e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(11); 632-643

Original Research Article

A Comparative Study of Transvaginal Ultrasound and Bishop's Score for Pre-Induction Cervical Assessment

Sri Prathiba Mahalakshmi Nagarajan[1], Sivachandran Kabilan[2]

[1]Assistant Professor, Department of Obstetrics and Gynaecology, Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research, Melmaruvathur, Tamil Nadu.

[2]Assistant Professor, Department of General Surgery, Melmaruvathur Adhiparasakthi Institute of Medical Sciences and Research, Melmaruvathur, Tamil Nadu.

Received: 25-09-2022 / Revised: 25-10-2022 / Accepted: 25-11-2022
Corresponding author: Dr. Sri Prathiba Mahalakshmi Nagarajan
Conflict of interest: Nil

Abstract

Background: In this study, we wanted to evaluate the efficacy of transvaginal ultrasound in predicting the cervical status before pharmacological induction of labour and compare the efficacy of transvaginal ultrasound and Bishop's score in pre-induction cervical assessment.

Materials and Methods: This was a hospital based prospective comparison study conducted among patients who presented with antenatal term singleton gestation selected for induction of labour with intact membranes to the Department of Radiology at GRH, (Govt. Rajaji Hospital), Madurai, over a period of 6 months after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

Results: When comparing the predictive values of the parameters of transvaginal sonography with Bishop's score, it was evident that Bishop's score was more predictive than the individual parameters.

Conclusion: Transvaginal sonography is an ideal alternative for Bishop's score to predict the outcome of induction of labour in nulliparous women with term gestation with intact membranes. The transvaginal sonographic parameters even as individual parameters are statistically more significant in pre-induction cervical assessment than Bishop's score. Cervical length measurement by transvaginal sonography has the highest sensitivity followed by Bishop's scoring system. Posterior cervical angle has the highest specificity followed by percentage of funnelling, both measured by transvaginal sonography. The comprehensive transvaginal sonography is therefore highly sensitive and specific than Bishop's score in pre-induction cervical assessment. As transvaginal sonography is an easy, less time-consuming method, it may be used as an alternative for cases where there is subjective variation in assessment of Bishop's score.

Keywords: Transvaginal Ultrasound, Bishop's Score, Pre-induction Cervical Assessment

Introduction

Induction of labour, one of the most common obstetric procedures, is the technique of artificially stimulating uterine contractions, before the onset of labour,

resulting in progressive effacement and dilatation of cervix, to achieve vaginal delivery. Throughout the world, in up to 20 % of women, labour is being induced by one method or the other. [1.2] There is an increase in the rate of obstetrically and medically indicated inductions, where the foetal and maternal risk of early delivery is relatively less than the risk of prolonging the pregnancy. Whatever be the indication for induction of labour assessment of pre-induction, cervical ripening is essential. There are several methods available for this assessment and newer methods are also being sought to. 'The Bishop's score described by Bishop in 1964 is the traditional cervical scoring system being used. [3,4,5] There are several studies with controversial results regarding the efficacy of Bishop's score in pre-induction cervical assessment. Subsequently, other methods were evaluated and in the search of an objective method, transvaginal ultrasonography was introduced. [6] The parameters like cervical length, posterior cervical angle and percentage of funnelling measured by transvaginal ultrasonography may be used to assess the pre-induction cervical status in a more objective way. Since 1960, prostaglandins have been used to induce labour. As per ACOG 2009, intra-cervical PGE2 as a gel preparation is being widely used for induction of labour. It is well known fact worldwide, that there is no universally accepted criterion for failure of induction, though a time frame of 24 hours is often used for the same. [7,8] Prediction of outcome of labour induction is essential to avoid unnecessary induction and preventable caesarean section.

Aims and Objectives

To find the efficacy of transvaginal ultrasound in predicting the cervical status before pharmacological induction of labour.

To compare the efficacy of transvaginal ultrasound and Bishop's score in pre-induction cervical assessment.

Materials and Methods

This was a hospital based prospective comparison study conducted among patients who presented with antenatal term singleton gestation selected for induction of labour with intact membranes to the Department of Radiology at GRH, (Govt. Rajaji Hospital), Madurai, over a period of 6 months after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants. Inclusion Criteria The study to be conducted in women admitted in GRH, Madurai with term gestation planned for induction of labour. Exclusion criteria: women with previous cesarean section, preterm pregnancy, multifetal gestation, eclampsia. Informed and written consent from the participant. Counselling and communication about the needs and method of study. The following details were tabulated for every woman participating in the study.Name, UHID number, History, age, parity, BMI, indication for induction of labour, method of induction, mode of delivery, Bishop's score, induction delivery interval, reason for caesarean section. Investigations: transabdominal ultrasound, transvaginal ultrasound for measurement of cervical length and posterior cervical angle.

Statistical Methods

Date was entered in MS Excel and analysed using Statistical Package for Social Sciences (SPSS) software. Results were presented as tables.

Sample Size

Overall, by various studies it has been estimated that Bishop's score has a sensitivity of 65 %, and specificity of 95 %. Based on this, the sample size of the study was calculated.

$N = \{Z^2 * Sn * (1-Sn)\}/\{L^2 * P^2\}$

Based on this, the sample size taken for a significant result is 150.

Results

Table 1

Sl. No	Age of the Patient (Years)	No. of Patients	Percentage
1	< 25	131	87.3
2	25 - 30	15	10
3	> 30	4	2.6
Age Distribution			
S. No	Body Mass Index	No. of Patients	Percentage
1	18.5 - 24.9	46	30.6
2	25 - 29.9	70	46.6
3	> 30	34	22.6
BMI			

Age does not influence the outcome of induction of labour.

As the p-value was > 0.005, BMI has no influence on the outcome of induction of labour. Therefore, even if we do not take an age and BMI matched population, as these two factors do not influence the outcome of induction of labour, they need not be considered as confounding factors.

The mean delivery time when the Bishop's score was less than 4 was 22.523 hours to 32.107 hours (95 % confidence interval) and when the Bishop's score was more than or equal to 4 it was 16.205 hours to 20.274 hours (95 % confidence interval). As the chi-square p-value was 0.005, there was significant variation in the induction delivery interval as predicted by Bishop's score. [9,10]

When the cervical length was less than 3 cm, the mean duration of induction to onset of labour interval was 15.933 hours to 20.099 hours (95 % confidence interval) and when it was more than or equal to 3, the mean induction delivery interval was 29.394 hours to 39.897 hours (95 % confidence interval). Hence, cervical length (chi square p-value < 0.0001) was highly significant in pre-induction cervical assessment. [11]

Table 2: Relationship between BMI and Outcome of Induction of Labour

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.402[a]	2	.818
Likelihood Ratio	.418	2	.811
Linear-by-Linear Association	.020	1	.886
N of Valid Cases	150		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .75.

Relationship between Age and Outcome of Induction of Labour

bmi * outcome Crosstabulation

Count

		outcome		
		women who had active labour	women who had failed induction	Total
bmi	18.5-24.9	33	13	46
	24.9-29.9	61	9	70
	>30	28	6	34
Total		122	28	150

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.368[a]	2	.113
Likelihood Ratio	4.229	2	.121
Linear-by-Linear Association	1.876	1	.171
N of Valid Cases	150		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.35.

Table 3: Comparison of Outcome of Labour

S. No	Indication	No. of Patients	Percentage
1	Post-dated	65	43.33
2	Non-severe preeclampsia	46	30.66
3	Oligohydramnios	39	26
4	GDM	2	1.33
5	Jaundice	2	1.33
Indication for Induction of Labour			
Induction to Onset of Labour Interval		Number of Women	Percentage
Less than or equal to 6 hours		13	8.66
6 - 12 hours		40	26.66
12 - 18 hours		22	14.66
18 - 24 hours		46	30.66
> 24 hours		29	19.33
Distribution of Induction – Onset of Labour Interval			
Outcome of Labour		Number of Women	Percentage
Labour natural		125	83.33
Lower segment caesarean section		23	15.33
Outlet forceps		2	1.33

Using the cut off of posterior cervical angle as 120, when the angle was greater than 120, the induction to onset of labour interval was 8.869 hours to 12.744 hours

(95 % confidence interval). When the angle was less than or equal to 12, the induction delivery interval was 22.074 hours to 27.558 hours (95 % confidence interval). The chi square p-value is < 0.0001; therefore, posterior cervical angle significantly predicts the induction delivery interval. [12].

Table 4: Kaplan-Meir Survival Analysis Showing Mean Duration of Induction of Labour Predicted by Posterior Cervical Angle

Means and Medians for Survival Time								
Bishop	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Less than 4	27.315	2.445	22.523	32.107	19.000	2.624	13.856	24.144
Greater than or equal to 4	18.240	1.038	16.205	20.274	16.000	1.805	12.462	19.538
Overall	21.921	1.219	19.531	24.311	18.000	1.750	14.571	21.429
a. Estimation is limited to the largest survival time if it is censored.								
Overall Comparisons								
			Chi-Square		df		Sig.	
Log Rank (Mantel-Cox)			7.962		1		.005	
Test of equality of survival distributions for the different levels of bishop.								
Kaplan-Meir Survival Analysis Showing Mean Duration of Labour Predicted by Bishop's Score								
Means and Medians for Survival Time								
Cl	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Greater than 30mm	34.645	2.679	29.394	39.897	24.000	.	.	.
Less than 30 mm	18.016	1.063	15.933	20.099	14.000	1.145	11.756	16.244
Overall	21.921	1.219	19.531	24.311	18.000	1.750	14.571	21.429
a. Estimation is limited to the largest survival time if it is censored.								
Overall Comparisons								
			Chi-Square		df		Sig.	
Log Rank (Mantel-Cox)			21.384		1		.000	
Test of equality of survival distributions for the different levels of cl.								
Kaplan-Meir Survival Analysis Showing Mean Duration of Labour Predicted by Cervical Length								
Means and Medians for Survival Time								
PCA	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	

			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Less than 120 degrees	24.816	1.399	22.074	27.558	21.000	.773	19.485	22.515
Greater than or equal to 120 degrees	10.806	.989	8.869	12.744	10.000	1.391	7.273	12.727
Overall	21.921	1.219	19.531	24.311	18.000	1.750	14.571	21.429
a. Estimation is limited to the largest survival time if it is censored.								
Overall Comparisons								
		Chi-Square		df		Sig.		
Log Rank (Mantel-Cox)		47.976		1		.000		
Test of equality of survival distributions for the different levels of PCA.								

Table 5: Kaplan Meir Analysis- Transvaginal Ultrasound Scoring

Means and Medians for Survival Time								
Fun	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Less than 40 percent	26.480	1.704	23.140	29.821	22.000	.909	20.218	23.782
Greater than or equal to 40 percent	14.776	.956	12.902	16.650	12.000	1.020	10.000	14.000
Overall	21.921	1.219	19.531	24.311	18.000	1.750	14.571	21.429
a. Estimation is limited to the largest survival time if it is censored.								
Overall Comparisons								
			Chi-Square		Df		Sig.	
Log Rank (Mantel-Cox)			24.482		1		.000	
Test of equality of survival distributions for the different levels of fun.								
Kaplan-Meir Survival Analysis Showing Mean Duration of Induction of Labour Predicted by Percentage of Funnelling								
Means and Medians for Survival Time								
Ctvs	Mean[a]				Median			
	Estimate	Std. Error	95% Confidence Interval		Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
.00	30.935	1.868	27.273	34.597	24.000	.480	23.060	24.940
1.00	14.047	.774	12.530	15.563	12.000	.295	11.421	12.579
Overall	21.921	1.219	19.531	24.311	18.000	1.750	14.571	21.429
a. Estimation is limited to the largest survival time if it is censored.								
Overall Comparisons								
			Chi-Square		df		Sig.	
Log Rank (Mantel-Cox)			55.248		1		.000	
Test of equality of survival distributions for the different levels of ctvs.								

When The Percentage of Funnelling Was Less Than 40 %, The Induction Delivery Interval Ranges Between 23.140 Hours To 29.821 Hours (95 % Confidence Interval). When The Percentage of Funnelling Was More Than or Equal To 40 %, The Induction Delivery Interval Was Between 12.902 Hours To 16.650 Hours (95 % Confidence Interval). The Cut-Off Of 40 % For the Percentage of Funnelling Significantly Influences the Induction Delivery Interval. [13-21]

The Comprehensive Scoring System Combining the Parameters Measured by Transvaginal Sonography, Was Significant in Predicting the Outcome Of Labour Following Induction ($P < 0.001$)

Table 6: Predictive Value of Posterior Cervical Angle

	Value	95% Confidence Interval
Sensitivity	71.67	62.72 - 79.51
Specificity	65.52	45.67 - 82.06
Positive likelihood ratio	2.08	1.24 - 3.48
Negative likelihood ratio	0.43	0.29 - 0.63
Positive predictive value	89.58	81.68 - 94.89
Negative predictive value	35.85	23.14 - 50.20
Prevalence	80.54	73.26 - 86.56
Predictive Value of Bishop's Score		
	Value	95% Confidence Interval
Sensitivity	85.95	78.46 - 91.60
Specificity	48.28	29.45 - 67.47
Positive likelihood ratio	1.66	1.16 - 2.38
Negative likelihood ratio	0.29	0.16 - 0.52
Positive predictive value	87.39	80.06 - 92.77
Negative predictive value	45.16	27.32 - 63.97
Predictive Value of Cervical Length		
	Value	95 % Confidence Interval
Sensitivity	25.62	18.12 - 34.35
Specificity	96.55	82.24 - 99.91
Positive likelihood ratio	7.43	1.06 - 52.21
Negative likelihood ratio	0.77	0.68 - 0.87
Positive predictive value	96.88	83.78 - 99.92
Negative predictive value	23.73	16.38 - 32.44

The sensitivity of bishop's score was 71.67 % and the specificity was 65.52 %. The sensitivity of cervical length in predicting the outcome of induction of labour was 85.95 % and the specificity was 48.28 %.

The sensitivity of posterior cervical angle in predicting the outcome following induction of labour was 25.62 % and the specificity was 96.55 %.

Table 7: ROC Comparing the Efficacy of the Different Transvaginal Parameters Measured as Compared with Bishop's Score

	Value	95 % Confidence Interval
Sensitivity	50.41	41.18 - 59.63
Specificity	79.31	60.78 - 92.01
Positive likelihood ratio	2.44	1.17 - 5.08
Negative likelihood ratio	0.63	0.48 - 0.81

Positive predictive value		91.04		81.52 - 96.64	
Negative predictive value		27.71		18.45 - 38.62	
Predictive Value of Percentage of Funnelling					
		Value		95 % Confidence Interval	
Sensitivity		66.12		56.95 - 74.47	
Specificity		79.31		60.28 - 92.01	
Positive likelihood ratio		3.20		1.55 - 6.59	
Negative likelihood ratio		0.43		0.31 - 0.58	
Positive predictive value		93.02		85.43 - 97.40	
Negative predictive value		35.94		24.32 - 48.90	
Predictive Value of Parameters of Transvaginal Ultrasonography					
Area Under the Curve					
Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95 % Confidence Interval	
				Lower Bound	Upper Bound
Bishop	.696	.056	.001	.585	.806
Cl	.680	.062	.003	.559	.801
PCA	.627	.051	.036	.528	.727
Fun	.643	.055	.019	.535	.750
The test result variable(s): bishop, cl, PCA, fun has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5					

The sensitivity and specificity of percentage of funnelling in predicting the outcome following induction of labour was 50.41 % and 79.31 % respectively.

The sensitivity and specificity of comprehensive transvaginal scoring in predicting the outcome following induction of labour was 66.12 % and 79.31 % respectively. [22-26]

When comparing the predictive values of the parameters of transvaginal sonography with Bishop's score, it was evident that Bishop's score was more predictive than the individual parameters.

Discussion

Bishop's scoring system is the traditionally used method for predicting outcome of induction of labour. To overcome the limitations of this method, transvaginal sonography has been studied as an alternative. [27] In our study, we compare the efficacy of transvaginal sonographic parameters like cervical length, posterior cervical angle and percentage of funnelling with that of Bishop's score.

In our study, 87.3 % of women belong to age < 25 years similar to that by Neha Baipai et al. where 93 % belonged to this age group.The maximum distribution of BMI is between 25 - 29.9 (46.6 %) and this is in contrast to that by Neha Bajpai et al. with maximum distribution of 83.7 % in the age group of 18.5 - 24.9.The confounding factors that may be present in our study are parity, age and BMI. Since we consider only nulliparous women, parity is ruled out. Since the p-value for age and BMI in predicting the outcome of induction of labour is > 0.05, null hypothesis is considered and is evident that age and BMI do not influence the outcome of induction of labour. [28-29] In a study by Bartha et al. prolonged pregnancy and oligohydramnios are the most common causes for induction of labour each contributing to 32.5 % cases respectively. In our study, post-dated

pregnancy is the leading cause contributing to 43.33 % followed by non-severe preeclampsia (30.66 %) and oligohydramnios 26 %. [30-32] Pandis et al. compared cervical length and Bishop's score in 240 women who underwent induction of labour for various indications. In this, vaginal delivery occurred in 80.8 % of women comparable to our study where vaginal delivery is the most common outcome of induction of labour contributing to 84.66 % of which 1.33 % is outlet forceps delivery and caesarean section due to failure of induction contributes to 15.33 %. In the same study, 78 % of the deliveries occurred within 24 hours of induction of labour. In our study, 80.66 % of the deliveries occurred within 24 hours of induction of labour. [33]

The median induction delivery interval is 2-107 hours in multipara and 4-114 hours in nullipara by a study by Pandis et al. Neha Bajpai et al. stated mean duration when Bishop's score was less than 4 as 14.53 hours to 15.78 hours and when the Bishop's score was greater than or equal to 4 as 14.03 to 15.45 hours with a p-value of 0.005. In our study with 150 nulliparous women, the median delivery time is 19.531 hours to 24.311 hours. The mean duration when Bishop's score was less than 4 as 22.523 hours to 32.107 hours and when the Bishop's score was greater than or equal to 4 as 16.205 hours to 20.274 hours with a p-value of 0.005. In a study by Bansiwal et al. the mean induction delivery interval when the cervical length cut off of 3 cm is taken was 11.6 to 23.8 hours. In our study, the mean induction delivery interval when cervical length is less than or equal to 3 cm was 15.933 hours to 20.099 hours and when the cervical length was more than 3 cm, 29.394 hours to 39.897 hours. The overall mean induction delivery interval predicted by cervical length was 19.531 hours to 24.311 hours with a significant p-value of < 0.001 In our study, the mean induction delivery interval when posterior cervical angle was less than 120 degrees was 22.074 hours to 27.558 hours and when posterior cervical angle was greater 120 degrees was 8.869 hours to 12.744 hours. The overall mean induction delivery interval predicted by posterior cervical angle was 19.531 hours to 24.311 hours with a significant p-value of < 0.001. In our study, the mean induction delivery interval when percentage of funnelling was less than 40 was 23.140 hours to 29.821 hours and when percentage of funnelling was greater than or equal to 40 was 12.902 hours to 16.650 hours. The overall mean induction delivery interval predicted by percentage of funnelling was 19.531 hours to 24.311 hours with a significant p-value of < 0.001. [34] In a study by Neha Bajpai et al. the mean induction delivery interval with a comprehensive transvaginal score less than 4 was 18 - 18.9 hours and with a score greater than or equal to 4 was 13.63 to 14.52 hours. In our study, the mean induction delivery interval comprehensive of transvaginal score less than 4 was 27.273 hours to 34.597 hours and with a score greater than or equal to 4 was 12.530 hours to 15.563 hours. The overall mean induction delivery interval predicted by comprehensive transvaginal score was 19.531 hours to 24.311 hours with a significant p-value of < 0.001. Verhoeven et al. has stated that in a subgroup analysis of studies conducted over nulliparous women with a cervical length cut-off of 3 cm, the sensitivity and specificity were 70 % and 74 % respectively with positive likelihood ratio of 2.7 and negative likelihood ratio 0.4. In our study, the sensitivity and specificity are 85.95 and 48.28 respectively with positive likelihood ratio and negative likelihood ratio of 1.72 and 0.28 respectively. [35] In our study, posterior cervical angle has a specificity of 96.55 and percentage of funnelling has sensitivity 50.41, specificity 79.31, positive likelihood ratio 2.44, negative likelihood ratio 0.63 which is comparable with that of Bishop's score. [36] In our study, though the sensitivity and specificity of comprehensive scoring

system is less than Bishop's score, it has higher negative predictive value and hence the area under the curve in ROC is greater than that of Bishop's score with a significant p-value < 0.001. [37]

Conclusion

Transvaginal sonography is an ideal alternative for Bishop's score to predict the outcome of induction of labour in nulliparous women with term gestation with intact membranes. The transvaginal sonographic parameters even as individual parameters are statistically more significant in pre-induction cervical assessment than Bishop's score. Cervical length measurement by transvaginal sonography has the highest sensitivity followed by Bishop's scoring system. Posterior cervical angle has the highest specificity followed by percentage of funnelling, both measured by transvaginal sonography. The comprehensive transvaginal sonography is therefore highly sensitive and specific than Bishop's score in pre-induction cervical assessment. As transvaginal sonography is an easy, less time consuming method, it may be used as an alternative for cases where there is subjective variation in assessment of Bishop's score.

References

1. Hughey MJ, McELIN TW, Bird CC. An evaluation of pre-induction scoring system. Obstet Gynecol 1976;48(6):63 5-41.
2. Jacson GM. Lumdir J. Bader TJ. The accuracy of digital examination and ultrasound in the evaluation of cervical length. Obstet Gynecol 1992;79(2): 214-8.
3. Ware V, Raynor BD. Transvaginal ultrasonographic cervical measurement as a predictor of successful labor induction. Am J Obstet Gynecol 2000; 182(5):1030-2.
4. Pandis GK, Papageorghiou AT, Ramanathan VG, Thompson MO, Nicolaides KH. Preinduction sonographic measurement of cervical length in the prediction of successful induction of labor. Ultrasound Obstet Gynecol 2001;18(6):623-8.
5. Gabriel R, Darnaud T, Chalot F, Gonzalez N, Leymarie F, Quereu C. Transvaginal sonography of the uterine cervix prior to labor induction. Ultrasound Obstet Gynecol 2002; 19 (3):254-7.
6. Studd J, Tan SL, Chervenak FA. Current progress in obstetrics and gynaecology. Tree Life Media (A Div of Kothari Medical) 2022:80-101.
7. Phelps JY, Higby K, Smyth MH, Ward JA, Arredondo F, Mayer AR. Accuracy and interobserver variability of simulated cervical dilation measurements: Am J Obstet Gynaecol 1995;173(3):942-5.
8. Boozarjomehri F, Timor-Tritsch I, Chao CR, Fox HE. Transvaginal ultrasonographic evaluation of the cervix before labor: presence of cervical wedging is associated with shorter duration of induced labor. Am J Obstet Gynecol 1994;171(4):1081-7.
9. Royal College of Obstetricians and Gynaecologists (RCOG).Induction of labour. In Evidence-based Clinical Guideline. Number 9. London: RCOG Press 2001.
10. Crowley P. Interventions for preventing or improving the outcome of delivery at or beyond term. The Cochrane Library 2003;2. http://www.update-software.com.
11. Gonen R, Degani S, Ron A. Prediction of successful induction of labor: comparison of transvaginal ultrasonography and the Bishop score. Eur J Ultrasound 1998; 7:183-7.
12. Ware V, Raynor BD. Transvaginal ultrasonographic cervical measurement as a predictor of successful labor induction. Am J Obstet Gynecol 2000; 182(5):1030-2.
13. Arulkumaran S, Gibb DM, Tambyraja RL, Heng SH, Ratnam SS. Failed

induction of labor. Aust N Z J Obstet Gynaecol 1985;25(3):190-3.
14. Ware V, Raynor D. Transvaginal ultrasonographic cervical measurement as a predictor of successful labor induction. Am J Obstet Gynecol 2000; 182(5):1030-2.
15. Pandis GK, Papageorghiou AT, Ramanathan VG, Thompson MO, Nicolaides KH. Preinduction sonographic measurement of cervical length in the prediction of successful induction of labor. Ultrasound Obstet Gynecol 2001;18(6):623-8.
16. Rane SM, Pandis GK, Guirgis RR, Higgins B, Nicolaides KH. Pre-induction sonographic measurement of cervical length in prolonged pregnancy: The effect of parity in the prediction of induction-to-delivery interval. Ultrasound Obstet Gynecol 2003;22(1):40-4.
17. Rane SM, Guirgis RR, Higgins B, Nicolaides KH. Pre-induction sonographic measurement of cervical length in prolonged pregnancy: The effect of parity in the prediction of the need for Cesarean section. Ultrasound Obstet Gynecol 2003;22(1):45-8.
18. Gardberg M, Laakkonen E, Salevaara M. Intrapartum sonography and persistent occiput posterior position: a study of 408 deliveries. Obstet Gynecol 1998;91(5):746-9.
19. Paterson-Brown S, Fisk NM, Edmonds DK, Rodeck CH. Preinduction cervical assessment by Bishop's score and transvaginal ultrasound. Eur J Obstet Gynecol Reprod Biol 1991;40(1):17-23.
20. Bishop EH. Pelvic scoring for elective induction. Obstet Gynecol 1964; 24: 266-8.
21. Anderson HF, Nugent CE, Wanty SD, Hayashi RH. Prediction of likelihood of preterm delivery by ultrasonographic measurement of cervical length. Am J Obstet Gynecol 1990;163(3):859-67.
22. Sonek J, Shellhaas C. Cervical sonography: a review. Ultrasound Obstet Gynecol 1998;11(1):71-8.
23. National Institute for Clinical Excellence. Inherited Clinical Guideline D – Induction of Labour. http://www.nice.org.uk [15 December 2003].
24. Metz CE. Basic principles of ROC analysis. Semin Nucl Med 1978;8 (4): 283-98.
25. Sheiner E, Levy A, Feinstein U, Hershkovitz R, Hallak M, Mazor M. Obstetric risk factors for failure to progress in the first versus the second stage of labor. J Matern Fetal Neonatal Med 2002;11(6):409-13.
26. Crane SS, Wojtowycz MA, Dye TD, Aubry RH, Artal R. Association between pre-pregnancy obesity and the likelihood of cesarean delivery. Obstet Gynecol 1997;89(2):213-6.
27. Pandis GK, Papageorghiou AT, Ramanathan VG, Thompson MO, Nicolaides KH. Preinduction sonographic measurement of cervical length in the prediction of successful induction of labor. Ultrasound Obstet Gynecol 2001;18(6):623-8.
28. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome:a study of 287, 213 pregnancies in London. Int J Obes Relat Metab Disord 2001;25(8):1175-82.
29. Boozarjomehri F, Timor-Tritsch I, Chao CR, Fox HE. Transvaginal ultrasonographic evaluation of the cervix before labor: presence of cervical wedging is associated with shorter duration of induced labor. Am J Obstet Gynecol 1994;171(4):1081-7.
30. Williams MC, Krammer J, O'Brien WF. The value of the cervical score in predicting successful outcome of labor induction. Obstet Gynecol 1997;90(5): 784-9.
31. Firmin JM, Caron P, Marpeau L. Does ultrasound examination when the

cervix is unfavorable improve the prediction of failed labor induction? Ultrasound Obstet Gynecol 2004;23 (4):357-62.
32. Goldberg J, Newman RB, Rust PF. Inter observer reliability of digital and endovaginal ultrasonographic cervical length measurements. Am J Obstet Gynecol 1997;177(4):853-8.
33. Gabriel R, Darnaud T, Chalot F, Gonzalez N, Leymarie F, Quereux C. Transvaginal sonography of the uterine cervix prior to labor induction. Ultrasound Obstet Gynecol 2002;19 (3):254-7.
34. Burnett JE. Preinduction scoring: an objective approach to induction of labor. Obstet Gynecol 1996;28(4):479-83.
35. Chandra S, Crane JM, Hutchens D, Young DC. Transvaginal ultrasound and digital examination in predicting successful labor induction. Obstet Gynecol 2001;98(1):2-6.
36. Gonen R, Degani S, Ron A. Prediction of successful induction of labor: comparison of transvaginal ultrasonography and the Bishop score. Eur J Ultrasound 1998;7(3):183-7.
37. V. A., Rajakumar S., & Rajagopal G. Possible steroidal effect of Boswellia serrata and homeostasis of Histidine – HDC- Histamine in Psoriasis. Journal of Medical Research and Health Sciences. 2022; 5(11): 2324–2328.