Assessment of Fetal Head−Perineum Distance via Ultrasound as a Predictor of Successful Vaginal Delivery Preceding Labor Induction

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Abstract

Background: The goal of intrapartum ultrasonography, a kind of ultrasound examination conducted during labor, is to examine the spatial connections between the fetal head and the delivery canal, such as the fetal head's position, attitude, and station, by measuring a set of parameters.

Aim: To determine whether transperineal ultrasonography measurements of the fetal head's position relative to the perineum are predictive of a smooth vaginal birth.

Patients and methods: This study will be a prospective cohort study that will be conducted on 120 term pregnant females between 37 and 42 weeks at Department of Obstetrics and Gynecology, Faculty of Medicine, Al-Azhar University Hospitals.

Result: Both fetal head−perineum distance (FHPD) and cervical length were significant in predication of successful induction; however, FHPD has the upper hand with sensitivity of 94.3% and specificity of 89.6%.

Conclusion: A FHPD of 5.63 cm has a sensitivity of 94.3% and a specificity of 89.6% for predicting a vaginal birth.

Keywords: Fetal head−perineum distance, Labor induction, Transperineal, Vaginal delivery

1. Introduction

In recent years, cesarean section (CS) rates have risen substantially all around the globe. In particular, it is crucial to differentiate between CSs that are medically essential and those that are not. Because putting off a cesarean might have unfavorable effects on both the mother and child, it should be done as soon as possible.[1]

Many medical organizations now advise against waiting for labor to start naturally if the hazards involved are higher than the potential benefits of inducing labor early.[2]

Although digital transvaginal examination is the 'gold standard' for obstetric practice, it is a subjective judgment dependent on the clinician's expertise and has various limitations, and so difficult vaginal births are avoided wherever possible. Frequent digital vaginal examinations (DVEs) are used in the clinical assessment of women in active labor to detect cervical dilation and fetal position.[3]

Labor dystocia is a medical term for extremely slow labor. In 2013, 19 000 maternal deaths were attributed to labor that did not progress. Labor dystocia may be diagnosed by keeping track of clinical observations made during serial digital vaginal examination (such as cervical dilation, fetal head station and position, the presence of caput succedaneum, and moulding) and comparing them to the expected development of labor.[4]

For 34% of laboring women, digital vaginal exams failed to identify the fetal head position, and for 51% of patients in whom the position could be characterized, the diagnosis was inaccurate. DVEs are

uncomfortable and humiliating for the women being evaluated, and they have been linked to complications such fetal infection, chorioamnionitis, endometritis, and a shorter time to delivery in premature labor.[5]

For a method that is thought to contribute to the rise in the cesarean birth rate, it is essential to identify the parameters related with the effectiveness of the induction, intended as vaginal delivery. Evaluation of the cervix is a major consideration.[6]

The dilation, effacement, consistency, and fetal station are used to calculate the Bishop Score. Given that the Bishop Score is a subjective measure, there may be substantial variation in results across separate assessments. The process of determining a Bishop Score is also tedious. Given the shortcomings of the Bishop Score, it's important to find other ways to predict whether or not an individual would be a good candidate for an intraocular lens (IOL).[7]

The goal of intrapartum ultrasonography, a kind of ultrasound examination conducted during labor, is to measure the spatial connections between the fetal head and the delivery canal, such as the fetal head's position, attitude, and station, by measuring a set of parameters. Sonography is conducted during labor and delivery by inserting a probe between the patient's labia for a transabdominal approach or by employing a cervicothoracic technique. Translabial ultrasound and transperineal ultrasound are terms for the latter type of examination (TPU). Images are acquired in the sagittal or transverse planes in both kinds of exams.[8]

The advent of intrapartum ultrasonography has aided in our comprehension of the intricate physiology of giving birth. It has been found to be useful in assessing the likelihood of an operational vaginal birth and providing objective data on the progression of labor.[9]

The proximity of the presenting component to the outlet is a crucial factor in the labor result. Examination of the genitalia from the outside helps establish whether the head is above or below the ischial spine. The digital assessment of head station during intrapartum is often wrong, incorrect, and not repeatable across various examiners. There is a large discrepancy between the results of a vaginally administered evaluation and those of an ultrasound examination done during labor.[10]

The purpose of this research is to ascertain whether transperineal ultrasonography assessments of the fetal head's distance from the perineum are reliable indicators of a trouble-free vaginal delivery.

2. Patients and methods

One hundred twenty women who had reached their last trimester of pregnancy participated in this prospective cohort research at Al-Azhar University Hospitals' Department of Obstetrics and Gynecology, Medical School. Women who were having their first child were included if they were between 18 and 35 years old, their gestational age was between 37 and 42 weeks, they were having a full-term, singleton pregnancy, their baby was presented head-down, and their BMI was between 18 and 25.

Approval of ethical committee was obtained as well as written consent was signed from all cases before participation in this study.

All women with age less than 18 and greater than 35 years, Gestational age less than 37weeks, were in labor, history of scarred uterus, Fetal congenital malformation, fetal malpresentation, need for emergency CS, DM or HTN, multiple pregnancies, rupture of membranes, intrauterine fetal death, contraindication for vaginal delivery, and polyhydramnios was excluded from the study.

The following were done to the patients: complete history, checkup on the whole bimanual examination and standard laboratory tests are used to identify adnexal masses and assess uterine size and shape.

Skin anomalies, swelling, ulcerations, growths like external genital warts (EGW) or tumors, rashes, lacerations, piercings, bruises, and discharge are all things a doctor should look for during a vulvar exam. Other common concerns include symmetry, hair quality and growth pattern, lacerations, and discharge.

The patient had a vaginal exam. The hymenal ring was seen by carefully separating the labia minora. Light pressure on the bulbocavernosus muscle served to relax the vaginal walls, allowing for an examination of the cervix's contour, level of erosion, and form of the OS. In order to check for proper head positioning and an unbroken membrane, as well as evaluate the numerous factors that make up the modified Bishop score (min 0, max 10).

An ultrasound of the transperineal region was performed on a supine patient who had an empty bladder using a portable Mindray DP-2200 ultrasound device with 3.5—6.5 MHz multifrequency transducers. For a reliable HPD measurement, the transducer was placed in a transverse section across the posterior commissure and the ischial-tuberosities, and a steady amount of pressure was applied. The transducer was oriented and slanted in a transverse view from the perineal skin surface to the

outermost bony limit of the fetal skull during intervals when the uterus was not contracting. The transverse distance between the fetal head's outer bony limit and the perineal skin surface was used to calculate the fetal head—perineum distance (FHPD).

Every pregnant patient admitted to the hospital had a transvaginal ultrasound. The presenting fetal part, the urinary bladder, the internal OS, the external OS, and the cervical canal were used as the standard anatomical landmarks, and all TVS examinations were performed using a Philips HD9 with a 2D convex probe 4—9 MHz (Philips international; Amsterdam, Netherlands) by a seasoned sonographer who was blinded to the patient's clinical data. The hyperechoic line from the internal OS to the external OS was utilized as a reference point, and the probe was withdrawn until a clear image of the cervical canal was obtained at the lightest touch. The internal OS looked as a little dimple or triangle on the background of the hypoechoic amniotic fluid. Three cervical length measurements were taken and averaged.

The induction protocol, dinoprostone, 3 mg vaginal tablets (prostaglandin E2) had been used (6 hourly induction, maximum 3 doses, if patient was not got into active labor, the induction was considered unsuccessful).

All data were collected, tabulated and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, IL, USA).

3. Results

Table 1.

The mean age ranged 21—35 years with mean BMI of 24.36 kg/m^2. Mean GA was 40.13 weeks and ranged 37—42 Table 2.

The most common indication was post-term pregnancy (75%) Table 3.

That mean cervical length was 2.96 ± 3.45 cm and mean bishop score was 4.27 ± 1.38. That mean Fetal head-perineal distance was 5.17 ± 0.837 cm Table 4.

That mean Induction-to-delivery interval was 6.72 ± 8.34 h. 72.5% of the patients showed

Table 1. Demographic characteristics and clinical data among the studied groups.

	Patients (n = 120)
Age (years)	
Mean ± SD	27.68 ± 4.32
Range	21—35
BMI (kg/m^2)	24.36 ± 1.58
Mean ± SD	19.6—25
GA (weeks)	40.13 ± 1.49
Mean ± SD	37—42

Table 2. Indication for induction distribution among the studied patients.

	Patients (n = 120) N (%)
Postterm pregnancy	90 (75%)
Oligohydramnios	26 (21.7%)
Others	4 (3.3%)

successful induction while 27.5% were unsuccessful Table 5.

That cervical length and FHPD were significantly lower in successful induction patients compared with failure induction while, Bishop score was significantly higher in successful induction patients compared with failure induction Table 6.

This table shows that both FHPD and cervical length were significant in predication of successful induction however, FHPD has the upper hand with sensitivity of 94.3% and specificity of 89.6%.

4. Discussion

Due to the possible advantages of an early birth, inducing labor has become standard practice in contemporary obstetrics for high-risk pregnant women. Inducing labor is a common practice for almost 5—15% of pregnant women, depending on the specific indicators for both mother and baby Vogel and colleagues.[11]

During vaginal births, the rate of fetal head fall is often utilized as a predictor of labor progress Amer and colleagues.[12]

The Bishop score has traditionally been used to assess the effectiveness of an induction; however, this score is observer based, and substantial discrepancies have been recorded between two resident physicians using the Bishop score Garcia-Simon and colleagues.[13]

Counseling patients prior to induction of labor and explaining the likelihood of a successful induction based on imaging results is an increasingly significant part of an obstetrician's toolkit, and ultrasound has emerged as an important auxiliary tool Ali and Hebbar.[1]

This study aimed to determine whether or not transperineal ultrasonography measurements of the

Table 3. Ultrasound measurement Cervical length, Bishop and Fetal head-perineal distance score of the studied patients.

	Patients (n = 120)
Cervical length (cm)	
Mean ± SD	2.96 ± 0.457
Bishop score	
Mean ± SD	4.27 ± 1.38
FHPD (cm)	
Mean ± SD	5.17 ± 0.837

Table 4. Induction characteristics of the studied patients.

	Patients ($n = 120$)
Induction-to-delivery interval (hrs.)	
Mean ± SD	6.72 ± 8.34
Induction	
Successful	87 (72.5%)
Failed	33 (27.5%)

distance from the fetal head to the perineum are useful as a predictor of a vaginal birth.

This study was a prospective cohort study that was conducted on 120 term pregnant females between 37 and 42weeks at Department of Obstetrics and Gynecology, Faculty of Medicine, Al-Azhar University Hospitals.

In the current thesis, regarding the demographic characteristics and clinical data among the 120 studied cases, age ranged from 21 to 35 years with mean 27.68 ± 4.32 years, mean BMI of 24.36 ± 1.58 kg/m^2 and mean GA was 40.13 ± 1.49 week. The most common indication was postterm pregnancy (75%).

In the same line was a recent study by Saroyo and Danarti,[14] titled Prediction of vaginal deliveries using fetal head descent assessed by transperineal ultrasound. A total of 323 women aged between 15 and 45 years were included in the study, the mean Mother's age was 28 years ranged from 15 to 45 years, Gestational ages was 41 weeks. BMI ranged from 25 to 38 kg/m^2.

Our results according to the transvaginal ultrasound measurement and Bishop score of the studied patients that mean cervical length was 2.96 ± 0.457 cm and mean bishop score was 4.27 ± 1.38. The mean Fetal head-perineal distance was 5.17 ± 0.837 cm.

In agreement was a recent study by Ali and Hebbar,[1] reported that, the mean Bishop score was 3.92 ± 1.18 ranged between 1 and 8. Transcervically measured cervical length mean was 2.89 ± 0.56 cm spanned between 1.2 and 4 cm. The mean FHPD was 5.19 ± 0.92 cm. ranged from 3 to 7 cm.

Also, a previous study by Eggebø and colleagues[15] showed that, the mean cervical length was 27.6 mm,

Table 5. Transvaginal ultrasound measurement and Bishop score among the patients according to induction outcome.

	Success ($n = 87$)	Failure ($n = 33$)	t	P
Cervical length (mm)				
Mean ± SD	2.28 ± 0.531	3.14 ± 0.682	7.3	0.000
Bishop score				
Mean ± SD	4.57 ± 1.45	3.21 ± 1.18	MU 281	0.000
FHPD (cm)				
Mean ± SD	4.79 ± 0.421	6.15 ± 0.327	16	0.000

Table 6. Correlation between Fetal head-perineal distance and cervical length.

Variables	AUC	S.E.	Sig.	95% Confidence Interval	
FHPD	0.873	0.032	0.000	0.790–0.931	
Cervical length	0.712	0.048	0.000	0.609–0.798	
Variables	Cutoff	Sensitivity	Specificity	PPV	NPV
FHPD	<5.63 cm	94.3%	89.4%	92.1%	95.9%
Cervical length	<3.12 cm	85.7%	78.7%	82.3%	80.5%

and the median was 28 (range, 6–54) mm., the mean distance from the fetal head to the perineum was 47.5 mm and the median was 46 (range, 26–108) mm.

The current study observed that mean Induction-to-delivery interval was 6.72 ± 8.34 h. 72.5% of the patients showed successful induction while 27.5% were unsuccessful. There was no significant difference between success and failure induction patients regarding demographic and clinical data (P>0.05).

In a study by Alvarez-Colomo and Gobernado-Tejedor[16] The 151 women included in the research were representative of 28.2% of all inductions started at the hospital throughout the study period. Women had an average age of 32.60 years, 68.2% were first-time mothers, and 9.3% had a history of prior CSs. One hundred and five women (69.5%) gave birth after induction, while 46 (30%) needed CSs. The model's inclusion of both isolated maternal height and BMI is something to highlight. As easy as it seems, the reason behind this is that both height and body mass index are linked to induction of labor, but in a backwards fashion. There is a strong correlation between a woman's height and body mass index and her risk of inducing labor unsuccessfully.

El-Bishry and colleagues[2] analyzed the relationship between the distance from the fetal head to the perineum and the length of the cervical canal in order to predict the success of induction of labor. Among the studied 112 cases, 35 (31.3%) underwent CS, while the remaining 77 (68.8%) underwent vaginal delivery (VD). No significant difference was found between CS and VD cases regarding age, BMI, GA and parity (P > 0.05).

Regarding the transvaginal ultrasound measurement and Bishop score among the patients according to induction outcome our results showed that, cervical length and FHPD were significantly lower in successful induction patients compared with failure induction while, Bishop score was significantly higher in successful induction patients compared with failure induction.

In agreement was a recent study by Ali et al.,[1] observed that Among women who had a successful

induction, those with a higher Bishop's score had a higher likelihood of vaginal birth, whereas those with a lower score were more likely to have a caesarean section.

Alvarez-Colomo and Gobernado-Tejedor[16] found that compared with cervical length and Bishop Score, the FHPD's prognostic value for the outcome of a labor induction is higher.

Contrary Garcia-Simon and colleagues[13] gives an overview of the ultrasonographically determined Bishop score and cervical length for each observer. When evaluating cervical conditions, all subgroups of included patients showed similar median Bishop scores and mean cervical lengths across all observers.

We found that, both FHPD and cervical length were significant in predication of successful induction; however, FHPD has the upper hand with sensitivity of 94.3% and specificity of 89.4%.

Along with our results was a study by Ali and Hebbar,[1] observed that FHPD had a greater sensitivity (97%), specificity (88.1%), and accuracy (93.6%) than Bishop's score and cervical length, respectively. The same was true when comparing ROCs in many ways.

Another study from Indonesia Saroyo and Danarti,[14] proved that Using a fetal head-toperineum distance cutoff of 43.5 mm, we found that 89% of women continued with a vaginal birth, with an AUC of 82.4% (95% CI, 69−95%) and a sensitivity of 91% and a specificity of 78%.

El-Bishry and colleagues[2] found that When performed after inducing labor, transperineal ultrasound's ability to measure the distance from the fetal head to the perineum is a strong indicator of whether or not the baby will be delivered vaginally. The induction of labor outcomes were measured quantitatively, and the ROC curve was constructed accordingly. The largest area under the curve was calculated for FHPD (0.794, 95% CI 0.704−0.884), followed by PCA (0.759, 95% CI 0.661−0.856) then CL (0.720, 95% CI 0.621−0.820) and lastly Bishop Score (0.676, 95% CI 0.573−0.780), although the difference is not statistically significant.

In a study by Ali and colleagues[17] FHPD had an 84.7, 84, and 61.8% sensitivity, specificity, and negative predictive value, respectively, for predicting a vaginal delivery after a 4.8 cm cutoff.

4.1. Conclusion

We conclude that a fetal head-to-perineum distance of 5.63 cm is the optimal cutoff for predicting a successful vaginal birth (94.3% sensitivity, 89.6% specificity). Future studies should investigate the predictive value of transperineal ultrasonography for women undergoing induction of labor, as well as the correlations between ultrasound results and the chosen mode of delivery.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

The authors declared that there were NO conflicts of Interest.

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