Comparison of Digital Vaginal Examination with Intrapartum Transabdominal Ultrasound to Determine Fetal Head Position: a Local Experience

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Objective: To investigate the accuracy of intrapartum digital vaginal examination in assessing fetal head position during active labour, and to compare accuracy of intrapartum digital vaginal examination for fetal head position between specialist trainee doctors and specialist obstetricians.
Methods: A total of 100 patients at term with normal singleton cephalic-presenting fetuses were recruited. Transabdominal ultrasound examination to determine the position of the fetal head was performed by a trained sonographer, followed immediately by digital vaginal examination by attending specialist trainee doctor or specialist obstetrician. Both examiners were blinded to each other's findings. A total of 112 measurements were generated. Statistical analyses included Chi-square test, Kappa test, and logistic regression analysis. p Values of <0.05 were considered statistically significant.
Results: Digital vaginal examinations were completely consistent with ultrasound assessment in 34 (30%) cases. Assuming that the fetal head position was correct provided it was within ± 45 degrees of the ultrasound assessment, digital examination was accurate in 77 (69%) of cases. The respective rate of agreement between the two assessment methods by specialist trainee doctors versus specialist obstetricians was 67% and 75% (p=0.69). There were no significant associations between accuracy of digital vaginal examination and maternal and labour characteristics.
Conclusions: Fetal head position during active labour determined by digital vaginal examination was accurate in about two-thirds of all cases, with only one-third of cases being in complete agreement with that obtained by ultrasound assessment. There was no statistically significant difference in accuracy of digital vaginal examination by specialist trainees compared with that by specialist obstetricians.
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Introduction

Intrapartum assessment of fetal head position and station is performed by Leopold's manoeuvres followed by transvaginal digital examination[1,2]. The aim is to look for clinical adequacy of the maternal pelvis, cervical position, dilatation, consistency and effacement, and fetal presentation and pelvic (ischial spine) station of the presenting fetal part[3]. Studies on intrapartum ultrasound examinations reported that such clinical assessment is often inaccurate, with clinical examination of the fetal head position being different in 27% to 53% of the cases[4-7].

Accurate assessment of the occipital position during labour is important, especially when operative vaginal delivery is needed, because it is an important determinant of successful and safe use of vacuum and forceps. Placement of the vacuum cup on the flexion point and placement of the forceps blades parallel to the sagittal suture are associated with high success rate and decreased maternal and fetal morbidity[8-10]. Even so, the use of intrapartum ultrasound for determination of fetal head position was not a routine practice in modern obstetrics.

This study aimed to examine the accuracy of digital vaginal assessment of the fetal head position, and also compare the difference in accuracy between specialist trainee doctors and specialist obstetricians.

Methods

At Kwong Wah Hospital, Hong Kong SAR, China, from May 2011 to June 2012, we recruited 100 nulliparous and multiparous women at term (≥37 weeks' gestation) with a singleton pregnancy who were in active labour. Active labour was defined as at least three regular painful

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uterine contractions in 10 minutes and cervical dilatation of ≥3 cm. Women in the second stage with active pushing and prolonged second stage (full cervical dilatation for >1 hour in nulliparous women, >30 minutes in multiparous women) were also included. Women with suspected fetal distress, fetuses with non-cephalic presentation, chorioamnionitis, pre-eclampsia/eclampsia, multiple pregnancies, and previous Caesarean section were not recruited. Informed consent was obtained from all patients at times when they did not have contractions, after approval by our hospital's ethics committee.

A portable 2-dimensional ultrasound machine in the labour ward (MyLab 25; Esaote, Florence, Italy) with frequency of 3.5 MHz was used for all ultrasound examinations in the study. Transabdominal ultrasound was first performed by a trained sonographer with the woman in supine position to determine the fetal head position. Transabdominal ultrasound was used because it is well documented as the gold standard for determination of fetal head position[4-7]. The ultrasound transducer was first placed longitudinally with reference to the abdomen to identify the cervical spine and occipital bone of the fetus, and then transversely, to obtain the position of the spinal column, the midline cerebral echo, and the cerebellum. The landmarks depicting the fetal position were the fetal orbits for occipito-posterior (OP) position, the midline cerebral echo for occipito-transverse (OT) position, and cerebellum or occiput for occipito-anterior (OA) position (Figure 1). The ultrasound findings of fetal occipital position were recorded on a datasheet depicting a circle, like a clock, with 24 divisions, each of 15 degrees (Figure 2).

Immediately after ultrasound examination, digital vaginal examination was randomly performed by either a specialist trainee doctor or specialist obstetrician, after a uterine contraction. The fetal head position was determined by palpation of the sagittal suture and fontanelles, and the

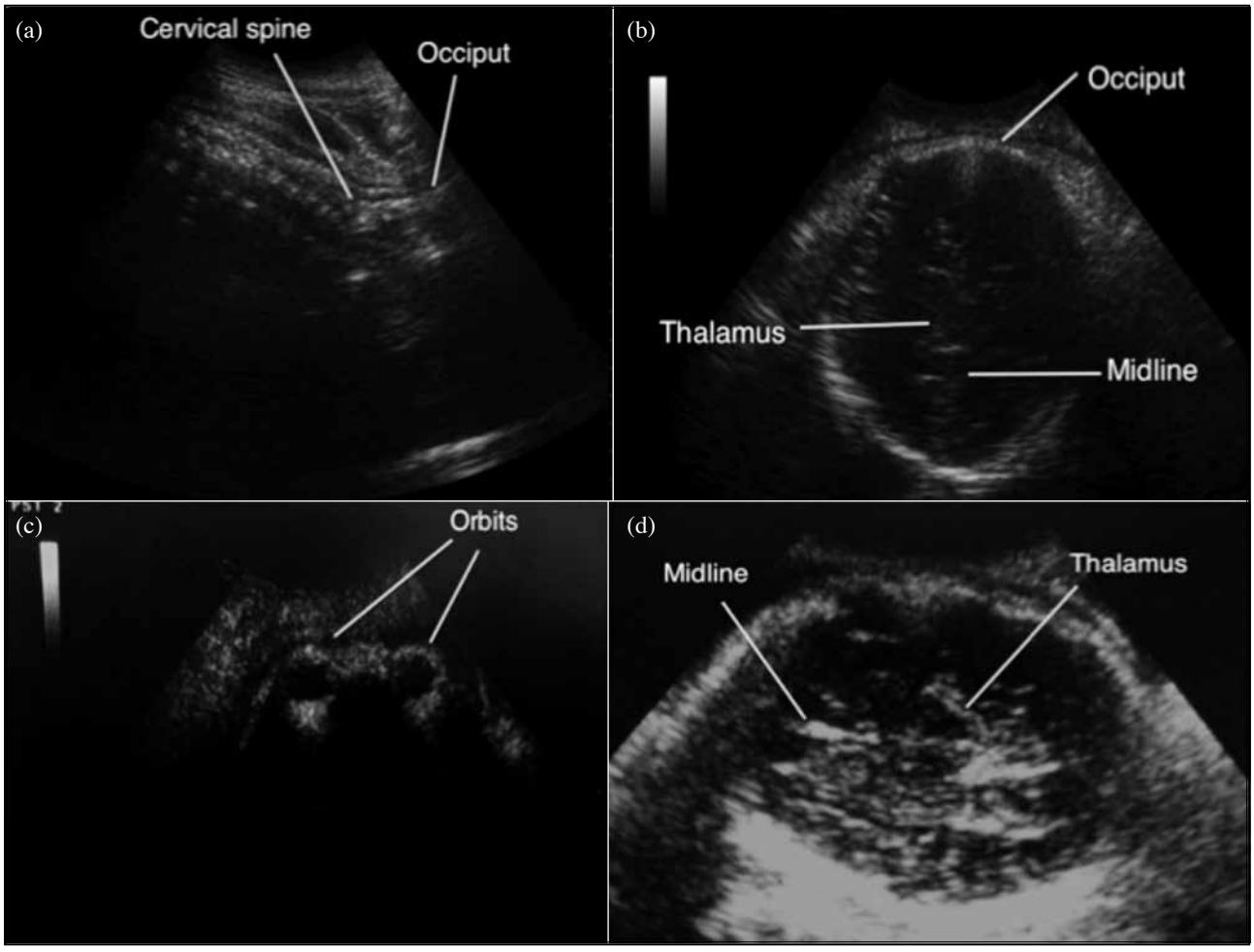

Figure 1. (a) Sagittal view of transabdominal ultrasound in a fetus with occipito-anterior position. (b) Transverse view of transabdominal ultrasound in the same fetus, obtained by turning the probe at 90 degrees. (c) Transverse view of a fetus in occipito-posterior position with both orbits used as landmarks. (d) Transverse view of a fetus in occipito-transverse position with midline cerebral echo, fetal thalami as landmarks

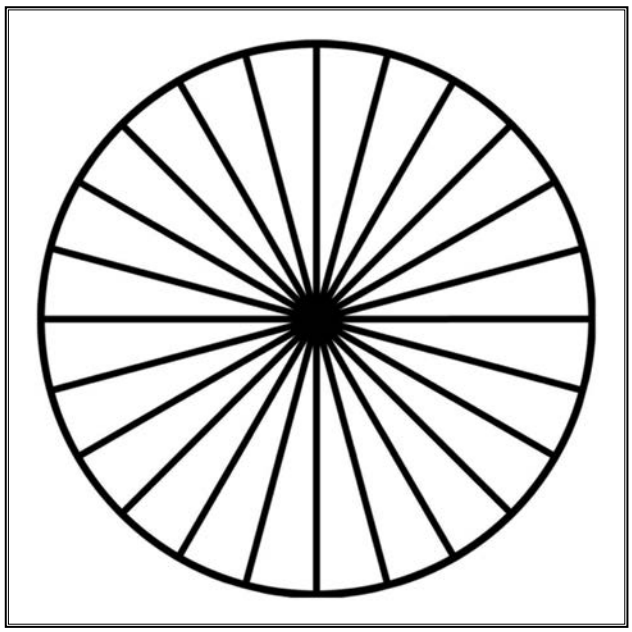

Figure 2. "Clock-face" with 24 divisions (each 15 degrees) used for fetal head position determination

location of these in relation to the maternal pelvis[11]. Both teams were blinded to each other's findings.

Statistical Analysis

Our study is a local pilot study and the sample size was based on that of a study by Sherer et al[4], which had a similar design, as well as primary and secondary outcome measure selection. The degree of agreement between the two examination methods was determined using Kappa test. Logistic regression was used to investigate the association between complete agreement in the fetal occipital position between the two examination methods and maternal and labour characteristics. The continuous numeric variables included maternal age, body mass index, gestational age, birth weight, and cervical dilatation. Presence of caput and presence of moulding were scored as 1 for 'yes' and 0 for 'no'; parity was scored as 1 for multiparous and 0 for nulliparous. Fetal head station at or below the ischial spine was scored as 0, and station +1 or above was scored as 1. Fetal OA was scored as 1 and occipito-lateral or posterior were scored as 2. Trainees were scored as 1 and specialists as 2. Statistical analysis was performed using SPSS version 20 (SPSS Inc., Chicago [IL], US).

Results

A total of 100 women in active labour participated in the study. Their mean (± standard deviation) maternal age was 31 ± 4 years. In all, 86 women were primiparous and 14 were multiparous. Their mean gestational age was 39 ± 1 weeks. Numbers of women recruited (could be repeated) at first stage, second stage and prolonged second stage were 49, 48, and 15, respectively, of which 10 were assessed in two encounters and one was assessed in all three encounters. A total of 112 measurements were generated.

The digital examinations were performed by specialist obstetricians in 18% (n=20) of cases, or by trainee doctors with 1 to 3 years (n=65) or 4 to 6 years (n=27) of experience in obstetrics and gynaecology. The ultrasound-determined fetal head position was OA in 78 (70%), OT in 15 (13%), and OP in 19 (17%) cases. Fetal head position determined by digital vaginal examination was the same as that determined by ultrasound examination in 34 (30%) of cases. Kappa test of concordance indicated a fair concordance of 0.32 (95% confidence interval [CI], 0.21-0.42; $p<0.05$). Assuming that the fetal head position was correct provided it was within ± 45 degrees of the ultrasound assessment, digital examination was accurate in 77 (69%) of cases, with Kappa test of concordance indicating a moderate agreement of 0.57 (95% CI, 0.46-0.67; $p<0.05$). Digital vaginal examination failed to identify the correct fetal head position in 35 (31%) cases, including six cases in which the difference from ultrasound examination was 136 to 180 degrees, two cases with a difference of 91 to 135 degrees, and 27 cases with a difference of 46 to 90 degrees (Table 1).

Table 1. Comparison of accuracy of digital vaginal examination in assessing fetal head position between trainee doctors and specialist obstetricians

Difference between digital vaginal examination and ultrasound examination	Trainees (n=92)	Specialists (n=20)	Trainees + specialists (n=112)
0° (Absolute agreement)	26 (28%)	8 (40%)	34 (30%)
≤45°	36 (39%)	7 (35%)	43 (38%)
46-90°	24 (26%)	3 (15%)	27 (24%)
91-135°	2 (2%)	0	2 (2%)
136-180°	4 (4%)	2 (10%)	6 (5%)

Table 2. Logistic regression analysis on the contribution of independent variables to the accuracy of digital vaginal examination

Variable	Data*	Odds ratio (95% confidence interval)	p Value
Age (years)	32 (19-40)	1.10 (0.96-1.25)	0.16
Body mass index (kg/m^2)	20.3 (15.4-36.7)	0.96 (0.82-1.13)	0.65
Parity		0.54 (0.11-2.60)	0.44
Nulliparous	86		
Multiparous	14		
Gestational age (weeks)	40 (37-41)	1.45 (0.87-2.43)	0.15
Birth weight (kg)	3.3 (2.3-4.4)	1.10 (0.24-4.99)	0.91
Cervical dilatation (cm)	10 (3-10)	0.89 (0.64-1.25)	0.51
Fetal head position	OA: 78 (70) OT+OP: 34 (30)	4.67 (1.61-13.52)	0.004
Fetal head station			
0 or below	35 (31)	2.65 (0.45-15.60)	0.28
1 or above	77 (69)		
Caput			
Yes	74 (66)	0.29 (0.10-0.83)	0.02
No	38 (34)		
Moulding			
Yes	73 (65)	0.79 (0.27-2.31)	0.67
No	39 (35)		
Years of experience			
1-6 (Trainee)	92 (82)	0.69 (0.19-2.45)	0.56
>6 (Specialist)	20 (18)		

Abbreviations: OA = occipito-anterior; OP = occipito-posterior; OT = occipito-transverse

* Data are shown as No. (%) of subjects or median (range)

Table 3. Comparison of characteristics of women who underwent digital vaginal examination by trainees versus specialists*

Characteristic	Trainees (n=92)	Specialists (n=20)
Age (years)	31 (19-40)	32 (24-37)
Body mass index (kg/m^2)	20.3 (15.4-31.3)	20.4 (15.5-36.7)
Parity		
Nulliparous	80 (87)	16 (80)
Multiparous	12 (13)	4 (20)
Gestational age (weeks)	40 (37-41)	39 (37-41)
Cervical dilatation (cm)	10 (3-10)	10 (3-10)
USG (OA)	65 (71)	13 (65)
USG (OT+OP)	27 (29)	7 (35)
Presence of caput	60 (65)	14 (70)
Presence of moulding	59 (64)	14 (70)

Abbreviations: OA = occipito-anterior; OP = occipito-posterior; OT = occipito-transverse; USG = ultrasonography

* Data are shown as No. (%) of subjects or median (range)

Logistic regression analysis revealed that fetal head position and the presence or absence of caput had significant independent contribution in explaining the variance in the accuracy of vaginal examination (Table 2). The odds ratio was 0.29 (95% CI, 0.10-0.83; p=0.02) for the absence of caput, while it was 4.67 (95% CI, 1.61-13.52; p=0.004) for OA fetal head position. The accuracy of digital vaginal examination (within ± 45 degrees of the ultrasound assessment) for specialist trainee doctors versus specialist obstetricians was 67% and 75%, respectively and this difference was not significant (p=0.69). The characteristics of both groups are shown in Table 3. There was no statistically significant difference in accuracy of digital vaginal examination between stage 1 and stage 2 of labour (p=0.31).

Discussion

Our results show that the degree of agreement between fetal head position determined by digital vaginal examination and that by transabdominal ultrasound was within ±45% in around 50% to 70% of patients during the first and second stages of labour; these echo with those from previous studies[4-7]. Although transabdominal ultrasound examination is easy to learn and perform because landmarks such as the fetal orbits, cerebellum, midline echo of the brain, and occiput could be easily identified, a report suggests that exact interobserver agreement only exists in 36.7% of cases[12]. Nevertheless, ultrasound assessment of fetal head position is highly reproducible and accurate as the difference is within 15 degrees in nearly 90% of cases, and within 30 degrees in all cases[12]. It is reasonable to assume a "complete agreement" in fetal head positions determined digitally and sonographically when the difference is within 45 degrees of each other.

Of the 35 (31%) cases in which there was difference of >45 degrees between the two methods of examination, six cases had differences of 136 to 180 degrees. This demonstrates that the examiners had correctly identified the fetal sagittal suture but had incorrectly designated the anterior and posterior fontanelles. The consequence of the incorrect assessment is especially important if instrumental delivery is required, as this could lead to placement of vacuum cups over the wrong flexion point, or underestimation of the difficulty of forceps delivery, especially in a fetus in OP position.

Our study findings suggest that the accuracy of digital vaginal examination is higher with OA fetal head position than OP and lateral positions. This is consistent with the findings by Akmal et al[7]. The accuracy was also increased when caput succedaneum was less. This can be explained by the fact that a large caput succedaneum may prevent differentiation of the various sutures and fontanelles, especially in prolonged labour[11]. It does not impair transabdominal assessment of the fetal head because ultrasound assessment is dependent upon correct identification of midline intracranial structures and/or anterior posterior cranial structures which are not affected by caput succedaneum. While the experience of the examiner was found to be associated with improved accuracy of vaginal examination in one study[7], it was not found to be significant in our study. Nevertheless, our study echoes the findings from previous studies[4] that age, parity, gestational age, cervical dilatation, and birth weight do not affect the accuracy of digital vaginal examination.

In recent years, the use of intrapartum ultrasound has been extended to include transperineal ultrasound for both accurate and reliable assessment of labour progress and outcome[13-20]. Various ultrasound parameters have been described, including head-perineum distance[13,15,20,21], angle of progression[16,17,19,22,23], and recently, head-symphysis distance[24] and pubic arch angle[25]. However, whether or not it is useful to incorporate these ultrasound parameters in the assessment of labour progress remains to be studied.

Intrapartum transabdominal ultrasound assessment of the fetal head position has been shown to be simple and easy to learn, and could overcome the overall high rate of error in fetal head position determination by digital vaginal examination, even in experienced obstetricians. Therefore, ultrasound scanning for the purpose of accurate determination of the fetal head position should be encouraged as part of examination of women in labour, especially before instrumental delivery[7].

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