Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 01, pp.11632-11640, January, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ALTERNATIVES TO BISHOP SCORE TO PREDICT SUCCESSFUL INDUCTION OF LABOUR

Jijisha Ali, *Shripad Hebbar and Lavanya Rai

Department of Obstetrics and Gynecology, Kasturba Medical College, Manipal University, Manipal, India

ARTICLE INFO

Article History:
Received 04th October, 2014
Received in revised form
04th November, 2014
Accepted 19th December, 2014
Published online 23rd January, 2015

Key words:
Labour assessment,
Intrapartum Ultrasound,
Induction of Labour.

ABSTRACT

The ultimate goal of antenatal and intranatal care is to have not only a healthy mother and a healthy baby, but also to achieve a successful vaginal delivery, keeping in mind the rising rates of caesarean deliveries. Though the aim is to achieve spontaneous vaginal delivery, many times labour has to be induced for various maternal and fetal indications. It has been stated that nearly about 13-20% term patients requires induction of labour (IOL) (Maslow and Sweeny, 2000). Recently intrapartum ultrasound examinations has been gaining popularity to assess not only labour mechanics, and also for assessing cervical findings for prediction of successful induction. Bishop's score obtained from pervaginal examination is considered as a tool to predict successful vaginal delivery. However, it is subjective and has significant inter observer variation. Ultrasound examinations are found to be superior to digital pelvic examination to determine fetal head position and station. Thus ultrasound can help the obstetricians in a significant way to counsel the patients before induction of labour and explain them the probability of successful induction.

Copyright © 2015 Jijisha et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Pioneer of obstetrical Ultrasound is Ian Donald. He emphasized the routine use of ultrasound in the department of medicine in 1958 and in department of obstetrics in 1962 Donald *et al.* (1962). He popularized the use of ultrasound in pregnancies. Norwegian SturlaEik–Nes (1984) Professor of Department of Gynecology and Obstetrics at the Trondheim University Hospital, Trondheim, Norway initiated projects to determine the value of routine ultrasound population screening and various aspects of ultrasound safety (Eik-Nes *et al.,* 1984). In 1970s, evaluation of the uterine cervix with ultrasound came into light and the transvaginal probe was developed one year later and proved its accuracy and diagnostic value. Cervix was measured in sagittal plane as a cylindrical moderately echogenic structure with a central canal. Bishop's score obtained from pervaginal examination is considered as a tool to predict successful vaginal delivery. Recently transvaginal ultrasound measurements have been considered better than Bishop's score. In 1986, O Lealy and Ferrell proposed a semi quantitative, ultrasound scoring system and compared this system against the Bishop's score (Leary *et al.,* 1982). They compared findings on ultrasound scanning (transabdominal) of cervix and lower uterine segment with those of digital examination in patients with preterm labour or those in whom induction was planned.

Corresponding Author: Shripad Hebbar
Department of Obstetrics and Gynecology, Kasturba Medical College, Manipal University, Manipal, India.

Highest risk of complications is observed during the progress of labour, and it is necessary to categorize patients into high and low risk categories before induction of labour. Every pregnant woman likes to know whether if she could deliver vaginally, or she will require an operative delivery when planned for induction of labour. Patients will be benefited if we could accurately predict who will deliver vaginally without complications, and who will require an operative delivery well before the onset of labour. This valuable information thus would reduce morbidity, improve safety, optimize utilization of resources, and improve satisfaction of women in labour or delivery process.

The use of ultrasound has overcome the problems by serial digital assessment of fetal head position and progression of labour and thus predicts the success of vaginal delivery. A hallmark study done by Barbera *et al.* in 2003 reported that the use of transperineal or translabial ultrasound, could predict whether patients would deliver vaginally or were at risk of requiring an abdominal delivery (Barbera *et al.,* 2003). Aprospective observational study conducted in Eunice Kennedy Shriver National Institute of Child Health and Human Development,in 2006 by Lami Yeo and Roberto Romero in 202 nulliparous women, suggested that the mode of delivery could be predicted accurately in up to 87% of cases before the onset of labour, with a combination of clinical and historical factors and ultrasound findings (Yeo and Romero, 2009). Thus ultrasound examination has thepotential to improve the predictive accuracy of labour outcome.

Role of ultrasound in assessing mechanism of labour

Ultrasound has gained a crucial role in our daily day to day practice in managing clinical aspects of labour offering an objective tool. Ultrasound examination is a quick, safe and non-invasive method. Use of ultrasound in antenatal monitoring and assessment of labour has become increasingly popular. Ultrasound provides valuable information like placental location, fetal weight, maturity, presentation and prolonged pregnancy information. Regarding mechanism of labour, ultrasound plays an important role. The cardinal movements observed during progress of labour when the fetus is in occiput anterior presentation are flexion, internal rotation, extension and external rotation. Entry of fetus occurs through the birth canal transversely and engages in the pelvic inlet. Left occipitotransverse (LOT) position is observed more than in the right (59% versus 41%).

Fig. 1. Picture and ultrasound image of left occipito transverse

Pressure of uterine contractions is necessary to bring about the descent of fetus. Fetal head flexes and rotates, when the descending head meets resistance. On reaching the vulva, flexed head undergoes extension and external rotation, and delivery of the shoulders and the rest of the body follow. Ultrasound is useful to see first cardinal movements, but the final cardinal movements are not visualized by ultrasound.

By ultrasound, when the occiput occupies the posterior half of pelvis, the presenting part can be either occipitoposterior position, brow presentation, or face presentation (mento anterior) depending upon the degree of extension of fetal neck. In such a scenario, pelvic examination is useful to differentiate the denominator (occipito-occipitoposterior position, siniput-brow presentation, mentum-face presentation). In occiput posterior presentation, movement of fetus is flexion, internal rotation, maximal flexion followed by extension and external rotation, ofwhich internal rotation can be monitored by serial intrapartum ultrasound examinations.

Fig. 2.Picture and ultrasound image of right occipito transverse

Fig. 3. Ultrasound image of first cardinal movement

Ultrasound assessment of cervical changes in first stage of labour

Cervical effacement is defined as the progressive shortening and thinning of the cervix during labour, and cervical dilatation is the cervical opening (funnel width) measured in centimeters (World Health Organization 2003).

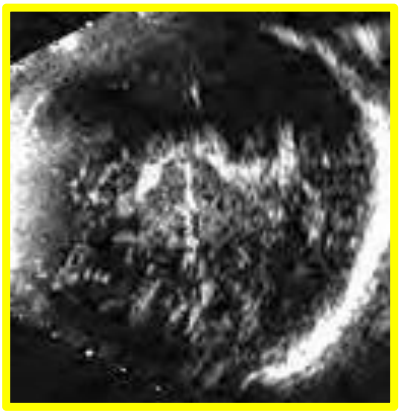


Fig. 4. Picture and ultrasound image of Internal rotation

Figure 5. Picture and ultrasound image of Right occipitio posterior

Ultrasound assessment of progress of labour

Assessment of labour progress is expressed in terms of progressive cervical dilatation and descent of the presenting part. Muller in 1868 introduced the concept of station (Munro Kerr *et al.,* 1980). In 1954, Friedman described the concept of partogram (Friedman *et al*., 1954). Later in 1965, he found a strong relationship between dilatation and station of head. One year later in 1976 he found the relationship between high station and arrest of labour and adverse labouroutcome. Lewin *et al.,* in 1977 found that using ultrasound, station of head can be assessed as the distance from the fetal head to the sacral tip of the mother (Lewin *et al.,*1977). Souka *et al*. in 2003 reported that fetal head position could not be assessed by digital examination in 61% of patients in 1st stage and 31% of patients in 2nd stage of labour (Souka *et al.,* 2003). Thus clinical examination cannot accurately determine fetal station and descent. The Salvesen in 2006 reported the value of three-dimensional ultrasound (3D) in labourprogress (Salvesen *et al*., 2006). Sherer *et al.* in 2007 reported a method that can be repeated and can be used as an objective tool to evaluate descent and dilatation (Sherer *et al*., 2007). He found that ultrasonically measured fetal head perineum distance can be used to assess labour.

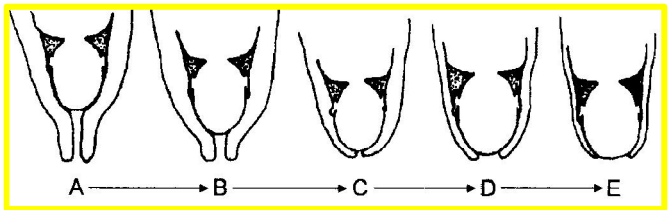
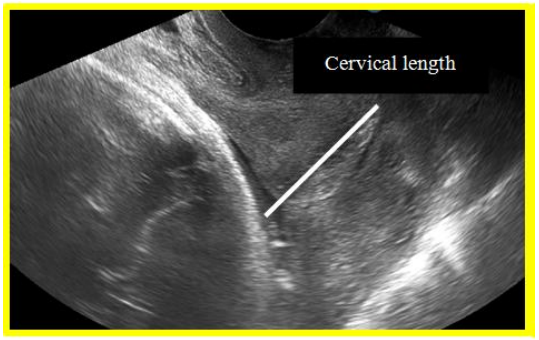


Fig. 6.Effacement and dilatation of the cervix (from WHO)



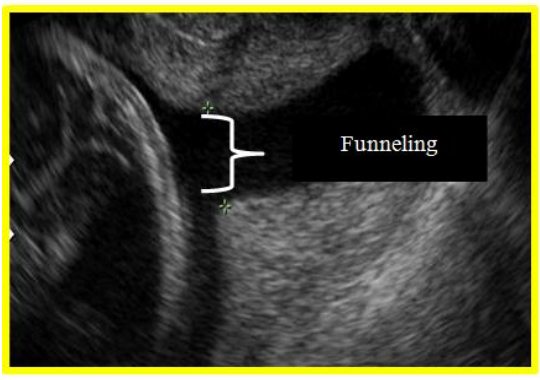


Fig. 7. Ultrasound pictures of cervical effacement and dilatation

Sharf *et al.* in 2007 found that the progress of labour can be assessed by ultrasound based computerized system (Yehuda Sharf *et al.,* 2007). In 2008 Fuchs *et al.* reported that 3D ultrasound can be used to observe sutures and fontanels during progress of labour (Fuchs *et al*., 2008).

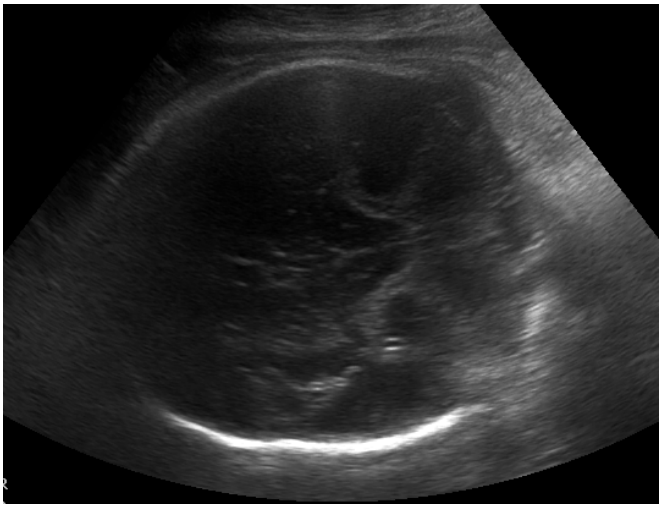


Fig. 8. Ultrasound study showing transverse suprapubic transabdominalsonographic view

Predictive factors for successful labour induction as assessed by ultrasound are as follows

A. Cervical status
B. Position
C. Engagement and station of head
D. Fetal head perineum distance and angle of progression
E. Fetal weight
F. Posterior cervical angle

A. Cervical status

House and Socrate described the cervix as a biomechanical structureand suggested studying the cervical deformation with Ultrasound (House *et al*., 2006). Cervical strength refers to the ability of the cervix to resist deformation or change (funnelling, effacement and dilatation) and loading refers to the forces acting to cause deformation. Lim *et al.* in 1992, reported correlation between transvaginal ultrasound and digital examination for assessing cervical length and dilatation in patients (Lim *et al*., 1992). They found that mean cervical dilatation as measured by digital examination was significantly greater than TVS assessment. In 1994, Boozarjomehri *et al.* evaluated 53 patients who were planned for induction of labour, (Boozarjomehri *et al.,* 1994). They underwent transvaginal ultrasonography and digital cervical examination. Statistical analysis showed that increasing cervical length was associated with a longer latent phase and presence off cervical wedging on transvaginal ultrasound was significantly associated with shorter latent phase.

A closed cervix corresponds to a 'T'shape. Zilianti *et al.* in 1995 reported that shape of cervix changes from 'Y' to 'V' or 'U' during the deformation process, (Zilianti *et al*., 1995).

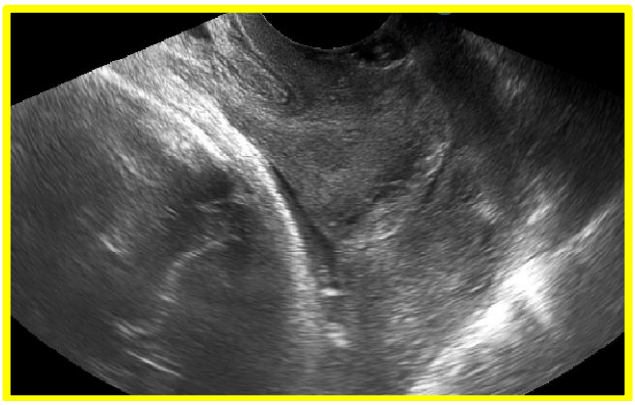


Fig. 9.Ultrasound image of cervical effacement

In1996, Watson *et al*. evaluated the 5 components of Bishop score, maternal parity and transvaginalsonographic assessment of cervical length, (Watson *et al.,*1996). Cervical dilatation was found to be an independent predictor of the duration of the latent phase. Chandra *et al*. in 2001 compared transvaginal ultrasound to measure cervical length and digital cervical examinations in 122 women prior to induction of labour, (Chandra *et al.,* 2001). They concluded that both the methods were equally significant in assessing successful vaginal delivery. Gabriel *et al.* in 2002 compared the Bishop score with transvaginalmeasurement of cervical length in 179 patients (Gabriel *et al*., 2002). They reported that these measurements can be used to predict the mode of delivery after induction of labour. They concluded that ultrasonically measured cervical length could predict the risk of caesarean delivery compared to Bishop score.

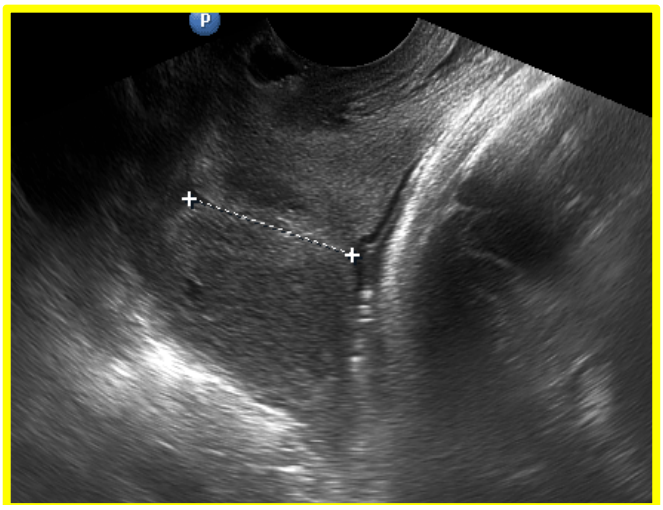


Fig. 10.Ultrasound image of cervical length

Rane *et al*. in 2003 compared parity with cervical length in 382 women before induction of labour, (Rane *et al*., 2003). They found that successful vaginal delivery occurred within 24 hours of induction in 67% of the women. Parity was a significant independent factor in their study. Yang *et al*. in 2004 compared cervical length with Bishop's score in 105 women undergoing IOL. They observed that induction of labour was successful in 93 out of 105 women (89%) and concluded that cervical length was better than the Bishop score in assessment of successful

labour induction. (Yang *et al.,* 2004) Bartha *et al.* in 2005, compared transvaginal ultrasound with the Bishop score.They randomized women undergoing IOL by prostaglandin into two groups based on either Bishop's score or transvaginal scan. They considered the cervix as unfavourable if Bishop's score was < 6 or ultrasound findings of cervix less than 3cm, funneling < 30% of total cervical length. They found that 85% of women required prostaglandins according to Bishop's score whereas in only 50% of ultrasound group the need for prostaglandin was present, (P <0.001). They concluded that transvaginal ultrasound reduced the need for intracervical prostaglandin treatment, without affecting the success of induction.

Elghorori *et al*. in 2006 modified the Bishop score by replacing the digital assessment of cervical length with Ultrasound measured cervical length, (Elghorori *et al*., 2006). The original Bishop score with cut-off level > 5 predicted a vaginal delivery with a sensitivity of 23 %; and specificity of 88%; while the modified Bishop score with cut-off level > 3 predicted a vaginal delivery with a sensitivity of 62%; and specificity of 82%, (Elghorori *et al*., 2006).

The value of cervical ultrasound in replacing Bishop's score has been reported with conflicting results. Transvaginal ultrasound was found to be a better predictor for successful IOL than the Bishop score. A meta-analysis of seven studies were included in 2006, concluded that ultrasound measurements are equal to the Bishop score (Crane *et al.,* 2006).

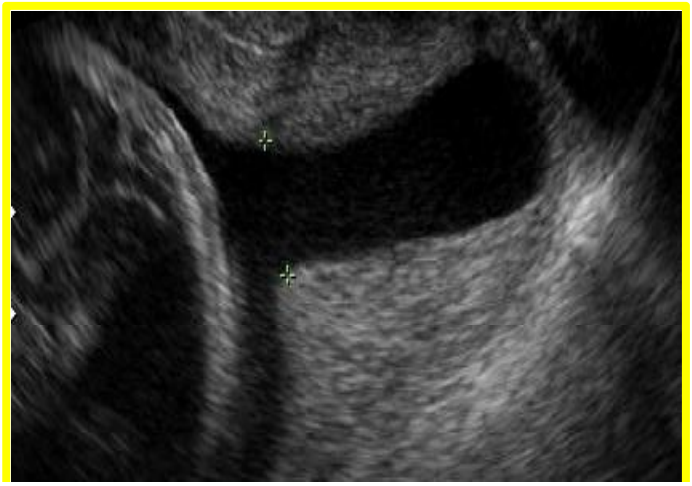


Fig. 11. Ultrasound image of cervical effacement

Hatfield *et al*. reported in 2007 that cervical wedging can be used as a predictor for successful IOL (Hatfield *et al.,* 2007). Another study by Tan *et al*. in 2007 compared Transvaginal ultrasound measured cervical length with digital examination in 249 women undergoing induction of labour (Tan*et al.,* 2007). They concluded that both were predictors of caesarean delivery, (P<0.001) with cut-offs for cervical length > 20 mm and Bishop score ≤ 5. One more study by Laencina *et al*. in 2007 compared the Bishop score and transvaginalultrasound to predict successful induction of labour in 177 women. (Laencina *et al.,* 2007) Multiple regression analysis was used to conclude that the Bishop score and cervical length were predictive factors for successful IOL. Vankayalapati *et al*. in 2008 used ultrasound to measured cervical length when labour was prolonged (Vankayalapati *et al*., 2008). They found cervical length was an independent predictor of the chances of spontaneous labour in nulliparous women and parouswomen. Another recent study in 2012 by *Ibrahim et al.* compared the cervical length measured by TVS with modified Bishop's score before induction of labour (Ibrahim *et al.,* 2012). They found that patients who delivered vaginally had a shorter cervical length and Bishop's score more than 5. Thus they concluded that both measurements were equally significant in assessing successful vaginal delivery.

B. Position of fetal head

Kreiser *et al*. in 2001 reported that ultrasound can be used to detect the fetal head position in the second stage of labour (Kreiser *et al*., 2001). These findings were compared with results of digital examination. It was found that fetal occiput position detected by ultrasound had lower error rate using the ultrasound technique (6.8%) compared to vaginal examination (29.6%, P < 0.01).Similarly Sherer *et al*. in 2002 used ultrasound to compare digital examination with ultrasound to assess fetal head position during first and second stages of labour (Sherer *et al*., 2002). They concluded that digital examinations did not determine the position of the fetal head during the first stage of labourin 76% of women and 65% during the second stage. They concluded that there is no clinical value in determining fetal head position during a normal labour, but can be used in labours that failed to progress. Souka *et al.* in 2003 also used ultrasound to determine the fetal head position during labour and compared it to digital examinations. They concluded that digital fetal head position assessment correlated only in 31% of the cases in the first stage and 66% of the cases in the second stage of labour (Souka *et al.,* 2003).

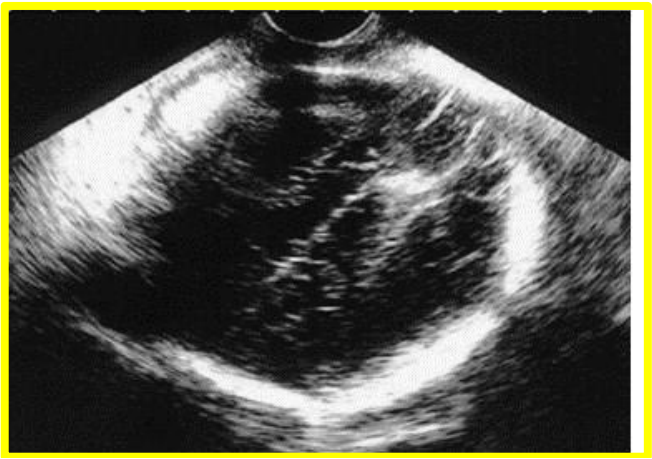


Fig. 12. Ultrasound image of fetal head position

Rane *et al*. (2004) found that OP position determined ultrasonically before IOL could be a predictive factor for caesarean delivery (Rane *et al*., 2004). Peregrine *et al*. in 2007 had a different opinion. They examined 289 women with ultrasound and found OP in 97 (36%) women before IOL. Only 8% of these fetuses remained in OP at delivery. They concluded that there is little clinical value in determining the

fetal head position before IOL (Peregrine *et al.,* 2007). Rozenberg *et al.* (2008) used ultrasounds to determine fetal head position and compared it with digital examination. They found that digital examination had 50% error rate in assessing fetal head position when compared to scan findings of fetal head position (Rozenberg *et al*., 2008).

C. Engagement and station

In 1977, Lewin *et al.* used ultrasound to measure the distance from the head to the sacral tip in 453 patients before and during labour. They concluded that ultrasound could predict lower station properly before forceps could be applied (Lewin *et al*., 1977).

Grischke, Dietz and coworkers in 1986 described the procedure of Transperineal ultrasound. This method was used to evaluate engagement. They concluded that ultrasound correlated with abdominal palpation, Bishop score and vaginal assessment ($p < 0.001$), (Grischke *et al*., 1986). Sherer *et al*. (2003) compared digital assessment of fetal head engagement with ultrasound and concluded that digital examinations correlated with ultrasound in 86% of cases (Sherer *et al.,* 2003).A study by Henrich *et al.* in 2006 used ultrasound in 20 women who were planned for vacuum extraction. They concluded that ultrasound provided objective information on the second stage of labour, head station and head direction and will be useful to assess the prognosis for successful operative vaginal delivery (Henrich *et al.,* 2006).

D. Fetal head perineum distance and angle of progression

Professor Hans Peter Dietzand his team from Sydney, in 2005 suggested a simple technique in evaluating the station of the fetal head using translabial ultrasound in 140 pregnant women who were not in labor (Dietz *et al*., 2005). A vertical line was drawn from the edge of the pubic symphysis, and a line perpendicular to it was drawn to the leading edge of the fetal head. This is called as the 'head progression distance. He concluded that fetal head progression distance measured by transperineal ultrasound had similar predictability compared to station of head assessed by clinical examination.

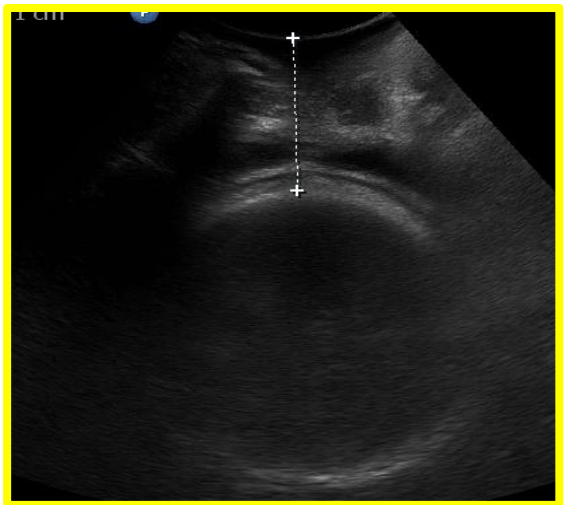


Fig. 13. Ultrasound showing fetal head perineum distance

Eggebo *et al.* in 2006 measured the shortest distance from the outer bony limit of the fetal skull to the skin surface of the perineum in 152 women with prelabor rupture of membranes at term (Eggebo *et al*., 2006). They concluded that lesser values of this measurement had quick labor without obstetric intervention. Henrich *et al*. in 2006 first reported three parameters on translabial ultrasound at the second stage of labor to predict the success of vacuum extraction (Henrich *et al*., 2006).

In a recent study by, Sherer *et al.* in 2007 suggested a new method to measure fetal head descent (Sherer *et al.,* 2007). He suggested that measuring the distance from perineum to the fetal head, can be used to assess labour as equal to transvaginal ultrasound measurement of station from leading edge of presenting part to external os. The concept of transperineal fetal head distance and angle of progression was later studied by Professor Karim Kalache at the Charit´e University Hospital in Berlin in 2009.Fetal head descent was quantified by measuring the angle between a line placed through the midline of the pubic symphysis along the pubic ramus and a line running from the inferior apex of the symphysis tangentially to the most anterior part of the fetal skull (Kalache *et al*., 2009).

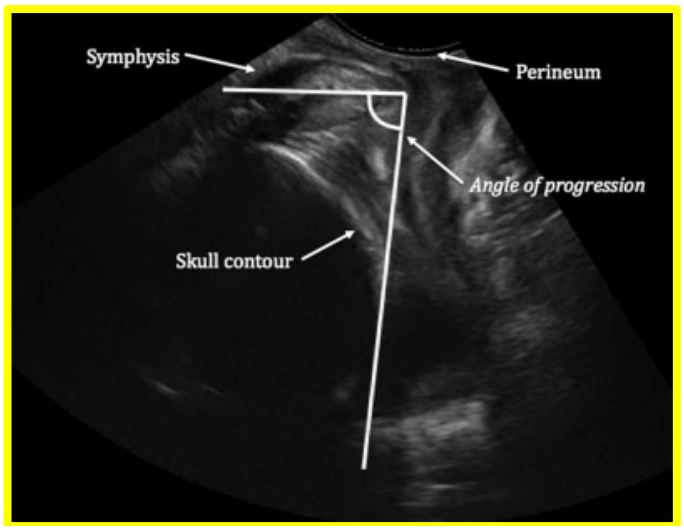


Fig. 14.Ultrasound image showing angle of progression

They found that among 26 cases with an occiput anterior position, an angle of progression of ≥120◦ was associated with a probability of successful vaginal delivery of 90%. Later in 2008, Eggebo *et al.* proved transperineally measured fetal head distance as a predictor for successful induction in 275 patients when ultrasound was done prior to induction of labour (Eggebo *et al.,* 2008). Another study conducted by Barbera, Pombari, Peruginoi used transperineal ultrasound to assess fetal head descent in labour and concluded that angle of head descent provided accurate means for descent of fetal head duringlabour in 2009 (Barbera *et al.*, 2009).An angle of progression of $\geq 120^0$was associated in all cases with a spontaneous vaginal delivery.

Another study published in 2012, by Torkidsen *et al.* compared two and three dimensional transperineal ultrasound methods in assessing fetal head descent in first stage of labour (Torkidsen

et al., 2011). They concluded 2D ultrasounds are simpler to learn and can be analysed quickly.

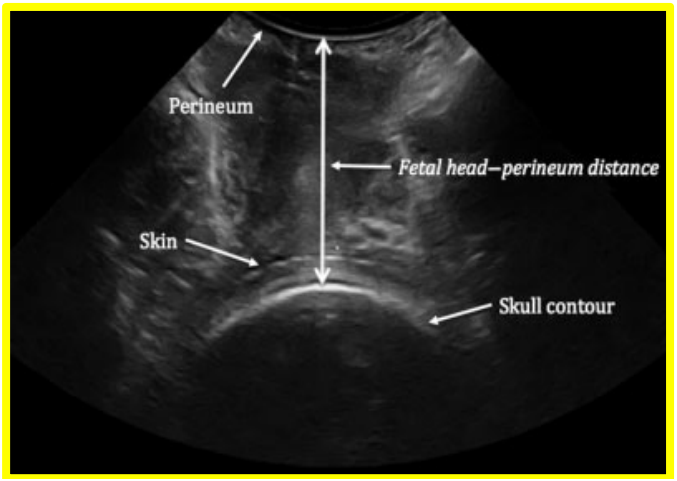


Fig. 15.Ultrasound image of how to measure fetal head perineum distance

Mohamed S. Ali *et al.* conducted study in Egypt in 2013 and showed that Fetal head–perineum measured by transperineal ultrasound examination can predict vaginal delivery after induction of labor, with a predictive value similar to that of ultrasonographically measured cervical length and the Bishop score (Mohamed *et al*., 2013). Another recent study done by Amin *et al.* in 2014 proved that transperineal ultrasound measurements, angle of progression and head progression distance could predict the mode of delivery in women with prolonged second stage of labour (Mohamed *et al.,* 2014). A statistically significant relation was found ($p< 0.001$) between both the angle of head progression and the head station and the mode of delivery.

E. Fetal weight

Recently it is seen that fetal weight could predict a successful IOL. Crane *et al.* in 2004 reported that birth weight to be an independent factor for duration of induced labours and the probability for a spontaneous vaginal delivery (Crane *et al*., 2004). Vrouenraets *et al.* in 2005 found birth weight > 3500 g to increase the risk of a caesarean delivery (Vrouenraets *et al*., 2005).

F. Posterior cervical angle

Gokturk *et al.* in 2014 did a prospective observational study in 223 women with singleton gestations planned for induction of labor in Department of Obstetrics and Gynecology, Karamursel State Hospital, Turkey (Gokturk *et al*., 2014). Their study was to evaluate sonographic cervical length, posterior cervical angle and fetal head position in predicting successful induction of labor and can be used as an alternative method to Bishop's score. Posterior cervical angle is defined as the angle between the cervical canal and the posterior uterine wall, and was measured using ultrasound at the junction of the line measuring the cervical length and posterior uterine wall. Their study concluded that multiparity status, cervical length, posterior cervical angle and Bishop's score can predict successful labor induction, but fetal head position is not predictive of successful induction of labor.Thus, definitely there is a role of ultrasound to predict the success of vaginal delivery before induction of labour and during 1st and 2nd stage of labour. This information will help obstetricians to counsel patients regarding the chances of successful vaginal delivery.

REFERENCES

Barbera A., Becker T., Macfarlane H. and Hobbins J. 2003. Assessment of fetal head descent in labor with transperinealultrasound. Teaching DVD. ACOG: Washington, DC, 176.

Barbera A., Pombar X., Perugino G., Lezotte D. and Hobbins J. 2009.A new method to assess fetal head descent in labor with transperinealultrasound. *Ultrasound Obstet Gynecol.,* 33: 313–319.

Bartha J.L., Romero-Carmona R., Martinez-Del-Fresno P., Comino-Delgado, R. 2005. Bishop score and transvaginal ultrasound for preinduction cervical assessment: a randomized clinical trial. *Ultrasound Obstet Gynecol.,* 25: 155-9.

Boozarjomehri F., Timor-Trisch I., Chao CR., Fox HE. 1994. Transvaginalultrasonographic evaluation of the cervix before labor: presence of cervical wedging is associated with shorter duration of induced labor. *Am. J. Obstet.Gynecol.,*171:1081–1087.

Chandra S., Crane JM., Hutchens D., Young DC. 2001. Transvaginal ultrasound and digital examination in predicting successful labor induction. *Obstet Gynecol*., 98: 2-6.

Crane JM. 2006. Factors predicting labor induction success: a critical analysis. *ClinObstet Gynecol.,* 49: 573-84.

Crane JM., Delaney T., Butt KD., Bennett KA., Hutchens D. and Young DC. 2004. Predictors of successful labor induction with oral or vaginal misoprostol. *J Matern Fetal Neonatal Med.,*15: 319-23.

Dietz H.P. andLanzarone V. 2005.Measuring engagement of the fetal head: validity and reproducibility of a new ultrasound technique. *UltrasoundObstet Gynecol.,* 25:165-168.

Donald I. 1962. Clinical application of ultrasonic techniques in obstetrical and gynaecologicaldiagnosis. *JObstetGynaecol Br Emp.,* 69: 1036.

Eggebo TM, Heien C, Okland I, Gjessing LK, RosmundstadP,Salvesen KA. 2008. Ultrasound assessment of fetal head–perineum distance before induction of labor. *Ultrasound Obstet Gynecol*., 32: 199–204.

Eik-Nes SH., Okland O., Aure JC. andUlstein M. 1984. Ultrasound screening in pregnancy: randomised controlled trial. Lancet 1: 1347.

Elghorori MR., Hassan I., Dartey W. and Abdel-Aziz E. 2006.A way to lend objectivity to Bishop score. *J ObstetGynaecol.,* 26: 311-6.

Friedman EA. 1954. The graphic analysis of labor.*Am J Obstet Gynecol.,* 68: 1568-75.

Fuchs I., Tutschek B. andHenrich W. 2008.Visualization of the fetal fontanels and skull sutures by three-dimensional translabial ultrasound during the second stage of labor. *UltrasoundObstet Gynecol.,* 31: 484-86.

Gabriel R., Darnaud T., Chalot F., Gonzalez N., Leymarie F. and Quereux C. 2002.Transvaginalsonography of the uterine cervix prior to labor induction. *UltrasoundObstet Gynecol.,* 19: 254-7.

Gokturk U., Cavkaytar S. and Danısman N. 2014.Can measurement of cervical length, fetal head position and posterior cervical angle be an alternative method to Bishop score in the prediction of successful labor induction?. *JMatern Fetal Neonatal Med.,* Sep 10:1-6.

Grischke EM., Dietz HP., Jeanty P. and Schmidt W. 1986. [A new study method: the perineal scan in obstetrics and gynecology]. *Ultraschall Med.,* 1986; 7: 154-61.

Hatfield AS., Sanchez-Ramos L. andKaunitzAM. 2007. Sonographic cervical assessment to predict the success of labor induction: a systematic review with metaanalysis. *Am J Obstet Gynecol.,*197(2):186-92.

Henrich W., Dudenhausen J., Fuchs I., Kamena A. and Tutschek B. 2006. Intrapartumtranslabial ultrasound (ITU): sonographic landmarks and correlation with successful vacuum extraction. *Ultrasound Obstet Gynecol.,* 28:753–760

Henrich W., Dudenhausen J., Fuchs I., Kamena A. and Tutschek B. 2006. Intrapartumtranslabial ultrasound (ITU): sonographic landmarks and correlation with successful vacuum extraction. *Ultrasound Obstet Gynecol.,* 28:753–760.

House M. and Socrate S. 2006.The cervix as a biomechanical structure. *UltrasoundObstet Gynecol.,* 28: 745-9.

Ibrahim A. 2012. Abdelazim1, MohannadLutfi Abu faza. Sonographic assessment of the cervical length before induction of labor. *Asian Pacific Journal of Reproduction*, 1(4): 253-257.

Kalache K.D., Duckelmann AM., Michaelis SAM., Lange J., Cichon G. and Dudenhausen JW.2009. Transperineal ultrasound imaging in prolonged second stage of labor with occipitoanterior presenting fetuses: how well does the 'angle of progression'predict the mode of delivery? *Ultrasound Obstet Gynecol.,* 33: 326–330.

Kreiser D., Schiff E., Lipitz S., Kayam Z., Avraham A. andAchiron R. 2001. Determination of fetal occiput position by ultrasound during the second stage of labor. *JMatern Fetal Med.,* 10: 283-6.

Laencina AM., Sanchez FG., Gimenez JH., Martinez MS., Martinez JA. And Vizcaino VM. 2007. Comparison of ultrasonographic cervical length and the Bishop score in predicting successful labor induction. *ActaObstetGynecol Scand.,* 86: 799-804.

Leary JA. And Ferrell RE.1982.Comparison of ultrasonographic and digital cervical evaluation. *Obstet Gynecol.,* 60: 137-147.

Lewin D., Sadoul G. and Beuret T. 1977.Measuring the height of a cephalic presentation: an objective assessment of station. *Eur J ObstetGynecolReprod Biol.,* 7: 369-72

Lim BH., Mahmood TA., Smith NC. and Beat I. 1992. A prospective comparative study of transvaginal ultrasonography and digital examination for cervical assessment in the third trimester of pregnancy. *JClin Ultrasound*, 20(9):599-603.

Maslow AS. and Sweeny AL. 2000. Elective induction of labor as a risk factor for cesarean delivery among low-risk women at term. *Obstet Gynecol.,*95: 917–922.

Mohamed A. Amin, Mohamed A. Eltomey and Ayman A. El-Dorf.2014. Role of transperineal ultrasound measurements in women with prolonged second stage of labor as predictors of the mode of delivery. *The Egyptian Journal of Radiology and Nuclear Medicine,* 45, 1295–1299.

Mohamed S. Ali, Mohamed A. and Abdelhafeez.2013.The distance from maternal perineum to fetal head distance as a predictive of successful induction of labor.*Nature and Science*, 11:19-24.

Munro Kerr. Operative obstetrics.10; 1980:14-6,43,51-3,67,135, 148, 161.

Peregrine E., O'Brien P. and Jauniaux E. 2007.Impact on delivery outcome of ultrasonographic fetal head position prior to induction of labor. *Obstet Gynecol.,*109: 618-25.

Rane SM., Guirgis RR., Higgins B. and Nicolaides KH. 2004. The value of ultrasound in the prediction of successful induction of labor. *Ultrasound Obstet Gynecol.,*24: 538-49.

Rane SM., Pandis GK., Guirgis RR., Higgins B. and Nicolaides KH. 2003. 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: 40–44.

Rozenberg P., Porcher R., Salomon LJ., Boirot F., Morin C. and Ville Y. 2008. Comparison of the learning curves of digital examination and transabdominalsonography for the determination of fetal head position during labor. *Ultrasound Obstet Gynecol.,*31: 332-7.

Salvesen KA. 2006. Ultrasound imaging of the pelvic floor: 'what name shall be given to this Child?' *Ultrasound Obstet Gynecol.,* 28: 750-2.

Sherer DM. 2007.Intrapartum ultrasound. *UltrasoundObstet Gynecol.,* 30: 123-39.

Sherer DM. and Abulafia O. 2003.Intrapartum assessment of fetal head engagement: comparison between transvaginal digital and transabdominal ultrasound determinations. *UltrasoundObstet Gynecol.,*21: 430-6.

Sherer DM., Miodovnik M., Bradley KS. and Langer O. 2002. Intrapartum fetal head positionII:comparison between transvaginal digital examination and transabdominal ultrasound assessment during the second stage of labor. *Ultrasound Obstet Gynecol.,*19:264-8.

Souka AP., Haritos T., Basayiannis K., Noikokyri N. and Antsaklis A. 2003. Intrapartum ultrasound for the examination of the fetal head position in normal and obstructed labor. *JMatern Fetal Neonatal Med.,* 13:59-63.

Tan P.C., Vallikkannu N., Suguna S., Quek KF. and Hassan J. 2007. Transvaginalsonographic measurement of cervical length vs. Bishop score in labor induction at term: tolerability and prediction of Cesarean delivery. *Ultrasound Obstet Gynecol.,*29: 568-73.

Torkildsen EA, Salvesen KA, Eggebo TM. Agreement between two and three dimensional transperineal ultrasound in women with prolonged first stage of labor. *Ultrasound ObstetGynecol.,* 2011; 37: 702-708.

Vankayalapati P., Sethna F., Roberts N., Ngeh N., Thilaganathan B. and Bhide A. 2008. Ultrasound assessment of cervical length in prolonged pregnancy: prediction of spontaneous onset of labor and successful vaginal delivery. *Ultrasound Obstet Gynecol.,*31: 328-31.

Vrouenraets FP., Roumen FJ., Dehing CJ. *et al.* 2005. Bishop score and riskofCaesarean delivery after induction of labour in nulliparous women. *Obstet Gynecol.,* Apr; 105(4):688-9.

Watson *et al.* 1996. Factors predicting successful labor induction. *Obstet Gynecol.,* 88 : 990-992.

World Health Organization, 2003. Department of Reproductive Health and Research. Managing complications in pregnancy and childbirth: a guide for midwives and doctors.

Yang SH., Roh CR. and Kim JH.2004. Transvaginal ultrasonography for cervical assessment before induction of labor.*J Ultrasound Med.,*23: 375-82.

Yehuda Sharf, Dan Farine, Moshe Batzalel, Yuri Megel. 2007. Continuous monitoring of cervical dilatation and fetal head station during labour. *Medical Engineering and Physics,* 29: 61-71.

Yeo L. and Romero R. 2009.Sonographic evaluation in the second stage of labor to improve the assessment of labor progress and its outcome. *Ultrasound Obstet Gynecol.,* 33(3):253-8.

Zilianti M., Azuaga A., Calderon F., Pages G. and Mendoza G. 1995. Monitoring the effacement of the uterine cervix by transperinealsonography: a new perspective. *J Ultrasound Med*., 14: 719-24.

****