The Egyptian Journal of Hospital Medicine (October 2025) Vol. 101, Page 4779-4786

Value of Transvaginal Ultrasonography versus Bishop Score in Predicting Successful Induction of Labor

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ABSTRACT

Background: Since the supravaginal region makes up over 50% of the cervical length (CL) and cannot be measured digitally, transvaginal ultrasonography (TVU) measurements may provide a more precise evaluation of the cervix than digital exams. Furthermore, it might be challenging to assess effacement in the closed cervix since it is subjective and varies greatly across examiners.

Objective: This study aimed to determine if the CL, posterior cervical angle, and cervical funneling measurements obtained by ultrasound are reliable indicators of a successful labor induction and to confirm the accuracy of the recently developed objective rating systems for cervical favorability.

Patient and methods: This prospective comparative trial involved 50 women who were induced into labor between 1/6/2023 to 1/1/2025. Patients from Outpatient Clinic, Obstetric & Gynecology Department, Menoufia University Hospital were chosen for the study.

Results: The success rate of induction was 78.0%, while 22.0% was failed due to fetal distress and failure to progress. The sensitivity, specificity and accuracy of Bishop score (6 hours) were 88%, 91% and 90% respectively while They were 99%, 98% and 99% in the new scoring ultrasound system respectively. The sensitivity, specificity and accuracy of Bishop score (12 hours) were 80%, 84% and 81% respectively while they were 90%, 87% and 88% in the new scoring ultrasound system respectively.

Conclusion: A novel ultrasound scoring method that is more objective in its assessment helped improve the prognosis of the outcome of labor. Compared to Bishop's score, TVS evaluation of the cervix was a more accurate indicator of the effectiveness of induction of labor.

Keywords: TVU, Successful induction, Bishop score, Labor.

INTRODUCTION

When the benefits of inducing labor outweigh the risks of extending the pregnancy, as in past-date, intrauterine growth retardation (IUGR) or certain pregnancy-related medical conditions, it is always recommended [(1)]. Successful induction of labor has been linked to certain cervical features [(2)].

The Bishop Score is regarded as the gold standard for predicting the length of induced labor and its result [(3)]. Many researches have shown that the Bishop score, which measures the cervix's favorability, is very subjective and has a poor prognostic value for the result of induction of labor, particularly in women with low Bishop scores [(4)]. In women undergoing induction, it has been demonstrated that the sonographic evaluation of cervical length (CL) and occipital position is more accurate than the Bishop score in predicting the outcome of labor. Predicting the outcome of induction based on maternal features and pre-induction sonographic data may reduce the number of Cesarean deliveries and their complications [(5)].

The supravaginal component of the CL, which cannot be measured digitally, makes transvaginal ultrasonographic measures potentially a more accurate way to examine the cervix than digital tests. Additionally, it might be challenging to evaluate effacement in the closed cervix since it is subjective and varies greatly across examiners [(1)].

Transvaginal ultrasound assessment of the cervical region, on the other hand, is quantitative and readily repeatable [(7)]. The Bishop score was shown to be less accurate in predicting the outcome of labor in women undergoing induction of labor than the preinduction sonographic evaluation of CL and occipital position [(8)]. Therefore, this study aimed to determine whether the Ultrasonographic measurements of the CL, posterior cervical angel and cervical funneling are good predictors for successful induction of labor and to validate the predictability of new objective scoring systems for the cervical favorability.

PATIENTS AND METHODS

Patients: 50 women who had labor induction participated in this prospective comparative research. Patients who visited the Obstetric & Gynecology Department of Menoufia University Hospital's Outpatient Clinic were chosen as cases. Prostaglandin E2 (3 mg) was used to induce labor in situations with poor cervical conditions (with a Bishop score of 5–7).

Inclusion criteria: Age of 18-40 years old. One live fetus at a time. Over 37 weeks GA. Having unbroken membranes. The cervix's Bishop score is more than 5.

Exclusion criteria: Women who are pregnant with several fetuses. Females with malpresentations diagnoses. Intrauterine fetal distress (IUFD), or intrauterine fetal death. Any level of vasaprevia or placenta previa. Women who, according to routine clinical testing, have a significant degree of cephalopelvic disproportion. Any unsettling cardiotocography (CTG). Women who should not give

Received: 02/05/2025
Accepted: 04/07/2025

birth vaginally because they have aggressive cervical cancer or active genital herpes. A birth weight of less than 1500 g is considered extremely low. Cervical amputation, cerclage, cautery, or conization, among other procedures. Patients who had a Cesarean section or myomectomy in the past. Patients who were in labor when they were admitted. Refusing to take part in the research.

II. Methods:

Every patient underwent the following procedures: Demographic and obstetric characteristics. Detailed history taking. GA was estimated by the first-trimester ultrasound scan. TV scans.

Ultrasound assessment: With the woman in a supine position and slightly inclined to the left lateral side to prevent supine hypotension, an ultrasound was performed using a GE LOGIQ P7 machine fitted with a 4–7MHz transabdominal probe to assess fetal viability, weight, and welfare as well as to make sure that inclusion and exclusion criteria were being respected. After the women were instructed to empty their bladders, the same assessor used a 3.5–5 MHz transvaginal probe to evaluate them.

Assessment of Bishop score: Using the Bishop score, a digital vaginal examination was performed right after the TVS to determine the cervix's favorability. In order to increase validity and reduce inter-observer error, the researcher took this action. After positioning the patient dorsally, an antiseptic solution was swabbed from the vulva. The examiner inserted the right index and middle fingers into the vagina while wearing sterile gloves. The cervix was located and evaluated for each of the five Bishop score factors.

Labor induction was carried out in compliance with accepted practices by: When a cervix has a Bishop score below 7, ATCO Pharma's Prostaglandin E2 (3 mg) and Dinoglandin A senior registrar or consultant evaluated the cervical status using the modified Bishop score before inserting the tablets high in the posterior vaginal fornix. The capacity to reach the active phase of labor, which is defined as cervical dilatation of at least 4 centimeters, was the main consequence of the induction process. A scoring system was used for ultrasonic assessment of inducibility [(9)].

Ethical approval: The Ethics Committee of Menoufia University's Faculty of Medicine gave its approval to the project. Every patient provided written informed consent. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

Version 24.0 of the IBM SPSS software program was used to provide data into the computer. Numbers and percentages were used to describe the qualitative data. The X^2-test was used to compare several groups with respect to categorical variables. To evaluate quantitative parametric data, which were given as Mean ± SD, the unpaired student t-test was employed. The independent t-test was used to compare two independent populations with data that were regularly distributed. Two-tailed probabilities are used to quote the findings of significance tests. At the 5% level, the results' significance was assessed. It was deemed statistically significant when the two-tailed P value was ≤ 0.05.

RESULTS

Table (1) showed that succeeded cases were 39 (78%) while failed cases were 11 (22%) and causes of failure were 5 (45%) for fetal distress and 6 (54.6%) for failure to progress.

Table (1): Distribution of the studied group regarding the outcome of induction

Induction out comes	**Number**	**Percent**
Success	39	78.0
Failure	11	22.0
Cause of failure		
Fetal distress	5	45.4
Failure to progress	6	54.6
Total	50	100.0

There were no statistically significant difference between basic demographic data and induction outcomes ($P > 0.05$) (Table 2).

Table (2): Comparison between basic demographic data and induction outcomes

	Successful induction "n=39"		Failed Induction"n=11"		T test P value
Age (years)					
Range	19-39		19-37		0.895
Mean	29.10±6.10		28.64±7.13		0.415 N.S.
Height (cm)					
Range	158-172		158-172		0.847
Mean	164.90±4.57		164.64±5.07		0.435 N.S.
BMI (kg/m^2)					
Range	21.26-32.85		21.8-30.9		1.69
Mean	27.46±2.93		26.07±3.32		0.092 N.S.
Parity	**No.**	**%**	**No.**	**%**	
Nullipara	16	(41.0)	5	(45.5)	0.070
1-2	19	(48.7)	5	(45.5)	0.965
>2	4	(10.3)	1	(9.1)	
Gestation age (weeks)					
Range	37.00-40.00		37-40		1.29
Mean	38.69±1.03		38.45±1.04		0.251 N.S.

There was statistically significant difference between scoring system at start and after 6 & 12 hours. Also, Bishope scor at 6 and 12 hours with induction outcome ($P < 0.05$). While, there was no statistically significant difference regardin Bichop score at start ($P > 0.05$) (Table 3).

Table (3): Comparison between bishop score at start and induction outcomes

Total score	Successful induction "n=39"	Failed Induction "n=11"	P value
Bishop score at start	5.18±0.51	5.45±0.52	0.060N.S.
Scoring system (a new scoring ultrasound system) at start	5.56±2.47	3.64±1.57	0.009*
Bishop score after 6 hours of Dinoglandin dose	8.87±1.06	6.64±0.67	0.001*
Scoring system (a new scoring ultrasound system) after 6 hours of Dinoglandin dose	7.92±1.33	3.27±1.56	0.001*
Bishop score after 12 hours of Dinoglandin dose	9.70±0.91	8.09±1.30	0.001*
Scoring system (a new scoring ultrasound system) after 12 hours of Dinoglandin dose	9.18±1.74	6.73±1.10	0.004*

Table (4) showed that 2nd stage of progress of labour ranged from 25 to 60 minutes with a mean value of 40 ± 14.04 and 3rd stage ranged from 10 to 15 minutes with a mean value of 12.28 ± 1.75.

Table (4): Duration of 2nd and 3rd stage of labor

Progress of labor	Successful induction
2 nd stage (min)	
Range	25.0-60.0
Mean	40.00±14.04
3 rd stage (min)	
Range	10.0-15.0
Mean	12.28±1.75

There was no statistically significant difference between incidence of complications of labour with induction outcomes, APGAR score and primary haemorrhage ($P > 0.05$), while there was statistically significant difference regarding hospital stay ($P< 0.05$) (Table 5).

Table (5): Comparison between incidence of complication of labor and induction outcomes.

Complication of labor	Successful induction "n=39"		Failed Induction "n=11"		P value
	No	%	No	%	
Obstruction					
No	36	92.31	11	100.0	0.942 N.S.
Yes	3	7.69	0	0.0	
Haemorrhage					
No	34	87.18	11	100.0	0.673N.S.
Yes	5	12.82	0	0.0	
APGAR score					
at 1 min	6.69±1.17		6.09±1.04		0.066 N.S.
at 5 min	8.97±0.81		8.91±0.70		
Primary haemorrhage					
No	36	92.31	11	100.0	0.942 N.S.
Yes	3	7.69	0	0.0	
Hospital stay (hours)					
Range	16.00-24.00		40-60		0.001*
Mean	19.44±3.04		47.73±8.47		

There was statistically significant difference regarding sensitivity, specificity and accuracy of both Bishop score (6 hours) and a new scoring ultrasound system (6 hours) in predicting successful induction. (P< 0.05) (Table 6 and figure 1).

Table (6): Sensitivity, specificity and accuracy of both Bishop score (6 hours) and a new scoring ultrasound system (6 hours) in predicting successful induction

Test Result Variable(s)	Area	Cut off value	P value	Sensitivity	Specificity	Accuracy	95% C.I.	
							Lower Bound	Upper Bound
Bishop score (6 hours)	0.901	7.1	0.001*	88.0	91.0	90.0	.891	1.00
a new scoring ultrasound system (6 hours)	0.992	6.0	0.001*	99.0	98.0	99.0	.971	1.00

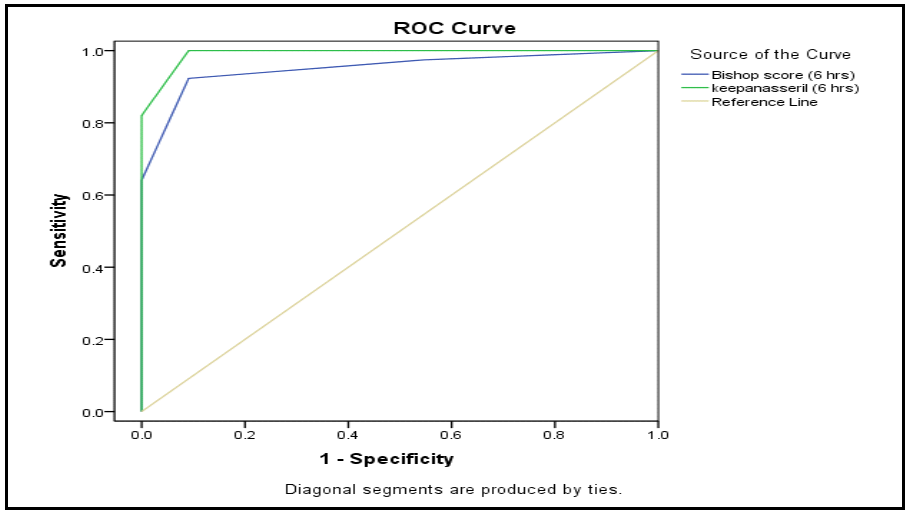

Figure (1): Sensitivity, specificity and accuracy of both Bishop score (6 hours) and a new scoring ultrasound system (6 hours) in predicting successful induction.

There was statistically significant difference regarding sensitivity, specificity and accuracy of both Bishop score (12 hours) and a new scoring ultrasound system (12 hours) in predicting successful induction. (P < 0.05) (Table 7 and figure 2).

Table (7): Sensitivity, specificity and accuracy of both Bishop score (12 hours) and a new scoring ultrasound system (12 hours) in predicting successful induction

Test Result Variable(s)	Area	Cut off value	P value	Sensitivity	Specificity	Accuracy	95% C.I.	
							Lower Bound	Upper Bound
Bishop score (12 hours)	0.832	8.2	0.005*	80.0	84.0	81.0	0.678	0.985
a new scoring ultrasound system (12 hours)	0.880	5.0	0.0001*	90.0	87.0	88.0	0.766	0.995

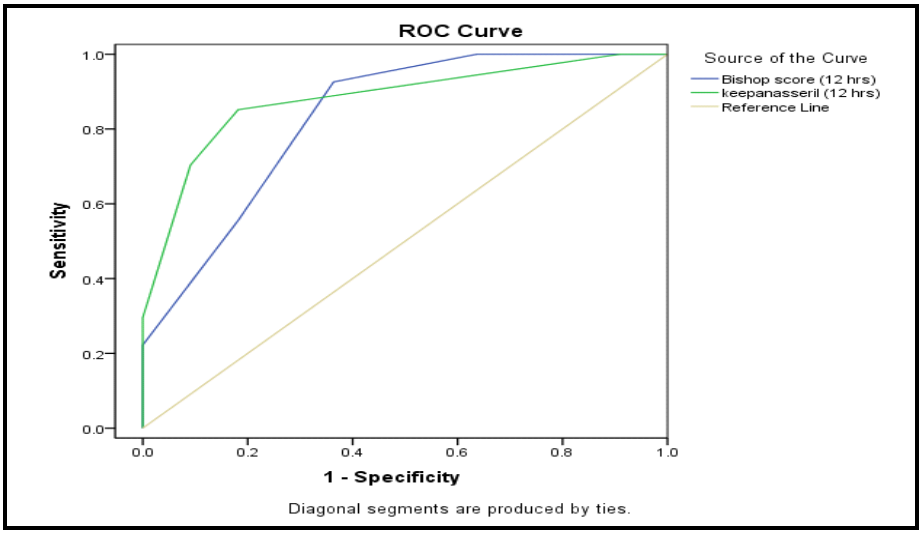

Figure (2): Sensitivity, specificity and accuracy of both Bishop score (12 hours) and a new scoring ultrasound system (12 hours) in predicting successful induction.

There was statistically significant relation between bishop score at 6 hours with a new scoring ultrasound system score at base line, between Bishop score at (6 & 12 hours) with a new scoring ultrasound system score at 6 hours and between Bishop score at base line, 6 &12 hours with a new scoring ultrasound system score at 12 hours (P< 0.05) (Table 8).

Table (8): Correlation between bishop score and a new scoring ultrasound system score at different period of follow up.

		Bishop score (base line)	Bishop score (6 hours)	Bishop score (12 hours)
A new scoring ultrasound system (base line)	Pearson Correlation	0.135	.350*	0.165
	P value	0.349	0.013	0.322
A new scoring ultrasound system (6 hours)	Pearson Correlation	-0.179-	0.653**	0.538**
	P value	0.213	0.000	0.000
A new scoring ultrasound system (12 hours)	Pearson Correlation	-0.348-*	0.410**	0.471
	P value	0.030	0.010	0.002

DISCUSSION

According to our study's findings, 78.0% of inductions were successful, whereas 22.0% failed because of fetal discomfort and inability to proceed. Similar to our research, **Eid *et al.*** [10] discovered that 30% of women had failed induction and were delivered by CS, whereas 70% of 50 participants had successful induction and vaginal delivery. **Agrawal *et al.*** [11] reported that most of the patients in their research were between the ages of 19 and 37 years, which is consistent with our findings. 25.87 ± 4.35 years old was the average age. Our research's demographic results, which showed that the participants' mean age was 29.9 years, are consistent with those of a prior study conducted by **Bastani *et al.*** [12].

We compared gravidity to effective induction and discovered that the relationship was not statistically significant in our study. The results are equivalent to those obtained by **Bajpai *et al.*** [13].

The Bishop score show insignificant difference between the succeded and failed cases at start, while **Scoring system (a new scoring ultrasound system)** showed a significant decrease in failed cases at start and after 6 and 12 hours where there was a significant decrease in both Bishop score and **Scoring system (a new scoring ultrasound system)** in failed cases less than succeded cases.

The sensitivity, specificity and accuracy of Bishop score (6 hours) was 88%, 91% and 90% respectively while it was 99%, 98% and 99% in a new scoring ultrasound system respectively. There was statistically significant difference regarding sensitivity, specificity and accuracy of both Bishop score (6 hours) and a new scoring ultrasound system (6 hours) in predict success of induction of labor. The sensitivity, specificity and accuracy of Bishop score (12 hours) was 80%, 84% and 81% respectively while it was 90%, 87% and 88% in a new scoring ultrasound system respectively. There was statistically significant difference regarding sensitivity, specificity and accuracy of both Bishop score (12 hours) and a new scoring ultrasound system (12 hours) in prediction of success of induction. This is consistent with **Yang *et al.*'s** [14] findings, which demonstrated a substantial correlation between effective induction and the Bishop Score and CL.

Our results differ from those of **Groeneveld *et al.*** [15] who decided to prevent Cesarean birth as much as possible by choosing a longer gap (96 hours) between the commencement of induction and vaginal delivery. In contrast to our study's 30% Cesarean birth rate, theirs was 17.3%. However, compared to our 48-hour interval, that extended time of labor may be viewed as an additional burden on the participants since it results in maternal tiredness and longer hospital stays, which raise morbidity and costs [15].

Our findings are supported by **Bastani *et al.*** [12] who discovered that TVU-measured CL might potentially take the place of the conventional Bishop score. We are also supported by **Rane *et al.*** [16] who discovered that parity and CL are reliable indicators of a successful vaginal birth within 24 hours of induction. **Tan *et al.*'s** [17] study, which involved 249 women who were hospitalized for labor induction, revealed that both the Bishop score and the CL ROC curves were predictive of Cesarean birth. Additionally, they discovered that transvaginal sonography was noticeably less uncomfortable than digital examination for determining the Bishop score.

The assumption that the same force is applied over a shorter distance may lead to a shorter CL and a more effective induction of labor. CL is brief, but the way the vector applied to the labor force is communicated can affect how effective the force is [18]. This force vector's predictable component is the UCA; if this angle is sharp, the force may be distributed by the vector, losing some of its initial labor force. On the other hand, if the angle is obtuse, the force may not be distributed by the vector, resembling the initial labor force [18]. According to **Paterson-Brown *et al.*** [19]**,** there was no correlation between CL and either the Bishop score or the interval of induction. Additionally, while the Bishop score was a strong predictor of a successful vaginal birth, it was not a reliable indicator of a successful labor induction. Although **Watson *et al.*** [20] found a substantial correlation between cervical effacement and ultrasonographic CL in the digital examination, neither factor was able to predict how long the latent phase of delivery would last. **Gonen *et al.*** [21] discovered that, in a multivariate model, only the Bishop score and parity were substantially linked to successful induction and the length of delivery, whereas both the Bishop score and CL were linked to both successful induction and the induction to delivery interval.

Bajpai *et al.* [13] developed the Manipal cervical scoring system by utilizing the following factors: CL, cervical position, funnel length and breadth, and distance of presenting portion to external. The ROC curve's AUC for successfully predicting the active phase of labor was 0.907, and a score of 4 or above yielded a sensitivity of 77% and a specificity of 93%. Bishop's score has a 0.815 AUC, a 65% sensitivity and an 86% specificity. In order to create a score, **Keepanasseril *et al.*** [9] employed the TVS characteristics of CL and posterior cervical angle in addition to parity. A score of six or above exhibited 84.6% specificity and 95.5% sensitivity for predicting vaginal delivery. In contrast, the Bishop's score of five showed a specificity of 80.8% and a sensitivity of 65.3%. TVS was therefore determined to be more effective than Bishop's score in predicting the induction's result among the aforementioned investigations. Patient parity and the use of various

criteria may be the cause of variations in sensitivity & specificity [13].

A number of earlier studies have evaluated the effectiveness of induction by comparing ultrasonographic results with the Bishop score. While several of these research have utilized bigger samples, the majority have employed smaller ones than ours. Despite minor variations in technique, CL has been proven to be a more accurate predictor than Bishop score in all larger-scale research, including ours [12]. The Bishop score has not been given much weight, CL has not been deemed the greatest predictor by many, and two studies have not revealed any difference in their predictive usefulness [22].

AUC comparisons and sensitivity & specificity metrics for specified cut points have not been included in studies that propose Bishop score as the best predictor. The AUCs reported for Bishop score vary greatly, occasionally falling as low as 0.46, and none of the other studies listed have found AUCs for CL to be between 0.66 and 0.89 [12]. **Rozenberg *et al.*** [23] compared the transvaginal CL and the pre-induction Bishop score in order to predict the time to birth in a research involving 266 women. They came to the conclusion that Bishop score was a more accurate predictor of vaginal birth and inducement to delivery than CL. With a hazard ratio of 1.2, 95% CI 1.1-1.3, a higher Bishop's score indicates a greater risk of vaginal delivery [24]. The study's inclusion of a diverse group aged 34–41 weeks was one of its limitations. Sonographic measurements may vary according on the GA since cervical ripening is a dynamic process that takes place in the third trimester before to the commencement of labor. CL is not likely to be a sign of cervical ripening, they added.

CONCLUSION

We discovered a substantial correlation between the Bishop score, the posterior cervical angle, and the ultrasonographic CL and effective induction of labor. We propose that a new, more objective scoring ultrasonography system might improve the ability to predict the outcome of labor. Compared to Bishop's score, the TVS evaluation of the cervix is a more accurate indicator of the effectiveness of labor induction.

No funding.

No conflict of interest.

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