Transvaginal Ultrasonographic Cervical Length Measurement as a Predictor of Successful Labor Induction.

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Summary:

Background; *Currently the only method in common use to assist the clinician in making Judgment is the ripeness of the cervix. Quantitatively this is expressed by the Bishop score. which is subjective and vary considerably among examiners, while transvaginal ultrasonographic cervical length measurement could represent a more accurate assessment of cervical effacement than digital examination,*

Objective: *to compare transvaginal cervical length measurement and the Bishop score as predictors of duration of induction and successful induction resulting in vaginal delivery at term.*

Patients and Methods; *cross sectional, prospective study on a group of 70 women with singleton gestations scheduled for induction at $\geq$ 37 weeks were studied. Transvaginal ultrasonographic measurement of cervical length was performed and the Bishop score was determined digitally. All labors were induced by continuous Oxytocin infusion and amniotomy performed when the head engaged and labor had become well established and cervix permitted.*

Results: *Vaginal delivery occurred in 52 (74.3 %) of patient. Both Bishop score and transvaginal cervical length showed a linear correlation with duration of labor. Women with cervical length < 3 cm had shorter labor and were more likely to be delivered vaginally than those with cervical length $\geq$ 3 cm, and women with Bishop score > 4 also had shorter labor and were more likely to be delivered vaginally .*

Conclusion: *Ultrasonographically measured cervical length can be an added diagnostic tool for evaluation of successful induction of labor and duration of induction and is less subjective than Bishop score.*

Key words: *induction of labour, cervical length, Bishop score.*

Introduction:

Induction of labor is an obstetric technique practiced since antiquity and it is one of the most common procedures performed in obstetrics,it is being used with increasing frequency, and this trend will probably continue for several reasons; improved and more sophisticated method of induction, better method for assessing fetal maturity, and economic and medical advantages of programmed delivery[1,2].

Critical in the decision making process for induction of labor is the likelihood of the induction resulting in prompt, safe, and successful vaginal delivery. Currently the only method in common use to assist the clinician in making Judgment is the ripeness of the cervix. Quantitatively this is expressed by the Bishop score[4].

The first scoring system is that of Bishop 1964, other less used system are Field scoring system (1966), Burnett scoring index (1966) and Friedman scoring indices *(1966 & 1967)*[1].

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The Bishop score continue to be used commonly for clinical significant changes in the cervix subsequent to cervical ripening therapy[5], however the specificity of the Bishop score in patient with transitional (6 to 9) or low < 5 score is poor. Although many of these patients delivered easily; such low score have been associated with high rate of prolonged labors and Caeserean section. Therefore there appear to be a real need for other markers that help the clinician predict the success of lobar induction[4].

Theoretically transvaginal ultrasonographic cervical length measurement could represent a more accurate assessment of cervical effacement than digital examination, because the supravaginal portion of the cervix usually comprise 50 % of cervical length, This portion is difficult to assess digitally. In addition effacement is subjective and can vary considerably among examiners. Moreover effacement is difficult to determine in closed cervix. In contrast transvaginal ultrasonographic cervical measurement is quantitative and easily reproducible[7], and it can cause little discomfort to the patient[8]. However digital examination remains the only method able to assess the consistency of the cervix.

Our purpose was to compare transvaginal cervical length measurement and the Bishop score as predictors of duration of labor induction and successful induction resulting in vaginal delivery at term.

Patients And Methods:

This prospective study was conducted in Baghdad teaching hospital during the period from *January 2001* to *October 2001*, approved by scientific committee of Iraqi board of Obstetric and Gynecology

Seventy women with singleton term pregnancies with vertex presentation scheduled to undergo labor induction at ≥ 37wk of gestation were recruited to this study

Induction was indicated for medical and obstetrical reasons. The most common indication for induction included post date pregnancies, pregnancy induced hypertension, decrease fetal movement with abnormal antenatal tests (biophysical profile, non stress test).

Both nulliparous and multiparous women were recruited into the study and decision to perform labor induction made by senior obstetrician before recruitment into the study

Women were excluded from the study if they had contraindication of labor such as: Malpresentation ,Placenta praevia ,Pelvic structural deformities ,previous caesarian section.

Patient consent was obtained and following preliminary explanation of the technique. Transvaginal ultrasonographic measurement of cervical length was performed with the standard longitudinal view of the cervix, care was taken to avoid pressure on the cervix from ultrasound probe, because compression may artificially lengthen the cervical measurement. We used a Kretz voluson 530D machine. The endovaginal probe is a *7 MHz* mechanical sector scanner that scans through an arc of 112 degree over a focal range of 1 to *6 cm*. Sonographer was masked to the Bishop score of the patients.

Patients were taken to the delivery room for induction of labor within 2 hours of ultrasonographic examination, digital examination for scoring of cervical favorablity was performed personally using the scoring system of Bishop. All women scheduled for induction had a proper medical and obstetrical records review, and complete physical examination. Gestational age was determined from prenatal record and early ultrasound.After preliminary preparation an intravenous solution was started and external fetal monitor was applied the patients were given a regime of steadily increasing dose of Oxytocin, with establishment of regular contraction every 2 to 3 minutes the dose continued just sufficient to maintain contractions at that rate.

Two primary outcome criteria were analyzed, duration of latent phase of labor and successful induction resulting in vaginal delivery. Caesarean section was performed for fetal distress and failed induction, failed induction was defined as inability to reach the active phase of labor.

For purpose of statistical evaluation, chi square test used for the comparison of proportion and student test for comparison of means.

Logistic regression model for mode of delivery was constructed with the use of parity, cervical length, Bishop score, Birth weight as independent variable and the mode of delivery as the outcome dependent variable.

All statistical tests were conducted with a level of significance of *0.05* with *p* value less than or equal to *0.05* considered statistically significant.

Backward stepwise multiple linear regression modeling used to identify the best mathematics model to predict the duration of latent phase of labor as the dependent variable. The sonographic cervical length, bishop score, birth weight and parity were the independent variable *p < 0.05* considered significant.

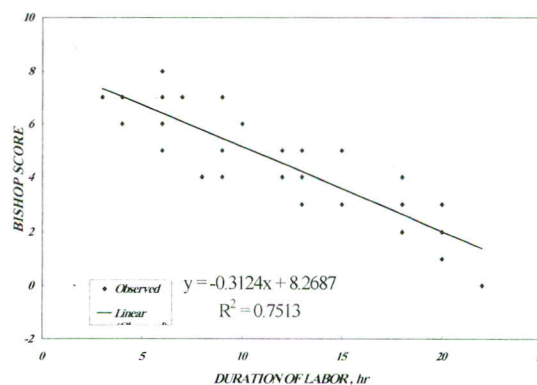**Fig. (I) correlation between Bishop score and Duration of labor**

$y = -0.3124x + 8.2687$
$R^2 = 0.7513$

Fig (II) correlation between Cervical length and Bishop score

$y = -0.234x + 11.537$
$R^2 = 0.9184$
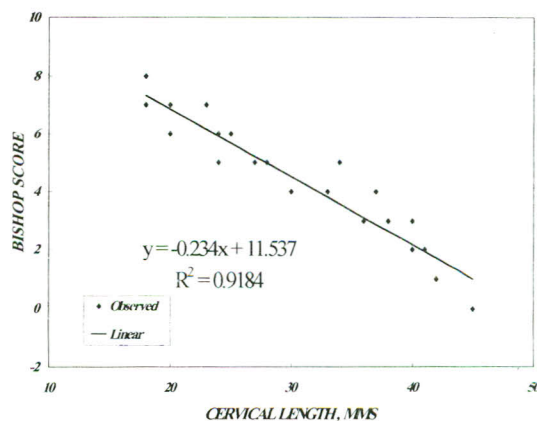
Fig (III) correlation between cervical length and duration of labor

$y = 1.3208x + 13.71$
$R^2 = 0.8223$
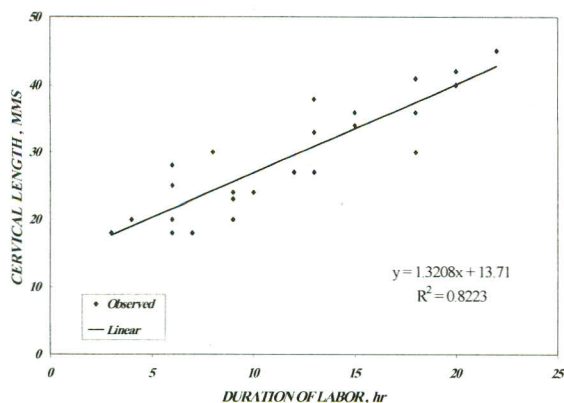
Results

A total of *70* women were included in the study, *32 (45.7%)* were nulliparous and *38 (54.3%)* multiparous (para *1-5*) mean gestational age was *39.9 wk ± 1.45* ranging from *37* to *42 wk*.(table 1)

Vaginal delivery occurred in *52 (74.28%)* of the patient, the remaining *(18)* underwent caesarian section.

Table (1) Patients characteristics

	Mean ± SD	range
Maternal age	**27.1 ± 4.7**	**17-36**
Parity **Nulliporous %** **Mulliporous %**	**1.8 ± 1.7** **45.7 %** **54.3 %**	**0-5**
Gestational age (wk)	**39.9 ± 1.4**	**37-42**
Birth weight (Kg)	**3.4 ± 0.3**	**2.5-4**

Table 2 shows the indications of induction; post date pregnancies, (gestation age *> 40 wk*) and pregnancy induced hypertension, The indications of decreased fetal movement also include non-reassuring antenatal tests.

Table (2) Indications of Induction

Indication	Frequency	Percent
Post date	25	35.7
P.I.H	20	28.6
↓ FM	18	25.7
PROM	5	7.1
IUGR	1	1.4 %
Diabetes	1	1.4 %
Total	70	100 %

↓ FM= decrease foetal movement
P.I.H= pregnancy induced hypertension
PROM= premature rupture of membrane
IUGR= intrauterine growth restriction

Table (3) shows the indications for caesarian section in the studied group.

The mean cervical length for the sample as a whole was *26.3 ± 8.2* ranging from *18* mm to *45* mm. The Bishop score for the sample as a Whole was *5.2 ± 1.7* ranging from *0-8*. The mean duration of labor was *7.9 ± 4.7* table (4).

Table (3) Indications of Caesarian Section

	Number	%
Failed induction	14	77.7 %
Foctal distress	4	22.2 %
total	18	100 %

Table (4) Duration of latent phase of Lobar, C.L, and Bishop Score in nulliparous and multiparous

Parily	Duration (h) mean ± SD	CL (mm) mean ± SD	Bishop mean ± SD
Nulli	8.4 ± 3.9	26.9 ± 8.06	4.8 ± 1.6
Multi	7.6 ± 5.3	25.8 ± 8.4	5.5 ± 1.7
Total	7.9 ± 4.7	26.3 ± 8.2	5.2 ± 1.7
	NS	NS	NS

NS
C.L= cervical length
NS= not significant
nulli= nulliparous
multi= multiparous

This table also shows that the difference between the cervical length and Bishop score of multiparous and nulliparous is not statistically significant, and although the duration of latent phase of labor is shorter in multiparous than nulliparous, but it does not reach statistical significance.

When using a Bishop score of *4* as a cutoff point and cervical length of *3* cm as a cutoff point, and when duration of labor is considered, table (5) shows that women with Bishop score *> 4* and cervical length *< 3* cm had significantly shorter latent phase labor than those with Bishop score of *≤ 4* and cervical length of *≥ 3* cm respectively, at *p* value *< 0.001 "t test used for statistical analysis"*.

Back word stepwise multiple linear regression modeling used to identify the best mathematics model to predict the duration of latent phase of labor on the dependent variable. The sonographic cervical length, Bishop score, Birth weigh and parity were independent variables only cervical length predict the duration of labor significantly *t=2.320 p=0.023 t* (statistics from *t* test).

When using a Bishop score of *4* and cervical length of *3* cm as a cutoff point, and when mode of delivery considered, table(6) shows that women

with Bishop score > *4* are more likely to be delivered vaginally than those with Bishop score of < *4. p* value < *0.005* the same apply to cervical length, where women with cervical length < *3* cm are more likely to be delivered vaginally than those with cervical length ≥ *3* cm *p*< *0.005* (chi-square test used for statistical analysis).

Table (5) Bishop and C.L Cutoff points significance

	Duration (h) mean ± SD	p valve
Bishop ≤ 4	12.22 ± 5.48	b < 0.001
Bishop > 4	5.89 ± 2.32	
C.L ≥ 3	12.2 ± 5.6	b < 0.001
C.L < 3	5.93 ± 2.33	

h= hours   p < 0.001
(significant)

Table (6) Bishop and C.L Cutoff Point Significance for the prediction of mode of delivery

	C.S	VD	p valve
Bishop ≤ 4	52.2 %	47.8 %	< 0.001
Bishop > 4	12.8 %	87.2 %	< 0.005
C.L ≥ 3	56.5 %	43.5 %	< 0.001
C.L < 3	10.6 %	89.4 %	< 0.005

C.S= Caeserian section   p < 0.005 (significant)
VD= vaginal delivery

Table (7) shows that both Bishop score and cervical length shows a linear correlation with duration of labor (*r=0.718, p< 0.01* for Bishop score, *r=0.731, p< 0.01* for cervical length). The Bishop and cervical length also correlated with each other at *p < 0.01, r=0.947.* This can also be shown graphically in Fig. *I, II, III.*

Table (7) Correlation of Bishop score and cervical length With duration of labor

Correlation	r-value	p valve
Bishop + duration	-0.718	<0.01
C.L + duration	0.731	<0.01
Bishop + C.L	-0.947	<0.001

C.L= cervical length
p< 0.01, < 0.001 (Significant)
r= correlation coefficient

A logistic regression model was constructed and included parity, Birth weight, Bishop score, and cervical length with mode of delivery as the outcome variable. The model correctly predict the mode of delivery for 88.57% of the cases, only parity (r=-0.3006) p < 0.002 was independent predictor of mode of delivery

Discussion

The goal of induction of labor is to achieve vaginal delivery by stimulating uterine contractions before the spontaneous onset of labor. .

To predict the ease of labor induction, various scoring systems have been designed. In *1964*, Bishop was the first to suggest quantitative pelvic scoring system. Since then many investigators have evaluated the Bishop scoring system and try to find better one.

Difference in cervical length and dilatation are objectively demonstrated by vaginal ultrasonography irrespective of the position of the cervix. Observer variation is much reduced using ultrasound technique [12].

In our study we studied the relationship between the Bishop score which is used traditionally before induction of labor and the new method of measuring the cervical length by transvaginal ultrasonography, and we found a linear correlation between the transvaginal cervical length measurement and Bishop score. (*p<0.001*   r-value -0.947).

This result also found by Ware V. et al.[7]. With *p<0.01* and confirmed the results of Watson Wf. et al.[6] who found that clinical assessment of cervical effacement correlate with the more objective sonographic determination of cervical length (*r= - 0.523 . P<0.001*).

In Paterson Brown et al. study[13] who used transvaginal ultrasound to assess the cervix in 50 women undergoing labor induction, surprisingly, there was no correlation between the clinical assessment of cervical effacement and sonographic measurement of cervical length.

When we studied the duration of labor in relation to the Bishop score and cervical length measurement by transvaginal ultrasound, both these parameters showed a linear correlation with the duration of labor (*r=-0.718 P<0.01*) for the Bishop score, *r=0.731 . p<0.01* for cervical length). This in agree with Ware V.[7] study, who also found a liner correlation between cervical length, Bishop score, and duration of labor (*r=0.43 .p<0.001, r=0.48 . p<0.001 respectively*)

In our study we used the same cut off points value of the Ware V.[7] study,(*3* cm for cervical length and *4* for Bishop score), we found that patient with cervical length < *3* cm and Bishop score > *4* had significantly shorter labor than those with cervical length > *3* cm and Bishop ≤ *4*, which is the same results found by Ware V.

These results in agree with Gonen et al.[13] who state that duration of labor significantly associated

with Bishop score and cervical length and also in agree with BoozerJomehri et al.[14] who suggest that tarnsvaginal sonography of the cervix might help to evaluate induction candidate.

When Backward step wise multiple linear regression model was constructed that include these parameters: Birth weight, parity, Bishop score and cervical length as independent variables, only cervical length predict the duration of labor significantly with $t = 2.320$ and $p = 0.023$.

So cervical length measurement by transvaginal ultrasound seem to be a better predictor of duration of labor and is less subjective. This in agree with BoozerJomehri et al.[14] who agreed that sonograohic measurement of cervical length is more accurate that digital examination because it is less subjective and include the entire cervical length. Although in the logistic regression model of Gonen et al.[13] only parity and Bishop score are significantly correlated with successful induction and duration of labor. Gonen studied 86 patient scheduled for induction of labor.

In our study, there was no significant difference between multiparous and nulliparous women regarding both Bishop score and ultrasonographically measured cervical length. Also there was no significant difference between duration of the latent phase of labor of nulliparous and multiparous women, this may be due to closeness of cervical conditions between the two groups. These results goes with that of Lang A.P.[3] who found that the clinical dictum that say it is easier to induce labor when the patient is multiparous does not appear to be completely correct and it is quite another matter that the cervical condition in multiparous at term are often more ripe than in the primipara, thus the cervical condition seem to be the only factor of importance for the inducibility of labor among those investigated in his study.

Our results also confirmed previous finding of Watson WJ. et al.[6] that maternal parity is not a significant factor in the length of latent phase of labor when other factors are controlled for.

In our study when the mode of delivery regarded, patient with cervical length < 3 cm and Bishop scare > 4 were more likely to be delivered vaginally than those with cervical length ≥ 3 cm and Bishop ≤ 4 this agree with Ware V. et al[7] . Other studies showed a conflicting results especially regarding Bishop score, as in Hendrix et al.[15] study where the accuracy of the Bishop score in predicting the likelihood of successful labor induction in nulliparous and multiparous women were evaluated and found that Bishop score appear to be a poor predictor of the outcome of labor induction, while the results of Gonen et al. showed that successful induction of labor significantly associated with Bishop score and cervical length[13].

When logistic regression model was constructed that include these parameters: parity, cervical length, Bishop score and Birth weight as independent variables, the model correctly predicts the mode of delivery for 88.57% of the cases. Only parity was independent predictor of the mode of delivery $r = 0.3006$. $p < 0.005$. While in the logistic regression models of Ware V. et al.[7] both cervical length and parity were independent predictor of mode of delivery.

In the logistic regression model of Gonen et al, only parity and Bishop score were significantly associated with successful induction.

Although these model showed conflicting results regarding cervical length and Bishop score, but all agree that parity is the most important predictor of the mode of delivery. But parity is factor of less importance in prediction of duration of labor as we mentioned earlier.

So cervical length measurement by transvaginal ultrasound is at least comparable to the Bishop scoring system and there are other aspects of ultrasonography that may make this technique more useful than the Bishop score to the clinician, reproducibility, quantitation and hard copy documentation.

Conclusion:

Reviewing the above data, cervical length measurement by transvaginal ultrasound is a reliable indicator of the mode of delivery and duration of labor induction .

Although it is comparable to the Bishop score but carry the properties of being less subjective, quantitative and more comfortable to the patient.

So a combination of transvaginal sonography and digital examination may be an improved method of cervical assessment for the further investigation of labor.

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