Role of Transvaginal Sonography in Preinduction Cervical Assessment. Is it helpful?

Panchampreet Kaur[1], Manpreet Kaur[2], Manjula Rao[3], Mini Mohan[4]

ABSTRACT

Introduction: Induction of labour is carried out in approximately 20% of pregnant woman. Favourability of cervix for labour induction is being assessed by bishop score worldwide. Our study aims to evaluate the relationship between preinduction sonographically measured cervical length and the Bishop score in term pregnancy and thereby assess which is a better predictor of successful vaginal delivery within 24 hours of induction.

Material and methods: This was a prospective double blinded study. Preinduction cervical assessment was undertaken in 121 women with singleton pregnancies at 36–41 weeks of gestation. The Bishop score was assessed by digital examination and the cervical length was measured by transvaginal sonography (TVS).

Results: Linear regression analysis showed that both bishop score (r=0.60) and cervical length(r=0.71) have significant association with induction to delivery interval independently but that of cervical length was statistically more significant. Multivariate cox regression analysis demonstrated that cervical length provided independent contribution in the prediction of the likelihood of delivering vaginally within 24 h (P<0.001). The best cut-off point was 28 mm for cervical length and 3 for the Bishop score for successful induction as found with receiver operating curves. Similarly, the Kaplan–Meier Survival curves indicated that better discriminatory results in the prediction of vaginal delivery within 24 h were achieved using cervical length rather than the Bishop score.

Conclusion: Transvaginal sonographic measurement of cervical length provides a useful prediction of the likelihood of vaginal delivery within 24 h of induction.

Keywords: Bishop Score, Transvaginal Sonography, Cervical length, Induction of Labour

INTRODUCTION

"Induction of labor has been defined as the stimulation of regular uterine contractions before the onset of spontaneous labor by using either pharmacologic or mechanical methods in order to cause cervical dilatation and subsequently delivery."[1] It has reportedly been said to occur in 47.6% of nulliparous and 41.0% of multiparous women attempting vaginal delivery.[2]

Traditionally bishop score has been used to assess the favourability of cervix prior to induction of labour and thereby predict successful vaginal delivery. Then came the era of ultrasonography and measurement of cervical length by transvaginal ultrasonography (TVUS) was being widely used for the prediction of preterm delivery in patients at risk for or with preterm labor.[3] However, it is still controversial whether ultrasonographic assessment of the cervix is valuable for the prediction of successful induction of labor in term or post-term gestation.

Although cervical assessment by bishop score is a subjective method, there have been numerous studies which claim bishop score to be a better predictor of vaginal delivery at term than cervical length on sonography. Patrick Rozenberg et al compared preinduction ultrasonographic cervical length and bishop score in predicting time to delivery interval after labour induction and they found bishop score to have better predictive value.[4] Ron Gonen et al observed similar results.[5] Some investigators have also reported that ultrasonographic evaluation of the cervix is useful in predicting successful labor induction,[6-9] whereas others published unfavourable results.[10-13]

So we planned a study which attempts to assess the role of transvaginal sonography in prediction of successful outcome of induction in comparison with clinical assessment obtained by the Bishop score and we have reviewed the literature for the same. The primary aim of this study was to examine the relationship between preinduction sonographically measured cervical length and the Bishop score; and to compare the two measurements in the prediction of successful vaginal delivery within 24 hours of induction. Also our objective was to calculate the most useful cut-off points for cervical length measured by transvaginal sonography and Bishop Score for prediction of successful labor induction.

MATERIAL AND METHODS

This was a prospective double blinded observational study which included patients undergoing delivery following induction of labour with pharmacological methods in the labour ward at a tertiary care centre in South India for a period of one year. The study protocol and consent form were reviewed and approved by the ethical committee of the hospital. Written informed consent was taken from all the patients.

Subjects: In this study, 121 women who got admitted in

[1]Ex Post Graduate Resident, [3]Senior Consultant, [4]Consultant, Department of Obst. and Gynae, Durgabai Deshmukh Hospital and Research Centre, Hyderabad, [2]Assistant Professor, Department of Obst. and Gynae, Government Medical College and Rajindra Hospital, Patiala, India

Corresponding author: Dr. Manpreet Kaur, 159-D, Model Town, Patiala-147001, India

International Journal of Contemporary Medical Research
ISSN (Online): 2393-915X; (Print): 2454-7379 | ICV (2015): 77.83 |

Volume 4 | Issue 7 | July 2017

1549

the labour ward with singleton pregnancies for induction of labour were enrolled. All women underwent cervical assessment by both transvaginal ultrasound and Bishop Score just prior to induction. Patients were selected randomly and inclusion criteria were strictly followed which were singleton pregnancy, period of gestation as 36-41 weeks, live fetus in cephalic presentation, patient not in labour and with intact membranes. Patients with parity more than one, previous caesarean section, any evidence of antepartum haemorrhage or having malformed fetus were excluded from the study.

A baseline detailed history of the patient was taken. All patients had a baseline level II anomaly scan. Risk parameters were assessed and indication for induction of labour was analysed and then they were subjected to cervical assessment after taking a written informed consent. Transvaginal sonography was carried out by obstetricians trained in Ultrasonography and blinded to cervical findings. We used a Siemens G-60 Ultrasound system with a 6.5-MHz transvaginal probe. The following parameters were studied: (1) cervical length, (2) internal os dilatation and (3) the presence of funnelling.

The standard technique of transvaginal sonographic evaluation of cervix was followed in which the probe is placed in the vagina approximately 3 cm proximal to the cervix without any pressure on the cervix to avoid distortion of the postion of cervix which thereby gives a false cervical length. The probe is adjusted to a position till the echogenic endocervical mucosa is visible along the length of the cervical canal. Thereafter, the image is enlarged so that the cervix occupies at least two thirds of the image, and both external and internal os are well seen in same frame. The callipers are used to measure the distance between the internal os and external os.[14-16] Also, the image should be such that anterior width of cervix equals the posterior width. The cervical length can be measured either by a straight line between internal and external os or by taking the measurement along the curve in cases where the cervical canal is curved and deviation is > 5 mm (measured as a distance from midpoint of straight line drawn between internal and external os to the centre of the cervical canal curve). Three measurements are obtained and the shortest, technically best measurement is recorded.[17]

The digital examination was performed by an obstetrician at the initiation of induction who was not aware of the sonographic findings and the score was assigned as per the standard Bishop scoring system which studies various parameters including cervix position, dilatation, effacement, consistency and head station of fetus. It is scored from 0-13.[18] Labour induction was carried out according to the standard protocol of this hospital. Patients were induced with 25 mcg of vaginal PGE1 tablets 6 hourly for maximum of 4 doses. Oxytocin augmentation was started at 3 cm or in cases with unsatisfactory progress of labor or following amniotomy. Continuous electronic fetal monitoring was done.

A partograph was maintained and each case was followed up till delivery. Cervical dilatation of 3-5 cm, in the presence of uterine contractions, was taken as the threshold for active labor.[19] The primary outcome measure studied was successful induction of labor. Successful induction for the purpose of this study was taken as a vaginal delivery within 24 hours from the start of induction. This endpoint has been traditionally used to examine the efficacy of inducing method.[20] Secondary outcome variables studied included the mode of delivery, the interval from the start of induction to the time of delivery.

STATISTICAL ANALYSIS

Out of 121 women studied who met the inclusion criteria, 4 women who delivered by caesarean section for fetal distress within 24 hours were excluded. So, the final statistical analysis has been done in 117 women.

The statistical analysis has been done using the Microsoft excel 2013 and XLSTAT statistical and multivariate analysis software, version 2012. The group of women was divided into approximate quartiles of cervical length and Bishop Score, respectively, and these subgroups were compared using Kaplan Meier curves. Linear regression analysis has been done. Multivariate Cox regression analysis has been used to investigate the two parameters as independent predictors of successful induction of labor. Receiver operating characteristic curves for the two methods have been compared. Two-sided P-values are reported throughout. We have considered a $P < 0.05$ as statistically significant.

RESULTS

Mean ($\pm$ SD) age of patients in the study group was 25.29 $\pm$ 3.28 years (Median - 25; range 19-33 years). The mean ($\pm$SD) gestational age at the time of induction was 39.33 $\pm$ 1.23 weeks (Median was 40.1 weeks; Range: 36-41 weeks). Table 1 shows various demographic and clinical parameters in the study group. Some patients had multiple indications for induction.

The inclusion of nullipara and parity =1 had no statistical significance on final results in our study group (P-0.07). Failed induction has been defined when patient remains in latent phase of labour even after complete regime of labour induction. Figure 1 shows that as the Bishop score increased, the chances of caesarean section reduced. However 76.4% (13/17) patients with Bishop Score of even 1 and 72.4% (21/29) with Bishop score 2 also delivered normally. The cervical length measured by TVUS is inversely proportional to successful vaginal delivery. As cervical length increases the chances of vaginal delivery decrease. However, 64% (11/17) patients with cervical length between 35-40mm had vaginal delivery but only 20% (1/5) patients with cervical length between 40-45 mm had vaginal delivery [Figure 2].

Linear Regression analysis showed that there was a significant association between the Bishop score and the induction to delivery interval ($r = 0.60$, $P < 0.001$) [Figure 3]. Similarly, figure 4 shows that there was a significant association between the cervical length and the induction to delivery interval ($r = 0.71$, $P < 0.001$). However association of cervical length with induction to delivery interval was found to be statistically more significant. Further analysis

Demographic characteristics	Results (n = 117)
Median Age	25 (range 19-33 years)
Parity	
Nullipara	93 (79.48%)
Multipara	24 (20.51%)
Mean Gestational Age	39.33 ± 1.23 weeks (Range: 36-41)
Indications for labour Induction	
Prolonged pregnancy	65 (55.56%)
Hypertensive Disorders	26 (18.06%)
Gestational Diabetes Mellitus	8 (6.84%)
Fetal Growth Restriction	6 (5.13%)
Oligohydramnios	22 (18.80%)
Decreased Fetal Movements	8 (6.84%)
Previous Intrauterine fetal demise	1 (0.85%)
Social Indication	2 (1.71%)
Study parameters	
Bishop Score	Median: 3(range 1-7); Mode: 3 (n -31, 26.5%)
Ultrasonographic cervical length	Median: 27mm (Range: 11.5 – 44.8)
Vaginal Delivery	103 (88.03%)
Cesarean section	14 (11.97%)
Table-1: Demographic and clinical details:	

Figure-1: Percentage of patients undergoing vaginal delivery/ Cesarean section vs. Bishop Score

Figure-2: Percentage of patients undergoing vaginal delivery/ Cesarean section vs TVS

Figure-3: Linear Regression analysis between Bishop score and log of induction to delivery interval

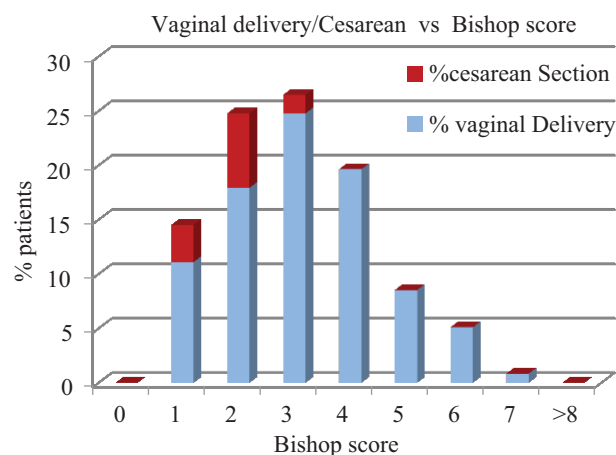showed that there is also a statistically significant association between cervical length and Bishop score (r = 0.80) (P=<0.001), so both are correlated.

In the receiver operating characteristic (ROC) curves when plotted (Figures 5,6) the best cut-off point for the prediction of successful induction was 3 for the Bishop score with a sensitivity of 0.69 and a specificity of 0.75 and that for cervical length was 28 mm with a sensitivity of 0.73 and a specificity of 0.81. In the ROC curves for internal os dilatation, the best cut-off point for the prediction of successful induction was 10 mm with sensitivity of 0.65 and a specificity of 0.68 area under curve (AUC) being 0.65.
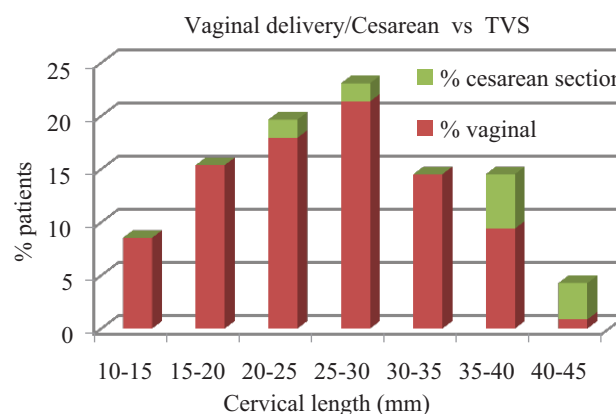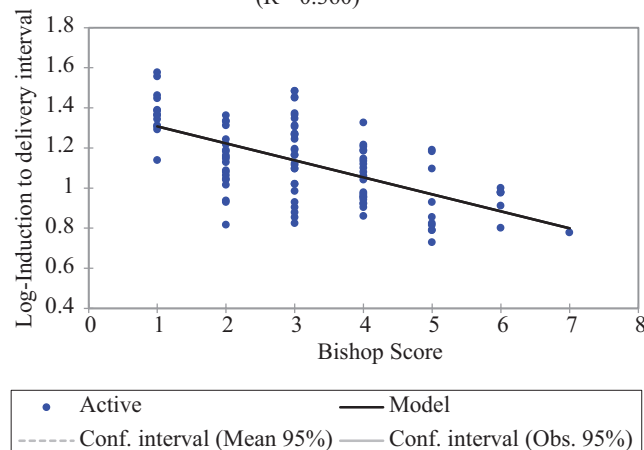
On comparing the all 3 ROC curves, cervical length (AUC: 0.86) appeared to be a single independent predictor than the internal os dilatation (AUC: 0.65) and Bishop Score (AUC: 0.81)

The Kaplan Meier survival distribution curves were studied (Figure 7) and it was seen that as the Bishop score decreases the proportion of women not delivering within 24 hours increases. There is distinction observed between various quartile curves. 50% median estimated induction to delivery interval was 16.5 hour for score 0-2, 15.5 h for score 3, 11.4 h for score of 4 and 8.1 h for score of 5-9 (DF: 3, *P*<0.001). Figure 8 shows that as the cervical length increases the proportion of women not delivered within 24 hours increases. In these curves there is clear distinction between various quartiles which is more than the curves plotted for Bishop Score. 50% median estimate of induction to delivery interval was 9.5 h for cervical length 19-25 mm, 20.5 h for 32-50 mm, 15.2 h for 25-32 mm and 9 h for 0-19 mm. (DF: 3, *P*: <0.001).

Multivariate cox regression analysis demonstrated that cervical length (*P*<0.001) and not Bishop Score (*P*- 0.63)
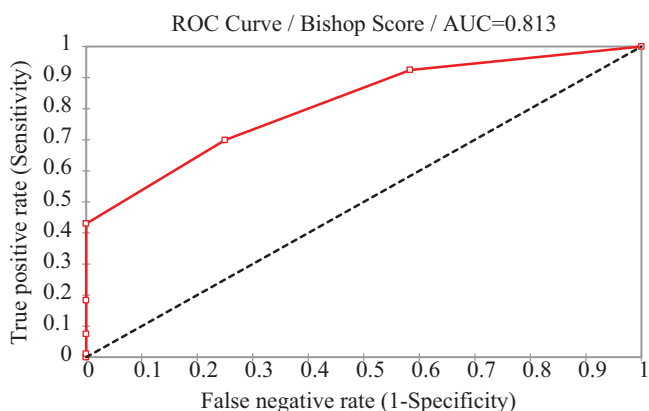
provided significant independent contribution in the prediction of the likelihood of delivering vaginally within 24 hours.

Incidence of complications in the study group was also analysed. 76.1% (n=89) patients had no complications, 3.4% (n-4) had atonic postpartum haemorrhage managed

International Journal of Contemporary Medical Research
ISSN (Online): 2393-915X; (Print): 2454-7379 | ICV (2015): 77.83 | Volume 4 | Issue 7 | July 2017
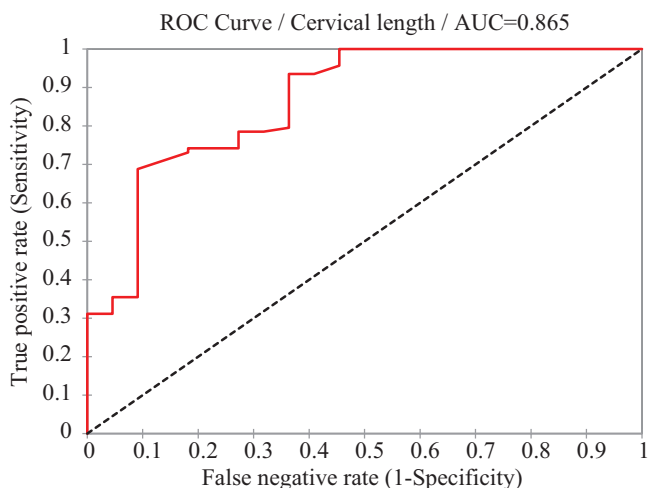
1551

medically, 10.3%(n-12) had meconium stained liquor out of which 2 underwent caesarean section, 3.4%(n-4) had both meconium stained liquor and mild postpartum haemorrhage. 1.7% (n-2) had cervical tear, 1.7% (n-2) had retained placenta and 3.4% (n-4) had shoulder dystocia. One had fetal distress in second stage and so had instrumental delivery.

Figure-4: Linear Regression analysis between cervical length and log of induction to delivery interval
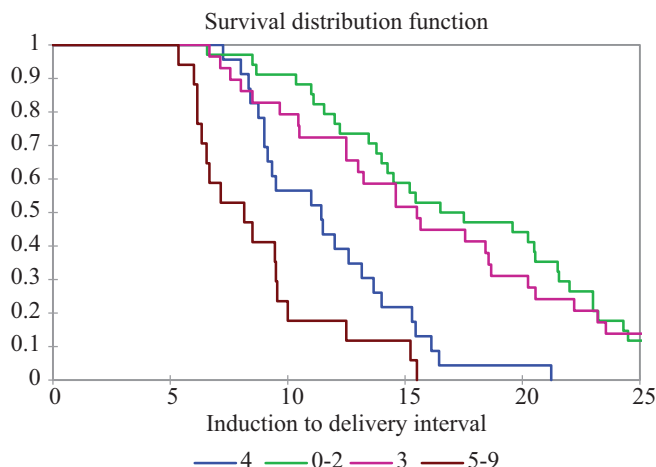

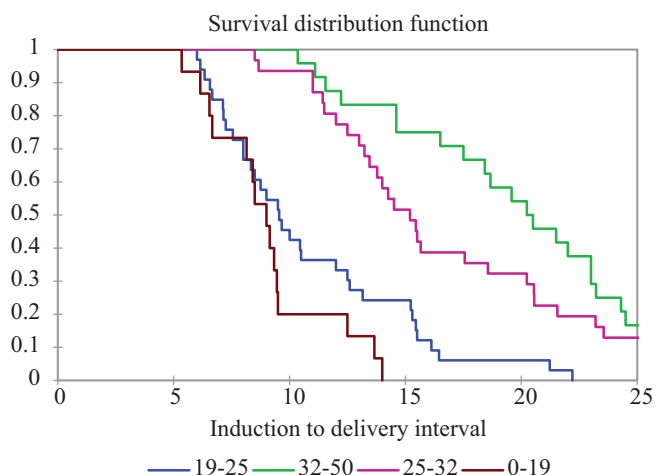**Figure-5:** Receiver-operating characteristic curve for Bishop Score

Figure-6: Receiver-operating characteristic curve for Cervical Length

DISCUSSION

Approximately 20% of women undergoing induction

Figure-7: Kaplan–Meier survival curve estimates of proportions not delivering within 24 h, by quartiles of Bishop Score (X Axis: Induction to Delivery interval in hours; Y Axis: Proportion of women not delivering within 24 hours)

Figure-8: Kaplan–Meier survival curve estimates of proportions not delivering within 24 h, by quartiles of cervical length.

Figure-9: Image showing ultrasonographic measurement of cervical length in a patient under study (Sagittal view of the endocervical canal which is open and membranes are visualized at the level of internal os)

1552

International Journal of Contemporary Medical Research
Volume 4 | Issue 7 | July 2017 | ICV (2015): 77.83 | ISSN (Online): 2393-915X; (Print): 2454-7379

Study Series	Gomez et al	Yang et al	Pandis et al	Present
Study Group (n)	177	105	240	117
Cut Off Points				
CL (mm)	24	31	28	28
BS	4	4	3	3
Cervical Length				
Sensitivity (%)	66	75	87	73
Specificity (%)	77	83	71	81
Bishop Sore				
Sensitivity (%)	77	51	58	69
Specificity (%)	56	75	77	75

Table-2: Receiver Operating Curve Analysis showing cut off points for cervical length and Bishop Score and respective sensitivity and specificity

of labor end up having a Caesarean delivery.[21] The rate of intraoperative complications in emergency caesarean sections is 14.5% compared with 6.8% in the elective group.[22] Bishop score is being universally used to assess cervical favourability for induction of labour. The cervix is divided into portio supravaginalis and portio vaginalis depending upon the portion lying above or below the reflection of vagina.[23] Effacement which starts at the internal os is difficult to assess by digital examination in a closed cervix. Sonographic measurement (Figure-9) of the cervical length is quantitative and can be done easily and with minimal or no discomfort to the patient.

As observed, our study demonstrated that induction to delivery interval is significantly associated with both the preinduction Bishop score and the sonographically measured cervical length. However, sonographically measured cervical length was better than the Bishop score in predicting the likelihood of vaginal delivery within 24 h of induction

We analysed the results of our study in detail and the same have been compared with the available literature. We performed a PubMed and google scholar search using the search terms ' Cervical length' AND 'induction of labour' OR ' induction of labor' OR 'Labour Induction' OR 'Labor Induction' AND 'Bishop Score' without any limits. The demographic details and basic clinical parameters were comparable to other studies.[7,24,25]

P C Tan et al compared transvaginal sonography for cervical length measurement and digital examination for Bishop Score assessment in women undergoing labor induction at term. They concluded that sonographically measured cervical length is better tolerated than digital examination. Both cervical length and Bishop Score are useful predictors of the need for Caesarean delivery following labor induction.[26] In our study we observed that 90% (n=93) women had vaginal delivery within 24 hours and 11.97% (n=14) had caesarean section. The results were comparable with the aforementioned study. So, preinduction cervix assessment gives insight into likelihood of vaginal delivery vis a vis caesarean section and thereby prevents unnecessary labour induction. G K pandis et al[7] stated that although both Bishop score and cervical length are correlated, cervical length is a better predictor of successful labor induction [R value (Cervical Length)= 0.70 > R Value (Cervical Length) =0.51; P= <0.0001] Ware and Raynor[8] also compared the two

parameters and found cervical length to be a better predictor of successful induction of labor [R(CL) = 0.69 > R(BS) = 0.65] Our study showed similar results. In the receiver operating characteristic curves, our results were comparable to those reported in previous studies as shown in table 2.

Further results of AUC between the two methods in our study were also comparable to various other studies concluding cervical length to be a better predictor of successful induction than Bishop Score.[25,27] Although some studies inferred Bishop Score and cervical length to be independent predictors of successful labor induction,[7,24] when we studied multivariate Cox regression analysis in our data, we found only cervical length to be an independent predictor.

Recently, Cochrane review was published to assess and compare bishop score with other methods to assess cervical ripening prior to induction of labour. When comparing with transvaginal ultrasonography (TVUS), they concluded that no method was superior than the other and TVUS is not feasible in resource poor settings and also more studies were needed to address complications and cutoff limits.[28] We, in our study have tried to focus on various parameters.

Strengths and Limitations of our study: Our study was a double blinded study. Also, ultrasound was done by an obstetrician trained in ultrasonography who could judge the parameters in a better way from an obstetrician point of view. Multiple statistical analytic methods have been considered to come to a proper conclusion. The cut off limits by both the methods and its relation to final outcome have been analysed. Also, light has been thrown on the complications involved. However, looking at the other side of the coin, other parameters like posterior cervical angle, occipital position and body mass index could have been studied.

CONCLUSION

Sonographic measurement of cervical is a quantitative and an objective method with minimum interobserver variation. However, those undertaking this measurement should receive appropriate training. Digital examination of the cervix does not involve extra cost, any extra equipment or any additional training. As except for one multivariate cox regression analysis, all other statistical analysis showed that Bishop Score is also significant although less than TVS. Bishop score remains the most cost effective and simple method of predicting the outcome of the induction of labor.

International Journal of Contemporary Medical Research
ISSN (Online): 2393-915X; (Print): 2454-7379 | ICV (2015): 77.83 | Volume 4 | Issue 7 | July 2017

1553

But definitely Transvaginal sonography is an objective method for preinduction cervical assessment and should be used as an adjunct to Bishop Score wherever possible and indicated.

ACKNOWLEDGEMENT

REFERENCES

1. Luis Sanchez-Ramos, Issac Delke. Induction of Labor in James Steer, Weiner, Gonik. High Risk Pregnancy: Management Options, ©Saunders, Elsevier 4/e 2011;1145-54.
2. Laughon SK, Zhang J, Grewal J et al.Induction of labor in a contemporary obstetric cohort. Am J Obstet Gynecol. 2012;206:486 e1–9.
3. V. Berghella, M. Palacio et al Cervical length screening for prevention of preterm birth in singleton pregnancy with threatened preterm labor: systematic review and meta-analysis of randomized controlled trials using individual patient-level data in Ultrasound Obstet Gynecol. 2017;49:322–329.
4. Rozenberg, P., Chevret, S., Chastang, C. and Ville, Y. Comparison of digital and ultrasonographic examination of the cervix in predicting time interval from induction to delivery in women with a low Bishop score. BJOG: An International Journal of Obstetrics and Gynaecology. 2005;112:192–196.
5. 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.
6. Gabriel R, Darnaud T, Chalot F, Gonzalez N et al Transvaginal sonography of the uterine cervix prior to labor induction. Ultrasound Obstet Gynecol. 2002; 19:254–7.
7. 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;18:623–8.
8. Ware V, Raynor BD. Transvaginal ultrasonographic cervical measurement as a predictor of successful labor induction. Am J Obstet Gynecol. 2000;182:1030–2.
9. Boozarjomehri F, Timor-Tritsch I et al. 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; 171:1081–7.
10. Chandra S, Crane JM et al. Transvaginal ultrasound and digital examination in predicting successful labor induction. Obstet Gynecol. 2001;98:2–6.
11. Gonen R, Degani S, and Ron A. Prediction of successful induction of labor: comparison of transvaginal ultrasonography and the Bishop score. Eur J Ultrasound. 1998;7:183–7.
12. Watson WJ, Stevens D, Welter S, Day D. Factors predicting successful labor induction. Obstet Gynecol. 1996; 88:990–2.
13. 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;40:17–23.
14. Sonek JD, Iams JD et al. Measurement of cervical length in pregnancy: comparison between vaginal ultrasonography and digital examination. Obstet Gynecol. 1990; 76:172–5.
15. Anderson HF, Nugent CE, et al. Prediction of risk for preterm delivery by ultrasonographic measurement of cervical length. Am J Obstet Gynecol. 1990;163:859–67.
16. Sonek J, Shellhaas C. Cervical sonography: a review. Ultrasound Obstet Gynecol. 1998;11:71–8.
17. Vincenzo Berghella, Adeeb Khalifeh. Ultrasound evaluation of Gravid Cervix. In Callen's Ultrasonography in Obstetrics and Gynecology, 6th/e by Mary E Norton, Leslie M. Scoutt, Vickie A. Feldstein © 2017 by Elsevier, inc.:655-60: ISBN:978-0-323-32834-0
18. Bishop EH. Pelvic scoring for elective induction. Obstet Gynecol. 1964;24:266-8.
19. F. Gary Cunningham, Kenneth J. Leveno, Steven L. Bloom et al. Normal labor in Williams's obstetrics 24/e © 2014 by McGraw-Hill Education; 960-2
20. Royal College of Obstetricians and Gynaecologists (RCOG). Induction of labor. In Evidence based Clinical Guideline Number 70. National Collaborating Centre for Women's and Children's Health. 2nd edition © 2008
21. Crowley P. Interventions for preventing or improving the outcome of delivery at or beyond term (Cochrane Review). In The Cochrane Library, issue 3. Oxford: Update Software, 2001
22. Vallikkannu N, Lam WK, Omar SZ, Tan PC. Insulin-like growth factor binding protein 1, Bishop Score, and sonographic cervical length: tolerability and prediction of vaginal birth and vaginal birth within 24 hours following labour induction in nulliparous women. BJOG 2016.
23. James P.Nott, Elizabeth A. Bonney et al The structure and function of the cervix during pregnancy in Translational Research in Anatomy. 2016;2:1-7.
24. B Bueno, San Frutos et al The labor induction: integrated clinical and sonographic variables that predict the outcome. Journal of Perinatology. 2007;27:4–8.
25. Soon Ha Yang, Cheong Rae Roh et al Transvaginal Ultrasonography for Cervical Assessment before Induction of Labor. J Ultrasound Med. 23:2004;375–382.
26. P C Tan, N Vallikkannu et al. Transvaginal sonographic measurement of cervical length vs. Bishop score in labor induction at term: tolerability and prediction of Cesarean delivery. Ultrasound Obstet Gynecol. 2007;29:568-73
27. Yildiz Uyar, Gurcan Erbay et al. Comparison of the Bishop score, body mass index and transvaginal cervical length in predicting the success of labor induction. Archives of Gynecology and Obstetrics. 2009;280: 357-62.
28. Ezebialu IU, Eke AC, Eleje GU, Nwachukwu CE. Methods for assessing pre-induction cervical ripening. Cochrane Database of Systematic Reviews 2015, Issue 6. Art. No.: CD010762.