Ultrasound Guided Pelvic Assessment in Case of Term Vaginal Delivery in a Tertiary Hospital in Bangladesh

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Abstract

Background: Evaluating labor progress, especially for first-time mothers, can be tough. Doctors usually rely on manual vaginal exams, but these can vary widely between different providers. Recently, ultrasound has become more popular because it's quick, painless, and gives a clear visual picture of what's happening during labor.

Objectives: The goal of this study was to see if specific ultrasound measurements angle of progression (AoP), head-perineum distance (HPD), midline angle (MLA), and fetal head direction can reliably predict who will deliver vaginally and who might need a caesarean section, especially in women having their first baby. **Methods:** We did a prospective observational study from December 2024 to May 2025. The study included 50 women at term, all first-time mothers, admitted at Dinajpur Medical College Hospital and the 250 Bedded General Hospital in Dinajpur, Bangladesh. During labor, participants had both regular clinical exams and ultrasound scans. All data were tracked using both standard labor charts and ultrasound-based sonopartograms. We used SPSS (version 25) for data analysis, performing chi-square and independent t-tests to identify significant relationships.

Results: Among the 50 participants, 38 women (76%) had successful vaginal deliveries, and 12 (24%) required caesarean sections mostly due to stalled labor or fetal distress. The women who delivered vaginally showed clear differences in ultrasound measurements compared to those who had caesareans. For vaginal deliveries, AoP was typically above 110 degrees, HPD was under 3 cm, and MLA was usually below 20 degrees. These differences were statistically significant ($p < 0.001$).

Conclusion: Ultrasound during labor gives valuable, practical information that helps clinicians manage childbirth more effectively. Adding measurements like AoP, HPD, and MLA into routine labor checks can improve the accuracy of delivery predictions and reduce unnecessary interventions. Further studies with more participants could confirm these benefits and encourage wider use of ultrasound in everyday labor practice.

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Introduction

Anyone who has ever spent time in a labor ward knows that no two labors are the same. What looks like a textbook case one minute can

turn complicated the next. For first-time mothers especially, it's not always easy to know whether labor is progressing well.[1] Most of the time, decisions are based on what we feel with our hands—vaginal exams, checking how far along things are, estimating the baby's position. It works, but it's not perfect. The truth is, these manual assessments are deeply subjective.[2,3] What one clinician perceives can differ from another, and this inconsistency can affect the course of management.

This is where ultrasound comes in not as a replacement, but as a support tool. It gives us something we can see. It's fast, repeatable, and doesn't make labor more uncomfortable for the patient . When used during labor, ultrasound can tell us exactly how the baby's head is positioned, how far it's descended, and how the cervix is changing—information that's critical, especially when the situation is borderline or not going according to plan.

In a place like Dinajpur, where the patient load is high and labor rooms are often busy, we need tools that are practical and reliable. We can't afford to waste time second-guessing or waiting too long to intervene . Ultrasound offers an extra layer of information—one that can make a big difference when timing and clarity matter most.[4-7]

This study came out of real clinical questions we face on the ground . Can ultrasound really help us predict who will deliver normally and who might need a C-section Are certain measurements—like the angle between the baby's head and the pelvis, or the space between the head and the perineum—consistently linked to labor outcomes? If we can answer those questions, even partially, we'll be better equipped to manage labor safely, especially in settings where every decision counts.

Methods

This prospective, observational study was conducted over a six-month period from December 2024 to May 2025 at the Dinajpur Medical College Hospital and the 250 Bedded General Hospital, Dinajpur . Ethical approval was obtained from the Institutional Ethical and Research Committee prior to initiation of the study. A total of 50 primigravida women, aged above 18 years irrespective of their socio-economic status with singleton pregnancies at term (≥ 37 to < 41 weeks) in vertex presentation during the active stage of labor (cervical dilation 4–10 cm) were recruited. All participants provided informed written consent prior to inclusion.Participants were monitored in the labor ward under the standard institutional protocol and supervision of qualified female personnel including obstetricians, staff nurses, and midwives. Vaginal examinations (VE) were performed at two-hour intervals to assess cervical dilatation, fetal head station, and position, which were charted on a WHO standard partograph along with maternal vitals and fetal heart rate. The fetal head station was assessed according to WHO criteria, ranging from –5 to +5 in relation to the ischial spines.[8-12] Ultrasound assessments adhered to the ISUOG Practice Guidelines [4]. Following each VE, transperineal ultrasound (TPUS) was performed using a curved 2D, 4.6 MHz transducer (EDAN). The procedure was carried out with the patient in lithotomy position.[13]

1. *Cervical Assessment*
   Cervical dilatation was evaluated in the sagittal plane, measuring from the inner anterior to the inner posterior cervical tissue margins.
2. *Fetal Head Descent*
   The fetal head perineal distance (HPD) was measured transversely as the shortest distance between the outer bony contour of the fetal skull and the perineum.
3. *Fetal Head Position*
   The fetal head position was defined using

anatomical landmarks—primarily fetal spine and orbits—and documented using a 12-hour clock face convention based on the occiput's orientation. Measurements were rounded to the nearest hour.

4. *Angle of Progression (AoP)*
   AoP was calculated as the angle between the long axis of the pubic symphysis and a line tangential to the leading edge of the fetal skull in midsagittal view.
5. *Fetal Head Direction*
   The head direction was classified into:
   • Head down: angle < 0°
   • Horizontal: 0°–30°
   • Head up: > 30°
   This dynamic reflects fetal descent and helps predict the ease of operative vaginal delivery.
6. *Sonographic Head Station*
   Sonographic station was calculated as the distance between the infrapubic plane (3 cm above ischial spines) and the deepest presenting bony part of the skull, adjusted by head direction angle.
7. *Midline Angle (MLA)*
   The MLA was measured using a transperineal axial scan, identifying the angle between the fetal cerebral midline and the anteroposterior pelvic axis. This rotation metric assists in evaluating fetal alignment during descent.
8. *Sono-Partogram*
   All sonographic findings were recorded using a sono-partogram enabling graphical representation of labor progress via ultrasound [11] and structured data sheet.

Measurement Standardization

All measurements were approximated to the nearest full unit. HPD and AoP were expressed in centimeters and degrees respectively, while fetal head position was standardized using clock-face orientation.

Statistical Analysis

Statistical analysis was conducted using SPSS software (version 25), employing chi-square tests to examine associations between categorical variables and independent t-tests for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Variables of the Study

Dependent Variable

The central outcome examined in this study was the mode of childbirth, clearly defined into two categories:

• Normal Vaginal Delivery (NVD).
• Caesarean Section (CS).

This was the primary factor assessed against various clinical and ultrasound markers collected during labor.

Independent Variables

This research identified several critical clinical and sonographic measurements, which were systematically recorded during active labor and evaluated for their predictive relationship with childbirth outcomes. These included:

1. *Fetal Head Position and Presentation***:** Determined using ultrasound by identifying clear fetal cranial landmarks in relation to maternal pelvic structures.
2. *Fetal Head Size***:** Assessed through standard ultrasound measurements, including biparietal diameter (BPD) and head circumference (HC).
3. *Pelvic Inlet Size:* Evaluated clinically, supported indirectly by sonographic evidence of fetal engagement and descent within the maternal pelvis.
4. *Cervical Length and Ripeness***:** Evaluated through combined clinical examination (e.g., Bishop score) and ultrasound imaging, highlighting labor preparedness.
5. *Fetal Station***:** Determined by traditional vaginal examination and supported by objective sonographic measurements using transperineal ultrasound (TPUS).
6. *Head-Perineum Distance (HPD):* Sonographically measured as an indicator of fetal head proximity to the perineal surface, reflecting the depth of fetal descent .
7. *Angle of Progression (AoP):* Defined as the ultrasound-measured angle between the pubic

bone and leading fetal head edge, closely correlating with fetal progression.

8. *Midline Angle (MLA):* Sonographically obtained to indicate the extent of fetal head rotation and alignment relative to maternal pelvic anatomy.
9. *Fetal Head Direction:* Sonographically classified as downward, horizontal, or upward, providing insights into the trajectory and efficiency of labor progression.

Confounding Variables

To ensure accuracy and reduce bias, the study carefully accounted for several other factors potentially influencing both ultrasound findings and childbirth outcomes. These included:

• *Maternal Age***:** Influences maternal physiology and labor progression patterns.

• *Type of pregnancy***:** Primigravidae or Multigravidae.

• *Any antenatal complication*: HTN, Diabetes, Preeclampsia, Eclampsia, HELLP Syndrome, Thyroid dysfunction.

•*Amniotic Fluid Volume***:** Conditions such as oligohydramnios or polyhydramnios potentially alter fetal positioning and ease of descent.

• *Placental Location***:** Anterior, posterior, or low-lying placental positions can influence fetal positioning, affecting labor outcomes indirectly.

• *Fetal Biometry***:** Includes crucial measurements such as estimated fetal weight and abdominal circumference, which affect labor management decisions.

• *Maternal Pelvic Anatomy***:** Structural pelvic variations, including sacral curvature, pubic arch angle, and prominence of the ischial spines, directly affect fetal descent.

• *Use of Labor Augmentation***:** Administration of oxytocin or similar interventions can alter labor duration and affect the mode of delivery.

• *Duration and Management of Labor***:** Prolonged or actively managed labor significantly impacts clinical decisions regarding interventions.

• *Postnatal complication*: PPH, Retained Placenta, Genital tract tear, others.

• *APGAR Scale for neonate:* Appearance, Pulse, Grimace/Reflex Irritability, Activity/muscle tone, Respiratory effort.

• *Operator Experience and Proficiency***:** Accuracy of sonographic and clinical assessments strongly depends on the individual operator's skill level, potentially influencing outcomes.

Results

Demographic Characteristics

A total of 50 primigravida women at term gestation (between 37 and 41 weeks) participated in this study. The mean age of the participants was 23.7 ± 3.4 years. Most of the women were from rural areas. All participants were in the active stage of labor and were assessed using both routine clinical examinations and ultrasound imaging techniques.

Delivery Outcomes

Among the 50 women studied 38 (76%) had a normal vaginal delivery (NVD), 12 (24%) required caesarean section (CS). The primary reasons for performing caesarean sections included non-progress of labor, fetal distress, and cephalopelvic disproportion.

Sonographic parameters were analyzed to evaluate their predictive value for the mode of delivery. The findings showed marked differences between the NVD and CS groups.

Table I: Sonographic parameters for the mode of delivery.

Ultrasound Parameter	NVD (Mean ± SD)	CS (Mean ± SD)	p-value
Angle of Progression (AoP, °)	118.4 ± 12.2	96.7 ± 10.5	< 0.001*
Head-Perineum Distance (HPD, cm)	2.3 ± 0.4	4.1 ± 0.6	< 0.001*
Cervical Dilatation (cm)	7.9 ± 1.1	6.1 ± 0.8	0.003*
Midline Angle (MLA, °)	15.7 ± 6.2	28.3 ± 7.5	< 0.001*
Fetal Head Direction	Mostly Downward	Mostly Upward	< 0.05

*Statistically significant ($p < 0.05$)

These results suggest that more favorable ultrasound findings - such as a larger angle of progression, shorter head-perineum distance, greater cervical dilation, and a lower midline angle—are associated with an increased likelihood of vaginal delivery. Conversely, unfavorable values were more common in the caesarean group.Chi-square testing was performed to examine associations between categorical sonographic parameters and the type of delivery. The analysis revealed:HPD less than 3 cm was significantly associated with normal vaginal delivery ($\chi^2 = 13.24$, $p < 0.001$). AoP greater than or equal to 110° was a strong predictor of vaginal birth ($\chi^2 = 11.68$, $p = 0.001$).MLA less than 20° was also significantly linked to successful vaginal delivery ($\chi^2 = 9.47$, $p = 0.002$).Independent t-tests were conducted to compare mean values of continuous variables between the two delivery outcome groups. Statistically significant differences were observed in:HPD ($t = 8.31$, $p < 0.001$), with lower values favoring vaginal delivery.AoP ($t = 6.14$, $p < 0.001$), with higher angles favoring vaginal delivery.MLA ($t = 4.22$, $p = 0.001$), with lower angles favoring vaginal delivery.These findings reinforce the clinical utility of sonographic parameters in predicting the mode of delivery and can assist clinicians in intrapartum decision-making.

Discussion

This study investigated the contribution of ultrasound-based intrapartum assessments in predicting delivery outcomes among primigravida women at term.[4,9] The analysis focused on a set of predefined sonographic markers and their association with the mode of delivery.[2] The data demonstrate that transperineal ultrasound (TPUS), when applied systematically during labor, provides clinically relevant insights into labor dynamics that are not always evident through routine vaginal examination alone.[1,7]

Interpretation of Key Findings

A substantial proportion of participants 76% achieved vaginal delivery, while 24% underwent caesarean section, primarily due to labor arrest, fetal compromise, or cephalopelvic disproportion. Differences in ultrasound-derived parameters between these groups were both notable and statistically significant.Participants who had vaginal deliveries typically exhibited:A wider angle of progression (AoP), averaging over 118°, which is consistent with improved fetal descent.A shorter head-perineum distance (HPD), suggesting closer proximity of the fetal head to the perineum.A lower midline angle (MLA), which often indicates favorable alignment of the fetal head .These findings align with the physiologic expectations of efficient labor progression and offer quantifiable, objective correlates to what has traditionally been assessed subjectively.The significance of these parameters is well-supported in existing literature. For instance, Eggebø and colleagues found AoP to be one of the most consistent predictors of vaginal delivery , while Molina et al. emphasized HPD's value in distinguishing between favorable and unfavorable labor trajectories.[3] Similarly, Dietz and Lanzarone highlighted the reproducibility of fetal station assessments via ultrasound, suggesting it as a reliable adjunct to clinical evaluation.

The statistical methods employed—including chi-square tests for categorical associations and independent t-tests for group comparisons—highlighted a consistent relationship between sonographic markers and delivery outcomes . Notably:HPD values below 3 cm and AoP values exceeding 110° were significantly more common in the vaginal delivery group.Lower MLAs also tended to correlate with non-operative deliveries, suggesting that optimal fetal head rotation plays a critical role.These associations reinforce the idea that TPUS can serve as a predictive framework during labor, offering early identification of cases that are more likely to require intervention.

Our observations resonate with patterns reported in prior studies. While variations in measurement technique and interpretation exist across institutions, the convergence of findings across multiple studies lends robustness to the use of intrapartum ultrasound. Importantly, our use of a sono-partogram offered a clear, structured visual tool for monitoring progress, augmenting the traditional partogram's limitations in objectivity.

One of the strengths of this research lies in its prospective approach, which allowed real-time data collection under controlled conditions. All participants were evaluated using standardized ultrasound protocols following ISUOG recommendations, which improves both the reliability and reproducibility of the findings.[4] However, this study is not without limitations. The modest sample size and its confinement to a single-center population may limit generalizability to broader obstetric populations. Moreover, while all efforts were made to reduce observer variability, ultrasound is still inherently operator-dependent, and subtle discrepancies in measurement may persist despite standardized training.Another limitation is the exclusive focus on primigravida women. Although this enhances internal consistency, it limits our ability to extrapolate findings to multiparous women, who may exhibit different labor dynamics due to prior cervical and pelvic adaptations.

Conclusion

This research shows that ultrasound-guided intrapartum evaluation, especially via transperineal ultrasonography (TPUS), offers important and objective information regarding labor progression in term first-time pregnant women. The evaluated sonographic parameters—like angle of progression (AoP), head-perineum distance (HPD), midline angle (MLA), and fetal head orientation—demonstrated statistically significant differences between vaginal deliveries and those necessitating caesarean sections. Among 50 participants, 76% experienced a normal vaginal delivery (NVD), whereas 24% had a caesarean section (CS). Ultrasound results such as AoP $\geq 110°$, HPD < 3 cm, and MLA $< 20°$ were highly indicative of successful vaginal delivery. Analyses using both chi-square and t-test validated that these factors could consistently distinguish between positive and negative labor results. Incorporating ultrasound into labor monitoring shows potential for enhancing maternal care by adding precise, non-invasive, and consistent tools to clinical assessments. It enables earlier detection of labor dystocia, improved intervention planning, and more assured decision-making, which may lower the number of unnecessary cesarean sections. In summary, this research endorses the regular implementation of intrapartum ultrasound—together with clinical evaluations—to improve safety, precision, and outcome forecasting in labor management. Additional studies involving larger populations are advised to confirm these results and support broader implementation in both tertiary and peripheral healthcare environments.

Disclosure

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