Original Article

Role of Transperineal Ultrasound in Assessment of Fetal Head Engagement as Indication of Cesarean Section Taking Mode of Delivery as Gold Standard

Taiba Suleman[1*], Syeda Khadija-Tul-Sughra Murrium[1], Saulat Nawaz[2], Syed Amir Gilani[1], Mehreen Fatima[1], Hafsa Talat[1], Gull e Hina[1], Mishal Asif[1]

[1]University Institute of Radiological Sciences and Medical Imaging Technology, Faculty of Allied Health Sciences, The University of Lahore, Lahore, Pakistan

[2]Nawaz Medicare Diagnostic Center, Faisalabad, Pakistan

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ABSTRACT

The frequency of caesarean sections has been gradually increasing in the past several decades. The usage of transperineal ultrasound (TPU) has been increasing. Many studies have demonstrated that TPU can provide valuable information for the clinician. **Objective:** To assess the role of transperineal ultrasound in fetal head engagement as indication of caesarean section taking mode of delivery as gold standard. **Methods:** A cross-sectional study was carried out in Radiology Department of Nawaz Medicare and DHQ hospital, Faisalabad. Written consent was taken from all patients before the ultrasound examination. Patients were assessed for eligibility in inclusion criteria. Confirmation of intrauterine living pregnancy, placenta site, fetal presentation, liquor amount and gestational age was done with routine obstetric ultrasound. Enrolled pregnant patients at term were assessed for the fetal head-perineal distance and cervical length by TPU examination. **Results:** One hundred and twenty-four (124) women participated in the investigation. Maternal age and gestational age were not determinants of outcomes of labor. Fetal head-perineal distance measured by TPU had a test sensitivity of 88.31 %, specificity of 78.72 %, the positive predictive value is 87.18%, the negative predictive value is 80.43% and diagnostic accuracy is 84.68%. **Conclusions:** The findings of this study shows that head perineal distance measured by TPU have higher sensitivity and is a non-invasive method which provides valuable objective measurements for fetal head engagement in primigravida at term and can be easily accepted and tolerated by women. Also, unnecessary caesarean section rate can be reduced by timely decision.

INTRODUCTION

Caesarean section (CS) rates have been gradually rising globally in recent decades, with a rate of 32.8 % [1]. Despite efforts to promote vaginal birth following prior caesareans, the caesarean rate of delivery has gradually risen from 5% to 30%-32% in the past decade, with a corresponding rise in costs with short and long-term maternal, neonatal, and childhood complications [2]. The World Health Organization claims that 9,700 women died in Pakistan due to maternal complications in 2015. The rates of CS in Pakistan's urban areas rose significantly from 2.70 % in 1990–1991 to 15.80 % in 2012–2013, according to studies, with rates of 35.90 percent and 36.40 percent in public and private hospitals, respectively, over the same time span [3]. Rate of maternal death has gradually risen in the U.S with the increased rates of caesarean section delivery in the past three-decade span [4], excessively affecting black women relative to others [5]. Fetal head engagement (FHE) can be refer to as the entrance of the fetal presenting

part into the maternal pelvic inlet and the start descent through the maternal pelvic canal. Ultrasound imaging has been used as an auxiliary modality to determine the fetal presenting part within the maternal pelvis [6]. For predicting labor progress and outcome, TPU methods are reproducible that evaluate fetal head descent [7]. Through determining the distance amid the outer bony limit of the fetal skull and the pubic symphysis or the skin surface of the perineum of mother, TPU imaging can enable objective quantification of the degree of descent of fetal head in the birth canal [8]. The frequency of CS is increasing globally in the past several decades. Current health care system especially in the developing countries does not utilize TPU for the prediction of mode of delivery, even though studies have shown that it is more accurate as compared to clinical examination. Direct assessment of the FHE with TPU may be a strong parameter for the prediction of mode of delivery. There are a small number of studies addressing explicitly the expediency of ultrasound in predicting the mode of delivery. TPU is a non-invasive, radiation-free, easily available and cost-effective imaging modality and should be used for the prediction of mode of delivery by fetal head engagement. The results of this study will be helpful in minimizing unnecessary CS rate.

METHODS

This is a Cross-sectional study conducted in the Nawaz Medicare and DHQ Hospital, Faisalabad. Non-probability purposive sampling technique was used in this research. The calculated sample size was 124. Among those cases, the mean age was 29.5 years and the mean gestational age was 38.4 weeks. Maternal age and gestational age were not determinants of outcomes of labor. Sample size calculation was done by using 90% confidence level, 6% absolute precision and by taking expected percentage of Caesarean delivery in women with HPD >40 mm as 7.92% [9]. The Inclusion Criteria includes pregnant females between 20-40 years of age, singleton pregnancy, Cephalic presentation, Gestational age of 37 weeks or more, Primigravida. Exclusion Criteria comprised of Fetal congenital anomalies. GE logic S6 Ultrasound machine with low frequency (<4MHz) convex probe was used. Patients were assessed for eligibility in inclusion criteria. Non-consented individuals and patients not meeting the inclusion criteria were excluded. Confirmation of intrauterine living pregnancy, placenta site, fetal presentation, liquor amount and gestational age was done with routine obstetric ultrasound. Enrolled individuals were assessed for the fetal HPD and CL by TPU (Figure 1). The transducer was positioned between the labia majora and pubic bone by compressing the soft tissues. The

ultrasound beam was at right angle to the fetal skull by the transducer angling until the skull shape was as clear as achievable. HPD was measured in mm during a TPU with the patient in lithotomy position with an empty bladder and a convex probe on the skin of the perineum (Figure 2) [15]. The fetal head– perineum distance was measured at cut-off values of 40 mm, 45 mm and 50 mm, and cervical length at cut-off values of 20 mm, 25 mm and 30 mm. The cut-off values were selected according to the previous researches [10-14]. Cervical length was measured in a transperineal scan with patient in same position and same probe measuring the length between the external and the internal os without any pressure to soft tissues (Fig. 5) [16].
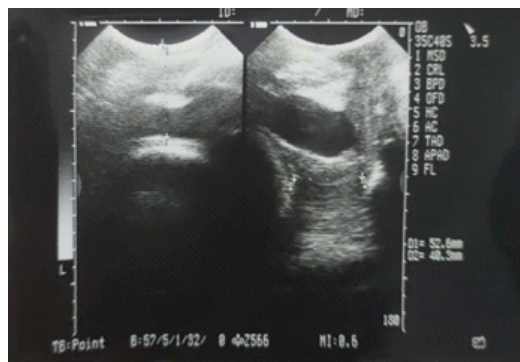

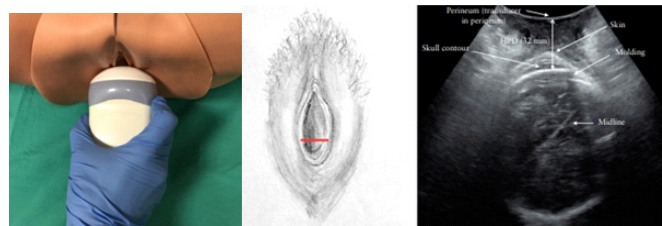**Figure 1:** HPD and CL measured with the help of TPU

Figure 2: Measurement of fHPD with TPU showing position of transducer and distance measurement [14]

After explaining the nature and purpose of the study and reading her information statement about the study, each participant gave her verbal agreement. Participants were given information about the study's goals and were promised that their participation would be voluntary. The participant's anonymity was protected throughout by ensuring that no names that could be used to identify them were used. Following inclusion criteria into this study, the data sheet was filled including all the required data for the research. Using SPSS statistics software, the acquired data was coded, tabulated, and statistically evaluated. For quantitative normally distributed data, statistical analysis was performed as the lowest and maximum of the range, as well as the mean ±SD, whereas qualitative data was calculated as number and percentage. The following diagnostic characteristics were calculated:

Sensitivity = (True positive results / Total positive results) x 100, Specificity = (True negative results / Total negative results) x 100, Predictive positive value = (True positive results / Total positive results) x 100, Predictive negative value = (True negative results / Total negative results) x 100, Diagnostic accuracy = ([True positive results + True negative results] / Total cases) x 100

RESULTS

This was a cross-sectional study of 124 pregnant women at term. Among those cases, the mean age was 29.5 years and the mean gestational age was 38.4 weeks. Maternal age and gestational age were not determinants of outcomes of labor. Among the studied cases, 47 (37.9%) underwent caesarean section, while the remaining 77 (62.1%) underwent vaginal delivery (Table 1).

	Positive (NVD)	Negative (CS)	Total
Positive (NVD)	68	10	78
Negative (CS)	9	37	46
	77	47	124

Table 1: Analysis for sensitivity and specificity

Parameter	Estimate	Lower – Upper 95% CIs
Sensitivity	88.31%	(79.25, 93.73[1])
Specificity	78.72%	(65.1, 88.01[1])
Positive Predictive Value	87.18%	(77.98, 92.88[1])
Negative Predictive Value	80.43%	(66.83, 89.35[1])
Diagnostic Accuracy	84.68%	(77.3, 89.97[1])

Table 2: Diagnostic characteristics of HPD and US findings in predicting mode of delivery

The overall sensitivity of HPD in predicting the mode of delivery is 88.31%, specificity is 78.72%, the positive predictive value is 87.18%, the negative predictive value is 80.43% and diagnostic accuracy is 84.68% (Table 2).

Normal or Caesarean section		Head–perineum distance (mm)	Cervical length (mm)
CS	N	47	47
	Mean	52.464	32.011
	Std. Deviation	7.5768	6.5946
	Minimum	36.3	21.9
	Maximum	69.4	48.7
NVD	N	77	77
	Mean	39.492	24.708
	Std. Deviation	5.8836	6.0605
	Minimum	24.4	15.2
	Maximum	53.1	42.1
Total	N	124	124
	Mean	44.409	27.476
	Std. Deviation	9.0986	7.1843
	Minimum	24.4	15.2
	Maximum	69.4	48.7

Table 3: Descriptive measurement of HPD and CL for normal or cesarean section delivery

In table 3 from total of 124 pregnant females 47 underwent c-section with minimum Head-perineum distance of 36.3 and maximum of 69.4 with average hpd value 52.46(SD=7.57) Cervical length with minimum and maximum of 21.9 and 48.7mm respectively, with average of 32.01(SD=6.59). While in 77 patient normal vaginal deliveries minimum Head-perineum distance of 24.4 and maximum of 53.1 with average HPD value 39.49(SD=5.88) Cervical length with minimum and maximum of 15.2 and 42.1mm respectively, with average of 24.70(SD=6.06). A value of 53 mm for HPD had the best statistical characteristics for vaginal delivery. Therefore, if the HPD is less than 53mm, the fetal head would be identified as engaged by this method according to this study. Figure 1 represents the bar graph for frequency distribution of patient age of 124 females with average age of 29.53 (SD=6.28) (Figure 3). It represents the bar graph for frequency distribution of gestational age of 124 females with average age of 38.42 (SD=1.37) (Figure 4).
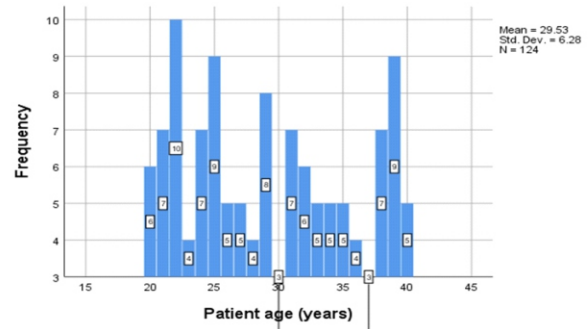

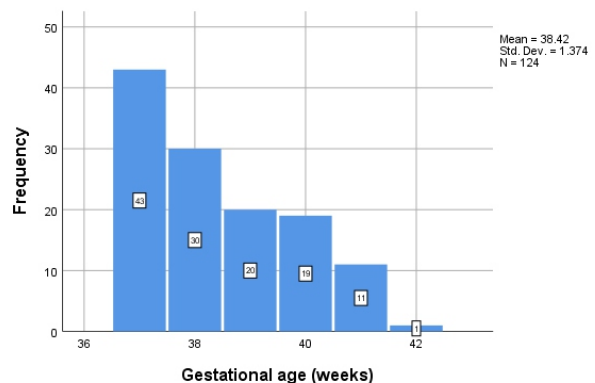**Figure 3:** Frequency of patient age represented by bar graph

Figure 4: Frequency of gestational age representing by bar graph

DISCUSSION

Among the studied cases, 47 (37.9%) underwent caesarean section, while the remaining 77 (62.1%) underwent vaginal delivery. Among those cases, the mean age was 29.5 years and the mean gestational age was 38.4 weeks. The overall sensitivity of HPD in predicting the mode of delivery is 88.31%, specificity is 78.72%. The present study found that

fHPD measurement by TPU is positive predictor of mode of delivery. The overall sensitivity of HPD in predicting the mode of delivery is 88.31%, specificity is 78.72%, the positive predictive value is 87.18%, the negative predictive value is 80.43% and diagnostic accuracy is 84.68%. The evaluation of FHE in labor depends upon the relation between the foremost limit of the fetal head and maternal perineum. For instance, the sensitivity of HPD to determine fetal engagement is 88%. Moreover, CL measured by transvaginal ultrasound is also helpful in predicting mode of delivery. Our study agrees with the Dimassi et al. [17], who also found that the HPD has positive predictor for valuation of fetal head engagement with sensitivity of 86.7% that is very close to our result. This study also agrees with Khazardoost et al [16], who concluded that Cervical length and fetal head-pubis symphysis distance measured by translabial ultrasound had a test sensitivity of 90 and 88 %, respectively. In a prospective trial of 275 women enrolled for induction of labor, Eggebo et al., [9] compared the fHPD determined by ultrasound as a predictor of induction of labour to cervical length, Bishop Score, and occiput position. CS accounted for 13% of all births. Nulliparous women accounted for 137 (47%) of the total. Nulliparous women had a 22% caesarean delivery rate compared to 5% for women who had one or more prior vaginal deliveries (P 0.01). The optimal cut-off values for predicting vaginal delivery were fHPD ≤40 mm, CL ≤25 mm, and cervical tilt >90 , according to the ROC curves. The results of current study agree with Eggebo et al., (9) who found that FHPD measurement can predict mode of delivery, but with a same predictive value to that of Bishop. El-Bishry et al., [18], was a prospective, observational study of 112 pregnant females at term (between 37-41 weeks). Based on this study, the FHPD, CL and posterior cervical angle are convenient in predicting the outcome of labor induction in comparison to Bishop Score. TPU examination is well tolerated by women than pelvic examination. The mean for pain perception among women who had vaginal examination was 3.6±0.9 (range: 2.0-5.0) which is significantly higher than that among women who had perineal ultrasound 1.0±0.6 (range: 0.0- 2.0). The results of this study match with current results about reproducibility of TPU. The use of ultrasound imaging as an adjuvant approach for assessing fetal head engagement in the maternal pelvis has been reported. TPU, for example, is commonly regarded as an easy, accurate, and consistent approach for determining fetal position. Ultrasound, on the other hand, is less commonly used to diagnose FHE. FHE can be diagnosed with ultrasound using a transperineal approach. Ultrasound measurements can also be performed using linear or angular approaches. The maternal perineum and the outer table of the fetal skull are the major anatomic landmarks in all of these approaches. The transperineal approach, reported by Dietz and Lanzarone [19]. involves performing an ultrasound examination from a sagittal plane. The pubic symphysis and the most foremost margin of the fetal skull are the bone landmarks used. They concluded that TPU quantification of head engagement is extremely reproducible and corresponds well with clinical measurements of head engagement. The present research established an HPD threshold below which the engagement diagnosis would be maintained. A measurement of 53 mm exhibited the best statistical characteristics for vaginal delivery, with good sensitivity. This approach will classify the fetal head as engaged if the HPD is less than 53mm. By comparison, Maticot-Baptista et al. [20] identified a 60 mm threshold with 89% specificity and a 94 % negative predictive value. Rivaux et al., [21] discovered that a 55 mm threshold had the best characteristics, with a 100 % sensitivity and negative predictive value, but a weak positive predictive value (29 %). These two investigations, however, only included a small number of patients, and their findings should be validated in a larger sample size. In a prospective research of 604 singleton pregnancies, Rane et al. [13] examined the effectiveness of pre-induction sonographic assessment of cervical length, posterior cervical angle, and occipital location in predicting the mode of delivery and compared it to Bishop Score. In 484 (80.1%) of the women, vaginal birth occurred within 24 hours following induction (64.2 %). In 120 cases, a CS was performed (19.9 %). CS was done in 120 (19.9%). The occipital position, cervical length, posterior cervical angle, and BMI were used to predict the likelihood of a vaginal birth within 24 hours. The occipital position, cervical length, parity, maternal age, and BMI were used to predict the likelihood of a CS. The sensitivity for ultrasound results was 89 %, and the Bishop Score was 65 %, in predicting vaginal delivery within 24 hours with a specificity of 75 %. CS sensitivities were 78 % and 53 %, respectively. Rane et al agreed with our kindly results as they found that TPU parameters are good predictors of mode of delivery. In summary, TPU was proven to be an easy, quick, painless, and reproducible approach for assessment of FHE that women tolerate well. In addition to clinical assessment, it can be employed in the delivery room.

CONCLUSION

Transperineal ultrasonography appears to be a quick, precise, and reproducible approach for the assessment of FHE and predicting mode of delivery using fetal HPD

measurement. The outcomes of this study suggest that TPU measurement of head perineal distance have a higher sensitivity and is a non-invasive approach that gives valuable objective measurements and is easily putative and tolerated by women. Also, unnecessary caesarean section rate can be reduced by timely decision.

REFERENCES

[1] Tarimo CS, Mahande MJ, Obure J. Prevalence and risk factors for cesarean delivery following labor induction at a tertiary hospital in North Tanzania: a retrospective cohort study (2000–2015). BMC Pregnancy and Childbirth. 2020,20(1): 1-8.doi.org/10.1186/s12884-020-02861-8

[2] Klemetti R, Che X, Gao Y, Raven J, Wu Z, et al. Cesarean section delivery among primiparous women in rural China: an emerging epidemic. American journal of obstetrics and gynecology. 2010 ,202(1): 65-e1.doi.org/10.1016/j.ajog.2009.08.032

[3] Kanji Z, Simonovich SD, Najmi N, Bishop-Royse J. Examining clinical indications for cesarean section in a university hospital in Karachi, Pakistan. Journal of Asian Midwives(JAM). 2019,6(1):14-25.

[4] Kazandjian VA, Chaulk CP, Ogunbo S, Wicker K. Does a Cesarean section delivery always cost more than a vaginal delivery? Journal of evaluation in clinical practice. 2007,13(1):16-20. doi.org/10.1111/j.1365-2753.2006.00690.x

[5] Antoine C, Young BK. Cesarean section one hundred years 1920–2020: The Good, the Bad and the Ugly. Journal of Perinatal Medicine. 2020, 1.doi.org/10.1515/jpm-2020-0305

[6] Minajagi PS, Srinivas SB, Hebbar S. Predicting the mode of delivery by angle of progression(AOP)before the onset of labor by transperineal ultrasound in nulliparous women. Current Women's Health Reviews. 2020,16(1):39-45. doi.org/10.2174/1573404815666191113153204

[7] Torkildsen EA, Salvesen KÅ, Eggebø TM. Prediction of delivery mode with transperineal ultrasound in women with prolonged first stage of labor. Ultrasound in obstetrics & gynecology. 2011,37(6):702-8. doi.org/10.1002/uog.8951

[8] Kalache KD, Dückelmann AM, Michaelis SA, Lange J, Cichon G, et al. 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 in Obstetrics and Gynecology. 2009,33(3): 326-30.doi.org/10.1002/uog.6294

[9] Tan PC, Vallikkannu N, Suguna S, Quek KF, Hassan J. Transvaginal sonographic measurement of cervical length vs. Bishop score in labor induction at term: tolerability and prediction of Cesarean delivery. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2007,29(5): 568-73.doi.org/10.1002/uog.4018

[10] Eggebø TM, Gjessing LK, Heien C, Smedvig E, Økland I, et a. Prediction of labor and delivery by transperineal ultrasound in pregnancies with prelabor rupture of membranes at term. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2006,27(4): 387-91.doi.org/10.1002/uog.2744

[11] Bartha JL, Romero-Carmona R, Martínez-del-Fresno P, Comino-Delgado R. Bishop score and transvaginal ultrasound for preinduction cervical assessment: a randomized clinical trial. Ultrasound in obstetrics & gynecology. 2005,25(2): 155-9.doi.org/10.1002/uog.1813

[12] Rane SM, Guirgis RR, Higgins B, Nicolaides KH. The value of ultrasound in the prediction of successful induction of labor. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2004, 24(5):538-49. doi.org/10.1002/uog.1100

[13] Pandis G, Papageorghiou AT, Ramanathan VG, Thompson MO, Nicolaides KH. Preinduction sonographic measurement of cervical length in the prediction of successful induction of labor. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2001,18(6): 623-8.doi.org/10.1046/j.0960-7692.2001.00580.x

[14] Ghi T, Eggebø T, Lees C, Kalache K, Rozenberg P, et al. ISUOG Practice Guidelines: intrapartum ultrasound. Ultrasound in Obstetrics & Gynecology. 2018,52(1):128-39. doi.org/10.1002/uog.19072

[15] Khazardoost S, Vahdani FG, Latifi S, Borna S, Tahani M, et al. Pre-induction translabial ultrasound measurements in predicting mode of delivery compared to bishop score: a cross-sectional study. BMC pregnancy and childbirth. 2016,16(1):1-7. doi.org/10.1186/s12884-016-1090-x

[16] Dimassi K, Amor AB, Belghith C, Khedija MA, Triki A, et al. Ultrasound diagnosis of fetal head engagement. International Journal of Gynecology & Obstetrics. 2014,127(1):6-9. doi.org/10.1016/j.ijgo.2014.04.008

[17] Eggebø TM, Heien C, Økland I, Gjessing LK,

Romundstad P, et al. Ultrasound assessment of fetal head–perineum distance before induction of labor. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2008,32(2): 199-204.doi.org/10.1002/uog.5360

[18] El-Bishry GA, El Kholy AL, Sweed MS, Hassan N. The accuracy of fetal head to perineum distance and cervical length in predicting the outcomes of labor induction. Evidence Based Women's Health Journal. 2020,10(1): 16-26.doi.org/10.21608/ebwhj. 2019.17674.1034

[19] Dietz HP, Lanzarone V. Measuring engagement of the fetal head: validity and reproducibility of a new ultrasound technique. Ultrasound in obstetrics & gynecology. 2005, 25(2):165-8. doi.org/10. 1002/uog.1765

[20] Maticot-Baptista D, Ramanah R, Collin A, Martin A, Maillet R, et al. Ultrasound in the diagnosis of fetal head engagement. A preliminary French prospective study. J Gynecol Obstet Biol Reprod 2009 ,38(6):474–80. doi.org/10.1016/j.jgyn.2009.04.001

[21] Rivaux G, Dedet B, Delarue E, Depret S, Closset E, et al.The diagnosis of fetal head engagement: transperineal ultrasound, a new useful tool? Gynecol Obstet Fertil 2012,40(3):148–52. doi.org/ 10.1016/j.gyobfe.2011.07.012