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VALIDATION OF CERVICAL LENGTH AND BISHOP SCORE AS PREDICTORS OF SUCCESSFUL TERM LABOR INDUCTION- A PROSPECTIVE VALIDATION STUDY

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Abstract

Objective: *To evaluate how accurately cervical length (CL) and Bishop score(BS) can predict successful induction of labor at term.*

Materials and Methods: *A prospective validation study was carried out at Lady Reading Hospital, Peshawar on 489 women at 37–42 weeks of gestation, aged 15–45 years, and scheduled for labor induction were included through consecutive sampling. Women with previous cesarean section, myomectomy, twin pregnancies, or prior use of oxytocin or prostaglandins were excluded. All participants were informed about the study purpose, assured of confidentiality, and provided written consent. CL was measured using transvaginal ultrasound, and BS was assessed clinically. Labor was induced with 25 µg misoprostol placed in the posterior vaginal fornix, and participants were observed for 24 hours. Data were analyzed using R (version 4.3.1) and MedCalc to calculate diagnostic statistics, and generate ROC curves.*

Results: *The average age was 27.1±3.1 years. CL under 27 mm predicted successful induction with 77.4% sensitivity, 60.9% specificity, and 75.3% overall accuracy. BS above 5 showed 80.0% sensitivity, 59.4% specificity, and 77.3% accuracy. ROC analysis showed areas under the curve of 0.87 for CL and 0.86 for BS.*

Conclusion: *Both BS and CLare effective tools for predicting successful term induction.*

INTRODUCTION

Inducing labor has become a routine part of modern maternity care. It involves the deliberate initiation of the birth process before it starts on its own.[1] Induction of labor aims for a safe outcome for both mother and baby. Several approaches can be used for this purpose, either mechanical tools or medications that prepare the cervix and induce slow contractions resulting in childbirth.[2] WHO's global assessment showed that about one in ten births required induction, particularly high in Asian and Latin American regions.[3] Induction of labor can lower the chances of infections such as chorioamnionitis if performed at the appropriate time. It also reduces the need for newborn antibiotic treatment, decreases neonatal intensive care admissions, and improves the overall birthing experience for mothers. It is

generally recommended when continued pregnancy poses a risk to the mother.[4, 5] The cervix is regarded as not ready for labor if the BS is below 6, so softening it becomes necessary before using oxytocin or carrying out an artificial rupture of membranes. Doing so helps lower the chances of induction failure and reduces the need for caesarean section.[6] myarid of methods can be used for preparing the cervix. Prostaglandin E2 is often used for the initiation of labor, but it is costly. Prostaglandins are natural hormones in the uterus and play a key role in loosening the cervix and promoting uterine contractions.[7] Induction of labor offers several clinical benefits. It may lower the likelihood of fetal macrosomia and its associated complications, like shoulder dystocia or the need for forceps delivery per vagina. Induction can prevent certain neonatal complications, like meconium aspiration syndrome and perinatal mortality. Successful induction relies on adequate cervical maturation and coordinated uterine contractions.[8, 9]The BS is used to judge the condition of the cervix before inducing the labor. The obstetrician records five findings, which are the components of the Bishop scale: cervical effacement, consistency, dilation, position, and the fetal station during the vaginal examination, with each item assigned a score from zero to two or three. When the total score is below four, the cervix is considered unfavorable, and induction should be delayed until cervical-ripening methods are used.[10] A score of six or more indicates a cervix that is more suitable for induction and gives a better chance of proceeding to a successful labor. The success of labor induction at term mainly depends on the condition of the cervix. Failed induction can lead to longer labor and a high chance of caesarean delivery. The BS is commonly used to evaluate cervical status, but the results can vary between examiners. Measuring CL by transvaginal ultrasound provides a more objective assessment, but its effectiveness compared with the BS is not elucidated in the local population. Comparing these two methods can help identify the better predictor of successful induction and guide safer, more effective clinical decisions. The objective of this was to assess the accuracy of BS and CL in predicting the success of inducing the labor.

MATERIALS AND METHODS

This prospective validation study was conducted in the Department of Obstetrics at Lady Reading Hospital, Peshawar, from 5th October 2024 to 30th March 2025, using a non-probability consecutive sampling technique. The sample size of 489 was calculated using EpiTools, with a 95% confidence level and a 12% margin of error, assuming a successful vaginal delivery rate of 86.9% after induction. The sensitivity and specificity of CL in predicting successful induction were 77.5% and 61.1%, respectively.[12]The inclusion criteria were all women who presented at term, between 37 and 42 weeks of gestation, within the reproductive age group of 15 to 45 years, and who were planned for induction of labor as determined by the consultant obstetrician. Women were excluded if they had a history of oxytocin infusion or oral prostaglandin intake, had twin pregnancies confirmed on ultrasound, or had a previous history of cesarean section or myomectomy.Ethical approval was acquired from the review committee of the hospital Ref: No. **1016/LRH/MTI.** Women at term (37–42 weeks) meeting the inclusion criteria were recruited from the outpatient department. The purpose and potential benefits were explained to all participants. Written informed consent was obtained from each participant.

A detailed medical history was taken, followed by physical and gynecological examinations. Transvaginal ultrasound and BS assessments were performed to predict the likelihood of successful labor induction, with a CL less than 27 mm and a BS greater than 5 considered favorable as used by previous study[13]. Successful induction was defined as the establishment of active labor and/or vaginal delivery within 24 hours of initiation of induction. This 24-hour timeframe was selected based on its frequent use in prior induction studies as a clinically meaningful measure of induction efficiency and to distinguish effective induction from prolonged or failed induction, which has been associated with increased maternal and neonatal morbidity. Each woman received an initial dose of 25 µg misoprostol placed in the posterior vaginal fornix using digital insertion. Participants remained in a recumbent position for 30 minutes following administration. Cervical status and uterine activity were reassessed at

6-hour intervals. No repeat doses of misoprostol were administered. Oxytocin augmentation was not used during the 24-hour observation period. Induction failure was defined as the absence of regular uterine contractions with cervical change within 24 hours of the initial dose. All participants were monitored continuously for maternal and fetal well-being for 24 hours after administration. All procedures were conducted under the supervision of an obstetrician with at least five years of clinical experience.Successful labor induction was defined as delivery per vagina occurring within 24 hours after the start of induction therapy. CL was evaluated using transvaginal ultrasound. The ultrasound was performed with the bladder empty and the patient in the dorsal lithotomy position. A sagittal view of the cervix was obtained, and the CL was recorded once the external OS, cervical canal, and internal OS were clearly visualized. A measurement of less than 27 mm was taken as a favorable sign for successful induction, and a BS above 5 was considered favorable. The clinicians responsible for intrapartum management and outcome assessment were blinded to the cervical length measurements and Bishop score results to minimize observer bias. To assess inter-observer reliability, cervical length measurements were independently performed in a randomly selected subset of participants by a second obstetrician who was blinded to the initial measurements. Inter-observer agreement for cervical length was evaluated using the intraclass correlation coefficient (ICC). Bishop score assessments were standardized using predefined criteria, and periodic calibration meetings were conducted to ensure consistency among observers.Data analysis was carried out in R program 4.3.1. Qualitative data were expressed as frequencies and percentages, while continuous variables were presented as mean and standard deviation. Two-by-two tables were put in MedCalc for determining the specificity, sensitivity, positive and negative predictive value of CL(<27 mm) and BS (>5) for predicting successful labor induction. Receiver operating characteristic (ROC) curves were also generated to judge the diagnostic performance of both predictors.

RESULTS

The mean age was 27.1±3.1 years. Among 489 women undergoing labor induction, a CL<27 mm accurately predicted successful induction in 329 women (67.3%) and correctly identified 39 women (8.0%) who did not achieve successful induction. There were 25 false positives (5.1%) and 96 false negatives (19.6%). Likewise, a BS >5 accurately predicted success in 340 women (69.5%) and failure in 38 women (7.8%), with 26 false positives (5.3%) and 85 false negatives (17.4%). **(Table 1)**CL<27 mm showed a sensitivity of 77.4% (95% CI= 73.2–81.1) and specificity of 60.9% (95% CI= 48.7–71.9) and resulting in an overall accuracy of 75.3% (95% CI =71.2–78.9). The BS >5 demonstrated similar performance, with a sensitivity of 80.0% (95% CI =75.9–83.5), specificity of 59.4% (95% CI =47.1–70.5), and accuracy of 77.3% (95% CI= 73.4–80.8). **(Table 2)**The diagnostic performance of CL(<27 mm) and BS (>5) in predicting successful labor induction at term is illustrated in the ROC curves. CL showed an area under the curve (AUC) of 0.87 (95% CI =0.84–0.91) The BS similarly demonstrated an AUC of 0.86 (95% CI =0.82–0.90). **(Fig 1)**Cervical length and Bishop Score were both significantly associated with successful labor induction. Shorter cervical length was moderately correlated with a higher likelihood of successful induction ($r = -0.42$, 95% CI −0.55 to −0.28, $p < 0.001$), while higher Bishop Scores were moderately correlated with greater chances of success ($r = 0.48$, 95% CI 0.35–0.60, $p < 0.001$). **(Table 3)**

Table 1. Cross tabulation of CL (<27 mm) and BS(>5) in predicting successful labor induction

Predictor	Category	Successful Induction (Yes)	Successful Induction (No)
Cervical Length	<27 mm (Favorable)	329 (67.3%)	25 (5.1%)
	≥27 mm (Unfavorable)	96 (19.6%)	39 (8.0%)
BS	>5 (Favorable)	340 (69.5%)	26 (5.3%)
	≤5 (Unfavorable)	85 (17.4%)	38 (7.8%)

Table 2. Diagnostic performance of CL (<27 mm) and BS (>5) in predicting successful labor induction

Predictor	Sensitivity (%) [95% CI]	Specificity (%) [95% CI]	Accuracy (%) [95% CI]
Cervical Length	77.4 (73.2–81.1)	60.9 (48.7–71.9)	75.3 (71.2–78.9)
BS	80.0 (75.9–83.5)	59.4 (47.1–70.5)	77.3 (73.4–80.8)

PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval

Table 3. Correlation of cervical length and Bishop Score with successful labor induction

Predictor	Correlation	95% CI	p
Cervical Length (mm)	–0.42	–0.55 to –0.28	<0.001
Bishop Score	0.48	0.35–0.60	<0.001

*Spearman correlation

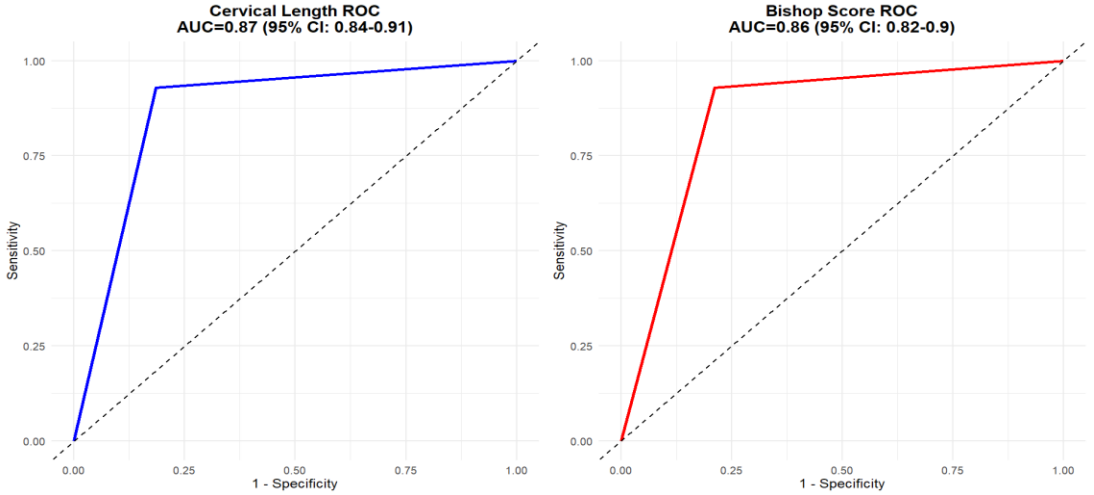

Fig 1. ROC Curves for CL and Bishop sacale in Predicting Successful Labor Induction at Term

DISCUSSION

Our study found that a CL<27 mm and a BS >5 were both significantly associated with induction success. Diagnostic analysis showed moderate sensitivity, specificity, positive predictive value, and negative predictive value for both parameters. Receiver operating characteristic (ROC) curve analysis found that areas under the curve (AUC) of 0.87 for CL and 0.86 for the BS, showing relatively moderate diagnostic accuracy.The predictive role of CL and the BS can be explained by physiology of cervix of the uterus. A shorter CL of cervix can be more favorable for labor. This is due to easy collagen remodeling, decreased cervical resistance, and

increased cervical compliance, which facilitate uterine response to induction agents.[14, 15] A higher BS reflects optimal cervical dilation, effacement, consistency, position, and fetal station. These factors indicate that the cervix is ready for labor and high chance of vaginal delivery after induction.[16] Our findings are consistent with those of Abdullah[6] who conducted a comparative clinical trial involving 294 women in Malaysia. They reported that a CL≤27 mm and a BS ≥4 had moderate sensitivity (69.1% vs 67%) and specificity (60.9% vs 55%) for predicting successful labor induction. The correlation between CL and BS in their study was strong (r = 0.745, p <0.001) similar to our results. Although their areas under the curve were lower (0.672 for CLand 0.643 for BS) and the difference may be due to the fact that our study has larger sample size.Milatović et al.[11] conducted another study on 252 women in Serbia and reported that both CL and BS were predictors of successful labor induction. They also reported additional ultrasound parameters, including cervical funneling, posterior cervical angle, and fetal head position, as important predictors. Although our study did not assess these additional measures but our results support their conclusion that CL and BS are reliable indicators of induction outcomes, showing similar or slightly higher predictive accuracy. Pirzada et al.[13] conducted an investigation in Pakistan on 110 women undergoing labor induction. They found that a CL>27 mm was more predictive of cesarean delivery than a BS ≤5. They reported that CL may better identify women at risk of induction failure. Li et al.[12] analyzed 138 women in a retrospective study and reported that a shorter CL(<3.415 cm) was strongly associated with successful induction (OR = 6.22), whereas the BS did not independently predict outcomes. These findings support our results that the use of CL measurement by transvaginal ultrasound as a reliable predictor.In addition to predictive accuracy, transvaginal ultrasound assessment is often preferred by patients due to lower discomfort compared with digital cervical examination, as highlighted by both Abdullah et al. and Milatović et al. This aspect enhances clinical applicability, particularly in outpatient or pre-induction counseling, and may improve patient satisfaction and compliance.This study has some limitations. Although it was prospective, several important variables were not recorded. These included detailed maternal comorbidities, specific indications for induction, cervical consistency and position beyond the Bishop score, and intrapartum factors such as uterine contraction patterns and clinician decision-making. The absence of these variables may have affected control of confounding factors and could have influenced the predictive performance of cervical length and Bishop score. The study was conducted at a single center and used a non-probability sampling method, which may limit generalizability. Future studies with a broader set of clinical variables and multicenter designs are recommended.

CONCLUSION

Our study shows that both CL and BS are reliable predictors of labor induction success. The slightly higher accuracy observed in our larger cohort highlights the advantage of using both clinical assessment and ultrasound measurements when planning induction. Future multicenter prospective studies should consider incorporating additional ultrasound parameters, maternal characteristics, and labor management factors to develop more precise predictive models.

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