

Comparison of Trans-vaginal Ultrasound Cervical Length Measurement and Bishop Score in Predicting Successful Labour Induction in Term Pregnancies at Ahmadu Bello University Teaching Hospital Zaria

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Abstract

The goal of induction of labour (IOL) is to achieve successful vaginal delivery and reduce caesarean section (CS). The gold standard method for assessing cervical status has been the use of the Bishop score (BS) which is not flawless leading to unnecessary intervention. Trans-vaginal ultrasound cervical length (CL) measurement has been compared with BS in predicting successful IOL. The objective of this study was to compare CL and BS in predicting successful IOL at Ahmadu Bello University Teaching Hospital. It was a cross sectional comparative study design conducted among pregnant women at 37-42 weeks of gestation slated for IOL between November 2017 to November 2018. Eighty-seven (87) women were recruited as participants. Each participant, had a trans-vaginal ultrasound (TVS) CL measured and each was followed by a digital cervical assessment using BS. Relevant data obtained was analysed using SPSS version 23. The significance level was considered at $P < 0.05$ IOL was successful in 66.2% (47) of the participants, while 15% (13) had CS. The receiver operating characteristic curve (ROC) demonstrated a better performance of the BS (AUC= 0.556, $P= 0.433$, CI= 0.426-0.673, PPV=52.8%) in predicting successful IOL than the TVS-CL measurement (AUC= 0.446, $P=0.391$, CI= 0.317-0.574) PPV=60.2%). Results further showed that the best cut off values for favourability for IOL for TVS-CL and BS were ≤ 2.5 cm and ≥ 5 respectively. The most important component of the BS predictive of successful IOL was cervical dilatation (OR= 0.603, $P=0.011$). TVS-CL did not demonstrate a diagnostic accuracy in predicting successful IOL in term pregnancies compared to BS.

Keywords: Trans-vaginal ultrasound, Cervical length, Bishop Score, Induction of labour and Zaria

INTRODUCTION

Induction of labour (IOL) is the most common intervention in modern obstetrics (Kant *et al.*, 2016). IOL is defined as iatrogenic stimulation of uterine contraction to accomplish delivery prior to the onset of spontaneous labour (Kant *et al.*, 2016). According to Kanwar *et al.* (2015), the goal of IOL is to achieve a successful delivery and reduce caesarean section (CS). It is carried out in approximately 20% of pregnancies (Kanwar *et al.*, 2015; Pandis, 2001). IOL is indicated when the benefit of delivery to either the mother or foetus outweighs those of continuing the pregnancies (Kant *et al.*, 2016). 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 (Pandis *et al.*,

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2001). However, approximately 20% of women with IOL end up having a caesarean delivery (Pandis *et al.*, 2001). CS is associated with increased risk of maternal and neonatal morbidities (Okafor *et al.*, 2023), risk for future pregnancies (Gillor *et al.*, 2017) and the risk of blood transfusion (Akinlusi *et al.*, 2018). The cost implication of caesarean section especially among women with low socio-economic status worsens their financial risk protection and tilts them and their families into abject poverty (Awoyemi *et al.*, 2020). The incidence of IOL has continued to rise over the past several decades (Gedam *et al.*, 2014).

Successful IOL can be predicted by assessing cervical status (Kant *et al.*, 2016; Khazardoost 2016). Although the Bishop score (BS) is traditionally the gold standard for assessment of cervical status (Latha *et al.*, 2016) yet, the procedure is painful (Khazardoost *et al.*, 2016) and gives discomfort to the patient (Latha *et al.*, 2016). Due to its subjective nature (Khazardoost *et al.*, 2016) BS can be accompanied with intra and inter observer variability even among the experienced obstetricians (Abou-elwafa *et al.*, 2017). BS does not assess the supra-vaginal portion of the cervix in a closed cervix, and hence the assessment of effacement which begins at the level of internal Os will be difficult to predict in a closed cervix (Kanwar *et al.*, 2015). Therefore, BS has a low predictive value especially in those with a low BS (Abou-elwafa *et al.*, 2017). IOL with a low cervical score has been associated with failure of induction, prolonged labour, and a high rate of caesarean deliveries (Abou-elwafa *et al.*, 2017). Despite the widespread use of BS, it lacks the power to predict success of induction. It is recommended that it is better to replace BS with another method that is a better predictor for the outcome of induction (Farnazeh *et al.*, 2016).

In contrast, trans-vaginal ultrasound (TVS) assessment of the cervix is an objective and more reproducible method, and moreover, it allows visualisation of the cervix beyond the closed external Os thereby permitting the measurement of the supra-vaginal portion of the cervix (Kanwar *et al.*, 2015). This can be done with minimal discomfort to the patient (Latha *et al.*, 2016). In other words, TVS can assess full CL and status of internal Os without invading endocervical canal and hence less invasive. The ultrasound finding can be documented by taking pictures and it is reproducible. Other co-existing findings like compound presentation if present can be documented, which can be easily missed by doing just a digital examination. Several studies have compared trans-vaginal CL with BS resulting in conflicting results (Abou-elwafa *et al.*, 2017). Some studies stated that TVS-CL measurement does not improve on the prediction of cervical favourability obtained by the BS, while other studies acknowledge that trans-vaginal CL measurement is a better predictor for successful vaginal delivery than BS (Khazardoost *et al.*, 2016).

A double blind, randomized control trial shows that differences in IOL outcomes with prostaglandin IOL exist based on race/ethnicity. Baseline modified BS was found to differ by race /ethnicity, with black people showing a significantly lower BS at base line compared to white people (Megan *et al.*, 2015). Black people were also found to have higher CS rate compared to white People and Hispanics (Megan *et al.*, 2015).

There are different reports that CL can be affected by parity, age, gestational age, race and populations (Esmat *et al.*, 2015). Mean CL, in addition to showing inter subject variability, appears to vary with ethnic identity (Joydev *et al.*, 2011). However, at present there is dearth of data regarding CL measurement by TVS for the Study population and ethnicities. As such, results of studies from the population of white people and ethnicities may not be truly representative for population of black people and ethnicities for this study.

Existence of these conflicting results, variability of CL by ethnicity, lack of predictive power of BS and high CS rate resulting from failed IOL emphasized the need for more research to aid come to a proper comparison especially in our settings where there is limitation and paucity of data. This study compared trans-vaginal CL measurement with BS to determine whether the former predicts the success of IOL better than the BS. Hence it could be a valuable tool in counselling women prior to IOL on the likelihood of successful IOL, and to validate its predictability.

METHODOLOGY

This was a cross sectional comparative observational study conducted among consenting pregnant women for IOL at 37-42 weeks of gestation at Ahmadu Bello University Teaching Hospital (ABUTH) Zaria. It was conducted between November 2017 and November 2018. IOL was done using misoprostol. Ethical approval was granted by the Health Research Ethics Committee of ABUTH (ABUTHZ /HREC/W29/2017) which was approved on the 17th October 2017, and an informed written consent was obtained from all participants.

Selection of the study participants

Eighty-seven (87) women were recruited consecutively having fulfilled the inclusion criteria. Women enrolled in this study were both nulliparous and multiparous with singleton viable fetuses, cephalic presentation, with gestational ages between 37 to 42 weeks, with intact membranes and a reassuring biophysical profile (BPP).

Exclusion Criteria

Patients excluded were those in active labour on admission, those with multiple pregnancies or fetal macrosomia, those with previous operations on the uterus or any degree of antepartum haemorrhage, malpositions, malpresentations, rupture of fetal membranes and any non-reassuring BPP.

Data Collection

Ultrasound measurements was done using EDAN DU 60 PROBE C361 with a transducer frequency 2.0-10.0MHZ, Convex array C361-2, Display 12.1" TFT-LCD and Grayscale of 256). The machine was equipped having a transabdominal transducer with the woman in supine position with knee and hip flexed to confirm gestational age, fetal viability and weight, wellbeing and ensure strict adherence to inclusion and exclusion criteria. The women were asked to empty their bladder. The women remained in the same position with knee and hip flexed after emptying their bladder; using a transvaginal transducer, a transducer gel was applied on the transducer and covered by a condom and it was placed in the anterior fornix of the vagina. The sagittal view of the cervix was obtained with the long axis view of echogenic endocervical mucosa along the length of the canal. The probe was withdrawn until the image was blurred and reapplied just enough pressure to restore the image (to avoid excessive pressure on the cervix which can elongate it). The image was enlarged so that the cervix occupies at least 2/3 of the image, and external and internal Os were well seen. The length of the cervix was measured along the endocervical canal from internal to external Os. At least three (3) measurements were obtained, and the shortest best measurement in millimetres was recorded to determine the mean.

This was shortly followed by a digital pelvic assessment for the BS (dilatation, effacement, station, consistency and position) by a different examiner who was blinded to the ultrasound measurements. The cervix was considered unfavourable when the BS was <6. Patients with unfavourable cervix (i.e score 0-5) underwent cervical ripening with 25 ug vaginal misoprostol until the cervix became favourable (BS of 6 or more) and the patients were then included into

the study population. Those who failed to attain a favourable BS after two insertions were excluded from the study and were replaced.

BS was then established and documented (the score ranged from 0 to 13), while a 25 ug of vaginal Misoprostol was inserted vaginally 6 hourly maximum of 4 doses. This was followed by documentation of time of insertion, dose inserted, BS at insertion, number of contractions, foetal heart rate, and cervical dilatation.

Insertion of another dose was withheld when 3 to 4 strong uterine contractions were achieved or previous dose remained un-dissolved. Uterine contraction were monitored half hourly and foetal heart rate every 15 minutes. Pelvic examination was performed 4 hourly following commencement of a palpable uterine contraction. A partograph was plotted when active phase of labour was attained and subsequent insertion of misoprostol was withheld. Labour was subsequently monitored until delivery. Successful IOL is defined as a delivery within 24 hours of initiation of induction. It is also that which results in vaginal delivery, either spontaneous or operative, in 24 hours of start of induction.

The primary outcome variable was the proportion of women who achieved vaginal delivery within 24 hours of IOL. The secondary outcome variables were the proportion of failed induction at more than and less than 24 hours, and induction delivery interval (IDI).

Accuracy was defined by area under the curve (AUC). The more it increased, the more the test was assumed to be accurate. When AUC was scored 0.5, while the diagnostic test is not useful. A score between 0.6 and 0.7 were a poor diagnostic test. When test result ranged between 0.7 and 0.8, it was tagged as being acceptable, and when it ranged between 0.8 and 0.9 it was tagged as being excellent while when the test result was greater than 0.9 it was considered outstanding.

Data Analysis

Data obtained was analysed using IBM SPSS version 23. Categorical data were presented as percentages and continuous variables were presented as Mean \pm Standard Deviation. Statistical tests such as sensitivity, specificity, positive and negative predictive values and chi square were determined. The predictive value of ultrasound measurements and BS were evaluated using receiver operative characteristics (ROC) curves. Logistic regression was also assessed. P value less than 0.05 was considered statistically significant.

RESULTS

During the study period, eighty-seven women were eligible for IOL. Majority (36.9%) of the participants were aged between 25 and 29 years with a mean age of 27.41 ± 5.90 years. Multiparae constituted 83% of the participants while 17% was primigravidae. The mean gestational age was 41 ± 0.3 weeks (ranged between 37 and 42 weeks). The indication for induction of labour was postdate pregnancy in 49 participants (56.3%), hypertensive disorders of pregnancy in 29 participants (33.3%), prolonged pregnancy in 7 participants (8.1%) and poorly controlled diabetes mellitus in 2 participants (2.3%).

Eighty-three women experienced the active phase of labour after IOL but only 47 participants (66.2%) had spontaneous vaginal delivery within 24 hours and 13 participants (15%) needed CS. Three participants (3.4%) had assisted vaginal delivery. The indications for CS were fetal distress and failed induction. Most of the CS (76.9%) were in primigravidas. The average induction to delivery interval within 24 hours found was 15.15 ± 4.78 hours in this study.

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Binary logistic regression of parity, TVS-CL versus successful IOL (less than or equal to 24 hours) indicates that at a TVS-CL of ≤ 2.7 cm, and ≤ 2.5 cm a favourable IOL outcome in primigravidae (AUC = 0.708, P=0.005, SN= 75%, SP= 33%) and multiparae can be predicted (AUC=0.397, P=0.134 SN=92%, SP=13%) respectively. It demonstrated that TVS-CL measurement is a better tool at predicting vaginal delivery within 24hours of IOL in primigravidae but a poor tool in multiparae with a statistically significant difference.

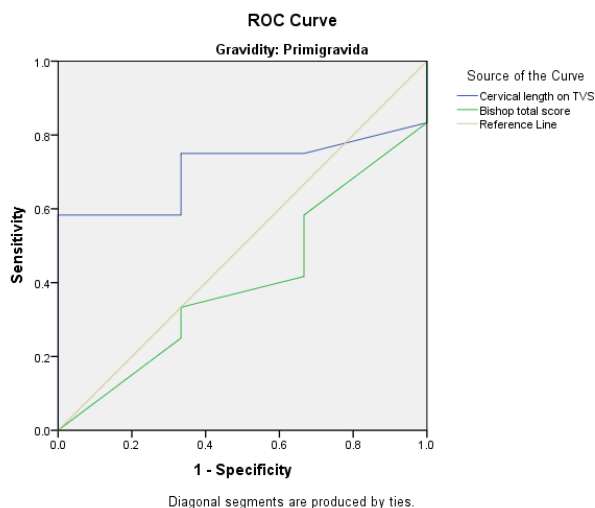


Figure 1: Receiver Operating Characteristic curve of Primigravidae for Transvaginal ultrasound Cervical Length and Bishop Score

Logistic regression analysis also showed that the individual parameters of the BS, were independently not predictive of successful IOL except for the cervical dilatation (OR=0.603, P=0.011).

However, the association between parity and the BS indicated that BS is a superior predictive tool in multiparae (AUC= 0.647, P value= 0.082, SN=57%, SP=56%) and a poor predictive tool in primigravidae (AUC=0.416, P-value=0.340, SN=43%, SP=45%) for IOL success less than or equal to 24 hours. It shows that a BS of ≥ 5 is favourable for IOL in multiparous participants and a BS of ≥ 6 in primigravidae.

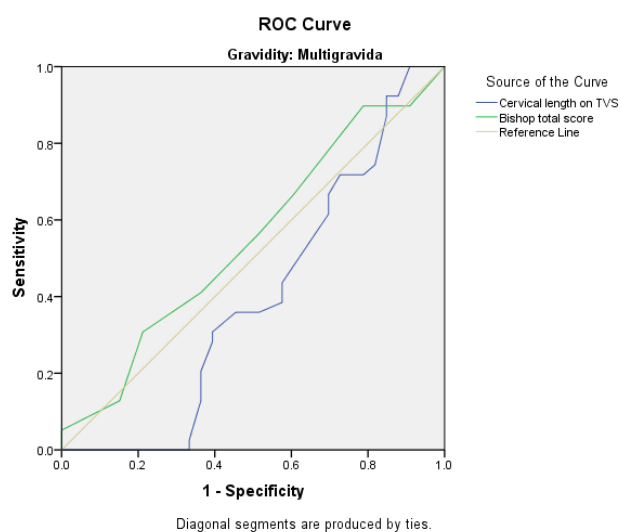


Figure 2: Receiver Operating Characteristic curve of multiparae for Transvaginal ultrasound Cervical Length and Bishop Score

Table 1: Diagnostic accuracy of Transvaginal ultrasound cervical length and Bishop Score in predicting induction of labour outcome

	Cut off Point	AUC	P-value	C.I	PPV	NPV
CL	2.5cm	0.446	0.391	(0.317-0.574)	60.7%	39.3%
BS	≥5	0.556	0.433	(0.426-0.673)	52.8%	47.2%

Key: BS-Bishop score, CL- Cervical length, AUC-Area under the curve, CI- Confidence interval , PPV-Positive predictive value, NPV-Negative predictive value

Out of all total births recorded in this study, 95.8% were born alive and 98% of the babies delivered had Apgar scores of between 7 and 10 in the 5th minute. Most of the babies (98%) had a favourable outcome, but 1% of the babies had moderate perinatal asphyxia and another 1% had severe perinatal asphyxia. All the babies delivered weighed between 1.4 and 4.25kg. Fourteen (14.5%) of the babies were admitted into Special Care Baby Unit (SCBU). The indications for admission were low birth weight and severe birth asphyxia. Among the total births, 4% had immediate neonatal death with birth weight ranging between 1.65 and 1.85 kg. The perinatal deaths were among participants that had severe pre-eclampsia and unfavourable cervix with foetal distress. Out of the 14.5% that were admitted, majority (71.4%) of the participants were discharged alive. Out of the participants that delivered babies during the conduct of this study, 3% had uterine hyper-stimulation but there was no uterine rupture or maternal mortality recorded.

DISCUSSION

The study compared trans-vaginal ultrasound CL measurement with a BS in predicting successful IOL.

The mean age of women induced was 27.41 ±5.90 years. This is comparable to 27.51 ±8.37 years among induced women in Ogoja, Nigeria (Lawani *et al.*, 2014), but marginally higher than 25.1 ±4.4 years found in Iran (Kharzadost *et al.*, 2016). The induction rate from this study was 6.6% which is lower than 11.5% reported by Lawani *et al.*, (2014). This finding could be due to the fact that this study focused on 37-42 weeks gestation and did not consider lower gestational ages.

The commonest indication for IOL in this study was postdate pregnancy (56.3%) which is higher than 45.8% found by Lawani *et al.* (2014) but similar to 56.8% reported by Abisowo *et al.* (2017)..This finding is in variance with a study that found prolonged pregnancy as the commonest indication (Gasser *et al.*, 2020) but mean gestational ages at induction in index study was similar to that Pandis *et al.*, (2001) of 41 weeks. However, previous study in Zaria by Mohammed *et al.* (2007) reported hypertension in pregnancy as the commonest indication.The disparity could be explained by the fact that only term pregnancies were recruited in this study, unlike Mohammed *et al.* (2007), gestational ages lower than 37 weeks were considered in their study.

The ROC curve in this study demonstrated better performance of the bishop score in predicting successful induction of labour than the TVS-CL measurement. The AUC of the BS and TVS-CL in this study are comparable to findings in other studies (Park *et al.*, 2009). The AUC for BS. In the study by park *et al.* (2009) was higher than that of TVS-CL (0.556 versus 0.446).In contrast however, separate studies reported (Rane *et al.*, 2003; Tan 2007) that sonographic CL had a better performance than BS.

Comparing the sensitivity, specificity, positive and negative predictive values of TVS-CL and BS obtained with those in other studies is challenging as different studies used different values in their analysis. Using the optimum cut off values of TVS-CL and BS (2.5 cm and ≥ 5), TVS-CL had a higher sensitivity (86 vs 56%) and positive predictive value (60.7 vs 52.8%) while the BS had a comparatively higher specificity (48 vs 47%) and negative predictive value (47.2 vs 39.3%). The sensitivity of BS ≥ 5 in determining successful IOL was 56% in this study. This compares with the findings of systematic review of the predictive performance of bishop score on induction success (Kolkman *et al.*, 2013). Khazardoost *et al.* (2016) reported a lower TVS-CL sensitivity of 54.8% compared to 86% in this study but comparable to 83% obtained by a separate study conducted by Abou-elwafa *et al.*, (2017).

In this study, at an optimum cut-off value of ≤ 2.5 cm, TVS-CL predicted successful vaginal delivery in our practice. This is comparable and lends credence to a previous study that found CL of ≤ 2.5 cm (Mohammed *et al.*, 2013) and < 2.4 cm (Rane *et al.*, 2003) respectively to be the best cut off for predicting successful IOL. However, Abdel hafiz (2014) reported a cut off CL of ≤ 3.3 cm for predicting mode of delivery, which is higher than the cut off of 2.5 cm in this study. In the same vein, an optimum BS cut off of ≥ 5 predicted successful vaginal delivery was reported in this study. This finding is similar to the BS (≥ 5) reported by Mohamed *et al.*, (2013) but higher than the BS (3) reported by Pandis *et al.*, (2001).

The proportion of participants who had spontaneous vaginal delivery within 24 hours of IOL was 66.2% in this study. This is comparable to 67.6 and 66.7% reported respectively in both multiparous and nulliparous women (Abisowo *et al.*, 2017; Pereira 2014). However, it is at variance with the report of Doyran *et al.* (2005), where all the participants had spontaneous vaginal delivery within 24 hours of IOL. The observed difference in vaginal delivery could be due to lack of homogeneity in the dosing of misoprostol used. A higher dose (50 ug) of misoprostol which is more efficacious and bioavailable was used in their study compared to lower dose (25 ug) in this study.

The CS rate in our study of 15% is comparable to 13% reported by Gasser *et al.* (2020) but lower than 19.2 and 43% reported by other studies. The main indication for CS in index study was fetal distress reported in previous studies (Pandis *et al.*, 2001; Lawani 2014; Kharzadost 2016). The increased CS rate reported in Iran by Gedam *et al.*, (2014) might have resulted from the characteristics of the study population, the hospital protocol, use of cardiotocograph, socioeconomic class of the patient, and the fact that oxytocin, a poor inducing agent and less efficacious cervical ripening agent was used in their study. Oxytocin was excluded as an inducing agent in this study.

The average induction to delivery interval within 24 hours was detected at 15.15 ± 4.78 hours in this study. This is similar to a study by Lawani *et al.* (2014) who detected an average delivery interval at 12 ± 3.6 hours in their study.

In this study, it was demonstrated that TVS -CL in nulliparous participants is better than BS in multiparous participants in predicting successful IOL within 24 hours. Conversely, it shows that the BS is a better predictor in multiparous participants but poor with primigravidae. This lends credence to the work of Doyran *et al.* (2005) that showed that CL was better than the composite Bishop score in nulliparous whereas BS was better than CL in multiparous when determining IDI. This also supports the finding by Gasser *et al.* (2020) who found the predictive values of CL to be better than those of BS and recommended its use to predict outcome of IOL.

Multiple logistic regression analysis showed that only cervical dilatation was predictive of successful IOL among the individual parameters of the BS. This lends credence to the work of Kant *et al.*, (2016) who found cervical dilatation to be the most important component of BS in predicting successful delivery induction (Shahnaz *et al.*, 2016).

All babies delivered in this study weighed between 1.4 and 4.25kg. The mean birth weight of the babies was 3.0 ± 0.60 . It was found that 87.6% of the babies were between 2.5 to 3.9 kg; 10% were less than 2.5 kg and 2% were 4 kg and above. These findings are consistent with the findings of Lawani *et al.* (2014) that found 80.5, 17.5 and 2% respectively. In this study, most of the babies (98%) had a favourable outcome with good Apgar score, but 1% of the babies had moderate perinatal asphyxia and another 1% had severe perinatal asphyxia. The poor perinatal outcome was possibly due to placental insufficiency among women with severe pre eclampsia and fetal distress whose birth weight were less than 1.8 kg. There was no demonstrable association between birth weight and fetal outcome. Khazardoost *et al.* (2016) found that all the Apgar score delivered were 9 or 10 in their study.

As a part of maternal complication, 3% of the participants had uterine hyperstimulation in this study which is lower than the 5.1% reported by Doyran *et al.* (2005) ...However, there was no uterine rupture or maternal mortality recorded in our study. This is unlike a previous study conducted in Zaria by Mohammad *et al.* (2007) that reported one case of uterine rupture. This could be due to the use of higher dose (50 ug) of misoprostol in previous study.

CONCLUSION

Owing to the results obtained in this study, for participants undergoing IOL at term with misoprostol, the optimum cut off point that predicts vaginal delivery in ≤ 24 hours is ≤ 2.5 cm and ≥ 5 for TVS-CL and BS respectively. TVS-CL does not demonstrate a diagnostic accuracy in predicting successful IOL in term pregnancies compared to BS. Nevertheless, the BS appears to be of poor predictive value.

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