Reproductive Sciences
2016, Vol. 23(5) 638-643

DOI: 10.1177/1933719115611754
rs.sagepub.com
SAGE

The Impact of Maternal Body Mass Index and Gestational Age on the Detection of Uterine Contractions by Tocodynamometry: A Retrospective Study

A. Aina-Mumuney, MD[1], K. Hwang, MS[2], N. Sunwoo, MS[2], I. Burd, MD, PhD[1], and K. Blakemore, MD[1]

Abstract

Objective: To examine the impact of maternal body mass index (BMI) and gestational age (GA) on uterine contraction detection by tocodynamometry. **Methods:** Gravidas with preterm labor (PTL) complaints who were evaluated by tocodynamometry, discharged from Labor and Delivery triage, and subsequently readmitted for preterm delivery were studied. Forty-six patients in whom contractions were detected (group 1) were compared to 49 women in whom contractions were not detected (group 2) with respect to BMI and GA at both evaluation and delivery. Multivariable logistic regression was used to adjust for confounders. **Results:** Group 2 had a higher mean BMI (31.7 vs 26.1, $P < .001$), were more likely to be obese (57.1% vs 19.6%, $P < .001$), and were more likely to have been evaluated in the mid-trimester (36.7% vs 17.4%, $P = .04$) compared to group 1. Independent risk factors for the inability of the tocodynamometer to detect contractions were obesity (odds ratio [OR] 0.18, 95% confidence interval [CI] 0.07-0.46) and evaluation in the mid-trimester (OR 0.33, 95% CI 0.13-0.84). **Conclusion:** Our study provides evidence that the effectiveness of tocodynamometry diminishes with increasing maternal BMI. Efficacy of tocodynamometry is also decreased at earlier GA, most pronounced below 25 weeks. To evaluate women with PTL symptoms in the mid-trimester or symptomatic obese women at any GA, a modality other than tocodynamometry could be valuable to more accurately assess uterine activity.

Keywords

effectiveness of tocodynamometer, midtrimester loss, preterm labor, uterine monitoring, body mass index

Introduction

Tocodynamometry was introduced in the 1890s and has been the mainstay for uterine contraction detection since the 1960s.[1] Worldwide, with available resources, its use has become ubiquitous, although its efficacy at contraction detection has rarely been evaluated. One study in patients between 36 and 41 weeks of gestation concluded that the tocodynamometer (TOCO) is as effective as the intrauterine pressure catheter (IUPC) at determining contraction frequency although inferior to the IUPC in evaluating contraction intensity.[2] More recently, however, Euliano et al compared abdominal electrohysterography (EHG) to both TOCO and the IUPC concluding that EHG had better correlation with the IUPC than tocodynamometry.[3] With increasing numbers of obese pregnant women today, it seems prudent to evaluate the efficacy of the TOCO, specifically regarding this population of women. Euliano et al noted that obesity negatively affected the sensitivity of both EHG and tocodynamometry, and increasing body mass index (BMI) correlated with decreasing ability of contraction detection, with the TOCO more greatly affected than EHG. Other studies evaluating the effect of obesity on the TOCO's effectiveness revealed obesity at term increases the likelihood of internal monitoring during labor due to poor quality tracings via external monitoring.[4,5]

All the aforementioned studies only evaluated the TOCO in term parturients. It would also be of practical interest to examine the efficacy of the TOCO in the late second and early third trimesters of pregnancy.

The present study sought to investigate how effectively the TOCO detects contractions in women presenting for evaluation of preterm labor (PTL) symptoms in an inner-city Labor and

[1] Division of Maternal Fetal Medicine, Department of Gynecology/Obstetrics, Johns Hopkins University School of Medicine Baltimore, MD, USA
[2] Department of Biomedical Engineering, Johns Hopkins University Baltimore, MD, USA

Corresponding Author:
A. Aina-Mumuney, Division of Maternal Fetal Medicine, Department of Gynecology/Obstetrics, Johns Hopkins University School of Medicine, Baltimore, 600 N. Wolfe St, Phipps 228, Baltimore, MD 21287, USA.
Email: aaina1@jhmi.edu

Delivery triage unit. We hypothesized that the TOCO would be less efficient at contraction monitoring in the obese population and at earlier gestational ages (GAs) by including women who presented with PTL symptoms not only beyond 24 weeks but also less than 24 weeks of gestation.

Methods

This study was conducted at the Johns Hopkins Hospital in Baltimore, Maryland, and was approved by our Institutional Review Board. The Johns Hopkins Hospital is an inner-city, university hospital setting. This retrospective cohort study employed an obstetrical database to identify all patients from January 2008 to June 2010 who delivered between 16-0/7 and 34-0/7 weeks of gestation, after presenting with preterm premature rupture of membranes (PPROM) or spontaneous PTL. Gestational age was determined from the recorded estimated delivery date which was calculated from the last menstrual period and was confirmed or established by either a first- or a second-trimester ultrasound. The study population was defined as only those patients who had been monitored via tocodynamometry (GE Series 250CX, GE Healthcare, Waukesha, WI) for uterine contractions during at least 1 triage visit prior to a later admission for PTL or PPROM resulting in preterm delivery. All patients in the study population had to have been discharged from the hospital after the period of their earlier triage evaluation either because contractions were not detected or because contractions were detected but quickly abated and resolved, or produced no cervical change. Only patients whose medical record notations and TOCO tracings were adequately documented on the last of these triage visits (penultimate visit) were eligible for inclusion in this study. Women with fetal anomalies were excluded as were those who were delivered for maternal or fetal indications (e.g., preeclampsia, abnormal fetal testing). Maternal demographics collected include maternal age, parity, history of preterm birth, race, and number of fetuses (singleton or multiple gestations).

The cardiotocograph tracing obtained on the penultimate Labor and Delivery triage visit prior to the subsequent presentation that led to hospital admission and preterm delivery was examined. From these tracings and the triage records, it was determined whether contractions were or were not detected at the penultimate visit.

Data and outcomes on the women in whom contractions were detected at the penultimate visit (group 1) were compared to those of the women for whom tocodynamometry recorded no uterine activity (group 2). These data included presenting complaint of the penultimate triage visit prior to the admission that resulted in delivery, GA at the penultimate triage visit, GA at delivery, BMI, total number of triage visits during gestation, and duration of the penultimate triage visit prior to the admission for PTL or PPROM that resulted in delivery. The midtrimester was defined as 16 to 26 weeks of gestation. The BMI was calculated from recorded maternal weight and height information or, if the actual BMI was documented on the visit in question, or at pregnancy onset if no other maternal weight later in gestation was obtained. The BMI was calculated by the formula: weight in kilograms divided by height in meters squared. The BMI categories were grouped as follows: underweight (BMI < 18.5), normal (BMI 18.5-24.9), overweight (25-29.9), and obese ($\geq$30). Women classified as underweight, normal, or overweight were combined and compared to those in the obese category. Underweight and normal women were then also combined and compared to overweight and obese women together as a group.

The outcomes of the patients in groups 1 and 2 were statistically analyzed using the Student *t* test or chi-square test where appropriate. Parity was reported as a median value (with a range of values presented) for each group and treated as a discrete variable and thus analyzed using the Wilcoxon rank-sum test. Differences in GA at penultimate triage visit and at delivery were analyzed using Mann-Whitney *U* test, since GAs were not normally distributed. A logistic regression model was devised to control for plausible biological confounders including race, parity, and type of gestation (singleton/multiple gestation). The *P* values for all analyses were 2 sided, and statistical significance was defined as $P < .05$. Statistical analysis was performed using SPSS 21 (Armonk, New York).

Results

A total of 163 women were identified through the database during the stated time period who were admitted and delivered at the specified GAs at our institution. For 68 women, we had no information about their triage visits. These were transport patients, patients who had received no prenatal care, or those who received prenatal care elsewhere and presented to our hospital for delivery only. In all, 95 women met all inclusion criteria and represent the study population. Contractions were detected in 46 of the 95 patients or 48.4% of the study population (group 1). Table 1 shows demographic information for the 95 patients. There were no significant differences between the two groups.

The relationship between contractions detected at the penultimate visit and various clinical characteristics is shown in Table 2. Of the 95 women, 37 (38.9%) were obese. The chief complaint in 17 of these 37 women was contractions or abdominal pain and was spotting or abnormal discharge in nearly all of the remainder. Contractions were undetected in 28 (75.7%) of these 37 obese women. In contrast, contractions were not detected in only 21 (36.2%) of 58 nonobese patients. This difference reached statistical significance ($P < .001$). Over half of all the women in whom no contractions were detected (group 2) were obese. The mean BMI in group 2 was also higher than in group 1 (31.5 vs 26.1, $P < .001$).

Only 28 patients in the study had sonographic assessment of cervical length (10 in group 1 and 18 in group 2). Funneling was noted in 12 of these women (4 in group 1 and 8 in group 2). While we did not have a sufficient number of cervical lengths to adequately compare the groups, it was noted that, of those with funneling, 75% were overweight or obese,

Table 1. Maternal Demographics Stratified by Ability of Tocodynamometer to Detect Contractions.

	Contractions Detected, Group 1 (n = 46)	No Contractions Detected, Group 2 (n = 49)	*P*
Mean maternal age, years	27.8 ± 7.0	28.5 ± 7.0	.63
Parity[a]	1 (0-6)	1 (0-7)	.25
History of preterm birth[b]	14 (30.4)	19 (37.3)	.53
Race[b]			.28
African American	27 (58.7)	36 (70.6)	
Caucasian	13 (28.3)	13 (25.5)	
Hispanic	4 (8.7)	0 (0)	
Other	2 (4.3)	2 (3.9)	
Multiple gestation[a]	14 (30.4)	12 (23.5)	.50

[a]Data expressed as median (range).
[b]Data expressed as n (%).

Table 2. Clinical Characteristics of Women Compared by Monitoring Groups.

	Contractions Detected, Group 1 (n = 46)	No Contractions Detected, Group 2 (n = 49)	*P*
Mean gestational age at penultimate triage visit, weeks	28.1 ± 3.5	23.9 ± 4.7	<.001
Penultimate triage visit in midgestation	8 (17.4)	18 (36.7)	.03
Mean gestational age at delivery, weeks[a]	30.6 ± 3.1	27.9 ± 5.7	.01
Mean interval between triage visit and delivery, days	12.8 ± 12.0	22.5 ± 22.1	.07
Mean BMI	26.1 ± 7.2	31.5 ± 6.0	<.001
Obese (BMI ≥30)	9 (19.6)	28 (57.1)	<.001
Overweight or obese (BMI ≥ 25)	17 (37.0)	40 (81.6)	<.001
No. of triage visits[b]	3.1 ± 2.8	2.2 ± 1.4	.08
Mean duration of penultimate triage visit, days[c]	2.2 ± 3.1	0.9 ± 1.6	.02
Complaining of contractions or pain[d,e]	20 (45.5)	26 (54.2)	.40

Abbreviations: BMI, body mass index; PTL, preterm labor; PPROM, preterm premature rupture of membranes; SD, standard deviation.
[a]Total 4 patients between 16 and 20 weeks (1 contractions group and 3 no contractions group).
[b]Prior to the visit in which the patient presented with PPROM or PTL that resulted in delivery, data missing in 6 patients (3 contractions group and 3 no contractions group); expressed as mean ± SD.
[c]Time spent in hospital. Data missing in 9 patients (6 contractions group, 3 no contractions group).
[d]Other presenting complaints included vaginal spotting, vaginal pressure, and vaginal discharge.
[e]Chief complaint not documented in 3 patients (2 contractions group and 1 no contractions group).

58.3% were in mid-gestation, 10 of 12 delivered before 30 weeks, and 7 delivered before 28 weeks. Of note, contractions were noted in only 4 of the 12 women with funneling.

The relationship between GA and detection of uterine contractions by the TOCO is also shown in Table 2. Twenty-six women were evaluated in triage in the mid-trimester. All but 4 presented at ≥20 weeks of gestation. Tocodynamometry was found to be significantly less likely to detect contractions in patients in the mid-trimester (69.2% vs 44.9%, $P = .03$). Specifically, the likelihood that contractions will occur undetected became greatest at 25 weeks of gestation. As Table 2 also demonstrates, women in whom contractions went undetected (group 2) were significantly more likely to deliver at an earlier mean GA (27.9 vs 30.6 weeks, $P = .01$). These findings remain significantly different between the groups even after exclusion of the 4 patients whose penultimate visit occurred before 20 weeks of gestation.

To better scrutinize the correlation between GA at the time of the penultimate triage evaluation and the effectiveness of tocodynamometry, we excluded overweight and obese women and analyzed only women who were underweight or had normal BMI (Table 3). Gestational age at the penultimate triage visit remained a significant factor in whether contractions were detected (24.0 vs 27.8 weeks, $P = .01$).

The impact of BMI and GA on the effectiveness of tocodynamometry was further evaluated using a logistic regression. Patients who were classified as obese by BMI criteria were 82% less likely to have contractions detected by the TOCO (odds ratio [OR] 0.18, 95% confidence interval [CI] 0.07-0.48, $P < .001$). This association persisted even when the overweight and the obese patients were combined as 1 category (OR 0.22, 95% CI 0.06-0.81, $P = .02$). If the patient was in mid-gestation at the time of triage evaluation, it was significantly less likely that contractions would be detected by the monitor (OR 0.32, 95% CI 0.11-0.92, $P = .04$). Gestational age at delivery was positively associated with the ability to effectively detect contractions at the penultimate triage visit (OR 1.14, 95% CI 1.03-1.26, $P = .01$). This inverse relationship between contraction detection and BMI as well as its more linear relationship with GA at triage visit persists even when only the patients beyond 20 weeks of gestation were included in the analysis.

Table 3. Impact of Gestational Age on Contraction Detection in Patients With Low or Normal BMI (Excluding Overweight and Obese Patients).

	Contractions detected (n = 28)	No Contractions detected (n = 11)	*P*
Mean gestational age at penultimate triage visit, weeks	27.8 ± 3.8	24.0 ± 4.5	.01
Mean gestational age at delivery, weeks	30.4 ± 3.3	28.9 ± 5.9	.29

Abbreviation: BMI, body mass index.

Discussion

The present study supports the hypothesis that obesity hinders the ability of the TOCO to detect uterine activity. Lack of uterine contraction detection was also associated with an earlier GA both at penultimate triage visit and at delivery. Taken together, our data corroborate what may be obvious to clinicians who triage patients in Labor and Delivery—that the TOCO is often ineffective in the obese patient and at early GAs. The rationale for this deficiency of the TOCO may be similar in both circumstances. Tocodynamometry detects contractions indirectly by displacement of the monitor on the maternal abdomen by the contracting uterus, thus increased abdominal girth or small uterine size (as in the mid-trimester) may not create an appreciable change in abdominal contour for the TOCO to record, despite the presence of contractions. Hess et al compared the TOCO to 2 other devices, the Term Guard monitor (another external monitoring system similar to the TOCO) and the IUPC in women at 17 to 36 weeks of gestation. They discovered the Term Guard ring monitor was superior to the TOCO below 30 weeks of gestation. In addition, when an IUPC could be placed, the standard TOCO identified fewer than half of the contractions recorded by IUPC below 25 weeks of gestation. In fact, only 16% of contractions were detected by the standard TOCO from 17 to 20 weeks. The study's limitations included the small number of patients in mid-gestation (n = 8) and lack of information regarding maternal BMI.[6]

That our study showed an earlier GA at delivery for women in group 2 suggests potential caveats to patient management. While some of this difference may be attributable to the earlier GA at the penultimate triage visit in that group, another potential explanation is the inability to detect contractions resulted in false reassurance for both provider and patient: that the presenting symptoms were not the result of contractions and, thus, dissuaded the patient from returning for evaluation although her symptoms may have persisted. These patients may have been counseled that they were not in PTL and thus sent home, only to ultimately deliver, often at a very early GA. We noted, furthermore, that women in group 2 trended toward fewer triage visits (and had a longer interval between their last triage visit and delivery) than their counterparts in group 1 as shown in Table 2. This lack of follow-up occurred, despite the fact that cervical funneling was identified in some of these women. For women in group 1, GA at delivery was significantly later. The validation of their symptomatology by the TOCO may afford such patients the opportunity to undergo evaluation for conditions known to predispose a woman to PTL (such as a urinary tract infection) and for which, if found, they would receive treatment. Likewise, patients with documented contractions might preferentially be counseled for subsequent management such as decreasing overall physical activity, stricter instructions to return if symptoms recur, or cervical length assessments.

In term patients, a good correlation (r = .75) has been demonstrated between the TOCO and the IUPC with respect to contraction frequency but not duration or intensity.[2] This confirmed the results of a similar study a decade earlier in 1991, although only 20 women were evaluated, with an average BMI of 31.8 (range 22.2-42.3).[7] In 2008, fewer adults were reported to have a healthy BMI compared to 1999, with recent obesity rates exceeding 30%.[8] The most recent prevalence of obesity among women in the United States was reported to be 35.8%.[9] Although pregnant women were excluded from this analysis, data on the US population has found that more than half of women of childbearing age are either overweight or obese.[10] Ehrenberg et al compared contraction frequency in obese/overweight women at risk of preterm birth to women who were normal/underweight at varying GAs and found obese women had fewer contractions between 22 and 34 weeks detected by tocodynamometry.[11] Although these study results were reported in 2009, the data from which their conclusions were generated were derived from patients undergoing home uterine activity monitoring from 1994 to 1996, and the maximum BMI reported was 38.0. More recent studies evaluating the ability of the TOCO to detect contractions in larger women who represent today's clinical population note poorer quality tracings from tocodynamometry in these women.[4,5] Even with newer technology, abdominal EHG, increasing maternal BMI appears to negatively affect the sensitivity of uterine activity detection at term when the large uterus should offer an advantage.[3]

With obesity rates rising and a known increased risk of preterm delivery in obese women,[12] the present study exposes the need for a more effective contraction monitor for all patient populations but especially for obese and women in mid-gestation. Even as recent studies show the promise of abdominal EHG, that technique also seems to be affected by maternal obesity.[3] When abdominal EHG was used alone or in conjunction with fetal fibronectin and/or cervical length to predict PTL, Most et al showed that the addition of abdominal EHG enhanced the predictive values of these 2 currently available tests for PTL and the use of these tests in combination was more predictive of PTL than using any 1 test alone. While the benefit of adding abdominal EHG to a patient's evaluation was not affected by maternal BMI, it is essential to note that the 2 groups of women evaluated had mean maternal weights of 138 and 144 pounds.[13]

Some would argue that our suppositions and conclusions regarding the women in group 2 are unfounded; specifically, on what grounds are we suggesting that at least some of these patients were in early PTL? To wit, our strongest argument is that these women went on to have preterm deliveries due to PTL or PPROM. The etiology of pregnancy loss in the mid-trimester, especially at <24 weeks of gestation, is largely categorized as idiopathic. A substantial proportion of these losses, however, may be due to "PTL." Quotation marks are added because by definition, "PTL" is not even considered a diagnosis before 20-0/7 weeks.[14,15] Yet, if known causes of pregnancy loss such as placental abruption, uterine anomalies, fetal aneuploidy, and incompetent cervix are summed up, they only account for about 50% of fetal wastage in the mid-trimester.[16] The remainder is potentially due to the onset of regular uterine contractions, what would be called "PTL" at >20 weeks. Recent studies suggest that pregnancy losses between 16 and 20 weeks have a similar pathophysiologic process to deliveries after 20 weeks as a result of PTL. These studies reveal, moreover, that this subset of early losses have similar implications on a woman's recurrence risk for a preterm delivery and should also be regarded as preterm births.[17,18]

With limited effectiveness of noninvasive devices for labor detection at a vulnerable stage of pregnancy—the midgestation—coupled with restricted use of an adjunct evaluation tool such as fetal fibronectin to more advanced GAs, women in the midtrimester, who possibly are having regular but undetected uterine contractions—might be excluded from standard protocols and preparations for a potential preterm delivery such as the administration of corticosteroids for accelerated fetal lung maturity. Of interest, in our study, we noted that symptomatic women in group 2 were not more likely to undergo another method of evaluation for their symptoms (such as sonogram for cervical length) and they were observed for a shorter duration than the women in group 1. A more effective uterine contraction monitor than the TOCO or abdominal EHG is not currently available. Until such a device emerges, patients like those in group 2 should perhaps be afforded alternative assessments and more intense scrutiny.

This study's limitations include its retrospective design and small sample size. The strengths of this study are inclusion of all patients in a consecutive cohort who met eligibility criteria, and the inclusion of women who's BMI ranged from the lower limit of normal to extreme obesity. In addition, we included women in the late second and early third trimesters which constitutes a time of either late pregnancy loss or extreme prematurity. We also evaluated the efficiency of the TOCO at a penultimate triage visit rather than at their final admission for delivery. This visit was selected, as it represented a time of missed opportunity for intervention. By the time the patient presented for delivery, she often had either advanced cervical dilation or PPROMs, thus the window to institute measures for preterm birth prevention had closed. While the interval from this penultimate visit to delivery was at times prolonged, and one could argue that these women were not contracting at the penultimate visit, these women had all been symptomatic and ultimately went on to deliver prematurely. For those women in whom contractions were not detected, the GA at delivery was significantly earlier than for those in whom contractions were detected.

Conclusion

Our study supports the concept that preterm uterine contractions may go undetected in obese patients as well as those in the mid-trimester. Available technology that involves uterine monitoring via the maternal abdomen is subject to inaccuracy as maternal BMI increases. A device that bypasses the maternal abdomen may be of practical benefit in order to better evaluate obese women and women below 25 weeks of gestation who present with symptoms strongly suggestive of PTL.

Authors' Note

Ethics Approval: NA_00036804: Relation of frequency of triage visits to preterm delivery, 2/23/10.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Financial Support: NICHD 1R41HD072684-01.

References

1. Cefalo RC, Knab DR, Quigley MM. An external tocodynamometer: adjunct to monitoring labor. *South Med J*. 1972;65(4):460-462.
2. Miles AM, Monga M, Richeson KS. Correlation of external and internal monitoring of uterine activity in a cohort of term patients. *Am J Perinatol*. 2001;18(3):137-140.
3. Euliano TY, Nguyen MT, Darmanjian S, et al. Monitoring uterine activity during labor: a comparison of 3 methods. *Am J Obstet Gynecol*. 2013;208(1):66. e1-e6.
4. Bakker PCAM, Zikkenheimer M, van Geijn HP. The quality of intrapartum uterine activity monitoring. *J Perinat Med*. 2008;36(3):197-201.
5. Ray A, Hildreth A, Esen UI. Morbid obesity and intra-partum care. *J Obstet Gynaecol*. 2008;28(3):301-304.
6. Hess LW, McCaul JF, Perry KG, Howard PR, Morrison JC. Correlation of uterine activity using the Term Guard monitor versus standard external tocodynamometry compared with the intrauterine pressure catheter. *Obstet Gynecol*. 1990;76(1 suppl):52s-55s.

7. Paul MJ, Smeltzer JS. Relationship of measured external tocodynamometry with measured internal uterine activity. *Am J Perinatol*. 1991;8(6):417-4120.
8. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. *JAMA*. 2010; 303(3):235-241.
9. Flegal KM, Carroll MD, Kit BK, Ogden CL. Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. *JAMA*. 2012;307(5):483-490.
10. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*. 2006;295(13):1549-1555.
11. Ehrenberg HM, Iams JD, Goldenberg RL, et al. Maternal obesity, uterine activity, and the risk of spontaneous preterm birth. *Obstet Gynecol*. 2009;113(6):48-52.
12. McDonald SD, Han Z, Mulla S, Beyene J; Knowledge Synthesis Group. Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses. *BMJ*. 2010;341:c3428.
13. Most O, Langer O, Kerner R, David GB, Calderon I. Can myometrial electrical activity identify patients in preterm labor? *Am J Obstet Gynecol*. 2008;199(4):378. e1-e6.
14. Carey JC, Gibbs RS. Preterm Labor and Post-Term Delivery. In: Gibbs RS, Karlan BY, Haney AF, Nygaard IE (Eds.) *Danforth's Obstetrics and Gynecology, 10th Edition* (pp. 165-186). Philadelphia, PA: Lippincott Williams & Wilkins; 2008.
15. Management of preterm labor. Practice Bulletin No. 127. American college of obstetricians and gynecologists. *Obstet Gynecol*. 2012;119(6):1308-1317.
16. Michels TC, Tiu AY. Second Trimester Pregnancy Loss. *Am Fam Physician*. 2007;76(9):1341-1346.
17. Silver RM, Branch DW, Goldenberg R, Iams JD, Klebanoff MA. Nomenclature for pregnancy outcomes: time for a change. *Obstet Gynecol*. 2011;118(6):1402-1408.
18. Edlow AG, Srinivas SK, Elovitz MA. Second trimester loss and subsequent pregnancy outcomes: what is the real risk? *Am J Obstet Gynecol*. 2007;197:581(6):e1-e6.