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Comparative study Of TVS cervical score and Bishop score in prediction of successful labour induction

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Abstract

Background: In today's obstetric practice, induction of labour is a common procedure. Before the imaging era, the favourability of the cervix was assessed by manual examination scored as the Bishop Score. However, subjectivity and high inter- and intra-observer variability are limitations of this approach. This necessitates the implementation of an objective method of assessment. We used transvaginal sonography (TVS) as an objective method of assessment of cervix by TVS cervical score comprising of five different parameters; cervical length, funnelling at the internal os, distance from the presenting part to the external os, and cervix position. This study aims to evaluate the role of the pre-induction transvaginal ultrasonographic (TVS) cervical score in predicting labour outcome and comparing it to the Bishop score in patients undergoing induction of labour.

Methodology: This observational prospective study included 100 pregnant women admitted for labour induction at a single tertiary care centre. The TVS examination which consisted of five parameters was performed after the clinical Bishop scoring. The TVS scores were compared with the Bishop scores for all patients. Labour induction was done within one hour of examination and the outcome of the induction was recorded.

Results: The mean age was 25.87 years [SD = 4.35]. Labour induction was successful in 74% of patients. At cut-off Scores of ≥ 4, TVS cervical Score performed better than Bishop Score (Sensitivity 93.24 vs. 67.57%, Specificity 73.08 vs. 65.38%). ROC analysis indicated that Area Under Curve (AUC) was more for TVS Score (0.91, 95% CI 0.84–0.97), compared to Bishop Score.

Conclusion: Transvaginal ultrasonography is an objective method of cervical assessment. We conclude from our study that the use of TVS score which consists of five different parameters in cervical assessment provides a better prediction of successful labour induction than the Bishop score, and so can prevent various complications associated with induction failure.

Keywords: Transvaginal ultrasonography, TVS score, Bishop score, Cervical length

Background

Induction of labour (IOL) is defined as the process of artificial initiation of uterine contractions, any time after attainment of fetal viability, by a method that aims to secure vaginal delivery [1]. Induction of labour is one of the most common interventions practiced in the modern world [2]. Overall, throughout the world, up to 20% of women have labour induced by one method or the other. The more common indications include post-term pregnancy (27%), membrane rupture without labour (26%) [3].

Appropriate selection of cases is crucial prior to induction, for which it is necessary to confirm the gestational age, pelvic adequacy, cervical status, foetal lung maturity,

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foetal presentation, and lie. Out of those, cervical status is one of the most important factors in predicting the likelihood of successful induction of labour. Appropriate case selection at the right time can prevent a variety of dangerous complications, including foetal distress, meconium-stained liquor to the fetus, and repetitive convulsions, as in the case of eclampsia, and disseminated intravascular coagulation (DIC) to the mother.

The cervical favourability before induction is assessed by many scoring systems like the Field system, Pelvic scoring system by Lange, but the Modified Bishop's scoring System is most commonly used. The scoring system assesses the position, consistency, length, dilatation of the maternal cervix, as well as the station of the fetal presenting part. However, assessment of Bishop's score by digital examination is a subjective method to assess the cervical status to predict the success of labour induction and it has a high inter and intraobserver variability [4] which led to search for a more objective method of assessment.

Transabdominal ultrasonography (TAS) is used as an objective method for the assessment of the cervix for induction of labour but as it requires filling of the bladder which may spuriously lengthen the cervix, concealing cervical shortening or funneling, and also the resolution of the scan is hampered by bowel gas, maternal obesity, shadowing from fetal parts. Due to these disadvantages led to a preference for the transvaginal examination [5].

Transvaginal ultrasonography (TVS) has gained increasing application in obstetric in the area of induction of labour. The supravaginal portion of the cervix, which typically accounts for about half of cervical length, is very difficult to assess digitally but can be easily assessed by TVS. Furthermore, ultrasonography findings are reproducible eliminating, interobserver variability.

Several studies in the past have evaluated the efficacy of ultrasound in prediction of successful labour induction and have focused mainly upon transvaginal measurement of few parameters like cervical length and not on other equivalent ultrasound representatives of Bishop Score components.

In this study, we included five parameters—cervical length, funnel width and length at the internal os, distance from the presenting part to the external os, and position of the cervix. These parameters were selected to match the components of Bishop Score—cervical length was comparable to effacement of cervix, cervical station was represented as distance of the presenting part to the external os and cervical dilatation was assessed by measurement of width and length of the funnel. The cervical funneling is an important predictor of successful induction as its presence may associated with reduction of delivery time [6]. The distance of the presenting part from the external os is another relevant parameter for successful labour induction deteremined clinically by the head distance either above or below the ischial spine, which is determined through per vaginal examination. However, digitally assessed head station during intrapartum period many times is erroneous, inaccurate and not consistently reproducible by different examiners [7]. The radiological determined of head station along with other mentioned parameters, can provide a better way to predict successful labour induction.

So, this study aims to determine the role of transvaginal ultrasound, with its ability to objectively measure the cervical parameters to predict the outcome of induction and its comparison with the subjective assessment of the cervix obtained by the Bishop score.

Material and methods

This was a hospital-based Prospective Observational study, conducted in our institution after getting approval from the Ethics and Scientific Review Committee of M.Y hospital and MGMMC Indore. The duration of the study was from April 2020 to September 2021.

Inclusion criteria

Patient with singleton pregnancy in vertex presentation having no contraindication for vaginal delivery.

Exclusion criteria

The excluded cases included those patients with history of uterine surgery like previous LSCS, myomectomy, severe maternal or fetal compromise, active genital infections, malpresentation, having any contra-indication to induction of labour, nonreassuring CTG, having contraindications to prostaglandins or vaginal delivery.

All patients were subjected to the following

- Clinical examination- Bishop Score findings were recorded and tabulated.
- Transvaginal ultrasonography examination was done using a 5–9 MHZ TVS probe according to the standard guidelines.
- In the ultrasonographic assessment of the cervix, three anatomic landmarks were noted in the sagittal view: the internal os, the external os, and the endocervical canal. Following parameters were assessed for TVS score (Table 1) as proposed by Bajpai et al. [4]:
- Each parameter was scored on a scale of 0 to 10, with a maximum TVS score of 10.
- This procedure was repeated three times and the shortest measurement was recorded.

Table 1 TVS (Transvaginal Ultrasound) score by Bajpai et al. [4]

Parameters	0	1	2
Cervical length (cm)	> 3	2–3	< 2
Funnel length(cm)	Absent	≤ 0.5	> 0.5
Funnel width(cm)	Absent	≤ 0.5	> 0.5
Position of the cervix	Curved	–	Straight
Distance between presenting part to external os(cm)	> 3	2–3	< 2

- We defined unfavourable cervix as having either Bishop score of ≤ 4 or TVS cervical score of ≤ 4. Labour was induced within one hour of cervical assessment.
- In our study, the onset of active labour (i.e., regular uterine contractions at 2–3-min intervals and cervix dilatation of 4 cm or greater) within 24 h of induction was considered as successful induction criteria.

Sample size and statistical analysis

- The present study was done on 100 patients referred to our institution for cervical length assessment by TVS who were admitted for labour induction.
- Data was tabulated in Microsoft Excel sheet, for the analysis of data.
- Further depiction of data was done in the form of various tables and charts.
- SPSS was used to analyse the data.
- Mean, Median and standard deviation of the quantitative variables were calculated.
- Appropriate tests of significance were applied to assess changes of cervix prior to induction by TVS.
- $p < 0.05$ were considered statistically significant.
- Binary logistic regression is applied to find out good predictor variables.

Results

The mean age of study population was 25.87 years [SD = 4.35] and gestational age ranged from 37 to 41 weeks. The majority (53%) of the cases were in 40–41 weeks gestational age. More number of cases (77%) were multigravida (Fig. 1).

The most common indication for induction in our study was postdatism (67%) and other indications are shown in Table 2

On analysis of Modified Bishop's Score, 37 cases had a preinduction Score of ≤ 4 and 63 cases had a Score of > 4. On evaluation of TVS cervical scoring system, 24 cases had TVS Score of ≤ 4 and 76 cases had a preinduction TVS Score of > 4. TVS score was calculated by 5 different parameters as described in Table 3.

The successful labour induction was 74%, and failed induction rate was 26% (Fig. 2).

Out of the 74 pregnant women who had successful induction, 50 cases had bishop score > 4 and with respect to TVS score, 69 cases had > 4 scores. Then,

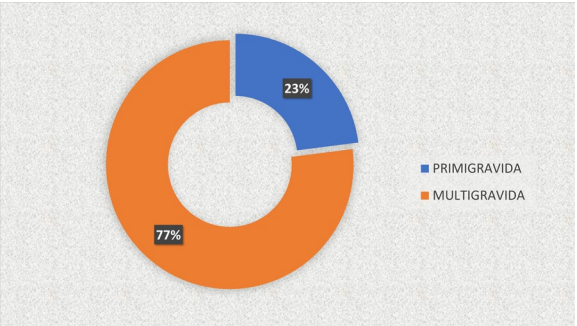


Fig. 1 Pie chart showing distribution of women according to gravidity

Table 2 Indication for induction of labour

Indication of induction	Number (%)
Fetal distress	2 (2)
Premature rupture of membrane	3 (3)
Moderate oligohydramnios	5 (5)
Preeclampsia	10 (10)
GDM	13 (13)
Postdatism	67 (67)
Total	100 (100)

Table 3 Assessment of TVS parameters

TVS parameters	Criteria	Count (%)
Cervical length (cm)	> 3	14
	≤ 3	86
Funnel length (cm)	Absent	11
	≤ 1	75
	> 1	14
Funnel width (cm)	Absent	11
	≤ 1	70
	> 1	19
Position of cervix (cm)	Curved	38
	Straight	62
Distance of presenting part to external os (cm)	> 3	42
	≤ 3	58

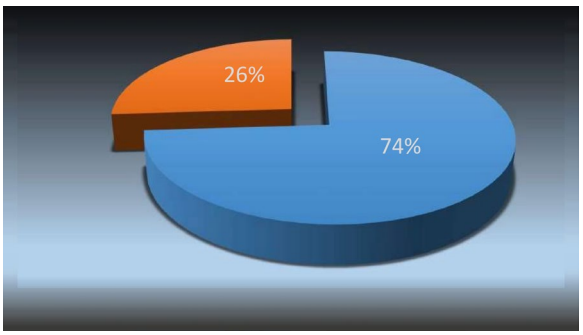


Fig. 2 Pie chart showing distribution of women according to outcome of labour induction

Table 4 Comparison of sensitivity, specificity, and predictive value

Statistic	Bishop score (%)	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	67.00	88.00

diagnostic parameters of both these methods were calculated which are shown in Table 4.

According to binary logistic regression applied on TVS parameters, only two parameters i.e. Cervical length and distance of presenting part to external os showed significant p value (< 0.005) at step 3 of backward stepwise elimination procedure (Table 5).

The success rate (90%) was higher when TVS score > 4, even if Bishop score was ≤ 4 and additionally when TVS score was less even if Bishop score > 4, the success rate (20%) was less and failure rate (80%) were higher (Table 6).

Table 6 Relation between bishop score and TVS score with outcome of induction of labour

		TVS score	Number Of cases	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)

Correlation of Bishop score with TVS Score was done by Receiver – operating characteristic curve (Fig. 3) in this study. The area under the curve for Bishop score is 0.791 ($p < 0.05$) & area under the curve for TVS score was 0.909 ($p < 0.05$) (Fig. 4).

Discussion

The majority of the cases in our study belonged to the age group of 19 to 37 years. The mean age was 25.87 years [SD = 4.35]. The demographic findings of our study are in concordance with previous study done by Bastani et al. [8] (the mean age of the participants was 29.9 years).

The majority of the cases were (53%) in the 40–41 weeks gestational age range. This is comparable to the results observed by Pandis et al. [9] and Bastani et al. [8] where the gestational range was also from 37 to 42 weeks.

Comparison was made between gravidity and successful induction, we found that, the relation was not statistically significant in our study. The result was comparable with the study conducted by Bajpai et al. [4].

In our study, we found that the most common indication for induction was postdatism (67%), followed by GDM (13%). Similarly, according to the study conducted by Pandis et al. [9] the most common

Table 5 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	7.382	11,366.920	0.002
	Funnel length	0.000	0.000	0.253	0.182
	Funnel width	0.125	0.002	7.844	0.325
	Distance of presenting part to external os	0.045	0.001	1.924	0.105
	Position of cervix	2.844	0.384	21.085	0.307
Step 3	Cervical length	25.26	8.235	7749.528	0.002
	Distance of presenting part to external os	0.030	0.001	1.044	0.045

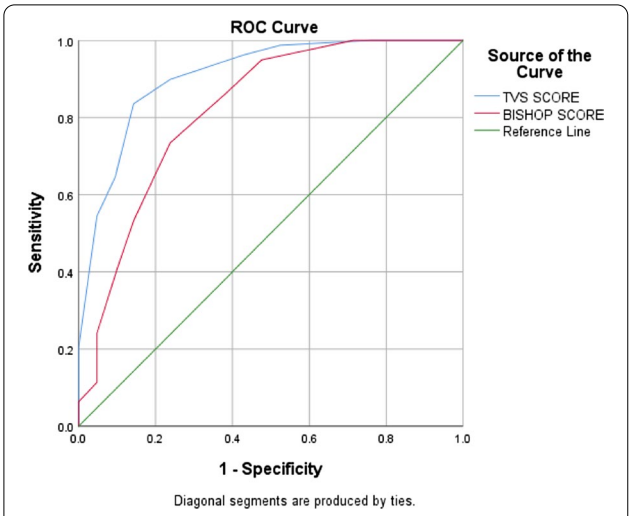


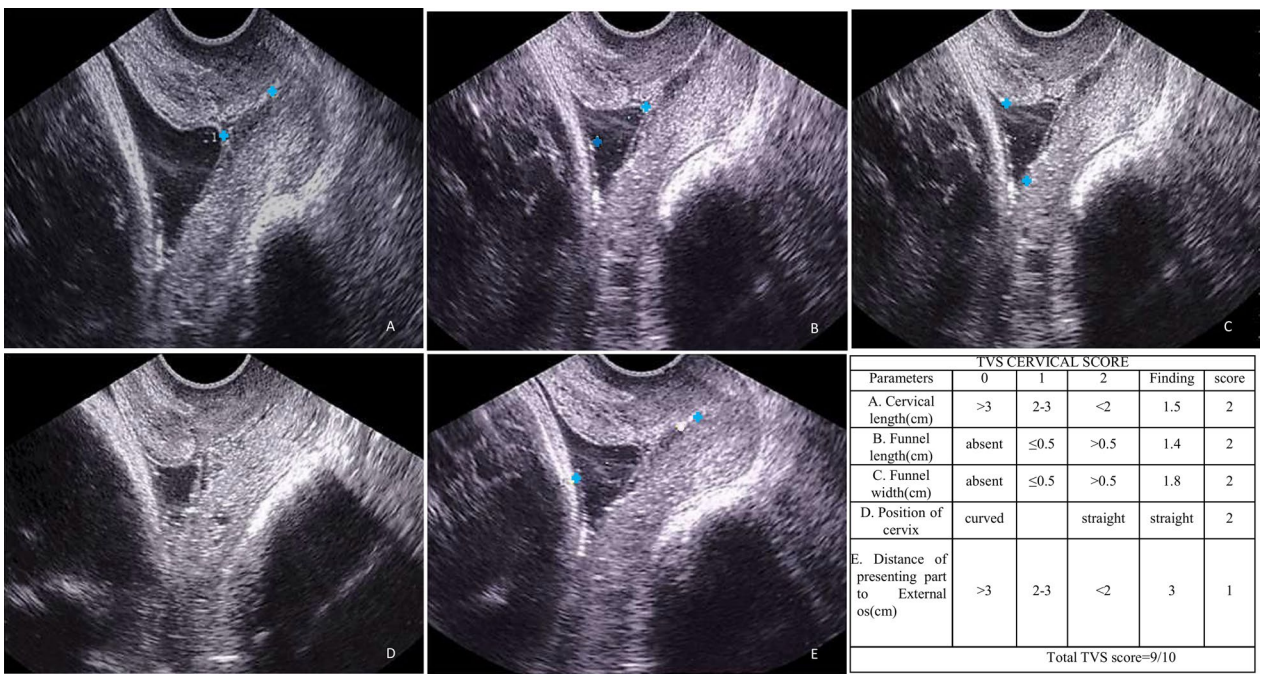
Fig. 3 Receiver–operating characteristic curves for the correlation of TVS score with Bishop Score

indications for induction were postdatism (60%) followed by preeclampsia.

In our study, labour induction was successful in 74% of cases, and failed induction was noted in 26% of cases. The result was comparable with the study conducted by Bajpai et al. [4]. Where labour induction was successful in 86.9% of cases and failed induction in 13.1%.

On evaluation with Bishop score, out of the hundred patients, most of them (59%) had score of > 4, while 41% cases had score < = 4. Of the total 59% cases having bishop score of > 4, 67.6% females undergone successful labour induction and 34.6% had failed induction. However, in 41 cases with Bishop score of < = 4, majority (65.4%) had undergone failed induction, while only 32.4% had successful induction. There was statistically significant difference with Bishop score of ≤ 4 versus > 4 in terms of induction outcome (for successful and failed induction). With false positive and false negative of 34.62% and 32.43%, respectively, we found Sensitivity, specificity, Positive Predictive Value, Negative Predictive Value and Accuracy of Bishop score in prediction of successful induction were 67.57%, 65.38%, 84.75%, 41.46% and 67.00%. These statistical data of our study was comparable with the study conducted by Raynelda et al.[10], Tan et al. [11], Ivars et al. [12] also with Gabriel et al. [8] study. This lower sensitivity and specificity of the Bishop score could be due to its subjective nature, and in few cases misinterpretation of cervix as favourable for successful induction with a high Bishop score, as in the case of cephalopelvic disproportion, despite the fact that the head floats high up in the pelvis, resulting in induction failure.

Out of the five different parameters of TVS score, the cervical length [Odd ratio = 25.26] and distance from



TVS CERVICAL SCORE

Parameters	0	1	2	Finding	score
A. Cervical length(cm)	>3	2-3	<2	1.5	2
B. Funnel length(cm)	absent	≤0.5	>0.5	1.4	2
C. Funnel width(cm)	absent	≤0.5	>0.5	1.8	2
D. Position of cervix	curved		straight	straight	2
E. Distance of presenting part to External os(cm)	>3	2-3	<2	3	1
Total TVS score=9/10					

Fig. 4 A 20-year-old female with gestational age of 40 weeks who admitted for induction of labour, and her Bishop score was 4, on TVS examination shows **A** cervical length-1.5 cm, **B** funnel length-1.4 cm, **C** funnel width-1.8 cm, **D** position of cervix-straight, **E** distance of presenting part to external os-3 cm constituting TVS score of 9/10 undergone successful labour induction even if Bishop score was less

presenting to external os [Odd ratio = 0.30] were found to be the two independent predictors of successful labour induction, in which cervical length found single most predictors for prediction of successful labour induction. The result was comparable with the study conducted by Bajpai et al. [4]

The cervical funneling was not found to be significant independent predictors for success of induction, it may be due to inclusion of patients towards term during which funneling may disappear due to descent of head. The result was similar with the study conducted by Boozrjomerhri et al. [13].

On evaluation with TVS score, majority (93.2%) of female had undergone successful induction, out of 76 cases with TVS score of > 4. And among 24 cases labelled as TVS score of < = 4, only 6.8% had undergone successful labour induction. With false negative of only 6.76%, we found Sensitivity, specificity, Positive Predictive Value, Negative Predictive Value & Accuracy of TVS score in prediction of successful induction were 93.24%, 73.08%, 90.79%, 79.17% & 88.00%. The result was comparable with the study conducted by Neha Bajpai et al.[4].

So, the success rate (90%) was higher when TVS score > 4, even if Bishop score was < = 4 and additionally when TVS score was less even if Bishop score > 4, the success rate (20%) was less and failure rate (80%) were higher. So, TVS score was more accurate as compared to the Bishop score in the prediction of successful labour induction (ROC = 0.911 vs. 0.735). The result is consistent with Neha Bajpai et al. [4], study (ROC = 0.907 vs. 0.815).

Several inferences can be considered on the basis of above results:

First, it is not possible to assess the changes of the internal OS via clinical examination when the external OS is closed, so the configuration of the internal OS and whole length of the cervix cannot be assessed by digital examination alone.

Second, the various components of the Bishop score may not have equal impacts on labour progression. Two parameters of Bishop score, i.e., effacement and dilatation of cervix both of which are indexes of cervical length, are more closely leads to successful labour induction than Bishop scores as shown by many studies. As a result, the involvement of other parameters involved in Bishop score assessment, such as consistency and position of cervix can reduce the efficacy of ability to predict successful labour induction.

Third, before or during labour, the dynamic changes of the cervix start from the internal os and progress towards external os. As only vaginal portion of cervix assessed by manual examination, Bishop's score may be limited in predicting labour induction outcomes, particularly in cases with unfavourable scores.

And lastly, Bishop score evaluation is biased by subjective and inter-observer variations.

All these shortcomings can be overcome by TVS scoring system as TVS score includes 5 different parameters, it offers advantages over the Bishop score by its ability to properly assess configuration of internal os, and the cervical length which is measured from the internal to the external os with visualization of the entire cervical canal, which are a better representative of cervical effacement.

Cervical funneling is an important predictor of successful induction as its presence associated with reduction of delivery time. The evaluation of funneling is easier to perform by TVS by measuring funnel length and width.

The position of cervix, whether it is curved or straight can be visualized using TVS with less discomfort to the patient. Again, distance of presenting part to external os which correlates with the head station detected by Bishop scoring system also can be objectively assessed.

Transvaginal sonography is an objective and reproducible method of assessment of the cervix than the Bishop scoring system which is subjective, with high inter and intra observer variation.

Because all of the patients in our study tolerated TVS well, we suggest assessment of cervix by this method which can be used in clinical practice to evaluate and follow up in term patients after the pelvis has been assessed by digital examination. This will help to reduce the frequent digital examinations, which can lead to premature rupture of membranes. Other co-existing findings, such as compound presentation, occult cord presentation can be documented, which can be easily missed if only a digital examination is performed.

Conclusion

Transvaginal ultrasonography is an essential tool for accurate assessment of pre induction cervical favourability. We conclude from our study that the use of this imaging tool in cervical assessment provides a better prediction of successful labour induction than the Bishop score. When such a facility becomes accessible, it has the potential to replace Bishop scoring system.

Being an objective tool, we recommend incorporation of transvaginal ultrasound as a part cervical assessment prior to induction of labour, so can prevent various complications associated with induction failure.

Abbreviations

TVS: Transvaginal ultrasonography; IOL: Induction of labour; CTG: Cardiotocography; LSCS: Lower segment Cesarean section; GDM: Gestational diabetes mellitus.

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Author contributions
All authors have contributed equally to this study. All authors read and approved the final manuscript.

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Availability of data and materials
All data supporting the findings of the current study are available within the article. Also, the datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
All study procedures were carried out after approval by the ethical committee of our institution.

Consent for publication
All participants in this study received a detailed explanation about the aim, objectives, and methodology of the study before enrollment. All subjects included in the current research gave their written informed consent to publish the data contained within the study.

Competing interests
We declare that we have no competing interest.

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