Prediction of vaginal delivery using Bishop's score, modified Bishop's score, and Levine's score

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Abstract

Background: Induction of labor is a common procedure in obstetrics. Women are anxious about their chances for successful vaginal delivery. Different scoring systems are available for the prediction of vaginal delivery.

Objective: To determine the role of Bishop's score, modified Bishop's score, and Levine's score in the prediction of vaginal delivery.

Study design: This prospective cohort study was conducted at the emergency department of obstetrics and gynecology from June 2022 to February 2023. All healthy, multiparous women with full-term pregnancies were recruited according to predetermined inclusion and exclusion criteria. The cervical length, and cervical assessment to determine the Bishop score were done. The modified bishop score was calculated. Levine's score was calculated using a web-based calculator. Patients were evaluated for a) Duration of the first stage of labor, b) Duration of the second stage of labor, c) total duration of labor, and e) The mode of delivery at the end.

Results: The Levine score correlated significantly with the duration of the first stage of labor, total duration of labor, the dose of Misoprostol, and the mode of delivery (p-value 0.007, 0.008, 0.011, and 0.043, respectively). The dose of misoprostol (50 μg) and fetal head station predicted vaginal delivery significantly (OR 0.055, 95% CI 0.007- 0.408, p-value 0.005) (OD 0.143, 95% CI 0.035- 0.588, p-value 0.007).

Conclusion: The Levine score correlated significantly with the mode of delivery. However, no score predicted vaginal delivery significantly.

Keywords: vaginal delivery; bishop score; modified bishop score; Levine score.

Introduction

Labor induction is a commonly practiced obstetrical procedure with rates reaching 33% (1). The state of the cervix as favorable or unfavorable dramatically influences the success rate of induction (2). It is crucial to present accurate data about the success rate of induction

to laboring women, especially when using cervical ripening agents (3). The first described predictive score was the Bishop's score, 1964. It comprises five parameters retrieved from vaginal examination: cervical dilatation, effacement, position, consistency, and fetal head station. However, it showed a limited predictive value and was applied to multiparous women needing oxytocin-augmentation (4, 5). Multiple modifications were introduced regarding the original bishop score. In 1982, Lang et al used a score including cervical dilatation and effacement and fetal head station. They doubled the score concerning cervical dilatation, and reported better correlation with obstetric outcomes than the original score (6, 7). Then, transvaginal ultrasound was used to determine the cervical length, which replaced cervical effacement in the Bishop score and was called the modified Bishop's score (5). Levine's score was established for women undergoing induction of labor using cervical ripening agents. It included variables that are essential in decreasing the rate of successful induction which are maternal height, parity, and BMI at delivery, gestational age $\geq$ 40, and the modified bishop score (8). External validation of the Levine's score proved its effectiveness in predicting failed induction of labor (3). No studies compared the predictive value of each scoring system for predicting labor among multiparous women. Accordingly, this study was conducted.

Methods

This was a prospective cohort study conducted at the emergency department of obstetrics and gynecology, Suez Canal University, from June 2022 to February 2023. The medical ethical committee approved the study before commencement, and informed consents were obtained from all enrolled patients.

All healthy, multiparous women with full-term pregnancies presenting to the emergency ward were recruited according to predetermined inclusion and exclusion criteria. Inclusion criteria: a) Adult (>18 years) multiparous women, b) gestational age between 40 - 42 weeks, c) Uncomplicated singleton pregnancy with vertex presentation, and d) without ruptured membranes. Exclusion criteria: a) Women with chronic diseases or complicated pregnancy; gestational and pre-gestational (type 1 & 2) diabetes, preeclampsia and\or renal and\or maternal heart diseases, fetal growth restriction, and fetal anomalies, b) obstetric indication for cesarean delivery, c) women refusing to participate in the study, d) women presenting in the active phase of labor, e) history of cervical insufficiency, f) history of previous cervical surgery (cone biopsy, LLETZ), g) previous preterm births, and h) women with intrauterine fetal death.

Eligible women for the study were subjected to the following:

- **History was taken** to obtain their sociodemographic characteristics (age, education, occupation, gravidity, parity, residency, parity, and previous surgeries). Moreover, the gestational age was confirmed based on the last menstrual period and an early ultrasound evaluation.
- **Clinical examination:** Height and weight were measured. BMI was calculated and classified according to WHO classification (9).
- **Ultrasound evaluation:** Transvaginal ultrasound was performed using a Mindray DC- 60 machine with a transvaginal probe V 11-3B. A sagittal view of the cervix with no compression was obtained. The cervical length was measured from the internal to the external os with the cervical canal wholly visualized. Measurements were obtained after enrollment and before the start of induction protocol, with the bladder empty. A senior radiologist did the cervical length measurement for all cases. Three measurements were obtained for the cervical length, and the shortest one was considered in the analysis.

- **Cervical assessment:** to determine the Bishop score. A Bishop score of 8 or greater was considered to be favorable for induction. A score of 6 or less was considered unfavorable for induction with indicated cervical ripening agents (10).
- **Modified bishop score:** was calculated by replacing cervical effacement with cervical length (5).
- **Levine's score:** was calculated using a web-based calculator (8).
- **Induction of labor:** We used Misoprostol (Vagiprost, Adwia, El Oubor, Egypt) with a dose of 25 µg per vaginal every 6 hours (11). Failed induction was managed after patient counseling with a further attempt to induce labor or C.S. delivery (12).

For multiparous women, cervical dilatation of less than 2 cm/4hrs was considered a failure to progress. Delayed progress in the second stage of labor was suspected when no change in fetal head descent or rotation was observed for 1 hour. Every condition was managed according to the NICE clinical guideline (13). The following was reported:

a) The duration of the first stage of labor, including both the latent and active phases. The latent phase was identified with the initiation of painful uterine contractions accompanied by either change in cervical effacement or dilatation up to 4 cm. The duration was reported since admission. The active phase was identified by the occurrence of regular painful uterine contractions accompanied with dilatation of the cervix from 4 cm (13),

b) Duration of the second stage of labor,

c) Total duration of labor, and

e) The mode of delivery eventually.

The primary outcome measure was the predictive role of the three scoring systems in predicting successful induction of labor among multiparous women. Secondary objectives included correlation between the three scoring systems and successful vaginal delivery and factors affecting the duration of labor.

The sample size was calculated at a significance level of 95% and an error level of 10% using a proportion of vaginal delivery among women undergoing induction of labor using bishop score (68.29%), a sensitivity of 60.7% (14), and a drop out of 10%. The minimum number required was 148 pregnant women.

Ethical approval: This study was conducted after the approval of the research ethics committee on 21/6/2022 with a number of 4925#.

Statistical analysis: Data were reported as mean and standard deviation, frequencies, and percentages. P values less than 0.05 were considered statistically significant. All statistical operations were done using the SPSS program (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 23. Pearson correlation coefficient was calculated between parametric quantitative variables, and Spearman was calculated for others. Significance was considered when the p-value was < less than 0.05. Cox regression was done for survival analysis. Analysis was constructed with a vaginal delivery as the outcome measure.

Results

Two hundred and forty-nine women were eligible for the study. Twelve women declined to participate in the study, leaving a total number of 237 women recruited. The mean age of the studied population was 30.219 ± 2.04, with a mean parity of 1.78 ± 0.59. the great majority were from rural areas (126, 53.2%) and middle education (93, 39.2%). The gestational age at admission was 41.01 ± 0.78 (Table 1).

The mean Bishop, modified Bishop, and Levine scores were 4.70 ± 0.88, 5.63 ± 0.99,

and 0.14 ± 0.04, respectively. The probability of C.S. was 14.46 ± 4.05 (Table 2).

Two hundred twenty- nine women delivered vaginally (96.6%). The dose of Misoprostol was 59.6 ± 20.46. the total duration of labor was 474.68 ± 170.6 (min) (Table 3).

The bishop score correlated significantly with the duration of the first stage of labor and the total duration of labor (p-value 0.015 each). The modified bishop score correlated significantly with the dose of Misoprostol (p-value 0.01). The Levine score correlated significantly with the duration of the first stage of labor, total duration of labor, the dose of Misoprostol, and the mode of delivery (p-value 0.007, 0.008, 0.011, and 0.043 respectively) (Table 4).

The modified bishop score and Levine score differed significantly between women who delivered vaginally and those delivered by C.S. (p-value 0.028 and 0.043, respectively) (Table 5).

Multivariate logistic regression, the dose of misoprostol (50 µg) and fetal head station predicted vaginal delivery significantly (OR 0.055, 95% CI 0.007- 0.408, p value 0.005) (OD 0.143, 95% CI 0.035- 0.588, p value 0.007).

Using survival analysis, the dose of Misoprostol (50 µg) contributed significantly to the duration of labor (Figure 1).

Discussion:

The state of the cervix before induction plays a significant role in the possibility of having a successful vaginal delivery (7). The bishop score correlated significantly with the duration of the first stage of labor and the total duration of labor. The modified bishop score correlated significantly with the dose of Misoprostol. The Levine score correlated significantly with the duration of the first stage of labor, total duration of labor, the dose of Misoprostol, and the mode of delivery. In a previous study, the modified bishop score correlated with vaginal delivery (7). This would be rendered to their recruitment of women undergoing a trial of labor after C.S. with a gestational age of 24 weeks to term.

The modified bishop score and Levine score differed significantly between women who delivered vaginally and those delivered by C.S. In an earlier study, the bishop score differed significantly between those with successful and unsuccessful induction of labor. This would be rendered to their recruitment of nulliparous and multiparous women ≥ 37 weeks. Also, the bishop score is a subjective and nominal scale limiting its role (14). Additionally, the method of induction differed between studies (15).

The dose of Misoprostol (50 µg) predicted vaginal delivery and significantly contributed to labor duration. There was no difference in vaginal and cesarean delivery rates (16, 17). This difference would be explained by different primary objectives, target population (different ethnic groups, obese, chronic illness), and induction methods between studies (use of Foley catheter). In an earlier study, vaginal Misoprostol was associated with shorter induction to delivery time. This was rendered to the steady increase of its plasma concentration (70- 80 min) and slow plasma clearance (up to 6 hours) (18). However, another study reported a shorter induction to delivery time; they used a 200µg slow-release Misoprostol vaginal insert (19). Direct comparison is hindered because of heterogeneous preparations, dosages, and methods of administration (20). Accordingly, a previous systematic review reported that successful vaginal delivery was achieved using Misoprostol with doses up to 50 µg in the first six hours of induction (21).

The bishop score, modified bishop score, and Levine score had no predictive role for successful vaginal delivery. Another study reported that cervical dilatation, cervical length, cervical position, and the overall modified bishop score had no predictive role for successful vaginal delivery. However,

this study included nulliparous women with gestational ages ≥ 37weeks (22). Previous studies reported cervical consistency as a significant predictor for vaginal delivery (3, 23). It has been reported that no existing score but for Levine score exclusively predicted successful induction of labor (3). However, another one reported that Levine's score could not predict C.S. rates precisely. This might be related to different demographic criteria of the studied population (24).

A bishop score ≥ 9 was associated with a 96% vaginal delivery rate in a previous review. They reported that a score of 4, 5, or 6 has no predictive role for C.S. (5), limiting its predictive capacity. This would explain the current results regarding the predictive role of the bishop score. In the multivariate model, the modified bishop score significantly predicted cesarean delivery. Additionally, components of the individual score items had no predictive role, especially the cervical dilatation (8), while we reported a significant role for the fetal head station. An earlier study reported a significant role for the head-perineum distance measured by ultrasound in predicting vaginal delivery (25). Contradicting results would be explained by the recruitment of women regardless of their parity and starting with unfavorable cervices (cervical dilatation and bishop score were ≤ 2 and 6, respectively).

Strength and limitations: We recruited a large number of participants. The study was conducted as a prospective cohort study. However; we had some limitations. We recruited multiparous women only, which would limit the generalizability of the results. Also, women were recruited with an unfavorable cervical examination, which is a limitation. We evaluated the predictive role of the three scoring systems for vaginal delivery only. Prediction of CS was not done. We used three scoring systems only. Further studies evaluating the role of other scoring systems are recommended.

Conclusion

The Levine score correlated significantly with the mode of delivery. However, no score predicted vaginal delivery significantly. The dose of Misoprostol and the fetal head station had significant predictive roles.

Conflict of interest: None

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Table 1: Sociodemographic characters of the studied population:

Age (mean ± SD)		30.219 ± 2.04
Parity (mean ± SD)		1.78 ± 0.59
Residence N (%)	Rural	126 (53.2%)
	Urban	111 (46.8%
Education N (%)	None	90 (38%)
	Middle	93 (39.2%)
	High	54 (22.8%)
Gestational age (mean ± SD)		41.01 ± 0.78
BMI (mean ± SD)		29.09 ± 2.23

Table 2: Obstetric data of the studied population

Cervical dilatation (cm) (mean ± SD)		2.08 ± 1.23
Effacement (%) (mean ± SD)		35.15 ± 5.41
Consistency	Soft	71 (30%)
	Firm	102 (43%)
	Hard	64 (27%)
Position	Anterior	18 (7.6%)
	Midway	131 (55.3%)
	Posterior	88 (37.1%)
Station		-1.35 ± 0.7
Cervical length (mm) (mean ± SD)		39.3 ± 7.3
Bishop score (mean ± SD)		4.70 ± 0.88
Modified bishop score (mean ± SD)		5.63 ± 0.99
Levine score (mean ± SD)		0.14 ± 0.04

Table 3: Obstetric outcomes after induction of labor

Mode of delivery N (%)	Vaginal	229 (96.6%)
	C.S.	8 (3.4%)
Dose of Misoprostol (µg) (mean ± SD)		59.6 ± 20.46
Duration of first stage (min) (mean ± SD)		455.49 ± 164.71
Duration of second stage (min) (mean ± SD)		20.96 ± 5.42
Total duration of labor (min) (mean ± SD)		474.68 ± 170.6
Fetal birth weight (gm) (mean ± SD)		3238.33 ± 272.34

Table 4: Correlation between different scores and patient characters

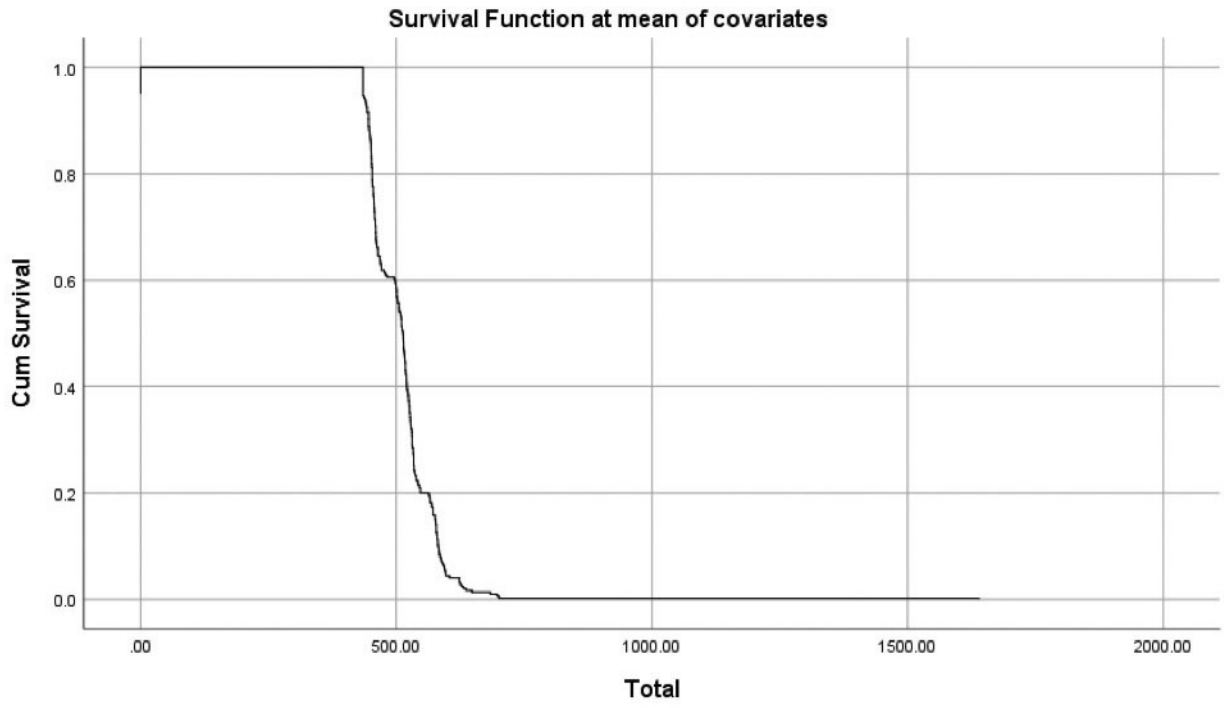
Variable	Bishop score		Modified bishop score		Levine score	
	Cor. coeff	P-value	Cor. coeff	P-value	Cor. coeff	P-value
Age	-0.044	0.501	0.075	0.251	-0.036	0.584
GA	0.048	0.459	-0.048	0.461	-0.023	0.726
Parity	-0.046	0.483	0.007	0.915	0.074	0.255
Dose of Misoprostol	-0.124	0.056	-0.167	0.010	0.165	0.011
Mode of delivery	-0.097	0.138	-0.127	0.05	0.132	0.043
Duration of first stage	0.159	0.015	0.076	0.243	-0.176	0.007
Duration of second stage	-0.017	0.805	-0.072	0.292	0.052	0.447
Total duration	0.157	0.015	0.068	0.300	0.172	0.008

Correlation is significant at the 0.05 level

Table 5: Bishop score, modified Bishop score, Levine score, and the mode of delivery:

	Bishop score	Modified Bishop	Levin score
Normal vaginal	4.72 ± 0.86	5.66 ± 0.98	0.143 ± 0.034
CS	4.25 ± 1.28	2.88 ± 1.13	0.173 ± 0.05
P value	0.138	0.028	0.043

Figure 1: The Cox regression model for women who had vaginal delivery.



Total = Total duration of labor