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Prediction of Successful Induction of Labour Jointly Using Bishop Score and Transvaginal Sonography in Primigravida Women in Pakistan

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ABSTRACT

Objective: To assess the diagnostic efficacy of the Bishop Score and Transvaginal Ultrasonography (TVS) in predicting successful labor induction in primigravida women in a peri-urban population in Islamabad. Additionally, the study aimed to evaluate the effectiveness of combining the predictions from both methods to enhance accuracy in predicting successful labor induction.

Methodology: A prospective comparative study was conducted at the Departments of Obstetrics and Gynecology, Rawal Institute of Health Sciences, and Farooq Hospital, Islamabad, from December 2021 to December 2022. A total of 520 pregnant, primigravida women undergoing labor induction were included, and they were randomly divided into two groups for assessment using either the Bishop Score or Transvaginal ultrasonography. The outcome of interest was documented as the initiation of active labor within 24 hours. The efficacy of each method was validated separately and jointly, and the predictive accuracy of all three predictors was compared.

Results: The two groups demonstrated that both TVS and the Bishop Score were individually effective at predicting successful labor induction ($p<0.00001$ for both methods). TVS outperformed the Bishop Score in several key predictive measures, such as accuracy and the F1 Score. However, combining predictions from both the Bishop Score and TVS significantly improved both positive and negative predictive values (by more than 10% for each metric), resulting in a more reliable prediction.

Conclusion: Both the Bishop Score and TVS are effective methods for predicting successful labor induction in the peri-urban population of Islamabad, Pakistan. While TVS showed significant quantitative advantages over the Bishop Score, combining both predictors yielded even better performance, suggesting that using both methods together should be prioritized for prediction.

Key Words: Induction of labour, Bishop Score, cervical length on TVS, primigravidas.

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Introduction

Approximately 5-25% of all pregnancies require near-term induction due to various feto-maternal indications, as continuing the pregnancy can pose risks to both the mother and the fetus.[1–3] Induction of labor (IOL) carries clinical implications and unpredictable durations, leading to increased costs for both patients and hospitals.[3] Ensuring a reliable assessment of the success of labor induction is beneficial for the well-being of both the mother and the baby.

For a labour induction to be successful, cervical status has been recognised as the most important factor.[4-6] Transvaginal Ultrasonography and the Bishop Score are commonly used methods for assessing the cervix. USG

findings are highly sensitive for preterm labor and can predict the feasibility of successful onset of labor after medical induction.[7, 8] On the other hand, the Bishop Score involves a digital examination of the cervix, evaluating parameters such as cervical length, dilation, consistency, position, and station of the presenting part.[9-11] However, the subjective nature of the Bishop Score and inter-examiner variability can lead to confusion and discrepancies. Moreover, according to Kant[12] and Jackson[13], 50% of cervical length is supra-vaginal, showing variations from patient to patient and is, therefore, difficult to assess. Hence, having another method of cervical assessment to corroborate the Bishop Score may prove useful.

Transvaginal sonography (TVS) is a widely employed technique for evaluating the cervix, encompassing measurements of cervical length and position.[14, 15] In the context of primigravidas, TVS has been advocated for its high accuracy and considered the superior method for assessing successful labor induction.[16] Unlike other approaches, TVS offers a more objective assessment of cervical length, position, and initial changes at the internal os. Moreover, it is user-friendly, allowing easy learning and implementation, and enables the recording and documentation of images for later inter-observer discussion. An additional advantage is that TVS is non-invasive, resulting in a pain-free and comfortable experience for the patient. Notably, a study conducted in Srinagar, India, demonstrated that a cervical length of 3.00cm or less through TVS has a sensitivity of 84% and specificity of 70.7% in predicting the success of labor induction.[17]

Given the existing evidence, our study aims to assess the diagnostic accuracy of TVS and the Bishop Score in predicting successful IOL and explore the potential synergies between the two methods. Enhancing sensitivity and prediction accuracy in labor induction can assist clinicians in making informed decisions and empower couples in their choices.

Methodology

This prospective comparative study was carried out at the Departments of Obstetrics and Gynecology, Rawal Institute of Health Sciences, and Farooq Hospital, Islamabad, from December, 2021 to December, 2022. A total of 520 primigravida women who met specific inclusion criteria were enrolled using non-probabilistic convenience sampling. The prospective comparative clinical study aimed to compare various variables and interventions.

Women were included such as maternal age between 18 to 30 years, singleton pregnancy, full term (37 to 41 weeks), longitudinal lie, cephalic presentation, and estimated fetal weight of 2.5 to 3.5 kg. Exclusion criteria consisted of fetal compromise, gross fetal anomaly, estimated fetal weight over 3.5 kg, pre-labor rupture of membranes, previous uterine surgery, and contraindication to vaginal delivery. Informed consent was obtained from all patients.

The 520 pregnant primigravida patients admitted for induction of labor were randomly assigned to two groups: Group A (Bishop Score assessment) and Group B (TVS assessment). The Bishop Score was used to determine "Favorable" (Bishop Score ≥3) or "Unfavorable" (Bishop Score ≤3) status. In Group B, TVS measured cervical length, classifying it as "Favorable" (≤3cm) and "Unfavorable" (≥3cm). Bishop score calculation and TVS were performed immediately before induction.

All patients were induced with Prostaglandin E2 (vaginal 3mg pessary inserted in the posterior vaginal fornix). A second dose was administered if the patient did not enter labor within 6 hours after the initial dose. Intermittent electronic fetal monitoring was conducted for all women undergoing labor induction. Once in established labor, vaginal assessments were performed every 4 hours, unless otherwise indicated. The patients were followed until the initiation of active labor or for 24 hours. The outcome was documented as the initiation of active labor or the absence thereof. If the patient did not go into labor after 24 hours, it was considered a failed induction of labor. The findings were recorded on the proforma by the attending registrar.

Successful Induction of Labour (IOL): The initiation of active labour within 24 hours from the start of induction. Cervical Length by TVS: Length between internal cervical os and external os. (Figure 1)

The collected data underwent variable conversion and subsequent analysis utilizing the Statistical Package for Social Sciences (SPSS) version 25. The variables included in the analysis were as follows: 1) demographic information of patients, comprising age, height, weight, and body mass index (BMI), 2) indication for labor induction, 3) Bishop score, 4) cervical length assessed through transvaginal sonography (TVS), and 5) initiation of labor.

Efficacy and predictive strength of each prediction method (Bishop Score and TVS) was individually confirmed using Fisher's Exact Test.

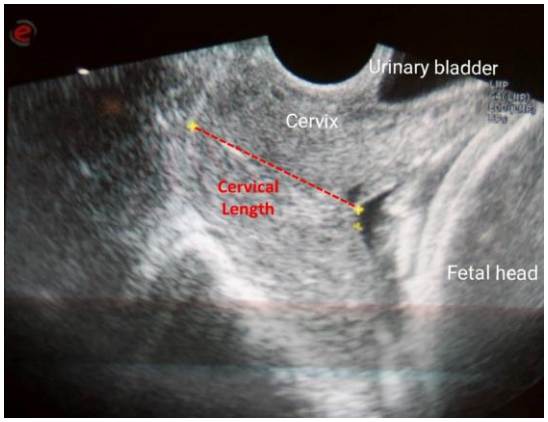

Figure 1: Transvaginal sonographic examination demonstrating measurement of cervical length from internal os to external os (Dashed red line).

Results

The study compared demographic variables (Age, Height, Weight, BMI) using the Mann-Whitney U-Test and "Gestational Age at Induction" using the Chi-Square Test with specified binning (Table I).

The mean age of participants was 20.6±1.9 years, with an age range of 8 years (minimum age 18 years, maximum age 26 years). The average gestational age was 39.7±0.9 weeks, ranging from 37 to 41 weeks. The mean cervical length for primigravida patients was 2.86±1.88cm. Group A had 53.2% of participants with favorable cervical lengths, while Group B had 63.2% (Table II).

Table I: Distribution of demographic characteristics and gestational ages in the two groups. (n= 520)

Variable	Group A (Bishop Score) (N=260)	Group B (TVS) (N=260)	P value
Age (years)	20.59 ± 2.23	20.05±1.58	0.153
Height (cm)	160.04 ± 10.94	161.84 ± 8.70	0.186
Weight (kg)	54.25 ± 10.82	53.52 ± 11.17	0.42
BMI (kg/m^2)	19.00 ± 3.74	21.03 ± 5.04	0.055
Gestational age at induction			1.0
37-38	14 (2.5%)	16 (3.0 %)	--
38-39	42 (7.5%)	38 (6.5%)	--
39-40	20 (3.5%)	14 (2.5%)	--
40-41	204 (36.5%)	212 (38.0%)	--

TVS outperformed the Bishop Score significantly in predicting induction of labor (chi-square statistic = 92.65, p<0.001, Mantel-Haenszel test). Descriptive measures in Table III indicated consistently higher prediction efficacy for TVS (Sensitivity, Specificity, Precision, Negative Predictive Value), and higher prediction errors for the Bishop Score (False Positive Rate, False Discovery Rate, False Negative Rate). Aggregate measures (Accuracy and F1 score) were also higher for TVS (Table III).

Table II: Results of induction of labour Bishop Score/ cervical length on TVS. (n=520)

Intervention	Successful induction Labor Prediction	Yes	No	Total	P Value
Group A: Bishop score (n= 260)					
	Favorable (> 3 score)	133	16	149	<0.00001
	Unfavorable (< 3 score)	83	48	131	
Group B: TVS (n= 260)					
	Favorable (< 3 cm)	166	11	177	<0.00001
	Unfavorable (> 3 cm)	50	53	103	

Table III: Descriptive measures on confusion matrices/contingency tables for each methodology (larger value is emboldened)

Metric	Bishop Score	TVS
Sensitivity	0.6157	0.7685
Specificity	0.75	0.8281
Precision	0.8926	0.9379
Negative Predictive Value	0.3664	0.5146
False Positive Rate	0.25	0.1719
False Discovery Rate	0.1074	0.0621
False Negative Rate	0.3843	0.2315
Accuracy	0.6464	0.7821
F1 Score	0.7288	0.8448

Table IV presents the results of combining the Bishop Score and Transvaginal Sonography (TVS) to improve prediction accuracy for induction of labor. The focus was on the positive predictive value (PPV) and negative predictive value (NPV) when both tests produced the same outcome. Resulted in significantly improved PPV and NPV, indicating that using both the Bishop Score and TVS together is highly recommended for predictive purposes in clinical cases.

Table IV: Comparison of PPV and NPV for individual and combined metrics (larger value is emboldened)

Metric	Bishop Score	TVS	Combination
PPV	0.62	0.77	0.97
NPV	0.74	0.82	0.95

Discussion

Induction of labour is the initiation of uterine contractions through medical or surgical means before spontaneous onset of labour.[17] It is commonly done for postdate pregnancies, pre-labor rupture of membranes, and medical disorders in pregnancy.[18] As 20-30% of all pregnancies

require induction of labour, predicting success of induction is an important and challenging issue for the obstetrician.

Traditionally, the Bishop Score has been used to assess cervical status.[11] However, studies have shown that it may not reliably predict the success of labor induction, particularly in cases with an unfavorable cervix. Additionally, the subjective nature of the Bishop Score can lead to considerable variations among different examiners.[19] As an alternative, transvaginal sonography (TVS) is used as a more objective measure of cervical length. Different cutoff points are employed for cervical length and the Bishop Score.

A study by Meijer-Hoogeveen et al. supports the use of both the Bishop Score and TVS in providing valuable information for clinicians and patients making decisions regarding labor induction or expectant management at term. The same cutoff point for cervical length used in their study was applied in our present study to assess its predictive value.[20]

In our study, the majority of patients were aged between 18 and 26 years, with a mean age of 20.64 (SD = 1.925), consistent with findings reported by Agrawal et al. [21] Additionally, a large number of patients between the gestational age range of 37 to 41 weeks, that aligns with the results of a study conducted in Egypt by Garite et al.[22]

In our study, 77.1% of patients had successful inductions, while 22.9% of patients had unsuccessful inductions. These results were comparable with a study carried out by Agrawal et al. but in a prospective cohort study by Kamel et al. 90.1% had successful induction while only 9.9% of patients had failed induction of labour and underwent cesarean delivery.[21,23]

Different researchers have recorded different predictive values of Bishop Score for outcome of labour induction.[24] In our study, 133 patients with favourable Bishop Score had successful IOL and only 16 patients had failed inductions.

Furthermore, we found that prediction of labor using TVS outperformed prediction using the Bishop Score. The differences observed (e.g. a ~0.14 increase in Accuracy, and a ~0.12 increase in F1 Score) strongly warrant higher adoption of TVS versus the Bishop Score as these values far outstrip improvements in predictive efficacy seen by methodologies in many other domains.[25, 26] Future work will attempt to statistically test differences in prediction metrics (such as Sensitivity, Specificity, Accuracy) using bootstrapping procedures and will explore changes in the prediction quality of each method for demographic subsets of the population.

We also used a Bayesian update procedure to calculate the positive and negative predictive values for the individual metrics and their combination. For both metrics, we found significant increases in prediction accuracy of the combined measure (on the order of 10-20% improvements in accuracy). However, the prediction thresholds for each measure used in this study are derived from previous work, and hence do not account for covariation/combination between these measures. Hence, future work can also use machine learning methodologies to infer whether different thresholds are more effective when the values for each predictor are combined, rather than working with prediction probabilities.

Recent studies have shown that transvaginal ultrasonographic cervical measurements are comparable (or even superior) to Bishop score in assessing cervical ripeness for labour induction.[26] In our study 166 patients with favourable cervical length on TVS had successful induction of labour and only 11 patients had failed induction of labour showing cervical assessment to be highly predictive for success of IOL, similar to results shown by Kamel et al. at the Cairo University Hospital.[23] According to a research by Bahadori et al., the cervical length evaluated by TVS had a higher predictive value than Bishop Score for the effectiveness of induction, with sensitivity and specificity of 66% and 76% (respectively), as compared to Bishop Score's 77% and 56%.[25] Our study supports this finding, aligning with the research conducted by Gonen et al, who concluded that the transvaginal ultrasonographic evaluation of the cervix prior to labor induction does not enhance the prediction of cervical inducibility determined by the Bishop Score.26 Notably, both studies encompassed various indications for labor induction.

Induction of labour is a common intervention in obstetrical practice. Bishop Score and cervical assessment by TVS are useful tools to make informed choices regarding method and timing of induction of labour and also mode of delivery. The findings of our study will aid the obstetrician and pregnant woman to make a decision based on specific background risk of cesarean delivery.

Our study has a few limitations. We used convenience sampling which limits generalizability of our findings. The procedures were performed in an academic setting with highly trained staff. The expertise of staff performing the

procedures may be lower in smaller clinics and rural hospital.

The advantages of the current study include: 1) enrolling a reasonable sample of women, 2) including patients from different ages, 3) a peri-urban setting in a developing country. Furthermore, all participants completed the study which increases the reliability of our findings.

Conclusion

In conclusion, our study demonstrates that both Bishop Score and TVS findings are highly reliable predictors of successful labor induction in primigravida women. Importantly, TVS performs significantly better than the Bishop Score in this population. Therefore, incorporating TVS into the assessment of induction success enables improved counseling for couples and reduces the risk of complications associated with failed inductions.

References

1. Getahun D. Epidemiologic considerations: scope of problem and disparity concerns. Clin Obstet Gynecol. 2014;57(2):326-30. https://doi.org/10.1097/GRF.0000000000000021
2. Osterman MJ, Martin JA. Recent declines in induction of labor by gestational age. NCHS Data Brief. 2014; 155):1-8.
3. Kamlungkuea T, Manonai J, Suriyawongpaisal P, Hansahiranwadee W. Factors Predicting Successful Vaginal Delivery Following Induction of Labor in Term Pregnancy. Int J Womens Health. 2022; 14:245-255. https://doi.org/10.2147/IJWH.S347878
4. Chhabra S, Varma P. Cervical status as a predictor of preterm labour. J Indian Med Assoc. 1992; 90(10):261-2.
5. Hutchison J, Mahdy H, Hutchison J. Stages of Labor. [Updated 2023 Jan 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK544290/
6. Romero JA, Downes K, Pappas H, Elovitz MA, Levine LD. Cervical length change as a predictor of preterm birth in symptomatic patients. Am J Obstet Gynecol MFM.2021;3(1):100175. https://doi.org/10.1016/j.ajogmf.2020.100175
7. Berghella V, Saccone G. Cervical assessment by ultrasound for preventing preterm delivery. Cochrane Database Syst Rev. 2019;9(9):CD007235. https://doi.org/10.1002/14651858.CD007235.pub4
8. Lim K, Butt K, Crane JM, Morin L, Bly S, Butt K, et al. Ultrasonographic cervical length assessment in predicting preterm birth in singleton pregnancies. J Obstet Gynaecol Can .2011; 33(5): 486-499. https://doi.org/10.1016/S1701-2163(16)34884-8
9. Kolkman DG, Verhoeven CJ, Brinkhorst SJ, van der Post JA, Pajkrt E, Opmeer BC, et al. The Bishop score as a predictor of labor induction success: a systematic review. Am J Perinatol. 2013 ;30(8):625-30. U=https://doi.org/10.1055/s-0032-1331024
10. Strobel E, Sladkevicius P, Rovas L, De Smet F, Karlsson ED, Valentin L. Bishop score and ultrasound assessment of the cervix for prediction of time to onset of labor and time to delivery in prolonged pregnancy. Ultrasound Obstet Gynecol. 2006;28(3):298-305. https://doi.org/10.1002/uog.2746
11. Bishop EH. Pelvic Scoring for Elective Induction. Obstetrics & Gynecology.1964; 24(2):266-268.
12. Kant RH, Bashir A, Gupta S. Study of transvaginal sonographic assessment of cervix in predicting the success of labour induction in nulliparous women. JK Science. 2016;18(1):6.
13. Jackson GM, Ludmir J, Bader TJ. The accuracy of digital examination and ultrasound in the evaluation of cervical length. Obstet Gynecol. 1992 ;79(2):214-8. https://doi.org/10.3109/01443619209013646
14. Chandra S, Crane JM, Hutchens D, Young DC. Transvaginal ultrasound and digital examination in predicting successful labor induction. Obstet Gynecol.2001;98(1):2-6. https://doi.org/10.1016/S0029-7844(01)01386-2
15. Abdullah ZHA, Chew KT, Velayudham VRV, Yahaya Z, Jamil AAM, Abu MA, Ghani NAA, et al. Pre-induction cervical assessment using transvaginal ultrasound versus Bishops cervical scoring as predictors of successful induction of labour in term pregnancies: A hospital-based comparative clinical trial. PLoS One. 2022;17(1):e0262387. https://doi.org/10.1371/journal.pone.0262387
16. Tanvir, Ghose S, Samal S, Armugam S, Parida P. Measurement of cervical biometry using transvaginal ultrasonography in predicting preterm labor. J Nat Sci Biol Med. 2014;5(2):369-72. https://doi.org/10.4103/0976-9668.136189
17. Beigh M, Mir MF, Amin R, & Shafi S. Role of transvaginal ultrasound in predicting preterm labor in Singleton pregnancies. Int. j. reprod. contracept. obstet.gynecol.2018;7(2):561. https://doi.org/10.18203/2320-1770.ijrcog20180172
18. Gill P, Lende MN, Van Hook JW. Induction of Labor. [Updated 2023 Feb 20]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459264/
19. Antsaklis, P. Intrapartum Ultrasound and Bishop Score: A New Obstetric Tool. in Intrapartum

Ultrasonography for Labor Management: Labor, Delivery and Puerperium (ed. Malvasi, A.) 75-84 (Springer International Publishing, 2021). https://doi.org/10.1007/978-3-030-57595-3_8

20. Meijer-Hoogeveen M, Roos C, Arabin B, Stoutenbeek, P, & Visser GH. Transvaginal ultrasound measurement of cervical length in the supine and upright positions versus Bishop score in predicting successful induction of labor at term. Ultrasound in Obstetrics and Gynecology.2009; 33(2): 213-220. phttps://doi.org/10.1002/uog.6219
21. Agrawal A, Tripathi PS, Bhandari. Comparative study of TVS cervical score and Bishop score in prediction of successful labour induction. Egypt J Radiol Nucl Med.2022;53:138. https://doi.org/10.1186/s43055-022-00794-0
22. Garite TJ, Casal D, Garcia-Alonso A, Kreaden U, Jimenez G, Ayala JA, Reimbold T. Fetal fibronectin: a new tool for the prediction of successful induction of labor. Am J Obstet Gynecol. 1996 ;175(6):1516-21. https://doi.org/10.1016/S0002-9378(96)70100-X
23. Kamel RA, Negm SM, Youssef A, Bianchini L, Brunelli E, Pilu G, Soliman M, Nicolaides KH. Predicting cesarean delivery for failure to progress as an outcome of labor induction in term singleton pregnancy. Am J Obstet Gynecol. 2021;224(6):609.e1-609.e11. https://doi.org/10.1016/j.ajog.2020.12.1212
24. Hafeez S, Akhter M, Siddique S & Jabeen, S. Induction of Labour: Accuracy of Transvaginal ultrasonography and Bishop Score (Manual Examination) in Prediction of Successful Induction of Labour at Term. The Professional Medical Journal.2019;434-437. https://doi.org/10.29309/TPMJ/2019.26.03.3266
25. Bahadori, Fatemeh et al. Predicting factors on cervical ripening and response to induction in women pregnant over 37 weeks. Medical ultrasonography.2013;15(3):191-8. https://doi.org/10.11152/mu.2013.2066.153.fb1ha2
26. Gonen R, Degani S, Ron A. Prediction of successful induction of labor: comparison of transvaginal ultrasonography and the Bishop score. Eur J Radiol. 1998;7(3):183-7. https://doi.org/10.1016/S0929-8266(98)00042-1