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Original Research Article

Transvaginal sonographic cervical length assessment in predicting the outcome of induction of labor

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ABSTRACT

Background: The aim of the study was to assess Bishop Score in women undergoing induction of labor followed by cervical length measurement by transvaginal sonography and to study the role of transvaginal sonographic cervical assessment in predicting outcome of induction of labor.

Methods: This was a prospective observational study carried out in 300 pregnancy women undergoing induction of labor. In all the women, Bishop score was calculated by per vaginal examination and cervical length assessed by transvaginal ultrasound, both prior to induction of labor

Results: This study has demonstrated that in singleton pregnancies undergoing induction of labor at 37-41 weeks of gestation, successful vaginal delivery within 24hrs of induction occurred in 66.8%. The study has also demonstrated that induction to delivery interval is significantly associated with both the preinduction Bishop score and sonographically measured cervical length, higher the Bishop score and lesser the cervical length, better the likelihood of vaginal delivery within 24 hrs of induction. The best cutoff point for successful induction was ≥ 3 for Bishop score and ≤ 2.5 cm for cervical length, which was obtained from the ROC curve.

Conclusions: Cervical length assessment by transvaginal ultrasound was a better predictor of successful induction of labor.

Keywords: Bishop score, Cervical length, Induction of labor, Transvaginal ultrasound

INTRODUCTION

Induction implies stimulation of regular contractions in term, pregnant women, before the spontaneous onset of labor, with or without ruptured membranes. When the cervix is closed and uneffaced, labor induction will often commence with cervical ripening, a process that generally employs prostaglandins to soften and open the cervix.¹

Induction is indicated when the benefits to either mother or foetus outweigh those of pregnancy continuation. The more common indications include membrane rupture without labor, gestational hypertension, oligohydramnios,

non-reassuring fetal status, post term pregnancy, and various maternal medical conditions such as chronic hypertension and diabetes.² Several factors increase or decrease the ability of labor induction to achieve vaginal delivery. Favourable factors include multiparity, body mass index (BMI) < 30 , favourable cervix, and birthweight < 3500 g.^{3,4} In general, about 20 percent of pregnant women are requiring induction of labor to terminate pregnancy.⁵ Induction of labor usually associated with an increased risk of cesarean delivery, especially when the cervix is not ready for induction.⁶ Successful induction of labour is defined as delivery within 24 hours of induction and depends on length, position, softness and dilatation of cervix. The Bishop

score, since its description in 1964, remains the gold standard for assessing favorability for induction of labor.⁷ The classical digital examination is subjective and has intra and inter observer variability. 50% of cervical length comprises of supravaginal portion of the cervix and varies from one woman to another. The assessment of this portion is difficult to estimate digitally and is highly subjective. Transvaginal ultrasound has been used successfully for measuring the length of cervix to predict the onset, duration and outcome of labour and obstetric outcome after labour induction. This method has been compared with the Bishop score achieving controversial results.⁸

Objectives

Objectives of current study were to assess Bishop score in women undergoing induction of labor followed by cervical length measurement by transvaginal sonography and to study the role of transvaginal sonographic cervical assessment in predicting outcome of induction of labor.

METHODS

Pregnant women admitted in Rajiv Gandhi Government women and children hospital, Puducherry for induction of labor after fulfilling the inclusion criteria was included in the study after obtaining a written, informed and valid consent. The study was conducted from December 2018 to May 2020.

Inclusion criteria

Singleton pregnancies, period of gestation as 37-41 weeks, live foetus in cephalic presentation, patient not in labour and with intact membranes were included in the study.

Exclusion criteria

Women with previous caesarian section, women with cpd, women with antepartum haemorrhage, evidence of malformed foetus, women with PROM were excluded from the study.

Procedure

This was a prospective observational study to carried out in 300 pregnant ladies admitted for induction of labor for various indications in the antenatal ward of our hospital. Pregnant women who are fulfilling the inclusion criteria were included. Basic obstetric history was taken followed by general examination and obstetric examination. Digital vaginal examination was done to evaluate cervix and to record standard Bishops score, which studies various parameters including cervical position, dilatation, effacement, consistency and station of head of the foetus.

The women were then taken up for transvaginal scan using Mindray diagnostic ultrasound machine model DC-

7, Shehzan China with a 7.5MHz TVS probe to assess the cervical length which was done by an experienced obstetrician. Labor induction was carried out according to the standard protocols of our hospital. Successful induction was defined as (for the purpose of this study): vaginal delivery within 24 hours of induction of labor. For those who underwent ceasarean section less than 24 hours from induction of labor, successful induction was taken as those who have entered into active stage within 24 hours of induction.

Outcomes

Primary: to find out the most useful cutoff value for cervical length by transvaginal scan and also the best cutoff value of Bishops Score to predict the outcome of successful induction of labor effectively. Secondary: mode of induction, induction to delivery interval and mode of delivery.

Statistical analysis

The statistical analysis was done using the Microsoft excel 2013 and SPSS statistical and multivariate analysis software, version 2012. The group of women was divided into approximate quartiles of cervical length and Bishop Score, respectively. Linear regression analysis was done. Multivariate Cox regression analysis was done to investigate the two parameters as independent predictors of successful induction of labor. Receiver operating characteristic curves for the two methods was compared. Two-sided p values were reported throughout, $p < 0.05$ was considered as statistically significant.

RESULTS

Our total study population was 300. Bishop score was calculated by per vaginal examination and cervical length was assessed by TVS, both prior to induction of labor. Best cutoff for Bishop was ≥ 3 and for cervical length was ≤ 2.5 cm, which was obtained from the ROC curve. Above table explains the various indications for induction of labor. Past dates, oligohydramnios, gestational diabetes and pregnancy induced hypertension were the common indications seen among our study population.

In our study population 232 (77.3%) had vaginal delivery and 68 (22.7%) had cesarean delivery. In our study population, 60% delivered within than 24hrs of induction, 27% delivered between 24-48hrs of induction and 13% delivered after 48hrs of induction. Among 165 study participants with successful induction, 60 of them had Bishop score less than 3 and 105 of them had Bishop score 3 and more. Whereas among 135 unsuccessful inductions, 78 of them had score less than 3 and 57 had score 3 and more. This difference in the proportion between successful and unsuccessful was statistically significant. With the best cutoff of cervical length as ≤ 2.5 cm, 85.3% of study participants had successful induction as compared to those with cervical length > 2 cm where

there were lesser chances of successful induction of labor. This difference in the proportion between successful and unsuccessful was statistically significant as p value is 0.001. This proves that lesser the cervical length, more the chance of successful induction.

Table 1: Distribution of study participants based on indication for induction (n=300).

Indication	N	%
Past dates	96	32
PIH, GDM	7	2.3
PIH	29	11
Oligohydramnios	75	25
Rh negative	9	3
GDM	43	14.3
BOH	1	0.3
Polyhydramnios	4	1.3
Hypothyroid	2	0.7
Reduced foetal movement	1	0.3
Raised Doppler	5	1.7
FGR	24	8
Total	300	100

Table 2: Distribution of study participants based on mode of delivery following induction (n=300).

Mode of delivery	N	%
Vaginal	232	77.3
CS	68	22.7
Total	300	100

Table 3: Distribution of study participants based on induction to delivery interval (n=300).

Induction to delivery interval (hrs)	N	%
<24	180	60
24-48	81	27
>48	39	13
Total	300	100

Table 4: Comparison of best cutoff of Bishop Score with outcome of induction (n=300).

Bishop score cutoff	N	Outcome of induction		P value
		Successful	Unsuccessful	
<3	138	60 43.5%	78 56.6%	0.001
≥3	162	105 64.8%	57 35.2%	
Total	300	165 100%	135 100%	

Table 5: Comparison of best cutoff of cervical length with outcome of induction (n=300).

Cervical length cutoff (cm)	N	Outcome of induction		P value
		Successful	Unsuccessful	
≤2.5	116	99 85.3%	17 14.7%	0.001
>2.5	184	66 35.9%	118 64.1%	
Total	300	165 55%	135 45%	

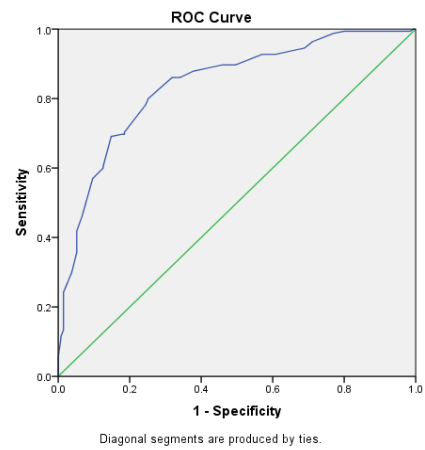


Figure 1: Receiver operating characteristic curves for correlation of cervical length and induction to delivery interval <24 hrs.

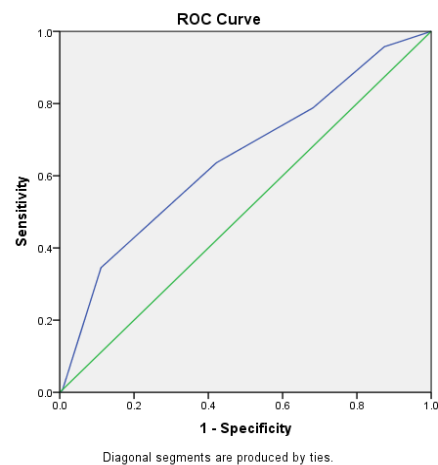


Figure 2: Receiver operating characteristic curves for correlation of Bishop score and induction to delivery interval <24 hrs.

The best cut-off value for the prediction of successful induction of labor for cervical length was ≤2.5cm with a sensitivity of 60% and a specificity of 87%. The best cut-off value for the prediction of successful induction of

labor was ≥ 3 for the Bishop score with a sensitivity of 63% and a specificity of 57%. Both Bishop score and cervical length have almost equal sensitivity in predicting the outcome of induction of labor. Cervical length has

better specificity in predicting the outcome of induction of labor than Bishop score. Cervical length has better positive predictive value than Bishop score, hence it is a better predictor of successful induction of labor.

Table 6: Comparison of sensitivity and specificity of primary outcome measures for successful induction of labor.

Primary outcome measures	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Bishop score ≥ 3	63.6	57.7	64.8	56.5
TVS cervical length ≤ 2.5 cm	60	87.41	85.3	64.1

Table 7: Comparison of best cutoff of cervical length among related studies.

Studies	Cervical length cutoff (cm)
Present study	2.5
Roshan et al¹⁵	2.4
Elghorori et al¹⁷	3.4
Shreya et al¹⁸	2
Panchampreet et al¹⁹	2.8
Ranjana et al¹⁴	2.7
Pandis et al¹²	2.4

DISCUSSION

This prospective observational study was conducted among 300 pregnant women who were admitted for induction of labor in the antenatal ward of our hospital. In a systematic review done by Crowley P et al showed that nearly 20% of the women undergoing induction end up in cesarean delivery.⁹ In a study conducted by Vallikkannu P et al documented that the prevalence of intraoperative complications was higher in emergency caesarean delivery (14.5%) in comparison to elective caesarean delivery (68%).¹⁰

The cervix favorability for induction of labor is commonly assessed by Bishop Score. Effacement which starts at internal os is difficult to assess by digital examination in a closed cervix. In such situation transvaginal sonography can be done easily to measure the cervical length. In this context this research was conducted to compare transvaginal sonography for cervical length measurement and digital examination for Bishop Score assessment in women undergoing labor induction at term.

This study has demonstrated that in singleton pregnancies undergoing induction of labor at 37-41 weeks of gestation, successful vaginal delivery within 24 hrs of induction occurred in 66.8%. The study has also demonstrated that induction to delivery interval is significantly associated with both the preinduction Bishop score and sonographically measured cervical length, higher the Bishop score and lesser the cervical

length, better the likelihood of vaginal delivery within 24hrs of induction.

TVS cervical length was a better predictor of successful induction of labor. Tan et al compared transvaginal sonography for cervical length measurement and digital examination for Bishop score assessment in women undergoing labor induction at term. They concluded that sonographically measured cervical length is better tolerated than digital examination.¹¹ In our study, after induction of labor, nearly 77.3% of the women had vaginal delivery and 22.7% underwent caesarean. The common indications for caesarean delivery were CPD in labor, failed induction and fetal distress. The studies conducted by Pandis et al, Cubal et al, and Ranjana et al showed prevalence between 60-74% on contrary a study conducted by Roshan et al showed prevalence as 40%.¹²⁻¹⁵ In our study population, 61.3% delivered within 24 hrs of induction, 26% delivered between 24-48 hrs of induction and 12.7% delivered after 48hrs of induction. In our study 66.8% of women who had vaginal delivery were induced successfully and delivered within 24 hrs of induction, on contrary, a study conducted by Park et al, it was only 59%.¹⁶

Bishop score and cervical length among related studies

In the receiver operating characteristic (ROC) curves when plotted, the best cut-off point for the prediction of successful induction was ≥ 3 for the Bishop score with a sensitivity of 63% and a specificity of 57% and that for cervical length was ≤ 2.5 cm with a sensitivity of 60% and a specificity of 87%. Among 165 successful induction, 99 participants had cervical less than 2.5 cm and 66 participants had score more than 2.5 cm, whereas among 135 unsuccessful induction, 17 participants had score less than 2.5 cm and 118 participants had score more than 2.5 cm. This difference in the proportion between successful and unsuccessful was statistically significant as p value is 0.001. 60 participants had bishop score less than 3 and 105 participants had score 3 and more whereas among 135 unsuccessful induction, 78 participants had score less than 3 and 57 participants had score 3 and more. This difference in the proportion between successful and unsuccessful was statistically significant (Table 7, 9). In this study, the sensitivity and specificity proved that

ultrasound cervical length is better predictor for successful vaginal delivery in comparison to Bishop Score. In a study conducted by Gomez et al²⁰, the best cut-off for predicting the successful induction for cervical length was 2.4cm and modified Bishop score 4 and study conducted by Shreya et al it was 2cm and score 4 for Bishop score.^{17,18} Tan et al found that cervical length cut-off value of 2 cm had 80% sensitivity and Bishop Score more than 5 had 64% sensitivity and concluded that cervical length and Bishop Scores are useful predictors of the need for caesarean delivery following labor induction.¹¹ Pandis et al stated that although both Bishop score and cervical length are correlated, cervical length is a better predictor of successful labor induction (R value cervical length=0.70 >R value, cervical length=0.51; p<0.0001).¹⁶ Ware and Raynor also compared the two parameters and found cervical length to be a better predictor of successful induction of labor (R value cervical length=0.69 >R value BS=0.65) our study showed similar results.¹⁹⁻²¹

Table 8: Comparison of best cutoff of Bishop score among related studies.

Studies	Bishops score cutoff
Present study	3
Elghorori et al ¹⁷	5
Shreya et al ¹⁸	4
Panchampreet et al ¹⁹	3
Ranjana et al ¹⁴	4
Pandis et al ¹²	4

Recently, Cochrane review was published to assess and compare Bishop score with other methods to assess cervical ripening prior to induction of labour. When comparing with transvaginal ultrasonography, they concluded that no method was superior than the other and transvaginal ultrasonography is not feasible in resource poor settings and also more studies were needed to address complications and cutoff limits.²² In the ROC curves, our study results are in concordance with other study findings conducted by Gomez et al, Yang et al and Tan et al whereas study conducted by Pandis et al inferred that Bishop score and cervical length to be independent predictors of successful labor induction.^{11,12,20,22,23}

Possible explanations for the decreased predictions of successful induction by Bishop Score when compared to cervical length would be: digital examination has limitations in terms of assessing the change of internal os when the external os is closed. In this situation, it would be difficult to measure the entire length of cervix and the configuration of internal os by palpation alone. The different components of Bishop score may not have equal effects on length of latent phase. Bishop score is measured by palpating the vaginal portion of the cervix but the dynamic changes of uterine cervix occur before or during labor starting from the internal OS and progress to

external OS. Bishop scoring is done on the ordinal scale rather than continuous scale, which might have reduced its quantification. Bishop score has more chance of interobserver and intraobserver variations.

Even though cervical length was superior in assessment of labor induction in comparison to Bishop score, the sensitivity for cervical length was not significantly in higher range. The possible explanation for this is, only the latent phase of labor component is to be correlated with cervical length but not the active phase. Hence women with long cervical length at the time of induction may experience a longer latent phase of the labor. And other factors such as cervical resistance, uterine contractions and forward pressure of the fetal head may also have the influence on the progression of latent phase of labor. Factors such as maternal stature, fetal weight and primipara were significantly associated with the active phase and second stage of the labor.¹⁶

Limitations

Limitation of current study were; all the components of the Bishop score were not analyzed separately so as to identify which could be a better predictor to predict outcome of induction of labor. Various other parameters regarding the cervix in TVS like dilatation, wedging, angulation etc. which may have increased the predictability of TVS assessment were not included in our study. Cervix could not be assessed at a fixed time interval between time of assessment to induction for all the cases.

CONCLUSION

Transvaginal ultrasonography measurement can be done easily with minimal discomfort to patients and it is useful in predicting response to induction. Sonographic measurement of cervical length is quantitative and an objective method with minimum interobserver variation. However, those undertaking this measurement should receive appropriate training. Digital examination of the cervix for assessment of Bishop Score does not involve extra cost, any extra equipment or any additional training. Majority of the successful induction is seen among age group between 20-30 years, cervical length ≤ 2.5 cm and Bishop score ≥ 3 . Cervical length proved as a good predictor for successful induction.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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