving a hospital neonatal mortality rate of 5 (95% CI 2–10) per 1000.

More than half (54.9%) of the women were between 20–34 years old. Forty-six percent were primiparous. Nearly all (99.3%) attended antenatal care at least once. Most of the women (89%) had a spontaneous vaginal delivery, 8% delivered by caesarean section, while 3.4% of the births were assisted breech delivery. Twenty-two percent of the women were referred from peripheral health centres. Of the 1,519 recorded deliveries the partograph was not used in 958 (63%). Overall, 53 (3.5%) of the women had a breech presentation at delivery (Table 1).

Table 1 shows the results of the univariate analysis. The crude analysis indicate that stillbirths were highly significantly associated with the following factors: referral from a peripheral health facility (odds ratio: 13.75, 95% CI (10.02–18.84), severe obstetric complication 11.74, 95% CI (8.58–16.06), birth weight <2500 g 6.32, 95% CI (4.67–8.55), residence in a PHC village 2.13, 95% CI (1.59–2.80), nonuse of patograph 2.48, 95% CI (1.78–3.45) and ≥4 pregnancies 2.24, 95% CI (1.61–3.10). Lack of antenatal care, assisted breech delivery, and maternal age 35 years and above were also associated with high stillbirth rate, OR = 5.5, 95% CI (1.58–19.16), 1.80, 95% CI (1.16–2.80), and 1.80, 95% CI (1.14–2.83), respectively. After adjusting for all the variables in a multivariate logistics analysis, presence of severe obstetric complication(s), birth weight <2500 g, caesarean section delivery and referral from a peripheral health facility were the most important factors highly significantly associated with higher stillbirth rates OR = 6.68 (95% CI. 3.84–11.62), 4.47 (95% CI. 3.04–6.59), 4.35 (95% CI 2.46–7.69), and 3.82 (95% CI. 2.24–6.51), respectively. However, the proportion of stillbirths was relatively lower in elective c/s groups (20.8%) than for the emergency c/s groups (23.5%), $P > .05$. In addition, other factors associated with high stillbirth rate were nonuse of partograph OR = 1.70 (95% CI 1.23–2.56), multiple pregnancy OR = 2.01 (95% CI 1.05–3.86), and not attending antenatal care OR = 4.46 (95% CI 0.84–23.43) (Table 1).

The association between maternal demographic/ obstetric factors and fresh stillbirths are presented in Table 2. On univariate analysis, complications during intrapartum period, being delivered at AFPRC hospital and birth weight <2500 g were significantly associated with fresh stillbirth, OR = 3.57 (95% CI 1.52–8.40), 2.15 (95% CI 1.26–3.66), and 2.15 (95% CI 1.27–3.63), respectively. After adjusting for the effect of all the variables in a multivariate analysis intrapartum severe obstetric complication was the only independent factor associated with high rate of fresh stillbirth; OR = 3.14, 95% CI (1.01–9.76).

Of the 1339 live births registered during the study period, 11 maternal deaths were recorded representing a hospital maternal mortality rate of 822/100,000 live births (LB). Of the 11 recorded maternal deaths, 7 (1,169/100,000 LB) and 4 (541/100,000 LB) were in Bansang and AFPRC hospitals, respectively.

4. Discussions

4.1. Main Results. The stillbirth rate found in the two rural hospitals in The Gambia was unacceptably high, pegging at 156 per 1000 total births. The reported early neonatal deaths rate was 5/1000 live births. Presence of severe obstetric complication showed a close association with stillbirth, followed by low birth weight, caesarean section, and referral from a peripheral health facility. Stillbirth was also associated with nonused of the partograph, multiple pregnancy, and lack of antenatal care. In addition, obstetric complications during the intrapartum period were independently associated with fresh stillbirths.

4.2. Methodological Considerations. Even though hospital-based data has a limitation in the correct appraisal of the magnitude of a problem in the general population, lack of nationwide vital registration system in many developing countries including The Gambia, has made population-based studies unfeasible. Some field reports on stillbirths from Zimbabwe [7] and The Gambia [9] were established from hospital data. These data are however very vital in rendering both clinical and research priorities. Several limitations of this study should be recognized. Due to the hospital-based design of the current study, we might have overestimated the stillbirth rate. The reported numbers of early neonatal mortality are small and such deaths may also underestimate the true neonatal mortality rates since no systemic follow-up mothers or infants were undertaken. Some of the women may have experienced neonatal deaths after discharge from hospital. Due to the practice of hospital discharge within 12 hours after delivery most of the early neonatal deaths were also not captured in the maternity records. Usually hospital data will show a very high percentage of deaths due to asphyxia since complicated births are more likely to come to hospital. The very small number of observations of early neonatal deaths in our study gives estimates with large uncertainty. Thus, the findings of our study cannot be generalized to the entire country and should be interpreted with caution.

4.3. Stillbirth Rates and Associated Factors. The reported stillbirth rate in the current study is higher than in a recent hospital-based study by Cham et al., 116 per 1000 births [9]. The rate is also higher than in other previously reported

Table 1: Demographic/reproductive and obstetric factors associated with stillbirth.

Characteristics	Total birth *n* (%)	Stillbirth *n* (%)	Crude OR (95% CI)	Adjusted[aa] OR (95% CI)
	1519	**237(15.6)**		
Maternal age (yrs)				
<20	509(33.5)	61(12.0)	1	1.
20–34	827(54.4)	140(16.9)	1.20(0.80–1.81)	0.97(0.57–1.65)
≥35	183(12.0)	36(19.7)	1.80(1.14–2.83)*	1.39(0.64–2.93)
Parity				
0	703(46.3)	77(11.0)	1	1.
1–3	380(25.0)	66(17.4)	1.31(0.92–1.86)	0.48(0.28–0.78)
≥4	436(28.7)	94(21.6)	2.24(1.61–3.10)***	0.35(0.20–0.63)
Residence				
PHC Village	473(31.1)	108(22.8)	2.13(1.59–2.80)***	1.14(0.78–1.66)
Non-PHC Village	1046(68.9)	129(12.3)	1	.
Admission status				
Referred	303(19.9)	153(50.5)	13.75(10.02–18.84)***	3.82(2.24–6.51)***
Booked	1216(80.1)	84(6.9)	1	1.
Antenatal Care				
No	10(0.7)	5(50.0)	5.50(1.58–19.16)**	4.45(0.84–23.43)
Yes	1509(99.3)	232(15.4)	1	1.
Mode of delivery				
Spontaneous Vaginal	1340(88.2)	191(14.3)	1	1
Assisted breech	53(3.5)	17(32.1)	1.80(1.16–2.80)**	1.64(0.74–3.60)
Caesarean Section	126(8.3)	29(23.0)	0.63(0.31–1.29)	4.35(2.46–7.70)***
Used of Patograph				
No	958(63.1)	187(19.5)	2.48(1.78–3.45)***	1.70(1.13–2.56)**
Yes	561(36.9)	50(8.9)	1	1.
Obstetric complication				
Yes	370	164(44.3)	11.74(8.58–16.06)***	6.68(3.84–11.62)***
No	1149	73(6.4)	1	1.
Type of birth				
Multiple	111(7.3)	20(18.0)	1.20(0.73–1.99)	2.01(1.05–3.86)**
Singleton	1408(92.7)	217(15.4)	1	1.
Birth weight				
<2500 g	278(18.3)	114(41.0)	6.32(4.67–8.55)***	4.48(3.04–6.59)***
≥2500 g	1241(81.7)	123(9.9)	1	

[aa] Adjusted for all variables listed in the table. * *P*-value <.01, ** *P*-value <.05, *** *P*-value <.001.

findings from The Gambia [10, 11] and, in one hospital-based study conducted in Zimbabwe, 61 per 1000 births [12]. Our rate is also considerably increased compared to the reported rates within Sub-Saharan Africa; 32.2 per 1000 births [5], and the WHO model estimates of 42 per 1000 births [2]. We speculate that the higher rates registered in our study could be attributed to the referral of complicated obstetric cases from peripheral health centres. Most of the obstetric cases referred often reach the hospital when it is already late. In addition, the high stillbirth rate may be in part due to the low degree of obstetric vigilance and improper labour management. Our study demonstrated a very high stillbirth rate and a relatively very low neonatal mortality rate. This may indicate a serious delay on behalf of the baby. Thus, it would be reasonable to assume that the babies do not even live to be born "asphyxiated." However, the small number of neonatal deaths gives insufficient power to conclude on this matter.

Unavailability and high cost of transportation, poor road conditions, and time to arrange for transport from remote villages may increase the time to reach a health facility [13]. Such factors could play an important role to the findings of the current study. At the time of an obstetric emergency, every moment of delay in seeking and

Table 2: Maternal demographic and obstetric factors associated with fresh stillbirth (FSB) (%).

Profile	FSB (%)	Crude OR (95% CI)	Adjusted[aa] OR (95% CI)
Age (years)			
<20	54.1	0.72(0.39–1.32)	0.76(0.27–2.15)
20–34	62.1	1.32(0.58–3.01)	1.91(0.42–8.41)
≥35	47.2	1	1
Parity			
0	59.7	1.24(0.64–2.40)	1.08(0.37–3.12)
1–3	54.5	1	1
≥4	58.5	1.05(0.57–1.94)	0.48(0.15–1.48)
Recruiting hospital			
Bansang	49.6	1	1
AFPRC	67.9	2.15(1.26–3.66)**	1.42(0.66–3.01)
Residence			
PHC Village	56.5	1	1
Non-PHC Village	58.9	1.11(0.66–1.85)	0.78(0.38–1.58)
Antepartum admission			
Yes	52.8	0.65(0.39–1.10)	0.80(0.30–2.10)
No	63.2	1	1
Timing of complication			
Antepartum	50.4	1	1
Intrapartum	78.4	3.57(1.52–8.40)**	3.14(1.01–9.76)**
Partograph used			
No	58.3	1.10(0.59–2.06)	1.73(0.70–4.30)
Yes	56.0	1	1
Mode of delivery			
Spontaneous vaginalBreech/others	55.5	1	1
Breech/others	64.7	1.43(0.40–5.18)	1.23(0.42–3.57
Caesarean Section	72.4	2.15(0.91–5.11)	1.32(0.32–5.45)
Birth weight (grms)			
<2500	48.2	1	
≥2500	67.7	2.15(1.27–3.63)**	1.67(0.81–3.44)

[aa] Adjusted for all variables listed in the table. ** P-value <.05.

receiving skilled care increases the risk of stillbirth, neonatal or maternal death or disability. If there were fewer delays, fewer babies would probably be stillborn, but many more would be born asphyxiated or die early. Reducing transport time to an EOC facility is challenging in rural settings where roads, public transportation, and communication infrastructures are poor and the terrain may be formidable [13]. Evidence exists that a functioning continuum of care between the home, health centre, and hospital is required to minimize potentially deadly delays and effectively link pregnant women and newborns to skilled obstetric and newborn care [13]. However, even where prompt referral was initiated, the gross shortage of trained human resources for health and inadequate facilities for emergency obstetric and neonatal care must be overcome to reduce perinatal deaths in rural hospitals in The Gambia.

Traditionally, advanced maternal age is viewed as risk factor for pregnancy complications and adverse perinatal outcomes including stillbirths [14, 15]. However, the biological mechanism underlying the increased risk for adverse perinatal outcomes with advanced maternal age is unclear [15]. Older mothers in our population had the highest percentage of stillbirths and the proportion of stillbirth increased steadily as age increases. However, the significant association was lost after adjusting for all the variables included in the study.

Almost all the women in our study (99%) attended antenatal care at least once. However, the percentage of stillbirth was much higher among mothers who did not attend antenatal care compared with those who did. This is consistent with results of other studies carried out elsewhere [12, 16]. Better understanding of foetal growth and development and its relationship to the mother's health has resulted in increased attention to the potential of antenatal care as an intervention to improve both maternal and newborn health [17]. Antenatal care provides a critical linkage between the woman and maternity care services. Thus, if promoted in concurrence with effective EOC and delivered in skilled

hands, it may become an effective instrument to improve maternal and perinatal birth outcomes particularly in developing countries [18]. However, opponents maintained that antenatal care could only detect morbidity during pregnancy and could not detect obstetric complications that would occur during labour [19].

Noncompliance in completing the partograph is common in Gambian hospitals. A higher percentage of stillbirths were observed in situations where the partograph was not used. In a recent paper by Cham et al. on foetal outcome in severe maternal morbidity, the partograph was not used in any of the 725 identified hospital deliveries [9]. The partogram graphically represents key events during labour. It is recommended for routine monitoring of labour to provide an early warning system; thus, assists the health worker to identify slow progress in early labour, hence, initiate appropriate interventions to avert prolonged and obstructed labour [20]. Few studies have assessed partograph used versus no partograph, the impact of which would be underestimated in higher-resourced settings where all women have close surveillance by experienced clinicians. In a larger WHO prospective study in South East Asian Hospitals, partograph used was found to be associated with reduced prolonged labour and stillbirth [21]. Inadequate intrapartum foetal monitoring may result in untimely execution of life-saving intervention, particularly in complicated deliveries. Thus, in low-resource settings partograph use is recommended for monitoring all women in labour, and can serve as a guide for timely referral to Comprehensive Emergency Obstetric Care (CEmOC) facilities [22].

Complications during pregnancy and childbirth have been long known to increase the risk of perinatal death. In our study a higher percentage of women admitted with obstetric complications lost their babies either during pregnancy, labour or shortly after delivery. This is consistent with findings by Cham et al. 2009 [9]. The high rate of stillbirth in multiple pregnancies and deliveries complicated by breech presentation in our study reaffirmed the call that screening for abnormal foetal presentations and multiple pregnancies could be one key component of antenatal care particularly in developing countries. Vanneste et al. demonstrated in one community-based study in Bangladesh that measurement of the fundal height had availed midwives the opportunity to identify a large proportion of women with twin pregnancies [18]. We speculate that timely referral of breech and twin pregnancies to an EOC facility will avert some of the adverse birth outcomes. Thus, refresher training in breech and twin delivery coupled with the presence of a skilled attended at all such deliveries seems warranted.

Most of the stillbirths in our study were fresh, with a fresh to macerated stillbirths ratio of 1.3 : 1. This indicates that most of the deaths probably occurred during labour, Fresh stillbirths are often used as proxy for stillbirths due to acute intrapartum insults [23]. The ratios of fresh to macerated stillbirths may indicate the availability and quality of prenatal and obstetric care, with high ratios suggesting inadequate or poor quality of EOC [12]. Thus, our results reaffirm the need for improved and timely access to EOC services during the intrapartum period in rural Gambia. In developed countries, less than 10% of all stillbirths are intrapartum stillbirths, while in developing countries almost one-half of all stillbirths are assumed to be intrapartum related [23]. The rate of intrapartum stillbirths have been substantially reduced in developed countries. This significant decline is mainly due to increased availability, quality, and access to EOC services and better intrapartum monitoring of high risk births [24]. Thus, understanding the burden of stillbirth has important programmatic and resource implications, which are of special interest in very low-resource settings like rural Gambia [25].

The unmet need for obstetric care is high in developing countries where most of the intrapartum stillbirths take place [26]. However, many of these deaths could be prevented with improved obstetric care [27]. The relatively low rate of intrapartum stillbirth in developed countries was to a larger extent due to the timely purveying of caesarean section [28]. Additionally, in developing countries caesarean section availability was associated with diminution in intrapartum stillbirth rates [27, 28]. However, nonavailability of EmOC, particularly caesarean section has been implicated as a risk factor for intrapartum stillbirth especially in cases of prolonged labour [29]. While caesarean section can be a life saving interposition for mother and child, evidence showed that its use, particularly in low-resource settings could be associated with increased risk of perinatal mortality, especially when it is performed late [30]. Consistent with the above findings, caesarean section deliveries in our study showed a higher proportion of fresh stillbirths when compared with a normal vaginal delivery. In addition, a larger proportion of stillbirths are observed in emergency c/s groups when compared with elective c/s group. We therefore speculate that caesarean sections are probably applied too late in these hospitals resulting to not saving the baby's life. This emphasises the importance of performing caesarean section (C/S) with the correct timing because early c/s could save more lives. Therefore, the increased risk of stillbirths must be considered when c/s is performed in the late stage of labour. The availability of quality EOC, pendent by emergency transport services and skilled providers is pivotal for effective maternal health services in The Gambia.

5. Conclusions

Our findings suggest that the stillbirth rate is unacceptably high in rural hospitals in The Gambia. The findings also reaffirmed the important contribution of severe obstetric complications on the birth outcome in these settings. We also demonstrated an association between stillbirths and nonuse of the partograph, as well as with assisted breech and caesarean section. Most of the stillbirths were fresh, suggesting that these deaths have occurred during labour or shortly before delivery, thus potentially avertable. Improved intrapartum care through safe, comprehensive essential, and emergency obstetric supported by emergency transport services and skilled personnel is warranted for improved foetal out-comes in low resource settings such as The Gambia.

Competing Interest

No competing interest. The authors are responsible for the content and writing of this paper.

Abbreviations

MDGs: Millennium development goals
EOC: Emergency obstetric care
AFPRC: Armed forces provisional ruling council
PHC: Primary health care
TBA: Traditional birth attendant
ENNM: Early neonatal neonatal mortality
CEmOC: Comprehensive emergency obstetric care.

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Clinical Study

Depressive Symptoms and Resilience among Pregnant Adolescents: A Case-Control Study

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Background. Data regarding depression and resilience among adolescents is still lacking. *Objective*. To assess depressive symptoms and resilience among pregnant adolescents. *Method*. Depressive symptoms and resilience were assessed using two validated inventories, the 10-item Center for Epidemiologic Studies Short Depression Scale (CESD-10) and the 14-item Wagnild and Young Resilience Scale (RS), respectively. A case-control approach was used to compare differences between adolescents and adults. *Results*. A total of 302 pregnant women were enrolled in the study, 151 assigned to each group. Overall, 56.6% of gravids presented total CESD-10 scores 10 or more indicating depressed mood. Despite this, total CESD-10 scores and depressed mood rate did not differ among studied groups. Adolescents did however display lower resilience reflected by lower total RS scores and a higher rate of scores below the calculated median ($P < .05$). Logistic regression analysis could not establish any risk factor for depressed mood among studied subjects; however, having an adolescent partner (OR, 2.0 CI 95% 1.06–4.0, $P = .03$) and a preterm delivery (OR, 3.0 CI 95% 1.43–6.55, $P = .004$) related to a higher risk for lower resilience. *Conclusion*. In light of the findings of the present study, programs oriented at giving adolescents support before, during, and after pregnancy should be encouraged.

1. Introduction

Adolescence is a time of physical changes, psychological maturation, and social value acquisition. Teenagers face many challenges and stressful situations related to educational commitment, social behaviour, sexual development, familial conflicts, economical problems, and substance abuse. These factors may certainly modulate personality and individual behaviour. Recent reports indicate that adolescents are initiating sexuality at an earlier age than in the past; in many cases contraceptive measures are not being used [1]. Pregnancies among adolescents are considered as a complication, as they favour education interruption, poor present and future health, higher rates of poverty, problems for present and future children, among other negative outcomes [2].

Adolescents display emotional responses toward an undesired pregnancy, presenting higher school dropout rates, social punishment, and segregation [1, 3]. Anxiety, stress, and depression are among the most frequently encountered reactions toward an unexpected pregnancy [4]; however, there is limited information regarding this reaction among adolescents as compared to older pregnant women [5]. Resilience, on the other hand, has been defined as the capacity that allows an individual to prevent, minimize, or overcome damage imposed by life adversity [6, 7]. It is a measure on how individuals cope, overcome, or even become positively strengthened by changes and challenges. Resilience is pivotal for adolescents to mature in healthy ways, including sexual health and well-being maintenance. Adolescents face many difficulties and stressful situations: personal

achievements (education and work), sexual development, family conflicts, sociocultural issues, substance use/abuse, antisocial behaviour, among others. Individuals with high resilience are less likely to engage in risky behaviors [7]. Furthermore, complex relationships exist between depressive symptoms and resilience in adolescents.

Despite the fact that resilience is important for adolescent personality maturation, up-to-date, studies assessing depressive symptoms, and resilience specifically in pregnant adolescents are still lacking. The present study aimed at assessing depressive symptoms and resilience among pregnant adolescents. It was hypothesized that prevalence of depressed mood would be greater and resilience lower among adolescents as compared to controls aged 20 to 30 years. Studies addressing resilience during pregnancy are scarce [8–10]. It has been assessed during pregnancy in various stressful situations: after ultrasound consultation for fetal malformations [8] and after exposure to a hurricane [9]. Another report examined resilience factors (maturity, self-esteem, and mother-grandmother relationships) shortly after delivery and parenting behavior at 6 months although no specific resilience measuring tool was used [10]. Despite the fact that resilience is important for adolescent personality maturation, up-to-date, studies assessing depressive symptoms and resilience specifically in pregnant adolescents are still lacking. The present study aimed at assessing depressive symptoms and resilience among pregnant adolescents. It was hypothesized that prevalence of depressed mood would be greater and resilience lower among adolescents as compared to controls aged 20 to 30 years.

2. Methods

2.1. Study Design and Participants. This case-control study was carried out from 1 February 2010 to 30 April 2010 in the Labor and Delivery Unit of the Enrique C. Sotomayor Obstetrics and Gynecology Hospital of Guayaquil, Ecuador after approval of the institution's Scientific, Research and Ethics Committee. Nulliparous women aged 19 or less, delivering at this facility a live, single child of more than 20 weeks in the working shifts of one of the authors (D.S-P; 12 hrs every 24 hrs) were considered eligible to be included as cases (adolescents). Those with an abortion and/or still births were excluded. Each teenager was surveyed in the first postpartum hour with a structured questionnaire containing general maternal data, the 10-item Center for Epidemiologic Studies Short Depression Scale (CESD-10) and the 14 item Wagnild and Young Resilience Scale (RS) [11–13]. Survey was pretested on several teenagers prior to the initiation of the study. Maternal and neonatal outcome data were directly assessed from the medical records of each subject. Delivery of a nulliparous woman (20 to 30 years) right after each indexed case was selected as the corresponding control. Controls were identified through the delivery log book and surveyed in the same fashion as cases. Participants were informed of the study, its objectives, and confidentiality and their full right to discontinue or refuse participation. Interviews were maintained anonymous and consent obtained orally.

The Enrique C. Sotomayor Obstetrics and Gynecology Hospital of Guayaquil, Ecuador, performs more than 30,000 deliveries per year, attending basically gravid women of low socioeconomic income of Guayaquil, the major coastal city of Ecuador with a population above 3 million inhabitants. Approximately 25% of annual deliveries correspond to those aged 19 or less [14].

2.2. Center for Epidemiologic Studies Short Depression Scale (CESD-10). The CESD-10 is a 10-item questionnaire assessing how individuals feel during the past week. This is a short version of the 20-item CESD tool. Each item can be graded according to a Likert scale: rarely or none of the time, <1 day (0 points); some or a little of the time, 1-2 days (1 point); occasionally or a moderate amount of time, 3-4 days (2 points); and all the time, 5 to 7 days (3 points). Items 5 and 8 are scored inversely. Final score is the sum of the 10 graded items with scores 10 or greater considered as depressed mood [11, 12].

2.3. The Resilience Scale (RS). The 14-item Wagnild and Young Resilience Scale (RS) was used to assess resilience status. This scale was constructed after interviewing resilient subjects and hence is an accurate tool for studying resilience. It is a Likert type scale used in various age groups and different conditions. Each item can be graded from "1" (strongly disagree) to "7" (strongly agree) [13]. Graded items are summed up to provide a total score. Although no cut-off value for abnormality is available, lower scores indicate less resilience.

2.4. Sample Size Calculation. It has been reported that 10–20% of all pregnancies may present depressed mood [5], with a 46% found among teens [15]. Hence, assuming a 15% prevalence of depressive symptoms in the control group, a sample size of 125 subjects per group (cases and controls) was calculated in order to detect a 2.5 increased risk of depressed mood among adolescents with an 80% power and a 95% confidence level.

2.5. Statistical Analysis. Analysis was performed using statistical packages: SPSS (Version 10.0 for Windows, SPSS, Chicago, IL, USA) and EPI-INFO 6.04 (Centers for Disease Control and Prevention, Atlanta, GA, USA/World Health Organization, Geneva, Switzerland). Data are presented as mean ± standard deviations, medians, percentages, odds ratios (OR), and confidence intervals (CI). Kolmogorov Smirnov's test was used to determine normality of data distribution. According to this, continuous nonparametric paired data was compared with the Wilcoxon signed-rank test. Percentages were compared with the chi-square or Fisher's exact test. Logistic regression analysis was used to determine risk factors related to depressed mood (Total CESD-10 scores 10 or more) and lower resilience (Lower total RS scores). Variables included in the regression model were those related to the: *mother* (age, habits, marital status, place of residency, adequacy of prenatal care), *pregnancy* (maternal and neonatal outcome data), and the *partner*

(age and habits). Interactions were also considered during regression model construction. A P value of <.05 was considered as statistically significant.

3. Results

During the study period, there were a total of 1,138 live singleton deliveries. Of these, 151 were nulliparous adolescents (13.3%). 151 nulliparous controls were selected for all cases giving a total of 302 gravid women who were surveyed. General demographic data of studied women are shown on Table 1. Adolescents had a nonmarried status and were studying in a higher rate than their counterparts. Partner age and grandmother's age at first child were significantly lower among adolescents. Gestational age at first antenatal visit was significantly higher among adolescents. Cesarean section rate among teenagers was significantly lower than controls (34.4% versus 47.7%, $P = .01$). Women displaying depressed mood ($n = 171/302$) had more cesarean section (41.1% versus 36.6%, $P = .44$). When depressed women were stratified as adolescents and adults, adolescents presented a similar cesarean rate (35.4% versus 33.3%) whereas adults a higher one (52.2% versus 40.7%) as compared to nondepressed ones; however, these comparison, were not found to be statistically significant. No other differences in maternal and neonatal data were observed among studied cases and controls (Table 2).

Total CESD-10 and RS scores found among studied women are depicted on Table 3. A 56.6% of all studied women presented CESD-10 total scores of 10 or more indicating depressed mood. Mean total CESD-10 scores and depressed mood rate did not differ among studied groups. Contrary to this, adolescents displayed lower RS total scores (indicating less resilience) and a higher rate of scores below the calculated median ($P < .05$). Logistic regression analysis (even after included several interactions) could not establish any risk factor for depressed mood among studied subjects; however, having an adolescent partner (OR, 2.0 CI 95% 1.06–4.0, $P = .03$) and a preterm delivery (OR, 3.0 CI 95% 1.43–6.55, $P = .004$) related to a higher risk for lower resilience.

4. Discussion

Adolescent pregnancies are increasing worldwide in relation to several biological, social, and personal factors. They are unintended in the majority of cases and create negative feelings both in adolescents (mother and progenitor) and their families. Although pregnant teenagers have similar obstetrical issues as older gravids, additional risks may appear when socioeconomical factors are taken into account [3, 16]. Sociodemographical characteristics of pregnant women (teenagers and non teens) of this series reflect those of the low income population of the Ecuadorian coast which are cared for at the Sotomayor Hospital. There were no significant differences between pregnant adolescents and young adult women in parameters such as lifestyle habits, rural residency, and prenatal care. Despite this, it is worthy to mention that women in the control group (also nulliparous) were in fact also young (mean 23 years). This maybe due to the fact that low income women cared for at Sotomayor initiate parity young, hence by 30 women already have 2 o 3 siblings. Both groups currently lived together with their partner in a similar rate, yet teenagers had a nonmarried status in a higher rate than adults. Although a significant higher proportion of adolescents were studying at the moment of the survey, this rate may be seen as low, moreover if the rest were working, doing nothing, or working and studying. General fertility rate in Ecuador is among the highest of Latin America and has increased from 84 to 100 per 1,000 in 2004. A 20% of women get pregnant before age 20 and 43% of illiterate adolescents have been pregnant as compared to 11% of those with higher education [17]. Although the number of prenatal visits was similar in studied groups, adolescents of the present series initiated some 2-3 weeks later as compared to young adults. These data could be considered as expectable in adolescents and related to the "*surprise*" of being pregnant and the difficulties of assuming pregnancy and obtaining appropriate care.

The risk of pregnancy among adolescents is related to family structure, education, and care. Risk increases with a previous teen pregnancy, lower partner age, and having mothers who were also pregnants adolescents. Partner and grandmother's age at first child was significantly lower among adolescents of our series, which is in correlation with other reports [18].

Perinatal outcome among adolescents of this study was similar to adults in terms of preterm birth rate, small-for-gestational-age (%), Apgar scores, and neonatal weight. These results support those of others [3, 19]. Reports indicate that adolescents have both shorter first and second stages of labor as compared to the general obstetrical population [20]. There is no clear explanation for this finding; however, it could be related to the way women experience the onset of their labor. A large proportion of these experiences bear no resemblance to the classical diagnosis of labor and most are unrelated to labor duration [21]. Although progression of labor was not specifically analyzed in this series, vaginal delivery rate was higher among adolescents supporting the findings of others [20]. Progression of labor may depend on factors such as maternal and fetal weight, ethnics, and the type of used analgesia. Overall cesarean section rate was high in our series as compared to results from other latitudes [22, 23]. Explanation to this may rely on the fact that Sotomayor hospital is a major referral obstetrical institution for low income women of a vast population of the Ecuadorian coast with high rates of inadequate prenatal care and medical/obstetrical complications. A lower cesarean section rate was found among our adolescents which correlates with other reports [3, 16, 22].

Depressive episodes may affect adolescents in up to 15% of cases, being more frequent among women with negative cognitions, interpersonal conflicts, low social support, and stressful life events [24]. Pregnant adolescents suffer depression, anxiety, frustration, and aggression in a higher rate than gravid adults [25]. Depression prevalence is much higher among pregnant teens than in adults, with rates varying

Table 1: General demographic characteristics of studied women.

Maternal data	All $n = 302$	Adolescents $n = 151$	Nonadolescents $n = 151$	P value*
Age (years)	20.0 ± 3.8	17.2 ± 1.4	23.0 ± 3.0	.001
Non married status (%)	187 (61.9)	103 (68.2)	84 (55.6)	.02
Currently living together (%)	236 (78.1)	116 (76.8)	120 (79.5)	.57
Sometime smoked during pregnancy (%)	1 (0.3)	1 (0.7)	0 (0.0)	.98
Sometime alcohol consumption during pregnancy (%)	15 (5.0)	5 (3.3)	10 (6.6)	.18
Rural residency (%)	86 (28.5)	45 (29.8)	41 (27.1)	.61
Before becoming pregnant				
Was studying	137 (45.4)	102 (67.5)	35 (23.1)	.001
Was working	80 (26.5)	18 (11.9)	62 (41.1)	.001
Nothing	65 (21.5)	24 (15.9)	41 (27.2)	.01
Working and studying	20 (6.6)	7 (4.7)	13 (8.6)	.16
Was performing family planning method before becoming pregnant	47 (15.6)	25 (16.6)	22 (14.6)	.63
Age of grandmother's first child	18.9 ± 3.9	18.7 ± 3.7	19.0 ± 4.0	.001
Number of prenatal visits	7.0 ± 2.6	6.9 ± 2.9	7.0 ± 2.3	.29
Less than 5 prenatal visits	42 (13.9)	22 (14.6)	20 (13.2)	.73
Gestational age at first visit	9.9 ± 6.9	11.1 ± 7.5	8.7 ± 6.2	.001
Partner data				
Age (years)	24.4 ± 5.7	22.0 ± 4.0	26.8 ± 6.0	.001
Current smoking habit	24 (7.9)	16 (10.6)	8 (5.3)	.08
Alcohol consumption	79 (26.2)	39 (25.8)	40 (26.5)	.89
Currently employed	254 (84.1)	124 (82.1)	130 (86.0)	.34

Data are presented as mean ± standard deviations and percentages (%); *P value after comparing cases and controls with Wilcoxon signed-rank test, chi-square test or Fisher's exact test.

Table 2: Maternal and neonatal outcome data.

Maternal outcome	All $n = 302$	Adolescents $n = 151$	Non Adolescents $n = 151$	P value*
Obstetrical complication (ante/intrapartum) (%)	152 (50.3)	69 (45.7)	83 (55.0)	.10
Vaginal delivery (%)	178 (58.9)	99 (65.6)	79 (52.3)	.01
Cesarean section (%)	124 (41.1)	52 (34.4)	72 (47.7)	.01
Intrapartum meconium staining (%)	13 (4.3)	4 (2.6)	9 (6.0)	.15
Neonatal outcome				
Gestation age at birth (weeks)	38.7 ± 2.0	38.6 ± 1.8	38.8 ± 2.1	.16
Neonatal weight (g)	2,897.0 ± 556.4	2,874.9 ± 518.0	2919.0 ± 593.2	.26
Preterm birth (%)	38 (12.6)	22 (14.7)	16 (10.6)	.29
Small-for gestational-age (%)	62 (20.5)	32 (21.2)	30 (19.9)	.77
Apgar score <7 at 1st min (%)	17 (5.6)	8 (5.3)	9 (6.0)	.80
Apgar score <7 at 5th min (%)	8 (2.6)	6 (4.0)	8 (5.3)	.58
Neonatal complication (%)	39 (12.9)	15 (9.9)	24 (15.9)	.12

* P value after comparing cases and controls with chi-square test or the Wilcoxon signed-rank test.

Table 3: Total CESD-10 and RS scores among studied women.

Parameters	All $n = 302$	Adolescents $n = 151$	Nonadolescents $n = 151$	P value*
Total CESD-10 score	10.9 ± 5.8	10.5 ± 5.9	11.2 ± 5.7	.31
Depressed mood (%)	171 (56.6)	79 (52.3)	92 (60.9)	.13
Total RS score	80.7 ± 10.5	79.3 ± 10.3	82.0 ± 10.5	.002
Total RS score <82 (median) (%)	141 (46.7)	79 (52.3)	62 (41.1)	.04

* P value after comparing cases and controls with Wilcoxon signed-rank test or the chi-square test.

from 16 to 50% [5, 15, 24, 25]. This wide prevalence range may reflect differences in sample composition (educational level, rural versus urban residency, minority groups, social support) and how depression is diagnosed. In our study, depressed mood and resilience were categorized using two validated tools. Depressive symptoms were assessed with the CESD-10, a tool widely used for depression research in the general population [12]. Other tools used to assess depressive mood include the Beck Depression Inventory, the Edinburgh Postnatal Depression Scale, the World Health Organization's Composite International Diagnostic Interview Short Form, among others [24]. The CESD-10 measures only current symptoms and reasonably identifies clinically depressed from nondepressed subjects [11]; moreover, the CESD-10 has shown high sensitivity, specificity, and positive predictive values [12].

Previous studies addressing depressive symptoms in pregnancy have been performed during prenatal consultations [26]. Depressive symptoms increase during the last trimester of pregnancy [27]. Positive depressive score for the 20-item CESD tool was more frequently found at mid-pregnancy among teens (46%) and disadvantaged American women (47%) [15]. Using the CESD-10, it has been reported that one out of five women in the antepartum period presents depressed states. This has been related to younger age, substance use (cigarette or alcohol), and having a past and current obstetrical or medical complication [28]. Using the CESD-10 tool, the present series found a similar rate of depressed mood among studied groups. Logistic regression analysis could not identify any single risk factor for depressed mood. Our findings suggest that factors explaining depressed mood in both groups must be similar and most likely not related to age yet to other conditions such as poverty, cultural, and risk behaviours seen in this specific low income population. Other factors related to depressed mood during pregnancy include cigarette, alcohol, or drug use [29] which were not present in the studied population.

Although decreased fetal growth has been observed in low income women who present depressive symptoms [30], the effect of psychosocial factors (i.e., depression, anxiety, stress, and low self-esteem) on infant birthweight and gestation duration in this population is still controversial [31]. A recent report found that depressed adolescents with suicidal ideation or attempts (as compared to those without) delivered babies with lower birthweight [5]. Perinatal outcome in our series did not differ even after stratifying for the presence of depressed mood. CESD-10 scores indicative of depressed mood have been associated to higher assisted vaginal deliveries and cesarean section rates [32]. This trend was not observed in the present series.

Resilience is a complex set of values that allows a person to withstand many of the negative effects of adversity. Therefore, a resilient individual can cope with adversity. Resilience is central for adolescents to develop and mature in healthy ways, including sexual health and well-being maintenance [6, 7]. Adolescence, the family, and the community seem to modulate resilience. In addition, low self-esteem, unplanned pregnancies, sexually transmitted infections, drug misuse, and lack of family care and guidance may negatively influence resilience [7]. Positive emotions assist high-resilient individuals in their ability to effectively overcome daily stress [33]. Assessing all the components of resilience is not easy. While many tools assess indirect measures of resilience such as self-esteem, sense of coherence, or school adjustment; others include a large number of measures or identify a particular subsample, making assessment difficult in the clinical setting [34]. The resilience tool used in the present series has shown to be appropriate in different situations, display high measures of consistency and correlation with life satisfaction scales [6, 35], and most importantly be useful among adolescents.

Studies assessing resilience during pregnancy are scarce [8–10] and have mainly focused on anxiety/depressive components using nonspecific tools. For instance, one study measured level of anxiety rather than resilience after ultrasound consultation in uncomplicated gravids with different risks of fetal abnormalities [8]. A second report assessed resilience in a cohort of pregnant women exposed to a hurricane. Resilience was based on an interview performed at delivery and 8 weeks later using the Edinburgh depression Scale and the Post-Traumatic Stress Checklist (nonspecific resilience measuring tools) as an indirect measure of mental health resilience after the hurricane experience during pregnancy [9]. The authors concluded that some women were resilient from depression and posttraumatic stress. A third paper examined resilience factors (maturity, self-esteem, and mother-grandmother relationships) shortly after delivery and parenting behavior at 6 months in a African-American adolescent cohort. Despite this no specific resilience measuring tool was used [10]. Our approach aimed at specifically assessing resilience in a sociodemographically homogeneous gravid population (adolescents versus adults) attending a particular healthcare system. To the best of our knowledge, it is perhaps the first to assess resilience in a case, control fashion (adolescents versus controls) at the time of delivery and most of all using a specific validated resilience tool. As compared to adults, our adolescents displayed lower total RS scores indicating less resilience in which having an adolescent partner and delivering preterm were related risk factors. Individual characteristics of teen mothers and positive family support increase their resilience [10]. Our results indicate that there is a need to develop clinical and emotional support programs for pregnant adolescents to strengthen resilience and improve emotional, mental and social capacities to overcome adversity. More research is warranted in this regard.

A high false positive rate for depressed mood can be found when the CESD tool is used [36]. This could be the case in our study. Although this may be seen as a limitation, it could, on the other hand, reflect a highly prevalent problem characteristic of our low income women. Risk factors for depression in our obstetrical population need to be further addressed; moreover, panic disorders, domestic violence or the presence of several comorbidities, determinants of psychosocial stress during pregnancy, were not explored [37]. We recognize that timing of the survey may also be seen as a limitation. Nevertheless, research was carried in the best possible Ecuadorian conditions considering the fact that

our hospital has a high delivery rate of low income women admitted for labor without prenatal care and in many cases discharged 24 or less hours. Followup under these conditions is very difficult and sometimes impossible.

Despite outlined limitations, important to mention is that this indeed maybe the first case-control study to concomitantly explore depressive symptoms and resilience in a low income pregnant series. The CESD-10 and the RS are easy to use tools and provide a rapid snapshot of the situation. More research in our population is needed to identify risk factors for depressed mood during pregnancy.

In conclusion, although prevalence of depressive symptoms was similar among studied groups, overall rate found in this series was two times that reported in the literature using the same tool (CESD-10). Adolescents displayed a lower level of resilience when compared to young adult gravids. Future research should aim at measuring resilience in adolescents some time after delivery of their first child in order to quantify their coping capacity and its impact on maternal fetal health. Our results are indicative that social support should be provided throughout pregnancy in order to increase resilience in our adolescent population. Programs need to be designed specifically for our cultural setting (i.e., include the partner and relatives). Positive adaptation to pregnancy—and support—will increase social competence which in turn will aid overcoming the difficult task of becoming a mother. Pregnant adolescents need help to manage negative feelings and communicate their needs to adults and institutions.

Conflict of Interests

The authors declare no conflict of interests.

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Case Report

Ex Utero Intrapartum Treatment for Fetal Oropharyngeal Cyst

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Background. A prenatally diagnosed fetal anomaly that could compromise the fetal airway at delivery can be managed safely with the ex utero intrapartum treatment (EXIT) procedure. *Case*. A 26-year-old healthy primigravida was diagnosed during her midtrimester anatomic ultrasound survey with a fetal oropharyngeal cystic structure located at the base of the tongue. The neonatal airway was successfully secured intrapartum using the EXIT procedure. *Conclusion*. Maintenance of fetoplacental circulation until the fetal airway is secured has been described for a multitude of fetal anomalies including cystic hygroma and teratoma. The literature also recounts its use for the reversal of tracheal plugging for congenital diaphragmatic hernia. A multidisciplinary approach to the antenatal and intrapartum care is essential for the successful management of these cases.

1. Introduction

A cystic mass at the base of the fetal tongue diagnosed antenatally is uncommon, relegated to case reports in the literature. Dr. Hartnick et al. [1] recently published a case report of a pregnancy complicated with a cystic mass in the mouth of the fetus measuring 2.0 cm by 2.3 cm noted on ultrasound, and because of the concern for the neonatal airway, the patient was delivered by an EXIT procedure. The procedure was successful with good outcomes for both the mother and the neonate. This case also demonstrated the importance of managing this case using a multidisciplinary approach [1].

Fetal airway obstruction at delivery is a potentially fatal complication. If a fetal oropharyngeal anomaly is noted antepartum, the neonatal airway can be secured intrapartum using the EXIT procedure, thus reducing potential neonatal morbidity and mortality [2]. Mychaliska and colleagues first described the systematic ex utero intrapartum treatment procedure to secure a fetal airway in 1997 [3]. Optimizing uteroplacental blood flow with the use of inhalational anesthetic agents and uterine tocolytics allows for the maintenance of fetal oxygenation.

We report a case of a pregnancy complicated by a fetal oropharyngeal cyst and successfully securing the fetal airway using the EXIT procedure. This report demonstrates the effectiveness of this procedure in securing the fetal airway while maintaining the fetoplacental circulation and adequate fetal oxygenation.

At our institution, an IRB approval is not required for a case report.

2. Case

A 26-year-old primigravida presented to the Maternal Fetal Medicine (MFM) clinic for consultation regarding a 1 cm cystic structure located at the floor of the fetal mouth. The structure had been visualized on an ultrasound in the radiology department at 21-week gestation. The patient was healthy without any significant medical or family history. Her prenatal laboratory evaluation was normal, and her medications included prenatal vitamins. An ultrasound, performed by the MFM department, at 25-week gestation, revealed a 1.4 cm × 1.4 cm cystic structure located posterior and inferior to the tongue (Figure 1). The lips, nose, mandible, palate, and profile were all normal. The differential diagnosis

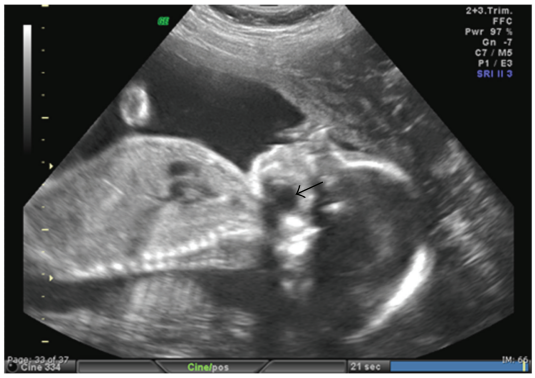

Figure 1: Ultrasound image at 26-week gestation demonstrating oropharyngeal cyst (black arrow).

Figure 2: Intraoperative image of EXIT procedure. The fetus is delivered to level of upper abdomen with the fetal head and neck stabilized by the obstetrician. The pediatric anesthesiologist performs direct laryngoscopy.

included a thyroglossal duct cyst or a branchial duct cyst. Magnetic resonance imaging at 26-week gestation revealed a 1.4 cm × 2 cm × 1.9 cm midline cystic lesion located at the base of the tongue/floor of the mouth. The differential diagnosis was then expanded to include epidermoid cyst and lymphangioma.

The case was discussed in the weekly NICU/MFM conference with the pediatric ENT physician in attendance. The options of securing the airway during an EXIT procedure or post delivery after clamping the umbilical cord were discussed. Since the oropharyngeal cyst had increased to 3.1 cm, the pediatric otolaryngologist felt that the fetal airway would be more safely managed during an EXIT procedure, allowing more time for controlled bronchoscope guided intubation, and if necessary, tracheotomy, while the fetus is being perfused and oxygenated with an intact fetal-placental unit. The team was kept informed of the progress during the antenatal course and would be available at all times for the delivery. In addition, the pediatric otolaryngologist consulted the pediatric anesthesiologist who would also be present during the EXIT procedure. Furthermore, the pediatric cardiologist would be in attendance for the delivery to monitor the fetal cardiac function. The EXIT procedure was scheduled for 39 weeks of gestation. Serial MFM ultrasounds were obtained at 32 and 36 weeks of gestation revealing dimensions of the mass at 2.1 cm × 1.1 cm × 2.1 cm and 1.9 cm × 2.3 cm × 3.1 cm, respectively. The estimated fetal weight at the last ultrasound was 2584 grams, 10th–50th percentile (Alexander growth curve) with minimal polyhydramnios (single deepest pocket, 8.34 cm). The placenta was posterior in location.

The patient presented in active labor at 37 + 3 weeks of gestation; the cervix was 6 cm dilated and 80% effaced. The EXIT team members were notified emergently. Fetal well being was reassured by a reactive nonstress test (NST). Intravenous magnesium sulfate was administered for tocolysis while the team was assembled. The anesthesiologist placed an arterial line for hemodynamic monitoring intraoperatively. Preoperative hemoglobin was 13.3 g/dL. A type and cross for four units of packed red blood cells were obtained, and the blood products were brought to the operating room. The pediatric anesthesiologist and the otolarnygologist recommended the use of a fetal paralytic agent prior to delivery to prevent the fetus from gasping at the time of delivery that would make the intubation process potentially more complicated and risky. Under ultrasound guidance, rocuronium was injected intramuscularly into the fetal thigh for paralysis. Ultrasound examination was continued until fetal movement ceased, occurring at approximately four minutes post injection.

The patient was then taken to the operating room where general endotracheal anesthesia was administered via rapid sequence induction with thiopental and succinylcholine. Paralysis was subsequently maintained with vecuronium. Deep inhalation anesthesia was achieved with high-dose isoflurane. Maternal laparotomy was then performed via a low transverse abdominal incision to expose the uterus. A low transverse incision was made in the lower uterine segment, and the infant was delivered to the level of the upper abdomen as shown in Figure 2. Continuous fetal cardiac monitoring was achieved with fetal transthoracic echocardiogram, monitored by the pediatric cardiologist in the operating room. Initially, two attempts at intubation with the laryngoscope were made but were unsuccessful. The vocal cords could not be visualized to pass the endotracheal tube. The third attempt was done via bronchoscope guidance and was successful. The mass was posterior in the oropharynx obstructing the view of the vocal cords. The pediatric otolaryngologist performed the bronchoscopy guided placement of the endotracheal tube. Placement of the endotracheal tube was confirmed and the tube was secured. The remainder of the infant's body was then delivered, the umbilical cord was divided, and the infant was taken to the warmer for attendance by the neonatology team. The total elapsed time of the EXIT procedure was 18 minutes.

The halogenated anesthetic was discontinued and oxytocin infusion was initiated following delivery of the placenta. Uterine massage and 40 units of intravenous oxytocin effected adequate uterine tone. The hysterotomy incision

was repaired in two layers. Estimated blood loss from the procedure was 1200 mL. No intraoperative fetal or maternal complications occurred. The mother's postoperative recovery was uncomplicated. She was discharged on the second postoperative day and had a normal 6-week postpartum checkup.

A neonatal MRI confirmed the cystic mass, arising from the midline at the base of the tongue, measuring 2.4 cm × 2.2 cm × 1.6 cm. The appearance of the mass was most consistent with a thyroglossal duct cyst. The cystic mass was initially drained. But, one week later, it recurred and then was surgically excised. Pathology was consistent with an embryologic remnant cyst. Follow-up examinations revealed a healthy, normally developing infant.

3. Comments

The EXIT procedure was initially designed to reverse the tracheal occlusion that was done antenatally in a fetus with severe congenital diaphragmatic hernia [3]. Because it is able to provide a stable fetal hemodynamic environment for a prolonged period, the EXIT procedure has been applied to the treatment of a variety of fetal conditions at delivery [4].

In order to achieve successful fetal oxygenation and the deep maternal anesthesia that provides fetal anesthesia during the EXIT procedure, it is necessary to maintain uterine hypotonia. In this case, uterine hypotonia was achieved using isoflurane intraoperatively. Additional methods include intravenous terbutaline or nitroglycerin [3].

To ensure fetal paralysis during the EXIT procedure (as recommended by the pediatric anesthesiologist), we administered intramuscular rocuronium into the fetal thigh under ultrasound guidance preoperatively. Fetal paralysis occurred in four minutes after the injection and was confirmed by ultrasound. To our knowledge, this is the first report using a fetal paralytic agent for an EXIT procedure. The decision was made based on the above reason—the clinical opinion of the pediatric subspecialists.

The EXIT procedure is associated with maternal risks that are well documented in the literature. Since it is necessary to maintain uterine hypotonia to maximize uteroplacental blood flow, the mother is at risk for hemorrhage and placental abruption.

The surgeons and anesthesia providers must have a low threshold for terminating the EXIT procedure before a significant loss of blood occurs.

In one large case series of thirty-one patients, the average time on placental bypass was 30.7 minutes, with a range from 8 to 66 minutes. The average blood loss was 848 mL [3]. In our case, securing the airway required eighteen minutes, and our estimated blood loss was 1200 mL.

It is important to deliver the fetus only to a level where the airway and neck can be accessed for evaluation. When the remainder of the fetal body fills the intrauterine cavity, the possibility of placental detachment is decreased. Other authors have described a technique similar to amnioinfusion to allow for persistent uterine distention with a lower risk of placental separation [4].

The importance of a multispecialty approach with constant communication cannot be overemphasized. In our case, despite a procedure which was scheduled to occur at 39 weeks of gestation, our patient presented in active labor at 37 weeks. The multiple team members had to assemble promptly to perform the EXIT procedure. This multispecialty team had met on several occasions during the course of this pregnancy, and thus, the role of each subspecialist was clear. This ensured a smooth assembly of all necessary personnel and equipment on short notice.

In summary, in this case of a fetal oropharyngeal mass, the fetal airway was successfully and safely secured using the EXIT procedure. In addition, this case demonstrated the importance of a multidisciplinary approach in managing such cases.

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