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COMPARISON OF TRANS-VAGINAL ULTRASOUND MEASUREMENT OF CERVICAL LENGTH & BISHOP SCORING IN PREDICTION OF SUCCESS OF INDUCTION OF LABOR IN POST-TERM PREGNANCY

By

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ABSTRACT

Background: Labor is a process of the fetus movement from the intrauterine to the extrauterine area; the process was named as the diagnosis clinic. It is an initial as well as a permanent contraction to produce the leveling and clinical dilatation which is connected to each other. The exact mechanism responsible for this process has been not fully understood yet.

Objectives: To compare between transvaginal ultrasonographic measurement of cervical length and Bishop's Score in prediction of successful induction of labor in post term pregnancies.

Patients and methods: The study had been conducted at Obstetrics and Gynecology Department, Al-Azhar University Hospital after the approval of research and ethics committee. This observational study included 80 pregnant women from the antenatal care clinic of Al-Hussein University Hospital during the period between January 2021 till July 2021.

Result: Cervical length was significantly lower in successful induction patients compared to failure induction, while Bishop score was significantly higher in successful induction patients compared to failure induction. Mean induction-to-delivery interval was 6.72 ± 18.34 hours. Most of the patients underwent vaginal delivery (86.2%), while only 13.8% of the patients.

Conclusion: Success of labor induction in women undergoing induction due to prolonged pregnancy can be highly predicted by transvaginal sonography of cervical length as it is more objective and accurate than Bishop Score. The 31.2 mm cut-off point for cervical length was the best predictor of vaginal delivery.

Keywords: Bishop score, Cervical length, Labor induction, Transvaginal ultrasound.

INTRODUCTION

Induction of labor is indicated when benefits to the mother or the fetus outweigh those of continuing the pregnancy such as post-dated pregnancy, preclampsia or fetal growth restriction, Induction of labor is performed in about 20% of all pregnancies and successful induction is reported to be related to cervical characteristics, or 'ripeness *(Rouse et al., 2011)*.

Today, Bishop Score remains the standard method to predict the duration and outcome of induced labor. However, the pre-induction 'favorability' of the cervix as assessed by the bishop score is very subjective and several studies have demonstrated a poor predictive value for the outcome of induction especially in women with a low Bishop score *(Kolkman et al., 2013).*

Over the last few years, cervical assessment has moved from digital examination to ultrasound evaluation, and ultrasound of the cervix has been the focus of much research. Transvaginal ultrasound (TVU) cervical length (CL) has been assessed in several populations (e.g. asymptomatic women as well as women with symptoms of preterm labour) to evaluate the risk of preterm birth, and in women before induction of labour to predict induction outcome *(Rathore et al., 2021).*

Measurement of transvaginal cervical length has primarily been used to detect cervical changes in women at risk of preterm delivery. However, the same cervical changes can be detected to predict the success of induction of labor. Theoretically, transvaginal ultrasonographic measurement of the cervix could represent a more accurate and objective assessment of the cervix than digital examination, because the supra-vaginal portion of the cervix usually comprised about 50% of the cervical length is very difficult to assess digitally in a closed cervix In addition, the assessment of the effacement, which starts at the internal os, was difficult to predict in a closed cervix. Also, sonographic measurement of the cervical length is quantitative and easily reproducible method of assessing the cervix, which can be achieved easily with minimal discomfort to the patient *(Banu et al., 2016).*

There is no obvious cause for the prolongation of pregnancy as the onset of labour is not fully understood. There is no consensus about the exact definition of prolonged pregnancy. Most authors depend on the completed 41 weeks of gestation from the first day of last menstrual regular period. The prolonged pregnancy accounts for 10% of all pregnancies. Incidence of prolonged pregnancy decreased with the use of ultrasound early in pregnancy avoiding false dating. A pregnancy becomes at risk at the end of 41 weeks of amenorrhea *(Sentilhes et al., 2017).*

The aim of the present study was to compare between transvaginal ultrasonographic measurement of cervical length and Bishop's Score in prediction of successful induction of labor in post term pregnancies.

PATIENTS AND METHODS

The study had been conducted at Obstetrics and Gynecology Department, Al-Azhar University Hospital after the approval of research and ethics committee. This observational study included 80 pregnant women collected from the antenatal care clinic of Al-Hussein University Hospital.

Inclusion criteria: Patients' ages were 18-35 years, sure of last menstrual period (LMP), regular cycle, no contraindication of vaginal delivery, singleton pregnancy, cephalic presentation, and no fetal or

maternal complication that contraindicate induction.

Exclusion criteria: Age <18 or >35 years, previous C.S, previous uterine surgery (i.e. myomectomy), placenta previa, dilatation of the cervix greater than 3 cm, non-cephalic presentation, and twin pregnancy.

Operational design: Explanation of the procedure to all women participating in the study. A written consent was taken from all patients before starting the study with counseling about risk and benefit of study.

Each patient was subjected to the following:

Complete history taking: Personal history including: name, Age, marital state, address menstrual history: including age of Menarche, menstrual disturbance, dysmenorrhea, related symptoms, obstetric history including parity and mode of delivery, present history: of chronic diseases and medication, past history of hypertension (HTN), diabetes mellitus (DM), family history of similar condition or diabetes, history of allergy to any medication and surgical history of operation, laparoscopic interference, treatment of hirsutism by Laser.

General examination: Evaluation of vital signs and measurement weight, height body mass index (BMI), abdominal and local clinical examination to assess fundal level and gestational age, scar of previous operation, mass, tenderness or rigidity, and any abdominal or pelvic clinically detectable pathology, bimanual pelvic examination of both adenexa, and uterus for detection of any abnormality of female genitalia.

Local vaginal examination: Pelvic capacity, the presenting part, presence of intact or rupture membranes, fundal grip, umbilical grip, first pelvic grip and fetal heart rate, Bishop score for cervical assessment including cervical dilation (cm), effacement (%), station of presenting part, consistency and position {using Bishop Score system}.

Complete real time trans-abdominal ultrasonographic examination including confirmation of gestational age, fetal number, viability, presentation, estimated fetal weight, position and grade of placenta, and amount of liquor.

Transvaginal ultrasonography was performed for all patients (after declaring the purpose of the approach and its advantages to each patient) by using 6-MHZ endovaginal probe *(Ezebialu et al., 2015)*.

Induction of labor was done using Prostaglandin E1 (misoprostol). The Initial dose was 25 microgram vaginal misoprostol tablet (vagiprost® 25 microgram each tablet, manufactured by ADWIA CO. S.A.E Egypt). Full reassessment was 6 hours after initial dose unless clinical condition indicated earlier assessment, second dose 25 micrograms was in cases with unfavorable cervix. The 3rd dose of misoprostol was given. If no cervical ripening after 4 doses of misoprostol, the procedure was considered a failure, and the patient was delivered by cesarean section *(Hofmeyr et al., 2011)*. If there was cervical ripening, during the period of induction, the fetal heart rate was monitored continuously, by means of electronic fetal heart rate monitoring (Cardiotocography). Also, maternal monitoring was done including, blood

pressure measurements every 2 hours, and frequent clinical evaluation (according to the condition).

Oxytocin was administered intravenously as a dilute solution using a constant-infusion pump. The initial dose was set at 5.3 mU/min, and this increased by one-half of the previous infusion rate every 30 min up to a maximum dose of 40 mU/min until regular painful uterine contractions ensued or labor progressed. The oxytocin infusion was continued for at least 12 hours. Amniotomy was not performed until the cervix was dilated to at least 3 cm and the vertex was engaged.

Induction attempt was considered successful if the patient reached the active phase of labor as demonstrated by progressive dilation and effacement of the cervix and followed by vaginal delivery.

Failure to progress in labor was considered as absence of cervical dilatation during the active phase of labor for at least 2 hours or absence of descent of the fetal head during the second stage of labor for at least 1 hour despite adequate uterine contractions.

Induction failure was considered as the inability to achieve the active phase of labor corresponding to a cervical dilation of ≥4 cm after a minimum of 12 h of oxytocin administration in the presence of ruptured membranes.

Outcome variables were as follows: Incidence of vaginal delivery in both groups, the interval time between administration of prostaglandins and the active phase of labor, the interval time from administration of prostaglandins and delivery, the need for oxytocin induction, complications of labor process. Cesarean section was done, no cervical ripening after 4 doses of misoprostol, fetal distress or abnormal fetal heart pattern, failed induction of labor, persistent contractile abnormalities or cervical dystocia, or neonatal wellbeing after labor.

Ethical consideration: Study protocol had been submitted for approval by the Ethical Committee of Faculty of Medicine – Al-Azhar University. Informed verbal and written consent had been obtained from each participant sharing in the study after explanation of the purpose and procedures of the study.

Statistical Analysis:

IBM SPSS-22 program (Inc, Chicago, IL, USA) has been used to preform statistical analysis. Data have been examined for normal distribution via the Shapiro Walk testing. Qualitative data have been presented as frequency and relative percentage. Chi square testing ($\chi 2$) has been utilized to determine change among 2 or more groups of qualitative variables. Quantitative data have been presented as mean ± SD (Standard deviation). Nondependent sample t-testing has been utilized in comparing among 2 nondependent groups of normal distribution variables (parametric data) &Mann-Whitney testing. P value < 0.05 was judged significant. ROC-curve was built to permit choice of threshold values for testing findings and comparisons of various testing approaches. Areas under ROC curves and their standard errors have been calculated via the technique of Cantor, and matched via the normal distribution, with correction for association of notes resulting from the same cases. AUC of ROC shows: 0.90 – 1 = excellent, 0.80-0.90 = good, 0.70-0.80 =

fair; 0.60-0.70 = poor; and 0.50-0.6 = fail. The optimal cut-off point has been recognized at point of maximum accurateness.

RESULTS

Age ranged 21 – 33 years with mean body mass index (BMI) of 28.43 kg/m2. Mean parity was 1.94 and mean gravidity was 2.39 **(Table 1)**.

Table (1): Demographic characteristics and clinical data among the studied groups

	Patients (n=80)
Age (years) Mean ± SD Range	 26.88 ± 3.94 21 – 33
BMI (kg/m^2) Mean ± SD	 28.43 ± 3.58
Gravidity Mean ± SD	 2.39 ± 1.02
Parity Mean ± SD	 1.94 ± 0.823
GA (weeks) Mean ± SD	 38.25 ± 1.23

The most common indication was prolonged pregnancy followed by hypertensive (18.8%) **(Table 2)**.

Table (2): Indication distribution among the studied patients

	Patients (n=80)	
	N	%
Prolonged pregnancy	37	46.3%
Hypertensive	15	18.8%
DM	12	15%
Small for gestational age	5	6.3%
Large for gestational age	3	3.85
Fetal distress	5	6.3%
Obstetric history	2	2.5%
Elective	1	1.2%

The mean cervical length was 26.96 ±3.45 mm and mean bishop score was 5.27 ± 1.83. About 6% of the patients were funneling **(Table 3)**.

Table (3): Transvaginal ultrasound measurement and Bishop score of the studied patients

	Patients (n=80)
Cervical length (mm) Mean ± SD	26.96 ± 3.45
Bishop score Mean ± SD	5.27 ± 1.83
Funneling	5 (6.3%)

The mean Induction-to-delivery interval was 6.72 ± 18.34 hours. Most of the patients underwent vaginal delivery (86.2%), while only 13.8% of the patients underwent cesarean section (CS) **(Table 4)**.

Table (4): Delivery characteristics of the studied patients

		Patients (n=80)
Induction-to-delivery interval (hrs) Mean ± SD		6.72 ± 18.34
Mode of delivery	**VD**	69 (86.2%)
	CS	11 (13.8%)

There was no significant difference between success and failure induction patients regarding demographic and clinical data **(Table 5)**.

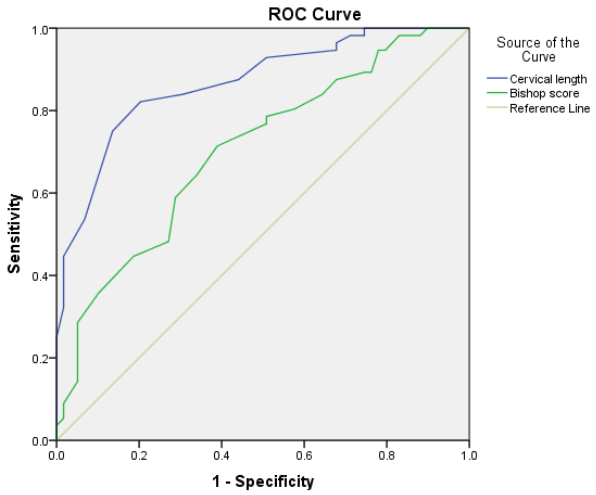
Table (5): Demographic characteristics and clinical data according to induction outcome

	Success (n=58)	**Failure** (n=22)	**P**
Age (years) Mean ± SD	27.98 ± 3.15	27.88 ± 3.67	0.812
BMI (kg/m^2) Mean ± SD	28.28 ± 1.63	27.64 ± 4.86	0.451
Gravidity Mean ± SD	2.31 ± 0.966	2.48 ± 0.905	0.651
Parity Mean ± SD	1.7 ± 0.723	1.63 ± 0.705	0.691

The cervical length was significantly lower in successful induction patients compared to failure induction while, Bishop Score was significantly higher in successful induction patients compared to failure induction **(Table 6)** and **(Figure 2)**.

Table (6): Transvaginal ultrasound measurement and Bishop score among the patients according to induction outcome

	Success (n=58)	**Failure** (n=22)	**P**
Cervical length (mm) Mean ± SD	28.21 ± 5.31	34.18 ± 6.82	**0.000**
Funneling	4 (6.9%)	2 (9.1%)	0.739
Bishop score Mean ± SD	4.57 ± 1.45	3.21 ± 1.18	**0.000**



Variables	**AUC**	**S.E.**	**Sig.**	**95% Confidence Interval**
Cervical length	0.864	0.032	**<0.00**	0.790 - 0.931
Bishop score	0.704	0.048	**<0.00**	0.609 - 0.798

	Cutoff	**Sensitivity**	**Specificity**	**PPV**	**NPV**
Cervical length	31.2	87.5%	79.7%	79.3%	82.5%
Bishop score	5	64.3%	89.8%	76.9%	66.1%

Figure (2): ROC curve for cervical length and Bishop Score as predictors for successful induction of labor in post-term pregnancies.

DISCUSSION

In the present study, Mean ± SD of age was 26.88 ± 3.94, and ranged 21 – 33 years with mean body mass index (BMI) of 28.43 kg/m2. Mean parity was 1.94 and mean gravidity was 2.39.

In agreement with our findings, *Eid et al. (2017)*, reported that the age of the studied group (n=50) ranged between 17 and 41 years with a mean of 24.3±5.7. They were 20 primigravidas and 30 multiparas. The body mass index (BMI) ranged between 22 and 38 kg/m2 with a mean of 26.0±4.2 kg/m2. The mean gestational age was 38.9±2.0 weeks (range: 35-42 weeks).

Another study of *Meijer-Hoogeveen et al. (2011)*, in which a total of 102 women agreed to participate in the study, reported that the age of the studied women ranged between 31 (21–41). They were 67% were primigravidas and 33% multiparas, the body mass index (BMI) with a mean of 26 (18–47) kg/m2.

In *Khalifa et al. (2018)*, study, there were 100 women with age ranging from 20-35 years old, 62 primigravidae and 38 multigravidae. All cases were post-date > 41 weeks.

There are various indications of induction of labor. Most common indication is post term pregnancy and induction for this indication has been shown to reduce the chances of perinatal death, Other indications include pregnancy induced hypertension, uncontrolled diabetes, abruptio plancenta, coagulopathy, obstetric cholestasis, premature rupture of membranes, chorioaminitis, intrauterine fetal growth restrictions, intrauterine fetal death, polyhydraminos, oligohydraminos *(Lamichhane et al., 2016).*

In the current study, the most common indication was prolonged pregnancy followed by hypertensive (18.8%).

Lamichhane et al. (2016) reported that the most common indications for induction in the present study were Postdated Pregnancy which accounts 44.5% and similar findings were observed i.e. 45.8% in a study of *Lawani et al. (2014)* "Outcome and significance of labor induction in a health resource poor setting" in Nigeria.

Eid et al. (2017) reported that the indication for induction of labor was passed date in 19 women (38%), rupture of membranes in 18 (36%), pregnancy induced hypertension in 11 (22%) and gestational diabetes in 2 (4%).

Another similar study of *Ekele et al. (2010)* also concluded that post-date and hypertensive disease of pregnancy were the commonest indication for induction.

Transvaginal ultrasonography has always been a method to predict preterm deliveries, and recently it is used successfully to predict the outcome of labor induction with varying success. Bishop's scoring system is the commonest method to determine the success of labor induction although it is very subjective and several studies have demonstrated a poor predictive value for the outcome of induction especially in women with a low Bishop score *(Selhi and Surapaneni, 2010).*

In the current study, the mean cervical length was 26.96 ±3.45 mm and mean bishop score was 5.27 ± 1.83. About 6% of the patients were funneling.

Khalifa et al. (2018) reported that fifty-eight patients had bishop score < 5 before starting induction. The mean bishop score was 5.31±2.27. Regarding sonographic assessment, 44 patients had cervical length.

Khandelwal et al. (2018) reported that the Bishop score of the subjects ranged from two to seven (2–7). The mean Bishop in this study population was 4.37 ± 1.23. The mean cervical length in this study was 25.59 + 6.07.

In the study on our hands, we found that the mean Induction-to-delivery interval was 6.72 ± 18.34 hours. Most of the patients underwent vaginal delivery (86.2%), while only 13.8% of the patients underwent cesarean section (CS).

Eid et al. (2017) revealed that induction succeeded in 35 women (70%); 15 women were delivered by caesarean section.

This comes in comparison with the study of *Khandelwal et al. (2018)* in which out of the 66 subjects, 55 (83.3%) underwent normal vaginal delivery, and 11 (16.7%) subjects were delivered by cesarean section. The indications of cesarean section were fetal distress (n = 03), pathological cardiotocography (n = 01), non-progressive first stage (n = 02), non-progressive second stage (n = 02), Four subjects underwent cesarean section before the onset of active labor for fetal indications. There were no cases of failed induction.

Also in contrast to *Groeneveld et al. (2010)* with our results as they chose a longer interval (18h) between start of induction and vaginal delivery in order to avoid caesarean delivery as much as possible. Their caesarean delivery rate was 17.3% compared with 13.8% in our study. But that long period may be considered extra burden on the participants comparing with our interval 48h as prolonged trial of labor leads to maternal exhaustion and longer hospitalization with consequent increased morbidity and financial cost.

In addition to above findings, we found that there were no significant differences between success and failure induction patients regarding demographic and clinical data.

In agreement with our findings, the study of *Eid et al. (2018)* reported that there was no significant difference between women with successful induction and those with failed induction regarding age, parity, body mass index (BMI), gestational age or indications for induction of labor.

This agrees with *Mosbeh and Al Sharkawy (2010)* who found that, parity and gravidity were statistically non-significant in the prediction of the success of labor induction and disagrees with *Ware and Raynor (2010)* who found that parity was a main predictor of the mode of delivery.

Induction of labor has become one of the most common interventions in obstetrics, and with this we have the increasing number of Cesarean sections. Identifying these risk factors which increase the risk of Cesarean section has become important so that we can induce patients putting them in lower risk of Cesarean section *(Ethiraj et al., 2019)*.

Furthermore, we demonstrated that there was a significant difference between

the studied groups regarding prolonged pregnancy only.

In the current study, it was found that cervical length was significantly lower in successful induction patients compared to failure induction while, Bishop Score was significantly higher in successful induction patients compared to failure induction.

The *Eid et al. (2017),* study found that cervical length was significantly longer and posterior cervical angle was significantly larger in cases of failed induction ($p < 0.001$ for both). The Bishop Score and Kepansereel score were significantly lower in association with induction failure ($p < 0.001$ for both). There was no significant association between the percentage of funneling and failure of induction ($p = 0.163$).

Bastani et al. (2011) agreed with our results as they found cervical length measured by transvaginal ultrasonography has the potential to replace the traditional Bishop score.

Rane et al. (2010) also agreed with us as they found that cervical length and parity are good predictors of success of vaginal delivery within 24 hours of induction.

Tan et al. (2011) in their study performed on 249 women admitted for labor induction, found that analysis of the ROC curves for cervical length and Bishop Score indicated that both were predictors of Cesarean delivery. Moreover they found that Transvaginal sonography was significantly less painful than digital examination for Bishop Score assessment.

In the present study, it was found that at a cut-off of Bishop Score of 5 the sensitivity was 64.3%, specificity was 89.8%, positive predictive value (PPV) was 76.9% and negative predictive value (NPV) was 66.11 % in prediction of successful induction.

At cut-off of cervical length of 31.2; the sensitivity was 87.5%, specificity was 79.7%, positive predictive value (PPV) was 79.3%, and negative predictive value (NPV) was 82.5% in prediction of successful induction.

In agreement with our findings, the study of *Eid et al. (2017)* reported that a cut-off of Bishop Score of 5 the sensitivity was 56.0%, specificity was 98.4%, positive predictive value (PPV) was 86.7% and negative predictive value (NPV) was 47.11 % in prediction of successful induction. These values were 61.2%, 91.3%, 88.6%, and 59.4%, respectively using a Keepanasseril score at a cut-off of 6.

Khalifa et al. (2018) reported that the best cut-off values to predict cesarean section (CS) for Bishop Score, cervical length and posterior cervical angle were 27mm and 4).15 Bishop Score had a sensitivity of 56.2% and specificity of 67.9% for prediction of VD, with a positive likelihood ratio of 1.75 and a negative one of 0.65, so cervical length by TVS was not a good predictor of evolution to VD among ladies with misoprostol induced labor and Bishop Score was a better predictor of VD under these circumstances.

A Cochrane review of *Ezebialu et al. (2015)* did not demonstrate superiority of one method over the other in terms of the main outcomes assessed. While use of TVUS was associated with an increased need for misoprostol for cervical ripening,

both methods could be complementary. The choice of a particular method of assessing pre-induction cervical ripening may differ depending on the environment and need where one is practicing since some methods (i.e., TVUS) may not be readily available and affordable in resource-poor settings.

CONCLUSION

Bishop score was superior in predicting the response to induction as compared to the cervical length measured by transvaginal ultrasonography. Successful induction correlated significantly with the Bishop Score and ultrasonographic cervical length. Success of labor induction in women undergoing induction due to prolonged pregnancy can be highly predicted by transvaginal sonography of cervical length as it was more objective and accurate than Bishop Score. The 31.2 mm cut-off point for cervical length was the best predictor of vaginal delivery.

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المقارنة بين استخدام الموجات فوق الصوتية المهبليه في تقييم عنق الرحم و مقياس بيشوب في التنبوء بنجاح تحفيز عملية الولادة للحالات التي تجاوزت العمر الرحمى الطبيعى

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خلفية البحث: المخاض هو عملية حركة الجنين من داخل الرحم إلى منطقة خارج الرحم. وقد تم تسمية العملية باسم عيادة. التشخيص، وهو تقلص مبدئي ودائم لإنتاج التسوية والتوسع السريري المرتبطين ببعضهما البعض. ولم يتم فهم الآلية الدقيقة المسؤولة عن هذه العملية بشكل كامل حتى الآن.

الهدف من البحث: المقارنة بين القياس بالموجات فوق الصوتية عبر المهبل لطول عنق الرحم ودرجة بيشوب في التنبوء بالتحريض الناجح للمخاض في حالات الحمل بعد الأوان.

المريضات وطرق البحث: أجريت الدراسة في قسم أمراض النساء والتوليد بمستشفى الأزهر الجامعي بعد موافقة لجنة البحوث والأخلاق.و شملت هذه الدراسة القائمة على ملاحظة 80 سيدة حامل تم جمعها من عيادة الرعاية السابقة للولادة في مستشفى الحسين الجامعي فى الفترة مابين يناير 2021 حتى يوليو 2021.

نتائج البحث: كان طول عنق الرحم أقل بشكل ملحوظ في مرضى الحث الناجح مقارنة بتحريض الفشل، بينما كانت درجة بيشوب أعلى بشكل ملحوظ في مرضى الحث الناجحين مقارنة بتحريض

الفشل. و كان متوسط فترة الاستقراء حتى التسليم 6.72 ± 18.34 ساعة. وقد خضع معظم المرضى للولادة المهبلية (86.2٪)، بينما خضع 13.8٪ فقط من المرضى للولادة.

الاستنتاج: يمكن توقع نجاح تحريض المخاض لدى النساء اللائي يخضعن للتحريض بسبب الحمل المطول عن طريق التصوير بالموجات فوق الصوتية عبر المهبل لطول عنق الرحم لأنه أكثر موضوعية ودقة من درجة بيشوب. وكانت نقطة القطع البالغة 31.2 مم لطول عنق الرحم هي أفضل مؤشر على الولادة المهبلية.

الكلمات الدالة: مقياس بيشوب، طول عنق الرحم، تحريض المخاض، الموجات فوق الصوتية عبر المهبل.