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Factors Influencing the Accuracy of Digital Examination for Determining Fetal Head Position during the First Stage of Labor

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Abstract

Objective: The objective of this study was to explore factors influencing the accuracy of transvaginal digital examination for determining fetal head position during the first stage of labor.

Materials and Methods: Fetal head position was assessed in 87 women in the first stage of labor at term with normal singleton cephalic presentation. Transvaginal digital examinations were performed by attending midwives and were followed immediately by transabdominal ultrasound assessments performed by a single sonographer. Accuracy was defined as agreement of the results of each examination. Multivariate logistic regression analysis was performed to determine the independent factors influencing accuracy.

Results: In only 40.3% of patients (n = 35) were transvaginal digital examinations consistent with ultrasound assessments. Multivariate logistic regression analysis showed that the accuracy of digital examinations was significantly associated with cervical dilatation more than 7 cm (odds ratio, 3.01; 95% confidence interval [CI], 1.03–9.4), birth weight less than 2,500 g (odds ratio, 8.68; 95% CI, 1.08–86.28), and the anterior occiput position group (odds ratio, 4.73; 95% CI, 1.76–13.49).

Conclusions: The present study demonstrates that transvaginal digital examination is less accurate than ultrasonography for determining fetal head position during the first stage of labor. The results suggest that ultrasound assessments should be routinely performed in patients with a cervical dilatation less than 7 cm, an estimated fetal body weight more than 2,500 g, the occiput posterior position, or the occiput transverse position.

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Key words: fetal head position, first stage of labor, digital examination, ultrasound assessments

Introduction

Intrapartum assessment of fetal head position is essential in the management of labor and is traditionally performed by means of transvaginal digital examination. This evaluation is highly subjective and subject to both interoperator and intraoperator variability, which could affect reproducibility.

Recent studies have demonstrated that the application of intrapartum transabdominal ultrasound is more precise than transvaginal digital examination for determining fetal head position in

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both first and second stages of labor[1–9]. These comparative studies cast doubt on the accuracy of digital examination and found error rates of 23% to 53%. Although several studies[2,5,6,10] have provided evidence for various factors influencing the accuracy of digital examination for determining of fetal head position, there has been no systemic analysis with appropriate statistical methods.

In the present study, we examined factors influencing the accuracy of transvaginal digital examination for determining fetal head position during the first stage of labor.

Materials and Methods

This prospective study was performed in the labor and delivery ward of the Tama Nagayama Hospital of Nippon Medical School in Tokyo. All subjects provided written informed consent for participation in this study, which was approved by the institutional review board.

From December 2006 through April 2007, 87 women with normal singleton, cephalic-presenting fetuses at term in the first stage of labor were prospectively recruited for the study. The gestational age was determined on the basis of the last menstrual period and a reliable menstrual history, and/or an ultrasound examination before 16 weeks' gestation. Both intact and ruptured membranes were included in this study. Exclusion criteria were cervical dilatation less than 3 cm, previous cesarean delivery, and contraindications to vaginal birth. Clinically indicated transvaginal digital examinations were performed by attending midwives (with 1 to 12 years of experience). The classic method of palpation of the sagittal suture and fontanelles and their location in relation to the maternal pelvis was used to determine fetal head position. Head position was classified as occiput anterior (OA), occiput posterior (OP), left or right occiput transverse (LOT or ROT), left or right occiput anterior (LOA or ROA), or left or right occiput posterior (LOP or ROP). All transvaginal digital examinations were performed in the absence of uterine contraction.

Immediately following transvaginal digital examination, transabdominal ultrasound fetal head position assessments were performed by independent single sonographer (Nagase, A) by means of real-time ultrasonography with a 3.5-MHz convex-type transducer (Hitachi-Medico EUB-555; Hitachi, Tokyo, Japan). The ultrasound examination was also performed in the absence of uterine contraction. Fetal head position was determined with a 2-step procedure as described previously[2,4]. The position of the fetal spine was determined at the level of the fetal heart in relation to the maternal abdomen. The position of the fetal occiput was restricted to within 90° clockwise or counterclockwise of the spine position. The transducer followed the spine downwards and was then placed on the pubic symphysis to achieve a transverse view with reference to the maternal anatomy. An attempt was made to demonstrate the fetal cranial contour, cranial midline, and fetal eyes or superciliary arch in the same plane. When demonstrated, other structures (nose, cheeks, ears, thalami, cavum septi pellucidi) could also assist in determining fetal head position. The fetal head position was classified as 1 of the 8 above-mentioned positions. The fetus was considered to be in the occiput transverse position when the anteroposterior diameter of the fetal head was within 45° of transverse. The fetal head position was considered to be either OA or OP, depending on the position of the fetal occiput, if the anteroposterior diameter was within 45° of an anteroposterior position. The same classification was used for the LOA, ROA, LOP, and ROP positions. Both examiners were blinded to each other's findings. Accuracy was defined as agreement of the results of each examination.

All fetal, maternal, and operator factors, such as maternal age at the time of delivery, parity, gestational age, cervical dilatation at examination, mode of delivery, Apgar score at 5 minutes, and experience of attending midwife, were collected from the medical records.

To assess the association between the agreements regarding fetal head position and each of a set of discrete variables, chi square analysis was performed. Independent 2-sample t-tests were used to compare patients divided into 2 groups on the basis of maternal age at delivery, gestational age, birth weight, Apgar score, and the experience of the midwife.

For univariate and multivariate logistic regression analyses maternal age was divided into 3 categories; yonger 30 years, 30 to 34 years, and older 34 years.

Parity was classificated into primiparous or multiparous. Cervical dilatation was divided into 3 categories: less than 5 cm, 5 to 7 cm, and more than 7 cm. Birth weight was divided into 3 categories: less than 2,500 g, 2,500 to 3,500 g, and more than 3,500 g. Similarly, the experience of the attendant midwife was divided into 3 categories: less than 2 years, 2 to 5 years, and more than 5 years. For the purpose of our analysis, the fetal head positions classified into the above-mentioned 8 positions were assembled into the occiput anterior position group, which included OA, LOA, and ROA: the occiput posterior position group, which included OP, LOP, and ROP: and the transverse position group, which included LOT and ROT. Stepwise logistic regression analysis was used to identify independent factors significantly associated with the accuracy of transvaginal digital examination for determining fetal head position. The independent variables initially included in the multivariate logistic model were as follows: maternal age (3 categories), parity (2 categories), cervical dilatation (3 categories), status of membrane (rupture or intact), birth weight (3 categories), experience of the midwife (3 categories), and fetal head position assessed with ultrasound (3 categories). For the final model, all independent variables were selected with a stepwise procedure (JMP version 4. SAS Institute Japan, Tokyo). The level of statistical significance used was a probability value of less than 0.05.

Results

All 87 subjects completed the study. All transabdominal ultrasound assessments were successful and yielded interpretable determination of fetal head position. In only 40.3% of patients (n = 35) were fetal head positions determination with transvaginal digital examination were consistent with those obtained with ultrasonography.

The characteristics of the patients according to the accuracy of fetal head position assessments are shown in **Table 1**. In the cervical dilatation at examination and the fetal head position assessed with ultrasound, there were significant differences between the 2 groups. The birth weights in the agreement group were slightly lower than those in the nonagreement group, but the difference did not reach the level of significance. There was no difference between the 2 groups regarding maternal age, parity, gestational age, status of fetal membranes, delivery mode, Apgar score, and the experience of the attending midwife.

Univariate analysis (**Table 2**) showed that birth weight was significantly associated with the accuracy of assessment. Patients with a birth weight less than 2,500 g had a higher rate of accuracy. A fetal head position in the occiput anterior position group also significantly affected the accuracy of transvaginal digital fetal examination. Maternal age, parity, cervical dilatation, rupture of membrane and the experience of the midwife did not significantly affect the accuracy of transvaginal digital examination in this univariate model.

A multivariate logistic regression model was constructed with maternal-, fetal-, and operator-related factors. The independent variables of the final model, which were selected with a stepwise procedure cervical dilatation, birth weight, and fetal head position. The results of multivariate logistic regression analysis are shown in **Table 3**. The factors significantly associated with the increased accuracy of transvaginal digital examinations include cervical dilatation more than 7 cm (odds ratio, 3.01; 95% confidence interval [CI], 1.03–9.4), birth weight less than 2,500 g (odds ratio, 8.68; 95% CI, 1.08–86.28), and a fetal head position in the occiput anterior group (odds ratio, 4.73; 95% CI, 1.76–13.49).

Discussion

Accurate intrapartum determination of fetal head position is important for the management of both normal and abnormal labor. Recent studies have shown that ultrasonography can help increase the accuracy of fetal head position assessment during labor, as there is a high rate of disagreement between digital examination and ultrasound examination[1–9]. Comparative studies have cast doubt on the accuracy of digital examination and have found error rates of 23% to 53%. In agreement with these findings, our results indicated a high rate of error (59.7%) in fetal head position as determined with transvaginal digital examination versus ultrasound assessment during the first stage of labor.

In prolonged labor, the head of the fetus is subjected to various pressures and undergoes

Table 1 Clinical characteristics of subjects with agreement regarding fetal head positionassessment between ultrasound and digital examinations during the first stage of labor

characteristics	Total n=87	Agreement n=35 (40.3%)	Non-agreement n=52 (59.7%)	Statistical Significance (p)
Maternal age at delivery (y, mean +/− SD)	30.7+/− 6.0	29.4 +/− 5.9	31.5 +/− 5.9	0.104
Parity (No., %)				0.353
Primiparous	51 (58.6%)	16 (31.4%)	35 (68.6%)	
Multiparous	36 (41.4%)	17 (47.2%)	19 (52.8%)	
Gestational age (w, mean +/− SD)	39.4 +/− 1.1	39.4 +/− 1.0	39.4 +/− 1.1	0.998
Cervical dilatation at examination (cm, mean +/− SD)	5.7 +/− 1.7	6.1 +/− 1.7	5.4 +/− 1.7	0.029
Rupture of membrane at examination (No., %)				0.171
Yes	39 (44.8%)	13 (33.3%)	26 (66.7%)	
No	48 (55.2%)	22 (45.9%)	26 (55.1%)	
Delivery mode (No., %)				
Spontaneous	78 (89.7%)	32 (41.0%)	46 (59.0%)	0.905
vacuum	6 (6.9%)	2 (33.3%)	4 (66.7%)	
cesarean section	3 (3.4%)	1 (33.3%)	2 (66.7%)	
Birth weight (g, mean +/− SD)	3,145.1 +/− 402.5	3,060.3 +/− 419.3	3,202.2 +/− 384.4	0.055
Apgar score at 5 minutes (mean +/− SD)	9.3 +/− 0.6	9.3 +/− 0.6	9.4 +/− 0.6	0.446
Experience of midwife (y, mean +/− SD)	4. 1 +/−3.5	3.9 +/− 3.6	4.3 +/− 3.5	0.607
Fatal head position assessed by ultrasound (No., %)				0.001
OA	4 (4.6%)	3 (75%)	1 (25%)	
LOA	18 (20.7%)	11 (61.1%)	7 (38.9%)	
ROA	9 (10.3%)	5 (55.6%)	4 (44.4%)	
OP	3 (3.5%)	0 (0%)	3 (100%)	
LOP	8 (9.2%)	2 (25%)	6 (75%)	
ROP	10 (11.5%)	3 (30%)	7 (70%)	
LOT	22 (25.3%)	7 (31.8%)	15 (68.2%)	
ROT	13 (14.9%)	4 (30.8%)	9 (69.2%)	

OA; occiput anterior, LOA; left occiput anterior, ROA; right occiput anterior, OP; occiput posterior, LOP; left occiput posterior, ROP; right occiput posterior, LOT; left occiput transvcrse, ROT; right occiput transverse.

characteristic changes in shape. Before complete cervical dilatation in prolonged labor, the portion of the fetal scalp immediately over the cervical os may become edematous and form a swelling known as caput succedaneum. If instrumental delivery is considered under these conditions, it is imperative that fetal head position be accurately determined. In our study, the formation of caput succedaneum did not interfere with transabdominal ultrasound assessment of fetal head position. Indeed, Wong et al.[10] have reported that intrapartum transabdominal ultrasound assessment improves the accuracy of vacuum cup placement during vacuum extraction for a prolonged second stage of labor.

Several studies have provided evidence for factors influencing the accuracy of digital examination for determining fetal head position. However, there has been no systemic analysis with appropriate statistical methods. The pioneering studies of Sherer et al.[2,3] have shown discrepancies of at least 45° between of assessments of fetal head position with transvaginal digital examination and transabdominal ultrasound in 53% and 39% of patients in the first[2] and the second[3] stage of labor, respectively. These findings were confirmed by Akimal et al.[4], who reported that intravaginal digital examinations at 3

Table 2 Univariate logistic regression analysis of subjects with agreement regarding fetal head position assessment between ultrasound and digital examinations during the first stage of labor

characteristics	Total n=87	Agreement n=35 (40.3%)	No agreement n=52 (59.7%)	Odds ratio *	95% CI	Statistical significance (p)
Maternal age at delivery (No., %)						
< 30 y	33 (37.9%)	15 (45.5%)	18 (54.5%)	0.94	0.35−2.52	0.908
30−34 y	32 (36.8%)	14 (43.8%)	18 (56.2%)	1		Reference
> 34 y	22 (25.3%)	6 (27.3%)	16 (72.7%)	0.43	0.13−1.33	0.151
Parity (No., %)						
Primiparous	51 (58.6%)	16 (31.4%)	35 (68.6%)	1		Reference
Multiparous	36 (41.4%)	17 (47.2%)	19 (52.8%)	1.51	0.63−3.61	0.353
Cervical dilatation at examination (No., %)						
< 5 cm	28 (32.2%)	9 (32.1%)	19 (67.9%)	0.82	0.27−2.43	0.717
5−7 cm	30 (34.5%)	10 (33.3%)	20 (66.7%)	1		Reference
> 7 cm	29 (33.3%)	16 (55.2%)	13 (44.8%)	2.13	0.76−6.17	0.156
Rupture of membrane at examination (No., %)						
Yes	39 (44.8%)	13 (33.3%)	26 (66.7%)	0.54	0.22−1.29	0.171
No	48 (55.2%)	22 (45.9%)	26 (55.1%)	1		Reference
Birth weight (No., %)						
< 2,500 g	6 (6.9%)	5 (83.3%)	1 (16.7%)	7.96	1.20−156.9	0.049
2,500−3,500 g	70 (80.5%)	26 (37.1%)	44 (62.9%)	1		Reference
> 3,500 g	11 (12.6%)	4 (36.4%)	7 (63.7%)	0.91	0.22−3.31	0.886
Experience of midwife (No., %)						
< 2y	11 (12.6%)	7 (63.6%)	4 (36.4%)	2.86	0.77−11.99	0.123
2−5 y	58 (66.7%)	21 (36.2%)	37 (63.8%)	1		Reference
> 5y	18 (20.7%)	7 (38.9%)	11 (61.1%)	1.04	0.34−3.05	0.942
Fetal head position assessed by ultrasound (No., %)						
anterior position	31 (35.6%)	19 (61.3%)	12 (38.7%)	7.61	2.26−29.5	0.002
posterior position	21 (24.1%)	5 (23.8%)	16 (76.2%)	1		Reference
transverse position	35 (40.2%)	11 (31.4%)	24 (68.6%)	1.65	0.50−6.01	0.422

* Curde Odds ratio

Table 3 Multivariate analysis of agreement regarding fetal head position assessment between ultrasound and digital examinations:
Results of forward stepwise logistic regression analysis

Variable	Odds ratio **	95% CI	p value
Reference category *	1		Reference
Cervical dilatation at examination			
> 7 cm	3.01	1.03−9.40	0.048
Birth weight (g, mean +/− SD)			
< 2,500 g	8.68	1.08−86.28	0.049
Fetal head position assessed by ultrasound			
anterior position	4.73	1.76−13.49	0.003

* The reference category comprises the subjects with cervical dilatation less than 8 cm, birth weight more than 2,500 g, and fetal head psition without occiput anterior position.
** A justed Odds ratio

cm to 10 cm cervical dilatation failed to identify the correct fetal position in 52% of cases. These results suggest that the accuracy of assessment increases with cervical dilation. Souka et al.[6] have also

demonstrated that correct assessment of the fetal head position was possible in only one-third of cases in the first stage and in two-thirds of cases in the second stage but that the assessment was more likely to be incorrect or not possible at all in cases of the OP position. Similar findings were reported by Chou et al.[7], who found that the OP position was not diagnosed with transvaginal digital examination in 30% of cases in the second stage of labor. Our analysis with multivariate logistic regression models confirmed and extended these previous findings. The results clearly demonstrate that the cervical dilatation, birth weight, and fetal head position are independent factors influencing accuracy.

Interestingly, we found in the present study that the experience of the attendant midwife did not significantly affect the accuracy of transvaginal digital examination. This result was consistent with previous studies[2,3]. A recent study has also demonstrated that for a given student, acquiring the ability to determine fetal head position in labor was significantly easier with transabdominal ultrasonography than with transvaginal digital examination[11]. Our results, together with those of previous studies, indicated that clinical experience has little effect on the accuracy of the determination of fetal head position and that transabdominal sonography is likely to further reduce the error rate. Intrapartum ultrasound might therefore, be used as an educational tool to assist physicians and midwives in training.

In summary, our data demonstrate that transvaginal digital examination is less accurate than transabdminal ultrasonography for determining of fetal head position during the first stage of labor. Our results also indicate that the cervical dilatation, birth weight, and fetal head position are independent factors influencing accuracy. The results suggest that ultrasound assessments should be routinely performed in patients with the cervical dilatation less than 7 cm, an estimated fetal body weight more than 2,500 g, the occiput posterior position, or the occiput transverse position.

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