Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/v60x3598

COMPARISON OF TRANSVAGINAL CERVICAL LENGTH AND MODIFIED BISHOP SCORE IN PREDICTING INDUCTION TO DELIVERY INTERVAL OF ≤ 24 HRS IN PRIMIGRAVIDAS ADMITTED FOR SAFE CONFINEMENT IN A TERTIARY CARE CENTRE IN SOUTH INDIA.

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Introduction

Induction of labour is a common intervention in modern obstetric practice, performed when the benefits of expediting delivery outweigh the risks of continuing pregnancy. Predicting the likelihood of successful induction is crucial for optimizing maternal and fetal outcomes, minimizing unnecessary interventions, and improving resource utilization.

The method commonly used to evaluate the readiness of the cervix before induction is the Modified Bishop Score (MBS), an updated version of the original Bishop Score developed by Calder. This scoring system assesses cervical readiness based on five clinical parameters: dilation, length, consistency, position of the cervix, and the station of the presenting fetal part. Scores range from 0 to 13, with higher scores (≥9) suggesting a favourable cervix for vaginal delivery and lower scores (≤4) indicating a need for cervical ripening prior to induction.

Despite its widespread use, MBS is inherently subjective and can vary significantly between examiners. To improve objectivity, O'Leary and Ferrell proposed an ultrasound-based scoring model in 1986, which evaluated cervical parameters and the lower uterine segment using transabdominal ultrasound[1]. However, this technique has notable limitations. For example, the requirement of a full bladder may artificially increase cervical length by compressing the anterior and posterior uterine walls. Additionally, factors such as maternal obesity, interference from fetal structures, and lower-frequency transducers can reduce the accuracy of this approach.

Transvaginal ultrasound (TVS) offers a more precise and reproducible alternative[2]. Performed with an empty bladder, TVS allows better visualization of the cervix, particularly the supra-vaginal portion, which constitutes about half of the cervical length and is difficult to assess manually in a closed cervix. Nevertheless, TVS is not free from technical challenges. Factors such as focal uterine contractions can obscure the internal os, making the cervix appear longer. Endocervical mucus or polyps may also create the illusion of separation between the anterior and posterior cervical walls, leading to underestimation of the true cervical length. Moreover, applying too much pressure with the vaginal probe may artificially increase the cervical measurement.

To ensure accurate and reliable cervical evaluation, TVS should be performed in accordance with standardized imaging protocols while accounting for these potential artifacts. With the increasing availability of ultrasound technology at district and primary care levels, TVS offers a practical and objective method for evaluating cervical readiness. Its implementation may improve the predictive accuracy of labour induction outcomes and support evidence-based decision-making in obstetric practice.

Need for this study

This study aimed to compare the performance of objective assessment of cervical length using transvaginal ultrasonography (TVCL) as compared to the more subjective MBS in predicting the outcome of labour induction in primigravida.

Aim of the study

To compare the of performance of TVCL and MBS in predicting successful induction of labour within 24 hours in primigravidas admitted for safe confinement.

Objectives

To compare the sensitivity, specificity, positive predictive value and negative predictive values of different cut off values of TVCL and MBS in predicting the occurrence of successful vaginal delivery within 24 hours of induction in primigravida between 37 and 42 weeks of gestational age, admitted for safe confinement.

MATERIALS AND METHODS

Design: Prospective observational study

Patient population and recruitment

Primigravida with gestational age ranging from 37 to 42 weeks who were admitted for safe confinement and labour induction under Obstetrics and Gynaecology in SAT hospital, Government Medical College, Trivandrum.

Study period

1ST January 2021 to 31st December 2021

Ethical considerations: Approval for conduct of the study was obtained from The Human Ethics Committee, GMC Thiruvananthapuram, vide HEC No:01/12/2021/MCT. The research conforms to the outline principles in the Declaration of Helsinki.

Inclusion criteria

1. Singleton pregnancy
2. Nulliparous patients
3. Live fetus with vertex presentation
4. Unruptured amniotic membranes
5. Gestational age between 37 and 41 weeks
6. Reassuring NST pattern before induction.
7. No contraindications for vaginal delivery
8. Bishop score ≤ 6

Exclusion criteria

1. Patients in the active phase of labour
2. Allergic to prostaglandins
3. Vaginal bleeding

4. History of uterine surgery like previous CS and myomectomy
5. Presence of severe maternal or fetal compromise, such as severe preeclampsia, severe IUGR, cardiac diseases.
6. Unwilling to provide informed consent

Methodology

After obtaining informed consent in the vernacular language, baseline characteristics, such as name, age, occupation, gestational age at induction, and indication for induction, were collected. Then Transvaginal ultrasonographic measurement of cervical length was performed by the principal investigator using the standard longitudinal view of the cervix after ensuring that patient's bladder was empty.

Following this, the MBS was determined by the resident doctor responsible for the induction. These doctors were not aware of the transvaginal cervical length measurements.

	Score			
Parameter	0	1	2	3
Cervical dilatation (cm)	Closed	1-2	3-4	5
Effacement (%)	0-30	40-50	50-70	≥80
Head station	-3	-2	-1,0	+1,+2
Consistency	Firm	Medium	Soft	
Position	Posterior	Mid position	Anterior	

Table 1: Components of Modified Bishop Score: To the above score determined following per vaginal digital examination, 1 point is added for pre-eclampsia and 1 point for each prior vaginal delivery. One point is subtracted for Post dated pregnancy, Nulliparity and premature or prolonged rupture of membranes. Total score is the sum of all points for each parameter.

Induction of labour was carried out according to the standard institutional protocol. Method of cervical ripening was chosen after assessing the modified bishop score. The protocol followed at SAT hospital is detailed below:

MBS ≤2 : mechanical method of induction was selected. A No.16 Foley catheter was inserted under strict aseptic precaution into the intracervical canal. The bulb was then inflated with 40 cc of sterile water. The catheter was then taped to the inside of thigh with a small degree of traction. The catheter was retained for 24 hours or until its spontaneous expulsion, whichever occurred first. Once the Foleys was removed or expelled, oral PGE1 25 µg tablets were administered after ensuring that the patient was not in established labour. FHR pattern was obtained and deemed to be reassuring. Oral PGE1 was continued according to the department protocol.

MBS ≥3 and ≤6, Oral PGE1 25 µg is given every 2 hourly, till a maximum of 8 doses. The electronic fetal heart rate was monitored before each subsequent dose. Subsequent doses were withheld if;

a) Patients are in active labour
b) Regular uterine contraction
c) Non-reassuring Cardio-toco-gram (CTG)

If the patient was not in labour even after 8 doses, reinduction was planned after 24hours from the last dose. Reinduction was continued until a maximum of 16 doses were administered.

Protocol for Transvaginal measurement of cervical length((TVCL)

Procedure is performed with the patient in dorsal lithotomy position. Longitudinal view of the cervix is obtained and the internal and external ora of the cervix are visualised. Magnification of the ultrasound image is kept at approximately 50-75% of the image. The cervical length is measured using callipers from the internal to the external os along the endocervical canal. Duration of the

examination was between 3-5 minutes, three measurements were taken within this time period and the shortest measurement was selected.

Augmentation of labour was done as per institutional protocol. Successful induction of labour was deemed to have occurred when active labour occurred at the end of induction protocol terminating in vaginal delivery. Induction of labour was deemed to have failed when the woman had not entered the active phase of labour (5-cm dilatation) despite induction.
Failure to progress was deemed to have occurred when the woman after entering the active phase of labour did not progress, because of either failure of the cervix to dilate or failure of the head to descent. These were considered as indications for caesarean section.

Outcome measured: Induction delivery interval

Statistical analysis
Induction to delivery interval was used to divide patients into two groups with 24 hours as the cut off. Patients who proceeded for caesarean section during the first 24 hours were excluded from the subsequent analysis. For each transcervial length measurement, rounded off to the nearest mm, the sensitivity, specificity, positive predictive values and negative predictive value were calculated. Similar calculation was done for MBS scores between 2 and 5. The results of sensitivity and (1-specitfivity) values were used to plot ROC curves for both MBS and Transvaginal cervical length. The values nearest to the left upper corner of the ROC curve were selected and the corresponding cut off values for TVCL and MBS were identified as optimal cut-off values. The area under the ROC curves were then compared to determine which of the two parameters was better in predicting induction to delivery interval of ≤24 hrs.

Results
One hundred forty-five primigravidas with gestational age 37-42 weeks who were admitted for induction of labour during the study period were enrolled in this study. Baseline characteristics are summarized in Table 1

Characteristic	Subgroup	Number (%)
Age	≤20	29 (20%)
	21-25	74 (51%)
	>25	42 (29%)
Body mass index (kg/m^2)	Underweight	5 (3.4%)
	Normal	78 (53.8%)
	Overweight	50 (34.5%)
	Obese	12 (8.3%)
Gestational age	37-38 weeks	45 (31%)
	38weeks and 1 day to 39 weeks	49 (33.8%)
	39 weeks and 1 day to 40 weeks	51 (35.2%)
Indication for induction	Due date	26 (17.9%)
	Decreased perception of fetal movement	12 (8.3%)
	Decreased Amniotic fluid index	16 (11%)
	Gestational Hypertension	26 (17.9%)
	Gestational Diabetes	24 (16.6%)
	Gestational thrombocytopenia	6 (4.1%)
	Fetal growth restriction	29 (20%)
	Transaminitis	6 (4.1%)

Table 1: Baseline characteristics of study population

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The study group was 145 women with age ranging from 18 to 37 years with a average age of 24 yrs. The mean body mass index (BMI) was 24.7 ± 3.7 kg/m^2. The most common indications for induction were gestational hypertension and pregnancy reaching due date.

Transvaginal Cervical Length in cm	Frequency	Percentage
2-2.5	11	7.6
2.6-3.0	57	39.3
3.1-3.5	72	49.7
>3.5	5	3.4
Total	145	100

Table 2: Distribution of TVCL in cm in patient population

Modified Bishop Score	Frequency	Percentage
1	1	0.7
2	22	15.2
3	56	38.6
4	37	25.5
5	23	15.9
6	6	4.1
Total	145	100

Table 3: Distribution of MBS in the study population

The distribution of MBS and TVCL in the study population is depicted in Tables 2 and 3. Sixty-six patients had bishop score ≥4 before starting induction. Regarding sonographic assessment, 68 patients had TVCL< 3 cm, and the mean cervical length for the whole study group was 3.05 ± 0.33cm.

Outcome measures

Successful vaginal delivery was achieved in 111 patients (76.6%) while CS was performed in 34 patients. The indications for caesarean section are given in Table 4. The most common indication for CS was fetal distress. Approximately 15 % of patients who underwent LSCS had failed induction.

Indication for LSCS	Frequency	Percentage
Fetal distress	14	41.2%
Failed induction	5	14.7%
Thick meconium-stained amniotic fluid	9	26.5%
First degree cephalo-pelvic-disproportion	6	17.6%
Total	34	100%

Table 4: Indications for LSCS in the study population

The induction to delivery interval ranged between 4 to 80 hours with the mean value being 27.7 hours and median value being 24 hours. The 9 patients who had LSCS within 24 hours were excluded from the analysis. Out of the 136 patients included in the analysis, 70 patients (63.1% delivered by vaginal delivery in ≤ 24 hours, 41 patients (36.9%) delivered by vaginal delivery beyond 24 hours and 25 patients (22.5%) delivered by LSCS beyond 24 hours.

TVCL (cm)	*Sensitivity (%)*	*Specificity (%)*	*PPV (%)*	*NPV(%)*
≤2.8	47.1	97	94.3	63.4
≤2.9	60	95.5	93.3	69.2
≤3	75.7	89.4	88.3	77.6
≤3.1	84.3	74.2	77.6	81.7
≤3.2	91.4	51.5	66.7	85
≤3.3	94.3	39.4	62.3	86.7

Table 5 : Sensitivity, Specificity, Positive predictive value (PPV) and negative predictive value (NPV) of serial cut-offs of transvaginal cervical length in predicting successful vaginal delivery ≤ 24 hrs.

MBS cuff off value	*Sensitivity (%)*	*Specificity (%)*	*PPV (%)*	*NPV (%)*
5	85.7	13.6	51.3	47.4
4	62.9	13.6	43.6	25.7
3	31.4	22.7	30.1	23.8
2	12.9	69.7	31	43

Table 6: Sensitivity, Specificity, Positive predictive value (PPV) and negative predictive value (NPV) of serial cut-offs MBS scores in predicting successful vaginal delivery ≤ 24 hrs.

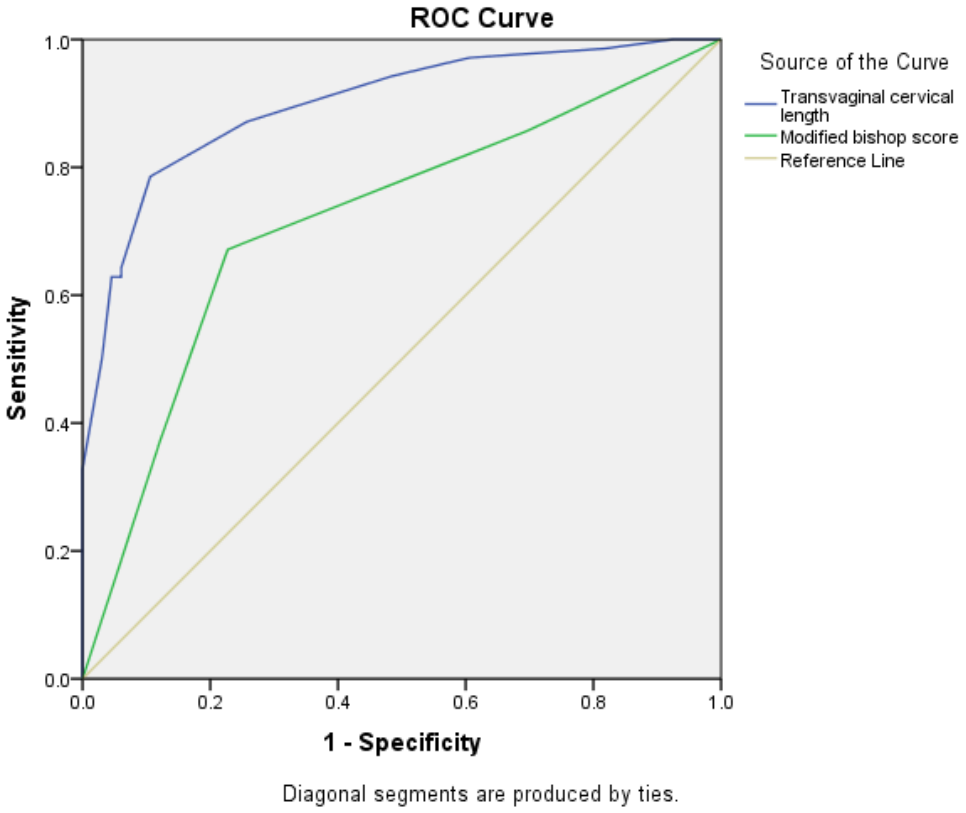

Figure 1: ROC curve of TVCL and Modified Bishop score in predicting successful labour induction (induction delivery interval < 24 hours).

	Area under the ROC curve	95% Confidence interval
TVCL	0.871	0.809 to 0.933
MBS	0.723	0.635 to 0.810

Table 7: Area under the curve with 95% confidence intervals for TVCL and MBS

In the ROC curve of TVCL, the cut of value of 3 cm has the best trade-off between sensitivity of 75.7% and specificity of 89.4% in predicting induction to delivery interval of ≤ 24 hours. In comparison, the MBS value of 4 has the best trade-off between sensitivity of 62.9% and specificity of only 13.6% in predicting induction to delivery interval of ≤ 24 hours. The ROC characteristics of TVCL value of 3 cm are closer to the left upper corner of the graph and hence better than the MBS value of 4 for predicting the induction to delivery interval of ≤ 24 hours. The area under the curve is higher for TVCL as compared to MBS.

DISCUSSION

Transvaginal cervical length measurement can be considered an objective representation of the cervical effacement of the modified bishop score. Based on Table 1, TVCL of ≤3 cm a positive predictive value of 88.3% and negative predictive value of 77.6%. MBS cut off values of 5 had a positive predictive value of 51.3 and negative predictive value of 47.4%, faring much worse than TVCL.

The analysis of ROC curves of TVCL and MBS in predicting induction to delivery interval of ≤ 24 hours indicates that in the ROC curve of TCL, the cut of value of 3 cm has the best trade-off between sensitivity of 75.7% and specificity of 89.4% in predicting induction to delivery interval of ≤ 24 hours. In comparison, the MBS value of 4 has the best trade-off between sensitivity of 62.9% and specificity of only 13.6% in predicting induction to delivery interval of ≤ 24 hours. The ROC characteristics of TCL value of 3 cm are closer to the left upper corner of the graph and hence better than the MBS value of 4 for predicting the induction to delivery interval of ≤ 24 hours. The area under the ROC curve is higher for TVCL as compared to MBS.

These observations place TVCL as a better tool to assess the possibility of induction delivery interval being ≤ 24 hours in primigravida as compared to MBS. The cut off values in our results are different from data from Pandis et al.[3] who reported a similar study of 240 women undergoing labour induction. In their study, TVCL performed better than MBS in predicting successful induction.

	Pandis et al(n=240)	This study(n=145)
Number of vaginal deliveries	194(80.4%)	111(76.6%)
Optimum cut off Cervical length MBS	 2.8 3	 3.0 4
Sensitivity for optimum cut off value TVCL MBS	 87% 58%	 75.7% 62.9%
Specificity for optimum cut off value TVCL MBS	 71% 77%	 89.4% 13.6%

Table 7: Comparison with other studies

The cut off value of 3.0 for TVCL in our study yielded lower sensitivity but higher specificity in prediction Induction to delivery interval of ≤ 24 hours as compared to the cut of value of 28 in Pandis et al. However, the MBS optimal cut off value of 4.0 in our study had better sensitivity but extremely low specificity of only 13.6%. The sensitivity of the MBS cut off value of 3 in our study was only 31.4% and specificity was the same as that for the cut off value of 4, i.e 13.6%. This points to the significant inter observer variation in calculation of MBS score as compared to the much better inter-observer co-relation of TCVL between studies. Gonen et al. [4] examined 86 women before induction and reported significant associations between both the Bishop score and sonographically measured cervical length with successful induction and the induction-to-delivery interval. However, in a logistic regression model that included these parameters as independent variables, only the Bishop score and parity were significantly correlated with successful induction and labour duration.

Ware and Raynor [5] examined 77 women before induction and found that both sonographically measured cervical length and Bishop score predicted induction-to-delivery interval and the likelihood of vaginal delivery.

Other studies ended with no difference between the Bishop Score and cervical length by TVS: Yanik et al[6] found that the Bishop Score, cervical length, maternal age, parity, and weight of the newborn all might affect the mode of delivery after IOL.Bishop score, although a subjective measure must be considered an important component of pre-induction evaluation. This study used a combination of many variables and concluded with the importance of Bishop score in preinduction evaluation.

Chandra et al[7] compared TVS (cervical length, dilatation, and presence of funnelling) with the components of the Bishop score. They found that TVS does not predict successful IOL or induction of VD interval as well as Bishop Score in postdate pregnancies.

The contradictory results of these studies are likely explained by many reasons. There was significant heterogeneity among studies regarding demographic characteristics, parity, indication for induction, gestational age, method of induction, and preinduction cervical favourability status. In several instances, different induction methods were used in the same study.

Transvaginal sonographic measurement of cervical length, which can be achieved easily and with minimal discomfort to the patient, provides a useful prediction of the likelihood of vaginal delivery within 24 hours of induction and of the induction-to-delivery interval. It helps in counselling the women regarding the outcome of labour induction.

Limitations of the study

1. Associations with other factors like maternal weight, maternal age, and BMI, were not considered in our study. It can be independent predictors in successful labour induction.

2. Did not analyse the different components of the bishop score separately to determine which factors contributed to the successful prediction in induced labour

3. Did not include other parameters of the transvaginal cervical assessment like dilatation, presence of wedging, and cervical angle, which could have added to the predictability obtained by cervical length alone.

4. Heterogeneous methods of labour induction were used. There is a potential bias in induction outcomes from the combination of different induction methods used in other studies.

Conclusion

This prospective observational study demonstrates that transvaginal cervical length (TVCL) measurement is a more accurate and objective predictor than the Modified Bishop Score (MBS) for predicting induction to delivery interval of ≤24 hours. A TVCL value of 3.0 cm provided the best balance of sensitivity (75.7%) and specificity (89.4%), outperforming the MBS, which showed much lower specificity at its optimal cut-off value of 4. However, the utility of this value in influencing the decision in choice of induction protocol is not clear. Based on the findings of this study, though TVCL is a better guide to predict whether the patient would deliver within 24 hour of induction, MBS remains the tool of choice in guiding strategy of induction. We suggest that TVCL, when available, should be used along with MBS to enhance patient counselling, optimize induction strategies, and potentially improve maternal and fetal outcomes**.**

Funding : Not applicable

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