ORIGINAL ARTICLE
THE EFFICACY OF TVS IN MEASURING CERVICAL PARAMETERS COMPARED TO THE BISHOP SCORE FOR PREDICTING LABOUR INDUCTION OUTCOMES

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Background: Labour induction requires accurate assessment of cervical readiness. The Bishop score is commonly used but is subjective and variable. Transvaginal ultrasonography (TVS) offers a more standardized approach. This study compares TVS and the Bishop score in predicting labour induction outcomes. Aim and objective was to evaluate the efficacy of TVS in measuring cervical parameters compared to the Bishop score for predicting labour induction outcomes. **Methods**: This is a descriptive cross-sectional study conducted at Pakistan Air Force Hospital, Kamra and Pakistan Air Force Hospital, Islamabad from December 2023 till May 2024. Pregnant patients with cephalic singleton pregnancies were included. TVS and Bishop scores were recorded, and labour induction was initiated based on these scores. Data were analyzed using SPSS. **Results**: Of 100 participants, most were between 19 and 32 years old (mean age 21.23 years) and more than 39 weeks pregnant. Induction success rate was 81%. TVS scores above 4 correlated with successful inductions (93.2% success rate), while lower scores had a higher failure rate (93.24% sensitivity, 73.08% specificity). **Conclusion**: TVS is more accurate than the Bishop score in predicting labour induction outcomes. Its wider adoption could improve the success of labour induction and reduce complications.

Keywords: Labour Induction; Transvaginal Ultrasonography; Bishop Score; Cervical Assessment; Pregnancy; Obstetrics

INTRODUCTION

Labour induction artificially starts uterine contractions after the foetus is viable to achieve a vaginal delivery.[1] Globally, about 20% of women undergo induction of labour[2], mainly due to overdue pregnancies (27%) and labour not starting after the membranes break (26%).[3]

It is crucial to assess several factors before inducing labour, such as gestational age, the structure of the pelvis, the cervix's condition, foetal lung maturity, and the foetus's position and presentation. The cervix's condition significantly affects induction success. Choosing appropriate cases and timing reduces risks like foetal distress, meconium in the amniotic fluid, eclamptic seizures, and maternal blood clotting disorders. The Modified Bishop's scoring system, which assesses the cervix's position, consistency, length, dilation, and foetal position, is commonly used. However, its reliance on manual exams leads to varied assessments, prompting the need for more standardized evaluation methods.[4]

Transabdominal ultrasonography (TAS) for cervical evaluation in IOL needs a full bladder, which may alter cervical measurements, hiding changes like shortening or funnelling and is influenced by factors such as bowel gas and maternal obesity. Consequently, transvaginal ultrasonography (TVS) has become the preferred method.[5] TVS effectively assesses the cervix's upper part, which is hard to gauge manually but is easily scanned with TVS. Additionally, ultrasound results are more consistent, reducing differences between observers.

Prior investigations have evaluated the precision of ultrasound technology in predicting the effectiveness of induced labour (IOL), predominantly through transvaginal assessments of cervical dimensions and additional criteria. In our recent study, we measured four specific parameters related to cervical assessment: cervical length, cervical position, the dimensions of the funnel at the internal cervical os, and the distance between the external cervical OS and the presenting foetal part.

These metrics correspond to the components of the Bishop Score. Specifically:

- Cervical length reflects the degree of effacement.
- The distance between the external cervical OS and the presenting foetal part indicates the foetal station.
- The funnel dimensions represent the extent of dilation.

Importantly, cervical funnelling, which suggests a favourable induction outcome, is associated with a reduced duration of labour.[6] Additionally, assessment of the distance between the external cervical OS and the presenting foetal part, often determined by the foetal head's position relative to the ischial spines during a clinical examination, is crucial. Nevertheless, manual evaluations of the foetal station are subject to variability and lack precision.[7] Radiological techniques offer a more reliable prediction of successful induction of labour.

This study aims to ascertain the efficacy of transvaginal ultrasound in measuring cervical parameters for the prediction of results of induction of labour by comparing these objective measurements with the subjective evaluations derived from the Bishop score for readiness of cervix for labour.

MATERIAL AND METHODS

This study was designed as a descriptive cross-sectional at Pakistan Air Force Hospital, Kamra and Pakistan Air Force Hospital, Islamabad from December 1, 2023 to May 31, 2024 after obtaining ethical approval from our institutional ethics committee. This research covered the period from April 2020 to September 2021. The study enrolled pregnant patients with cephalic presentation of a singleton pregnancy who were candidates for a normal or assisted vaginal delivery. The study excluded all patients with multiple pregnancies, patients with severe maternal or foetal complications, malpresentations, active genital infections, patients with history of past uterine surgeries such as myomectomies or caesarean sections, or contraindications to the use of prostaglandins in labour induction. Clinical evaluations, including Bishop Score outcomes, were carried out and recorded. We used a 5–9 MHz TVS probe for transvaginal ultrasound exams, adhering to standard protocols. The ultrasound of the cervix identified three key anatomical features in the sagittal view: external os, the endocervical canal, and the internal os. We followed the methodology of Bajpai et al. to calculate TVS scores[4], which could range from 0 to 10, with 10 representing the highest possible score. Measurements were taken three times, and the shortest was used for analysis. A cervix was considered unfavourable if either the Bishop score or the TVS cervical score was 4 or less. Labour induction was initiated within one hour of the cervical evaluation, with successful induction defined as achieving active labour with regular uterine contractions every 2–3 minutes and cervical dilation of at least 4 cm within 24 hours.

Our study included 100 patients who underwent cervical length assessments by TVS before labour induction. We collected and analyzed data using Microsoft Excel and presented results in various charts and tables. Further data analysis was performed using SPSS. We calculated means, medians, and standard deviations for quantitative variables, and applied significance tests to assess changes in cervical conditions before induction by TVS, with $p<0.05$ indicating statistical significance. Binary logistic regression was used to identify key predictive variables in our study population.

RESULTS

The mean±SD age of participants in the study was 21.23±2.28 years, and they were between 36 and 40 weeks pregnant. Over half (53%) were at least 38 weeks pregnant. Additionally, 77% had been pregnant before and for 23% this was their first pregnancy. The most common reason for inducing labour was postdatism (62%), among others (table-1). In evaluating the modified Bishop's score, thirty-seven participants scored ≤4 before induction, and 63 scored >4. Using the TVS cervical scoring system, 24 scored ≤4, and 76 scored >4 before induction. The TVS score uses five criteria, detailed in Table 2. The success rate of labour induction was 74%, with a failure rate of 26%.

Of those who successfully underwent induction, 50 had a Bishop score >4, and 69 had a TVS score >4. Diagnostic details for both scoring systems are in Table-3.

Analysis of TVS parameters through binary logistic regression showed significant values ($p<0.005$) for cervical length and distance between the external cervical OS and the presenting foetal part in the backward stepwise elimination at step 3 (Table-4).

The success rate reached 90% when the TVS score exceeded 4, regardless of the Bishop score ≤4. In contrast, a lower TVS score resulted in a 20% success rate and an 80% failure rate, even if the Bishop score was >4 (Table-5).

We examined the relationship between the Bishop score and TVS score by looking at the Receiver Operating Characteristic curve. The results showed that the area under the curve for the TVS score was 0.909, and for the Bishop score it was 0.791. Both of these findings are statistically meaningful, with a p-value less than 0.05.

Table-1: Indication for induction of labour

Indication of induction	Number (%)
Postdate pregnancy	62 (62)
Gestational diabetes Mellitus	17 (17)
Preeclampsia	10 (1 0)
Moderate oligohydramnios	6 (6)
Premature rupture of membrane	3 (3)
Foetal distress	2 (2)
Total	IOO (100)

Table-2: Assessment of TVS parameters

TVS parameters	Criteria	Count (%)
Cervical length (cm)	>3	15
	≤3	85
Funnel length (cm)	Absent	12
	≤1	72
	>1	16
Funnel width (cm)	Absent	10
	≤1	69
	>1	21
Position of cervix (cm)	Curved	38
	Straight	62
Distance of presenting part to external os	>3	42
	≤3	58

Table-3: Comparison of sensitivity, specificity, and value

Statistic	Bishop score (%)	predictive TVS score (%)
Sensitivity	67.57	93.24
Specificity	65.38	73.08
Positive Predictive Value	84.75	90.79
Negative Predictive Value	41.46	79.17
Accuracy	67	88

Table-4: Results of binary logistic regression for outcome of induction

TVS parameters		Odd ratio	95% C.I.for odd ratio		p value
			Lower	Upper	
Step 1	Cervical length	28.96	6.4	112.92	0.002
	Funnel length	0	0	0.3	0.18
	Funnel width	0.13	0.002	7.84	0.325
	Distance between presenting part and the external os	0.05	0.001	1.92	0.11
	Position of cervix	2.84	0.4	21.08	0.31
Step 3	Cervical length	25.26	8.23	49.5	0.002
	Distance between presenting part and the external os	0.03	0.001	1.044	0.05

Table-5: Relation between bishop score and TVS score with outcome of induction of labour

		TVS score	Number	Outcome	
				Success	Failed
				Count (%)	Count (%)
Bishop score	≤4	≤4	19	4 (21.05)	15 (78.94)
		>4	22	20 (90.90)	2 (9.09)
	>4	≤4	5	1 (20)	4 (80)
		>4	54	49 (90.75)	5 (9.25)

DISCUSSION

In our study, most subjects were between 19 and 28 years old, with an age of 21.23±2.28 years. Our study population was younger than that reported in literature.[2,8] Likewise, 53% of our participants were at least 38 weeks pregnant, which is similar to the 37–42 weeks found in research.[2,8,9] Our analysis did not find a significant relationship between gravidity and the success of induction, echoing the findings of Bajpai *et al*.[4]

The main cause for induction in our research was postdatism at 67%, followed by gestational diabetes mellitus at 13%. This pattern resembles that found in Pandis *et al*.[9], where postdatism and preeclampsia were predominant. The induction success rate in our study was 74%, closely matching the 86.9% success rate reported elsewhere in literature with a corresponding failure rate of 26%.[2,4]

In our study, we examined the Bishop scores of participants. Among them, 59% scored above 4, with 67.6% achieving successful labour induction, while 34.6% experienced failure. Conversely, among the 41% scoring 4 or lower, 65.4% had induction failures, and 32.4% succeeded. These findings underscore the Bishop score's significance in predicting induction outcomes. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy rates were 67.57%, 65.38%, 84.75%, 41.46%, and 67.00%, respectively. These results align with previous studies.[8,10–12] The Bishop score's lower sensitivity and specificity may stem from subjective assessments that occasionally misjudge the cervix's readiness for induction.

Our research indicated that the length of the cervix and the gap between the baby's presenting part and the external os are important factors in determining the success of induction, with the length of the cervix being the most important factor. This finding agrees with the work of Bajpai *et al*.[4] Additionally, we observed that cervical funnelling does not play a major role in predicting induction outcomes, which may be due to the fact that most of our patients were close to their delivery dates. This is consistent with the findings of Boozrjomerhri *et al*., who noted that funnelling tends to decrease as the baby's head moves downward.[13]

Using the TVS score, 93.2% of women with scores over 4 had successful inductions, while only 6.8% with scores of 4 or less succeeded. The TVS score showed a false-negative rate of 6.76%, with sensitivity, specificity, positive predictive value, negative predictive value, and accuracy rates of 93.24%, 73.08%, 90.79%, 79.17%, and 88.00% respectively, supporting the findings reported in the literature.[4]

When the Transvaginal Sonography (TVS) score was above 4, the success rate for labour induction was 90%, even when the Bishop score was 4 or less. However, if the TVS score was 4 or less and the Bishop score was above 4, the success rate dropped to 20%, with an 80% failure rate. These findings highlight that the TVS score is more accurate in predicting successful labour induction compared to the Bishop score. Specifically, the TVS score had a higher area under the Receiver Operating Characteristic (ROC) curve (0.911) compared to the Bishop score (0.735), which aligns with results reported elsewhere in literature (ROC= 0.907 vs. 0.815).[2,4]

The study highlights several key points:

1. Assessing Changes in the Cervix:
Clinically examining the internal os (the opening of the cervix) becomes challenging when the external os (the outer part of the cervix) is closed. This limitation makes it difficult to digitally assess the full length and configuration of the cervix.

2. Components of the Bishop Score:
The Bishop score, which assesses readiness for labour induction, has different components. Among these, cervical effacement (thinning) and dilation (widening) are better predictors of successful labour induction than other factors. Factors like cervical consistency and position may reduce the accuracy of the Bishop score's predictions.

3. Dynamic Changes and TVS Scoring:
Dynamic changes in the cervix before and during labour impact the prediction of labour induction outcomes, especially when Bishop scores are unfavourable. To address subjectivity and variability, the TVS (transvaginal sonography) scoring system uses five distinct parameters to evaluate the internal os and the entire cervical canal.

4. Cervical Funnelling and TVS:
Cervical funnelling (a specific shape change) is an important predictor of successful induction. TVS allows measurement of funnel length and width, and it provides a less uncomfortable way to visualize the cervix whether it appears curved or straight.

5. Objective Measurement of Distance:
Transvaginal ultrasonography also objectively determines the distance from the presenting part (usually the baby's head) to the external os. This measurement correlates with the head's position in the Bishop score, aiding in assessing labour readiness.

Transvaginal sonography (TVS) provides a more consistent and measurable way to assess the cervix compared to the subjective Bishop score. The Bishop score can vary significantly depending on the observer. Our study found that transvaginal sonography (TVS) is well-tolerated by patients. Therefore, we recommend using TVS for cervical evaluation in clinical practice, especially for monitoring term patients after an initial digital pelvic exam. This approach may reduce the need for frequent digital exams, which could potentially lead to premature rupture of membranes. Additionally, TVS allows for the detection of conditions like compound or occult cord presentations that might go unnoticed during a digital exam alone.

Conclusion:
Transvaginal ultrasonography is essential for evaluating cervical readiness before induction. Our research confirms its effectiveness in predicting successful labour induction outcomes better than the Bishop score. With wider availability, this technology might supplant the Bishop scoring system. We recommend incorporating transvaginal ultrasound into cervical assessments before induction to reduce complications from unsuccessful inductions.

Study limitations:
The study has several limitations that should be noted. Firstly, it was conducted at a single tertiary care hospital in Karachi, which could restrict the generalizability of the findings to broader populations with different healthcare settings and practices. Secondly, the sample size of 100 participants might be considered relatively small, potentially affecting the statistical power and the ability to detect smaller differences or associations. Thirdly, the study's exclusion criteria, such as excluding patients with multiple pregnancies or severe maternal or foetal complications, could introduce selection bias, limiting the study's external validity. Fourthly, the subjective nature of the Bishop score assessments and the reliance on transvaginal ultrasound (TVS)

measurements may introduce measurement bias, affecting the accuracy and reliability of the results. Additionally, the study's timeframe from April 2020 to September 2021 could limit the generalizability of the findings to other time periods with potentially different clinical practices or patient populations. Moreover, the findings are based on the use of TVS, which is operator-dependent and influenced by equipment quality and adherence to standard protocols, potentially impacting the reproducibility of the results in other settings. Furthermore, the study's focus on comparing TVS and the Bishop score for predicting labour induction outcomes limited the evaluation of other potential factors influencing induction success, such as maternal obesity or foetal presentation, thus restricting the comprehensive assessment of induction success predictors. Lastly, while ethical approval was obtained, detailed discussions on ethical considerations related to patient comfort and safety during TVS examinations were lacking, highlighting a potential limitation in patient-centered care and ethical practice. These limitations should be considered when interpreting the study's findings, and further research may be warranted to address these potential biases and limitations.

AUTHORS' CONTRIBUTION

AA: Literature search. AA: Conceptualization of study design. GS: Data collection, proof reading. ST: Data analysis. SS: Data interpretation. SA: Write-up.

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