RESEARCH ARTICLE

Correlation of Digital Vaginal Examination with Transabdominal Ultrasound to Assess Fetal Head Position during Active Labor

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Abstract

Introduction: An accurate intrapartum assessment of the fetal head position (FHP) is considered important for the management of both normal and abnormal labors. The position of the fetal head influences the obstetric outcomes such as labor dystocia, choice of instruments for assisted delivery, and the success of vaginal delivery. It is well accepted that the FHP is an important determinant of success of vaginal delivery, with the occiput anterior (OA) positions favoring mostly good labor outcomes, while the occiput posterior (OP) and occiput transverse positions having a higher rate of instrumental delivery or cesarean section.[5–7] Digital vaginal examination (DVE) for determination of FHP can be subjective and inaccurate. This study was aimed to compare transabdominal ultrasound with DVE for determination of FHP during active labor.

Materials and methods: This is a prospective observational study at Vardhman Mahavir Medical College and Safdarjung Hospital. Low-risk pregnant women in active labor with singleton fetus in vertex presentation were enrolled in the study. Digital vaginal examination and transabdominal sonography were done for the assessment of FHP in the first and second stages of labor and prior to instrumental vaginal delivery. Labor and neonatal outcomes were recorded.

Statistical analysis: Categorical variables were presented in number and percentage, and continuous variables were presented as mean ± standard deviation (SD) and median. Qualitative variables were correlated using Chi-square test. Interrater κ agreement was used to find out the strength of agreement between FHP by DVE and ultrasonography (USG). A p value of <0.05 was considered statistically significant. The data were entered in MS Excel spreadsheet, and the analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

Results: The absolute agreement between DVE and transabdominal sonography for determining FHP was 55.82% in the first stage of labor, and the composite accuracy was 77.01% when FHP in DVE was assigned as correct within ±45° in transabdominal sonography ($\kappa = 0.538$ and $p \leq 0.0001$). The absolute agreement between DVE and transabdominal sonography for determining FHP was 66.27% in the second stage of labor, and the accuracy was improved by 20.30% when FHP in DVE was assigned as correct within ±45° in transabdominal sonography ($\kappa = 0.606$ and $p \leq 0.0001$). Ultrasound was able to correctly diagnose and facilitate instrumental delivery in the OA and occiput transverse positions. κ showed moderate concordance (0.560). Majority (96%) of the women chose transabdominal ultrasound as the preferred modality for the FHP assessment as it is less obtrusive procedure than DVE, while 4% women had an equivocal response.

Conclusion: Digital vaginal examination can fail to detect the correct FHP due to the presence of tense bag of membranes, caput succedaneum, and molding in active labor. A higher percentage of the occiput transverse and OP positions can be misdiagnosed on vaginal examination. Transabdominal ultrasonography (TAS) should be used to correctly determine the FHP in such conditions.

Clinical significance: Transabdominal ultrasonography should be used to confirm the FHP prior to instrumental delivery and cesarean section, which will facilitate correct application and prevent intrapartum complications.

Keywords: Active management of labor, Antenatal ultrasound, Digital vaginal examination, Fetal head position.

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Introduction

Correct assessment of fetal head position (FHP) is essential in the management of labor.[1] Knowledge of the exact position of the head in the maternal pelvis can help predict the course of labor.[1,2] Traditionally, this assessment is performed by intrapartum physical examination consisting of Leopold's maneuver followed by digital vaginal examination (DVE). The presence of tense bag of membranes, large caput succedaneum, asynclitism of the fetal head, and molding can lead to misinterpretation of the FHP.[1] Clinical examination can be subjective and inaccurate.[3–6] Every vaginal examination is intrusive and can be uncomfortable for the patient, especially when the examination is repeated. Ultrasonography has been widely used in obstetrics for the assessment of fetal cardiac activity, fetal presentation, and placental localization. These measurements result in a more accurate clinical assessment with better outcomes for vaginal delivery and decrease cesarean section rates.[7–10] Intrapartum ultrasound has become a topic of interest for various researchers to develop a tool for an objective method of assessment of labor progress. Few authors have assessed the

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accuracy of DVE for the determination of FHP in comparison with ultrasound. This study is aimed to compare DVE and transabdominal USG to assess FHP during active labor.

Materials and Methods

Full-term nulliparous pregnant women with singleton pregnancy in the active phase of the first stage of labor (cervical dilatation 4–6 cm) with cephalic presentation were enrolled in the study after an informed consent. Digital vaginal examination was carried out for the assessment of cervical status, station of head, membrane status, and any cephalopelvic disproportion. The FHP was noted by the attending obstetrician, and this was followed by TAS which was done within 10 minutes of DVE. Women prepared for emergency cesarean section due to fetal and maternal indication in the first stage of labor, pregnancy with intrauterine death, women with medical emergencies necessitating immediate delivery, previous cervical surgery (cone biopsy and cervical cerclage), fetal macrosomia (baby weight ≥ 4 kg), and all other nonvertex presentations in labor were excluded from the study.

All ultrasonographic assessments were done by the investigator of the study. The person performing the ultrasound examination was blinded to the findings of DVE. For the assessment of USG, Toshiba's model SSA640 A with 3–5 Hz probe was used. Compliance of Preconception Prenatal Diagnostic Techniques Act (PCPNDT Act) Act was strictly adhered.

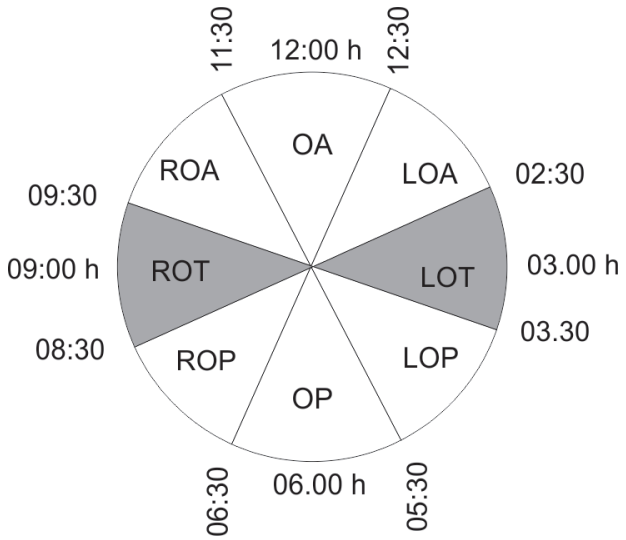

Fig. 1: Position of the fetal head on transabdominal sonography

On DVE, the FHP was determined based on the position of the occiput and posterior fontanel. Transabdominal ultrasonography was performed using 3–5 Hz probe of two-dimensional (2D) ultrasound. The FHP was determined using the fetal spine as landmark and defining the occiput as the denominator. Transabdominal ultrasonography findings were taken as gold standard. It was expressed in the form of 12-hour clock system such that the examiner was always facing the perineum. By TAS, the OA position was defined to be from >9:30 to <2:30 clock hours, the left occiput transverse (LOT) position from 2:30 to 3:30 clock hours, the right occiput transverse (ROT) position from 8:30 to 9:30 clock hours, and the OP position from >3:30 to <8:30 clock hours (Fig. 1).

The operator first determined the location of the fetal spine with the ultrasound probe placed longitudinally on the mother's abdomen. If the cervical spine was seen at the midline, then the fetus was in the direct occiput anterior (OA) position (Fig. 2). If the cervical spine was seen by tilting the probe more than 45° from midline, then the fetus was in the right occiput anterior (ROA) or left occiput anterior (LOA) position. If the cervical spine was only seen by putting the probe near either left or right anterior superior iliac spine, then the fetus was determined to be in the LOT or ROT position, respectively. If the cervical spine could be seen, then the ultrasound probe was rotated to orientate transversely to the maternal spine and the operator would identify the fetal orbits. Depending on the orientation of the fetal orbits, the FHP was classified as direct occiput posterior, left occiput posterior (LOP), or right occiput posterior (ROP) position accordingly (Fig. 3). Both examinations were done in the active first stage of labor (cervical dilatation 4–6 cm) and the beginning of the second stage of labor (full dilatation) in the same women. In some cases, in the second stage of labor, the FHP could not be determined due to deeply engaged head.

Statistical Analysis

Categorical variables were presented in number and percentage, and continuous variables were presented as mean ± SD and median. Qualitative variables were correlated using Chi-square test. Interrater κ agreement was used to find out the strength of agreement between the FHP by DVE and USG. A p value of <0.05 was considered statistically significant. The data were entered in MS Excel spreadsheet, and the analysis was done using SPSS version 21.0.

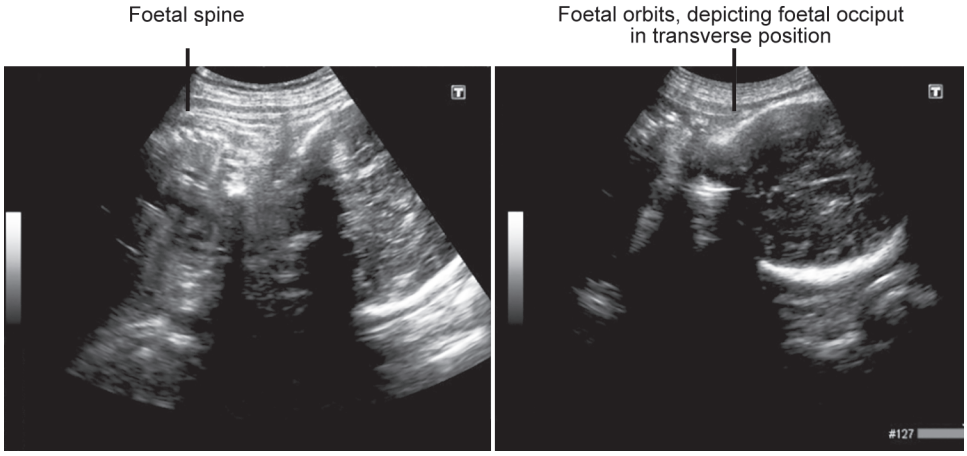

Fig. 2: Fetal head position on transabdominal sonography

Results

A total of 335 women were enrolled in the study and were followed up by DVE and transabdominal sonography to determine the FHP in the active first stage (cervical dilatation 4–6 cm) and in the second stage of labor. The mean age of women participating in the study was 22.81 ± 2.91 years. Maximum number of women (60.0%) had mean body mass index (BMI) of 23.25 ± 11.85 kg/m^2. The mean gestational age of women was 39.07 ± 0.79 weeks (37–42 weeks). Period of gestation was 39–39^{+6} in 54.39% of women. Most of the babies born were between 2.5 and 3.5 kg [236 (70.45%)], and 20.30% babies born were of low birth weight (Table 1).

Fig. 3: Transabdominal ultrasound probe placement

Among 335 women, 302 (90.15%) delivered vaginally, 12 (3.58%) underwent operative vaginal delivery, and 21 (6.27%) had cesarean section.

In the first stage of labor, the position of the fetal head by TAS could be determined in all the observations, while DVE failed to determine the FHP in 37 (11.04%) observations due to the presence of tense bag of membranes (Table 2).

During the first stage of labor, the absolute agreement in DVE and USG was 55.82% (187) in the study group, and it improved to a composite agreement of 77.01% (258) when additional ±45° was considered as correct agreement. There was moderate concordance between vaginal examination and transabdominal sonography in the first stage of labor ($\kappa = 0.538$; $p \leq 0.0001$) (Table 2).

Digital vaginal examination failed to determine the FHP in the second stage of labor in 12 (3.58%) observations due to deeply engaged head and obstructed view by maternal pubic bones on TAS. During the second stage of labor, there was absolute agreement between DVE and sonography for the position of the fetal head in 66.27% (222) observations. The agreement between DVE and TAS improved by 20.30% (68) observations when the FHP in vaginal examination was ±45° with TAS; therefore, the composite agreement between DVE and TAS was 86.56% (290) observations. The position of the fetal head by vaginal examination significantly correlated with TAS in the second stage of labor ($p < 0.0001$), and κ showed good concordance (0.606) (Table 3).

Twelve (3.58%) women underwent operative vaginal delivery (vacuum- or forceps-assisted delivery). Transabdominal sonography was able to correctly diagnose and facilitate instrumental delivery in the OA and occiput transverse positions. There was good concordance between DVE and TAS for determining the FHP in the

Table 1: Sociodemographic characteristics of study population

	Mean ± SD	*Range*
Maternal age (years)	22.81 ± 2.91	21–24
BMI (kg/m^2)	23.25 ± 11.85	21.1–23.8
Gestation age (weeks)	39.07 ± 0.79	37–42
Birth weight (g)	2865.70 ± 338.0	1,850–3,988

Table 2: Agreement between fetal head position by digital vaginal examination and transabdominal sonography in the first stage of labor

	Actual no. diagnosed by TAS		*Absolute agreement with DVE*		*Additional accuracy ±45° with DVE*		*Composite accuracy*	
FHP	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Occiput anterior position	85	25.37	49	57.64	26	30.58	75	88.23
Occiput transverse position	178	53.13	106	59.55	31	17.41	137	76.96
Occiput posterior position	72	21.49	32	44.44	14	19.44	46	63.88
Total	335	100	187	55.82	71	21.19	258	77.01

Table 3: Agreement between fetal head position by digital vaginal examination and transabdominal sonography in the second stage of labor

	Actual no. diagnosed by TAS		*Absolute agreement with DVE*		*Additional accuracy ±45°*		*Composite accuracy*	
	Number	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*
Occiput anterior position	301	89.85	211	70.09	61	20.26	272	90.36
Occiput transverse position	10	2.98	5	50.0	4	40.0	9	90.0
Occiput posterior position	12	3.58	6	50.0	3	25.0	9	75.0
Undetermined	12	3.58	–	–	–	–	–	–
Total	335	100	222	66.27	68	20.30	290	86.56

Table 4: Agreement between fetal head position in vaginal examination and ultrasonography in "operative vaginal delivery"

	Actual no. diagnosed by TAS		*Absolute agreement in*	
	Number	*Percentage*	*Number*	*Percentage*
Occiput anterior position	10	83.33	7	70.0
Occiput transverse position	1	8.33	1	100.0
Occiput posterior position	1	8.33	0	0.00
Total	12	100	8	66.67

Table 5: Patient's preference for ultrasonography and digital vaginal examination

Preference	*No. of women (n)*	*Percentage*
TAS	321	95.80
DVE	–	–
Equivocal	14	4.17
No comment	–	–

Table 6: Time duration for transabdominal sonography in the first and second stages of labor

Time taken (minutes)	*First stage (%)*	*Second stage (%)*
1–3	321 (95.82)	311 (92.83)
3–5	14 (4.17)	12 (3.58)
>5	–	12 (3.58)

second stage of labor, $\kappa = 0.633$; $p \leq 0.0001$, in women undergoing operative vaginal delivery (Table 4).

There were 12 (3.58%) neonates with an Apgar score <7 at 1 minute in the second stage of labor which improved in the next 5 minutes. No adverse maternal or neonatal outcomes were reported in this study. Patient preference was also evaluated and was found that 96% women preferred transabdominal ultrasound as the preferred modality to DVE for determining the FHP (Table 5).

Time duration for performing TAS in the first and second stages of labor was also evaluated. It took 1–3 minutes to perform ultrasound in the first stage of labor in 321 (95.82%) women and in 311 (92.83%) women in the second stage of labor (Table 6).

Discussion

An accurate intrapartum determination of the FHP is considered important for the management of both normal and abnormal labors as this influences the obstetric outcomes such as management of labor dystocia, choice of instruments for assisted delivery, and the success of vaginal delivery.[2–4] It is well accepted that the FHP is an important determinant of success of vaginal delivery, with the OA positions favoring mostly good labor outcomes, while the OP and occiput transverse positions having a higher rate of instrumental delivery or cesarean section.[11–13]

In this study, the position of the fetal head by TAS could be determined in all the observations in the first stage of labor, while DVE failed to determine the FHP in 37 (11.04%) observations. The absolute agreement in the OA positions was 57.64% and the composite agreement improved to 88.23%. Shetty et al. reported absolute agreement between vaginal examination and USG in 31.5% cases in the first stage of labor which was lower than this study.[4] In their study, the absolute agreement in the LOA position was 46.2% and LOT was 32.8%. In this study, the LOA and LOT positions had absolute agreement in the first stage of labor with USG in 65.45% and 64.29% observations, respectively, which was higher than the study by Shetty et al.[4] In this study, the absolute agreement in the OP position was 44.44%, and the composite agreement improved to 63.88%. There was moderate concordance between DVE and TAS in the active first stage of labor ($\kappa = 0.464$; $p \leq 0.0001$). Shetty et al. reported that when vaginal examination findings within 45° of the ultrasound assessment were assigned as correct, the rate of error decreased from 69% to 34%.[4] In this study, DVE failed to determine the FHP in 37 (11.04%) cases, and in 22.98% women, vaginal examination differed by >45° with respect to ultrasound examinations. In these women, the vaginal examination was hampered in 59.45% cases due to the presence of caput and in 40.54% cases due to the presence of tense bag of membranes. The rate of error was found to be 50–76% with vaginal examinations when ultrasound examination findings were taken as gold standard in studies by Akmal et al.[3] and Sherer et al.[5] Thus, in the first stage of labor, there is moderate concordance between vaginal examination and TAS and the absolute agreement in both tools in the anterior positions of the fetal head. Also, TAS is accurate for all the FHPs. Hence, TAS should be used as an adjunct in the first stage of labor to supplement the DVEs specifically where the DVE findings are undetermined.

In comparison with the first stage of labor, DVE was able to determine the FHP in more number of cases by 8% in the second stage of labor, and this may be due to increased surface area of the fetal head accessible to palpation and the lower station of the fetal head during the second stage of labor. In this study, there was absolute agreement between vaginal examination and TAS for FHP in 66.27% observations in the second stage of labor (73.77% in LOA). The composite agreement increased to 86.56%. The absolute agreement was 50% both in the LOT and ROT positions and in the OP, LOP, and ROP positions. The composite agreement improved to 75.0% in the second stage of labor, and κ was moderately concordant (0.516). Chan et al. reported absolute agreement between vaginal examination and USG in 30% cases, and κ was fairly concordant (0.32).[15] The composite agreement was 69%, which was significant ($p < 0.05$), and κ was moderately concordant (0.57) in these cases.[15] Sherer et al. reported absolute agreement in 40% of cases ($p = 0.044$), and κ was fairly concordant (0.25) in the second stage of labor.[16] They reported a composite agreement of 68%; however, κ was still fairly concordant (0.30).[16] Their study sample was, however, half that of this study.

Dupuis et al. studied 110 patients and reported 70% absolute agreement between vaginal examination and USG in the second stage of labor, and κ showed good concordance (0.66).[17] The composite agreement was 80%, and κ was 0.74 showing good

concordance.[17] Zara et al. ($n = 34$) reported absolute agreement between vaginal examination and USG in 54% of cases ($\kappa = 0.073$), and the composite agreement was in 80% of cases ($\kappa = 0.728$).[14] Akmal et al. studied 64 patients, reported 73.43% agreement in determining the FHP when digital examination was within ±45° of the USG findings.[3] In this study, the position of the fetal head by vaginal examination significantly correlated with TAS in the anterior positions ($p < 0.0001$), and κ showed moderate concordance (0.606). Digital examinations are reliable for the anterior positions in the second stage of labor. However, DVE failed to detect correct head position in the transverse and posterior positions of the head where the correlation with TAS was only in 50%; hence, ultrasound should be used as an adjunct for confirmation in the OP, occiput transverse, and undermined positions in the second stage of labor.

Correct determination of the fetal head in the second stage of labor is essential, particularly before instrumental delivery.[3] Errors in the assessment of the fetal head may result in deflexed and asynclitic head attitudes and consequent failure of vacuum delivery.[6,18] In this study, 12 (3.58%) women underwent operative vaginal delivery (vacuum- or forceps-assisted delivery). Digital vaginal examination was able to determine correct FHP in 100% observations in the ROT and ROA positions in the second stage of labor before operative vaginal delivery. Digital vaginal examination had agreement with TAS during the second stage of labor in seven (70%) observations in the OA, LOA, and ROA positions. There was no agreement between vaginal examination and sonography in the OP positions ($\kappa = 0.633$).

Akmal et al. study reported that there was 75% agreement in determining the FHP by vaginal examination and USG prior to instrumental delivery, and the accuracy of digital examination was higher in the OA positions (83%) than it is for the occiput transverse and OP positions (54%) as was in our study.[19] Vacuum cup detachment and failure of application is more likely to take place in an occiput lateral or OP position.[19] In this study, there was no case of displacement of cup or failed instrumental delivery. Mola et al. examined the outcome of 59 trials of instrumental deliveries and reported that in the 12 cases in which the trial failed, it was 4.5 times more likely that a deflexing application of the vacuum cup had been performed.[20] Vacca[21] and Kreiser et al.[22] examined the outcome of 244 vacuum extractions and reported that application of the vacuum cup was not correct in about half of the procedures and failure rates increased with the magnitude of incorrect application (4–35%).

The subsequent application of forceps after failed trial of vacuum delivery increases the risk of subdural or cerebral, intraventricular, and subarachnoid hemorrhage by 7.3, 3.5, and 8.2 times, respectively.[23] Therefore, early diagnosis will help the obstetrician to provide women with additional information about the need for operative vaginal delivery. In this study, ultrasound was able to correctly diagnose and facilitate instrumental delivery in the OA and occiput transverse positions. κ showed moderate concordance (0.560).

In this study, DVE failed to determine the FHP in 8.66% observations due to the presence of caput succedaneum in 86.2% and molding in 13.79% observations. In two (0.60%) observations, the FHP remained undetermined by USG; also, these were found to be in one (0.30%) in the LOT position and one (0.30%) in the ROT position during the delivery of the baby. In this study, the position of the fetal head by TAS could not be determined in 3.58% observations due to deeply engaged head and obstructed view by maternal pubic bones on TAS. Dupius et al. have reported in 6.36% cases, the positions of the fetal head were undetermined by DVE, but no data were available about the actual position of the fetal head.[17] Other reference studies have not reported the undetermined positions by DVE and USG. In this study, 96% women chose transabdominal ultrasound as the preferred modality for the FHP assessment because ultrasound is less invasive procedure than DVE, while 4% women had an equivocal response.

Conclusion and Recommendations

Digital vaginal examination can fail to detect the correct FHP due to the presence of tense bag of membranes, caput succedaneum, and molding in active labor. A higher percentage of the occiput transverse and OP positions can be misdiagnosed on vaginal examination. Transabdominal ultrasonography should be used to correctly determine the FHP in such conditions. Transabdominal ultrasonography should be used to confirm the FHP prior to instrumental delivery and cesarean section, which will facilitate correct application and prevent intrapartum complications. It is also a preferred modality of intrapartum assessment by women in labor. However, TAS may be hampered by deeply engaged head and maternal pubic bones. In such situations, transperineal ultrasound can be a useful tool.

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