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Original Article

Accuracy of Ultrasound Measurement of Fetal Head Station for Prediction of the Difficulty of Assisted Vaginal Delivery

Umber Arooj Tahir[1], Hafsa Tauseef[2], Faryal Akhtar[2]
[1]Department of Obstetrics and Gynaecology, Ibn-e-Siena Hospital and Research Institute,
[2]Medical and Dental College, Ibn-e- Siena Hospital Multan.

Abstract

Background: Recently the use of ultrasound for the measurement of fetal head engagement during assisted vaginal delivery has increased. However, this finding has not been proved reproducible by sufficient studies and only limited-series studies have tested its accuracy.
Objective: To evaluate the accuracy of ultrasound measurement of perineum-to-skull ultrasound (PSUD) in predicting the outcome of assisted vaginal delivery.
Methods: A prospective cohort study was conducted in the Department of Gynecology and Obstetrics, Ibn-e-Siena Hospital, Multan, from September 2023 to September 2024. A total of 200 pregnant women with a gestation age of more than 34 weeks presenting with singleton pregnancies in cephalic position undergoing assisted vaginal delivery were included by consecutive sampling. Women were divided into group A, including women in whom PSUD was measured, and group B, which included women in whom PSUD was not measured. The difficulty of vaginal birth was primarily assessed by the extraction difficulty criterion. A digital vaginal examination was performed to record the fetal head station and presentation before each attempt of delivery according to ACOG classification and sections of the pelvic outlet. A suprapubic ultrasound was performed after examination.
Results The mean PSUD was 41.7±12.2 mm, and a higher PSUD was significantly related to extraction difficulty (p <0.0001). PSUD was not significantly associated with neonatal outcomes. The sensitivity for the prediction of difficult extraction was 73.5% at 40 mm PSUD, and the specificity was 48.2% (positive predictive value: 24.1% and negative predictive value: 89.4%). PSUD and digital vaginal examination had a moderately significant association (r =0.35, p <0.01). After adjusting for confounding factors, multivariable analysis revealed that PSUD ≥40 mm (OR: 2.42 (1.48-3.71), p =0.0001), PSUD ≥50 (OR: 2.156 (1.38-3.30), p =0.0004) and PSUD ≥60 OR: 2.99 (1.73-5.38), p =0.0001) were significant indicators of difficult delivery.
Conclusion: The ultrasound measurement of the perineum-to-skull is a reliable and reproducible prognostic method to predict the difficulty of assisted vaginal delivery. However, due to its low specificity, other factors must be considered.
Key words: Fetus, pregnancy, ultrasound, vaginal examination.

Introduction

The incidence of assisted vaginal births ranged from 2 to 10% in Pakistan, which is comparatively lower than in high-income countries due to a lack of equipment and training of healthcare staff.[1] It is important to assess the position of the fetus when the cervix is fully dilated and assisted delivery is imminent. Head engagement is evaluated when the fetus is in an engaged position to determine the mode of delivery.

The fetal head engagement is crucial to diagnose through digital examination, as it often relays different information than abdominal signs, which commonly indicate that the assessment of head position would be distorted by caput succedaneum.[2] The findings of the digital exam also differ from the results of the true fetal head station.[3]

Corresponding Author:
Umber Arooj Tahir
Department of Obstetrics and Gynaecology
Ibn-e-Siena Hospital and Research Institute
Multan.
Email: aroojumber036@gmail.com
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Authors Contribution

UAT conceptualized the project. HT & FA did the data collection. HT performed the statistical analysis. UAT & HT did the literature search. Drafting, revision & writing of manuscript were done by FA.

Skinneret al reported that digital vaginal examination of the fetal head station interpreted the position of the head at high, mid, or low pelvis wrongly in 20% of cases when compared to the true fetal head station and in 80% of cases when compared to the American College of Obstetrics and Gynecology classification.[4]

Recent studies have suggested the use of ultrasound for the measurement of fetal head engagement. Zegarra et al found that ultrasound was accurate and reliable in measuring the angle of the fetal head as compared to digital examination to predict the outcome of assisted delivery.[5] It has been proposed to measure the perineum-to-skull ultrasound distance linearly, as it is a relatively easier approach. However, this finding has not been proved reproducible by sufficient studies, and only limited-series studies have tested its accuracy.

This study was conducted to evaluate the accuracy of ultrasound measurement of PSUD in predicting the outcome of assisted vaginal delivery.

Methods

A prospective cohort study was conducted in the Department of Gynecology and Obstetrics, Ibn-e-Siena Hospital, Multan from September 2023 to September 2024. A total of 200 pregnant women with a gestation age of more than 34 weeks presenting with singleton pregnancies in cephalic position undergoing assisted vaginal delivery were included by consecutive sampling. Women with multiple pregnancies, spontaneous vaginal deliveries, undergoing cesarean section, in non-cephalic position, and without PSUD measurement were excluded. All women provided their informed verbal and written consent to become a part of the study.

Obstetric and neonatal data were recorded for all women. Women were divided into group A, including women in whom PSUD was measured and group B, which included women in whom PSUD was not measured. The difficulty of vaginal birth was primarily assessed by extraction difficulty criterion defined as the difficulty of the delivery through the operators' perspective (easy, average, or difficult), the need for two or more vacuum devices, the need for internal obstetrical maneuver, need of a second instrument, duration of extraction being more 10 minutes and switch to c-section due to failed extraction. The secondary assessment included assessment of the above-mentioned criterion individually, along with perineal tear, umbilical artery <7, and Apgar <5 after five minutes.

A digital vaginal examination was performed to record the fetal head station and presentation before each attempt of delivery according to ACOG classification and sections of the pelvic outlet. A suprapubic ultrasound was performed after examination. A vacuum extractor was used in most cases except in women with gestation age <37 weeks or if the operator decided to use another type of instrument. Assisted delivery was performed in the lithotomy position, with an empty bladder and an engaged fetal head. The fetal head station was measured before the use of instruments after the determination of presentation by suprapubic ultrasound.

All data were analysed by SPSS version 23. Mean and standard deviation were used to present quantitative variables, and a student's t-test was performed to compare them. Percentage was used to present qualitative variables, and Fisher's exact test or x^2 test was performed to compare them where applicable. The ROC curve was formed to assess difficult extraction. The association between PSUD and the possibility of difficult extraction was evaluated by multivariable regression analysis while adjusting for confounding variables such as macrosomia, nulliparity, and cephalic presentation. Spearman's coefficient established a relationship between digital examination and ultrasound measurement. Significance was taken at a *p*-value less than 0.05.

Results

A total of 200 pregnant women were included in the study, among whom PSUD was measured in 100 women (50%). Maternal and obstetrics data did not differ significantly between groups; however, BMI was higher in group A, but this finding was not clinically related (Table-1). Fetal distress was more frequent in group B (26%) than in women who underwent ultrasound (18%) (*p* <0.0001). Vacuum devices were used in 91 (91%) women in group A and 93 (93%) in group B, Thierry's spatula in 7 (7%) and 5 (5%), and obstetric forceps in 5 (5%) and 5 (5%), respectively.

In women who underwent ultrasound, the delivery was regarded as difficult by the obstetrician in 4 (4%) cases, two or more vacuum detachments were used in 10 (10%) cases, the second instrument was employed in 5 cases (5%), duration of extraction was more than 10 minutes in 10 (10%) cases and the obstetrical maneuver was used in 2 (2%) cases (Table-2). Four women (4%) switched to c-section due to failed extraction. Twenty assisted deliveries met the difficulty extraction criteria, among which failed first instrument (88%), c-sections (100%), and difficult delivery considered

Table 1: Maternal and obstetrics data of study groups.

Variables	*Group A (n=100)*	*Group B (n=100)*	*p*
Maternal age	30.2 ± 4.23	29.5 ± 4.48	0.153
BMI (kg/m2)	27.7 ± 4.46	26.8 ± 4.19	0.021
Null-parity	85 (85%)	87 (87%)	0.507
Gestation age	39.9 ± 1.31	39.8 ± 1.42	0.046
Epidural anesthesia	90 (90%)	90 (90%)	0.654
Posterior or transverse presentation	25 (25%)	20 (20%)	0.187
Fetal distress	18 (18%)	26 (26%)	<0.0001
Birth weight > 4000 g	6 (6%)	4 (4%)	0.335

Table 2: Mean PSUD with respect to extraction difficulty criterion and neonatal data.

Criterion	*Mean PSUD*	*p*
The operator regarded delivery as difficult (n=4)	50.8	0.0001
Duration of extraction being more than 10 minutes (n=10)	48.1	<0.0001
Need for two or more vacuum devices (n=9)	45.3	0.01
Need of second instrument (n=5)	49.9	<0.0001
Shoulder dystocia (n=2)	48.7	0.03
Difficult extraction according to primary criterion (n=20)	45.8	<0.0001
Arterial pH 7 or less	41.6	0.79
5-minute Apgar 5 or less	38.7	0.70
Presence of 3rd or 4th-degree perineal lesions	42.0	0.88

by the operator (85%) had high overlap rates. The mean PSUD was 41.7±12.2 mm, and a higher PSUD was significantly related to extraction difficulty (*p* <0.0001). PSUD was not significantly associated with neonatal outcomes.

The AUC on the receiver operating characteristics curve was 0.65 (95% CI 0.61-0.72, *p* <0.01). The maximum Youden index was obtained at 39 mm PSUD. The sensitivity for the prediction of difficult extraction was 73.5% at 40 mm PSUD, and the specificity was 48.2% (PPV: 24.1% and NPV: 89.4%).

Table 3: Multivariable analysis for prediction of difficult delivery based on composite criterion.

Adjustment criteria	*Odds ratio*	*95% CI*	*p*
PSUD > 40 mm	2.42	1.48-3.71	0.0001
Null-parity	1.57	0.93-2.94	0.09
Fetal presentation	1.70	1.11-2.63	0.01
Birth weight >4000 g	2.69	1.28-5.86	0.010
PSUD >50 mm	2.156	1.38-3.30	0.0004
Null-parity	1.538	0.92-2.85	0.20
Fetal presentation	1.642	1.10-2.61	0.02
Birth weight >4000 g	2.909	1.41-6.20	0.006
PSUD >60 mm	2.99	1.73-5.38	0.0001
Null-parity	1.47	0.79-2.80	0.22
Fetal presentation	1.91	1.23-2.94	0.005
Birth weight >4000 g	2.87	1.40-6.23	0.004

After adjusting for confounding factors, multivariable analysis revealed that PSUD ≥ 40 mm (OR: 2.42 (1.48-3.71), *p* =0.0001), PSUD ≥ 50 (OR: 2.156 (1.38-3.30), *p* =0.0004) and PSUD ≥ 60 OR: 2.99 (1.73-5.38), *p* =0.0001) were significant indicators of difficult delivery (Table-3). PSUD and digital vaginal examination had a moderately significant association based on ACOG classification (r =0.35, *p* <0.01) as shown in Figure.

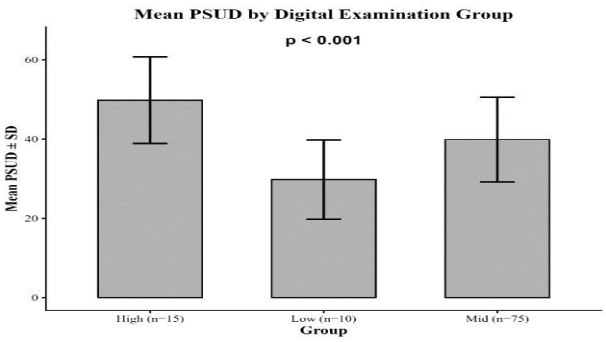

Figure: Association of digital examination and PSUD measurement.

Discussion

The results of the present study show that PSUD measurement was significantly associated with difficult birth, especially at the 40 mm threshold, with the highest sensitivity (73.5%) and specificity (48.2%). Findings of the digital examination also predict the difficulty of delivery, but the results are less reliable. Our findings are similar to previous studies.[6-8]

Our results also showed that digital vaginal examination of the fetal head had a moderate but significant association with ultrasound measurement. Boulmedais et al also concluded that

the association between findings of digital exam and ultrasound were moderately associated (r=0.53).[9] Hans et al reported that a PSUD threshold higher than 60 mm was associated with non-cephalic presentation, while Rivaux et al described this threshold at 66.4 mm, which is similar to our study.[10,11]

Chan et al described abdominal and translabial methods of ultrasound to measure fetal head station, which are subcategorized into linear and angular approaches.[12] One of the linear methods, transperineal ultrasound, used in our study is a straightforward, accessible, and easy approach. In comparison, angular methods used in different studies report an angle of progression of 145.5° or <120° as a predictor of failed assisted vaginal delivery. However, this method is complex and time-consuming. Hence, we employed the ultrasound method for PSUD measurement.

We found that PSUD ≥ 40 mm had the highest prognostic accuracy for the prediction of extraction difficulty. Choudhary et al assessed an ultrasound measurement of <45 mm as the prognostic threshold of vaginal delivery.[13] Similarly, Dasgupta et al concluded that PSUD >45 or 55 mm, and Horst et al reported that PSUD 50 mm was significantly associated with failed extraction.[14,15]

However, PSUD had a limited specificity was 48.2% at 40 mm PSUD, which makes it an adequate tool alone for diagnosing patients. This is significantly lower than Saroyo et al., where PSUD had a specificity of 78.2% at a 43.5 mm cut-off value[16]. Similarly, a 88.1% specificity was reported by Ali & Hebbar at a cut-off value of 55 mm.[17]

Our study has some limitations. As 50% of the population did not undergo an ultrasound, a selection bias may have influenced the study results, although the findings of both groups were comparable. Additionally, the rate of instrumental extraction failure was statistically insignificant due to low incidence, which indicates the need for instrument use in delivery.

Conclusion

The ultrasound measurement of the perineum-to-skull is a reliable and reproducible prognostic method to predict the difficulty of assisted vaginal delivery.

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Availability of Data: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval: The Institutional Review Board of Multan Medical & Dental College, Multan approved the study via letter no. C-68-1020-A dated 30/08/2023.

Conflict of Interest: None declared.

References

1. Alwazzan A. The Perinatal and Maternal Outcomes of Instrumental Vaginal Delivery: Perinatal & Maternal Outcomes of Instrumental Vaginal Delivery. Pak J Health Sci 2023; 4(1) 155-60.
2. Haumonte J-B, Blanc J, Castel P, Mace P, Auquier P, d'Ercole C, et al. Uncertain fetal head engagement: a prospective randomized controlled trial comparing digital exam with angle of progression. Am J Obstet Gynecol 2022; 227(4): 625.
3. Kamel R, Negm S, Badr I, Kahrs BH, Eggebø TM, Iversen JK. Fetal head descent assessed by transabdominal ultrasound: a prospective observational study. Am J Obstet Gynecol 2022; 226(1): 112.
4. Skinner SM, Giles-Clark HJ, Higgins C, Mol BW, Rolnik DL. Prognostic accuracy of ultrasound measures of fetal head descent to predict outcome of operative vaginal birth: a comparative systematic review and meta-analysis. Am J Obstet Gynecol 2023; 229(1): 10-22.
5. Zegarra RR, di Pasquo E, Dall'Asta A, Minopoli M, Armano G, Fieni S, et al. Impact of ultrasound guided training in the diagnosis of the fetal head position during labor: A prospective observational study. Eur J Obstet Gynecol Reprod Biol 2021; 256: 308-13.
6. Nallet C, Zegarra RR, Mazellier S, Dall'Asta A, Puyraveau M, Lallemant M, et al. Head-to-perineum distance measured transperineally as a predictor of failed midcavity vacuum-assisted delivery. Am J Obstet Gynecol MFM. 2023; 5(2): 100827.
7. Rizzo G, Mattioli C, Mappa I, Bitsadze V, Khizroeva J, Makatsariya A, et al. Antepartum ultrasound prediction of failed vacuum-assisted operative delivery: a prospective cohort study. J Matern Fetal Neonatal Med 2021; 34(20): 3323-9.
8. Carvalho Neto RH, Viana Junior AB, Moron AF, Araujo Junior E, Carvalho FHC, Feitosa HN. Assessment of the angle of progression and distance perineum-head in the prediction of type of delivery and duration of labor using intrapartum ultrasonography. J Matern Fetal Neonatal Med 2021; 34(14): 2340-8.
9. Boulmedais M, Monperrus M, Corbel E, Blanc-Petitjean P, Lassel L, Béranger R, et al. Predictive value of head-perineum distance measured at the initiation of the active second stage of labor on the mode of delivery: A prospective cohort study. Eur J Obstet Gynecol Reprod Biol 2023; 280: 132-7.
10. Hans R, Reddy D, Shetty J. Serial intrapartum ultrasound to predict vaginal delivery using angle of progression and head-progression distance in term

nulliparous women. Eur J Obstet Gynecol Reprod Biol 2025; 305: 125-31.
11. Plurien A, Berveiller P, Drumez E, Hanssens S, Subtil D, Garabedian C. Ultrasound assessment of fetal head position and station before operative delivery: can it predict difficulty? J Gynecol Obstet Human Reprod 2022; 51(4): 102336.
12. Chan VYT, Lau WL. Intrapartum ultrasound and the choice between assisted vaginal and cesarean delivery. Am J Obstet Gynecol MFM 2021; 3(6): 100439.
13. Choudhary N, Verma S, Gandhi S, Monga A, Charan V, Kumari A. Ultrasound assessment of foetal head-perineum distance prior to induction of labour as a predictor of successful vaginal delivery: a prospective study from a tertiary care hospital of Rajasthan. Int J Reprod Contracept Obstet Gynecol 2023; 12(7): 2235-41.
14. Dasgupta S, Mittal P, Bharti R, Mittal M, Pandey D, Suri J. Fetal Head–Perineum Distance on Transperineal Ultrasound as Predictor of Vaginal Delivery in Term Nulliparous Women Undergoing Induction of Labor. Obstet Gynecol 2022; 16(3): 174-80.
15. Horst W, do Valle JB, Godoy EDP, Silva JC. Fetal Head-to-Perineum Distance as a Predictor of Successful Vaginal Delivery: A Secondary Analysis of Intrapartum Ultrasound Data. Concilium 2024; 24(14): 74-85.
16. Saroyo YB, Danarti MD, editors. Prediction of vaginal deliveries using fetal head descent assessed by transperineal ultrasound. Journal of Physics: Conference Series; 2018: IOP Publishing. (Accessed on 18th March, 2026) Available from https://iopscience.iop.org/article/10.1088/1742-6596/1073/2/022016/pdf
17. Ali J, Hebbar S. Ultrasound assessment of foetal Head–Perineum distance prior to induction of labour as a predictor of successful vaginal delivery. J Obstet Gynecol India 2019; 69: 129-35.