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Role of pre-induction cervical length measured by transvaginal ultrasonogram in predicting vaginal delivery

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Abstract

Introduction: Induction of labor is the most common intervention in modern obstetrics. The traditional method of assessing the cervix is by the Modified Bishop's score. Transvaginal ultrasonogram (TVS) is an objective method to assess the cervical length. This study focuses on efficacy Transvaginal ultrasonogram (TVS) in predicting successful induction of labor. Transvaginal sonography appears to be a feasible alternative to the traditional bishop's score.

Aims and objectives

1. To measure the cervical length before induction by TVS method in term antenatal patients undergoing elective induction of labor.
2. To study the efficacy of TVS method in predicting successful induction of labor resulting in vaginal delivery.
3. Compare cervical assessment by transvaginal sonography and digital examination in prediction of outcome of labor induction.

Material and methods: This is a prospective observational study conducted at Public Health Centre, Chennai, on 100 primigravidas> 37 weeks gestation, who were induced electively for various indications. They were assessed for the pre-induction cervical length by TVS. They were induced with Dinoprostone Gel (PGE2 GEL). The outcome of induction was studied by Receiver Operative Curve (ROC) analysis.

Results: In this study, TVS method had predictive validity for vaginal delivery and labour induction was successful in 79.33% of patients. Mean cervical length by digital examination was 2.7 cm, whereas the mean sonographic cervical length was 3.3cm. There was a significant difference of 0.6cm in mean cervical length measured by two methods (P=0.01). The best cut off point for predicting successful induction of labor was ≤3.4cm for sonographic cervical length (sensitivity 0.80, specificity 0.85, positive predictive value 0.79 and negative predictive value 0.27).

Conclusion: This study suggests that TVS measurement of cervical length is good predictors of vaginal delivery. Even, statistically TVS cervical length is a better predictor of successful induction of labor than other method.

Keywords: Transvaginal Ultrasonogram, Modified Bishop's score, Induction of labor

Introduction

Induction of labor is a process where uterine contractions are initiated by medical or surgical means before the spontaneous onset of labor and is carried out in approximately 20% of pregnancies (1). The commonest indication for induction is prolonged pregnancy, and several studies have shown that induction, compared to

expectant management, is associated with a substantial reduction in perinatal mortality (2-4). Transvaginal ultrasonography has gained increasing application in obstetric in the area of induction of labor. Transvaginal cervical length measurement has primarily focused on detecting cervical changes in women at risk for preterm delivery (6). The supravaginal portion of the cervix usually comprising about 50% of the cervical length is very difficult to assess digitally. Transvaginal ultrasonogram (TVS) is an objective method to assess the cervical length. Transvaginal assessment of cervical length is always better than trans-abdominal (TA) assessment (5). As the probe is closer to the cervix, better visualisations with better measurements are possible. Recent studies suggest that ultrasonographic measurement of cervical length may provide a more sensitive assessment of successful induction of labor (6). Theoretically, transvaginal ultrasonographic measurement of the cervix could represent a more accurate assessment of the cervix than digital examination, because the supra vaginal portion of the cervix usually comprising about 50% of the cervical length is very difficult to assess digitally in a closed cervix. In addition, the assessment of the effacement which starts at the internal OS will be difficult to predict in a closed cervix.

This study was done to determine if transvaginal ultrasound, with its ability to objectively measure the cervical length, could predict the outcome of induction better than clinical assessment obtain by the Bishop score. If so, transvaginal ultrasonographic measurement of cervical length can be used as an adjunct tool to the traditional Bishop score and add yet another dimension of information in the field of successful induction of labor. So transvaginal sonographic measurement of the cervical length is quantitative and easily reproducible method of assessing the cervix which can be achieved easily with minimal discomfort to the patient.

Materials and methodology

Study design: The study population constituted of term antenatal mothers attending our antenatal department who were induced electively for various indications. The study was conducted after approval from Institutional Ethics and Scientific committee and after taking informed consent from the participants. The sample size for the study is 100 primi gravida with gestational age ranging between 37-42 weeks who are admitted for labor induction under Obstetrics and Gynaecology in Public Health Centre, West Mambalam, Chennai, who satisfy the inclusion and exclusion criteria and are willing to be a part of the study with duration of the study from 1st March 2019 to 1st March 2020.

Sampling procedure: Among the antenatal mothers admitted to the hospital for induction, 100 patients satisfying the inclusion and exclusion criteria will be included in the study and examined.

- Patients undergoing elective induction of labor at term gestation are assessed for the pre induction cervical length by Transvaginal ultrasonography
- These patients undergo induction of labor with Dinoprostone Gel (PGE2 GEL).
- The outcome of induction and efficacy of predicting successful induction are studied.

Inclusion criteria

- Nulliparous women less than 35 years of age with 37 to 42 weeks gestation admitted for induction of labor
- Women with singleton live pregnancy
- Women with cephalic presentation
- Women with intact membranes with no vaginal bleeding

Exclusion criteria

- Multiparous women

- Women with multiple pregnancy
- Women with non cephalic presentation
- Women in labor with > 3 cm cervical dilatation
- Women with prelabor rupture of membranes
- Women with previous uterine or cervical surgeries

Women who fulfilled the above criteria were included in the study. Informed consent was obtained from the patient and family members after explaining about the study in detail.

History and clinical examination

A detailed history of the patient including age, socio-economic status and other relevant medical history were obtained. The gestational age of the patient was confirmed with her dates and first trimester ultrasound. General examinations including weight, height, pallor, pedal oedema, pulse rate, blood pressure were measured. Systemic examination of cardiovascular, respiratory and central nervous system was done and details were noted. Obstetric examination and assessment of cervical status was done.

Cervical assessment

The patient underwent a transvaginal sonography for cervical length assessment. The probe was placed in the vagina approximately 3 cm proximal to the cervix to avoid any distortion of its position or shape and a sagittal view of the cervix, with the echogenic endo cervical mucosa along the length of the canal, was obtained (7, 8). The calipers were used to measure the distance between the internal os and external os and the furthest points at which the cervical walls were juxtaposed. Three measurements were obtained and the shortest, technically best measurement in the absence of uterine contractions was taken as the final measurement (9, 10).

In our institution, patients who cross their dates by 3 days (40 weeks+3 days) were induced in view of post datism. Induction was done with PGE2- DINOPROSTONE Gel 0.5 mg by intra cervical application. With the patient in a lithotomy position, the cervix is exposed using a sims speculum and anterior lip is held with sponge holding forceps. The tip of the PGE2 gel dispensing cannula, which is attached to the pre-filled syringe, is inserted gently to just below the internal os. The gel is then instilled into the cervix. The patient is kept in a reclining position for the next 30 minutes. The women had further vaginal examination after 6 hours and depending upon the Bishop's score, further doses of dinoprostone gel were considered.

The maximum recommended dosage is 1.5 mg (three doses) within a period of 24 hours. Oxytocin augmentation was started in cases of unsatisfactory progress of labor and artificial rupture of membranes (amniotomy) was performed as and when required (11).

The indication for induction, number of PGE2 gel doses, achievement of active phase, need for oxytocin, mode of delivery, induction delivery interval, number of lower segment esarean sections (LSCS) and their indications and birth weight were noted and tabulated.

The Cochran formula is:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is the desired level of precision (i.e. the margin of error),
- p is the (estimated) proportion of the population which has the attribute in question,
- q is 1 – p.
- Where n = sample size.

Z = 1.95 at 95% level of confidence = estimated proportion = (2.9% = 0.029). e = level of precision (5% = 0.05). n = 1.962 × 0.029 × (1 − 0.029)/0.05 × 0.05. Attrition rate of 20% = 8.6. New sample size = 52; a sample size of 60 was adjudged to be adequate (12).

The TVS cervical length score in predicting vaginal delivery was assessed by Receiver Operative curve (ROC) analysis. Area under the ROC curve along with its 95% CI and P value are presented. The sensitivity, specificity, predictive values and diagnostic accuracy of the screening test with the decided cut off values along with their 95% CI were presented. Reliability of the screening test was assessed by kappa statistic along with its 95% CI and P value. P value < 0.05 was considered statistically significant.

Data Analysis

The data were analyzed using the IBM SPSS Statistics 20 (IBM Corp., Armonk, NY, USA). Continuous variables were analyzed using simple percentages and student's t-test while categorical variables were represented using simple percentage.

Results

Table 1: Pre-induction cervical length measured by transvaginal sonography

S.No	Cervical length (cm)	No. of cases	%
1.	2.0-2.5	3	1
2.	2.6-3.0	22	20
3.	3.1-3.5	45	41.7
4.	3.6-4.0	20	29.3
5.	4.1-4.5	10	8
6.	Total	100	100

The cervical length (cm) assessed by Transvaginal sonography ranges from 2.4cm to 4.5cm. Mean cervical length was 3.4±0.42 cm and median was 3.4cm (Table 1).

Table 2: Pre-induction cervical length (cm) measured by digital examination.

S.No	Cervical length (cm)	No. of cases	%
1.	1.5-2.0	8	2.7
2.	2.1-2.5	51	67
3.	2.6-3.0	40	30
4.	3.1- 3.5	1	0.3
5.	Total	100	100

After doing cervical assessment by Transvaginal sonography, digital examination of cervix was done by an Obstetrician blinded to the Transvaginal sonography findings Digital findings of cervix was scored according to modified Bishop score. The cervical length (cm) assessed by digital examination of cervix ranges from1.5cm to 3.5cm (Table 2).

Table 3: Clinical / Ultrasound findings

Parameters	n (%)	Mean (SD)	Mode	Median
Pre induction cervical length		2.9 (0.69)	2.03	3.01
<3 cm	29 (48.3)			
≥3 cm	31 (51.7)			

Table 4: Influence of the cervical length on induction delivery interval.

Variable	Cervical length		value
	≤3 cm	>3 cm	
Duration of labor			
<6 cm	24	8	0.001
≥6 cm	5	23	

$X^2 = 19.526$; df (1) = 0.00001; R = 0.681 value = 0.001. RR for cohort CL ≤ 3: 4.20 (95% CI 1.85–9.529). RR for cohort CL > 3: 0.30(95% CI0.163–0.568).

Table 5: Regression analysis of preinduction cervical length vs. duration of labor with confounding variables

Statistics	Nil	Parity			Age			
		0	1–4	>4	<20	20–29	30–39	≥40
Model fit								
Regression	0.681	0.701	0.639	0.794	1.000	0.552	0.745	0.849
R^2 (%)	46.4	67.5	74.4	65.5	67.4	77.7	55.4	72.1
Std error estimate	2.13	2.22	2.312	1.239	—	2.303	2.049	1.583
ANOVA								
F value	50.128	14.505	22.732	10.209	—	10.07	27.377	18.092
value	0.001	0.002	0.001	0.019	—	0.004	0.001	0.004
Coefficient								
t-value	7.08	3.809	4.768	3.195	—	3.174	5.232	4.253
value	0.001	0.002	0.001	0.019	—	0.004	0.001	0.004

Women with decrease sonographic cervical length, has shorter Induction to active phase interval. Women with cervical length between 2-2.5cm, all of them achieve active phase within 6 hours of induction and with cervical length between 2.6 to 3.0cm, induction to active phase duration was 6 hours in 86.7% of women. Women with cervical length between 3.1 to 3.5cm, 77.6% achieve active phase within 6 hours and with a cervical length between 4.1 to 4.5cm, only 4.1% achieve active phase within 6 hours of induction. There was significant relationship between sonographically measured cervical length and induction to active phase interval (P=0.001). There was no significant relationship between sonographically measured cervical length with active phase duration (P=0.86).

Women with decreasing digital cervical length, has shorter Induction to active phase duration. Women with cervical length between 1.5- 2.0cm, all of them achieve active phase within 6 hours of induction and with cervical length between 2.1 to 2.5cm, induction to active phase duration was 6 hours in 80.63% of women. Women with cervical length between 2.6 to 3.0 cm, 40% achieve active phase within 6 hours and with a cervical length between 3.1 to 3.5 cm, none of them achieve active phase within 6 hours of induction. There was significant relationship between digitally measured cervical length and induction to active interval (P=0.037). No significant relationship (P=0.97) was found between digitally measured cervical length with the mean of active phase to vaginal delivery interval.

In this study, TVS method had predictive validity for vaginal delivery and labour induction was successful in 79.33% of patients. Mean cervical length by digital examination was 2.7 cm, whereas the mean sonographic cervical length was 3.3cm. There was a significant difference of 0.6cm in mean cervical length measured by two methods (P=0.01) (17, 18). The best cut off point for predicting successful induction of labor was ≤3.4cm for sonographic cervical length (sensitivity 0.80, specificity 0.85, positive predictive value 0.79 and negative predictive value 0.27) (19, 20).

Discussion

Our study showed that difference in cervical length so an independent test of equal variance shows a significant difference between these difference cervical lengths with induction delivery interval/duration of labor. There is also a positive correlation between induction delivery interval/duration of labor and cervical length. Some of the findings in this study agree with the study that reported that cervical length is a significant predictor of induction delivery interval (21 - 23). Our study showed that a cervical length of less than 3 cm is associated with an increased relative risk for short induction delivery interval/duration of labor. This agrees with the report that successful induction of labor is associated with a short cervical length, which is a marker of cervical effacement (24). The model fit analysis showed that although there is a positive functional relationship between pre induction cervical length and induction delivery interval, this could only account for less than fifty percent (<50%) change in the dependent variable for a unit change in the predictor variable. It could be deduced that other factors other than cervical length are involved in the prediction of induction delivery interval (25). This study also showed that increasing parity is a significant prediction of induction delivery interval.

Conclusion

This study suggests that TVS measurement of cervical length is good predictors of vaginal delivery. Even statistically, pre-induction cervical length measured by transvaginal ultrasonogram is a better predictor of successful induction of labor and eventually vaginal delivery when compared to any other methods. Higher cervical lengths of more than 2.25 cm measured by transvaginal ultrasonogram before induction can be considered as an independent predictor of probability of caesarean section in patients who are electively induced.

Additional points

One of the limitations of this study is its cross-sectional nature and the small sample size, which limit the conclusion that one can draw from the study. Increasing the sample is advocated in the study area to help authenticate our findings. Because it is a hospital-based study, the finding of this study could not be generalized in the area of study; this could be circumvented by conducting further research on this subject involving recruitment of participant from other mission hospitals in the area and even conducting a randomized controlled study on the place of cervical length on the induction of labor.

Ethical Approval

Ethical approval for the study was obtained from the Research and Ethics committee of the hospital.

Limitations of the study

1. Did not analysis the different components of bishop score separately to see which factor can contribute to the successful prediction in induced labor.
2. Did not include the other parameters of the transvaginal cervical assessment like dilation, presence of wedging, or cervical angle which could

have probably added in the predictability obtained by cervical length alone.

3. Association of other factors like maternal weight, maternal age, are not considered in our study. It can be independent predictors in successful labor induction.

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