Original Article

The Comparison of Intrapartum Sonographic Signs and Digital Examination in Fetus with Cephalic Presentation

Rachaya Moonsri, MD[1], Panyu Panburana, MD[1], Sommart Bumrungphuet, MD[1]

[1] Department of Obstetrics and Gynecology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Objective: The agreement of fetal head position examined by digital vaginal examination (DVE) and intrapartum sonographic signs (ISS) in pregnant women during labor.

Materials and Methods: A cross-sectional study was conducted. Two hundred eight-term singleton pregnant women attending labor at Ramathibodi Hospital, Thailand with the fetal cephalic presentation, cervical dilatation of 4 to 8 cm, station –2 or below and no contraindication for DVE were enrolled. The DVE evaluating fetal head position was performed by the third-year obstetrical residents. After DVE, ISS via transabdominal ultrasound for determining fetal head position was obtained immediately by the first researcher. The DVE report and the ultrasonographic images of ISS were recorded separately. The fetal head position based on ISS was designated by the second researcher blinded to the DVE result. The agreement of DVE and ISS for determining fetal head position was analyzed.

Results: Two hundred eight pregnant women were analyzed. The fetal head position detected by DVE was consistent with that of ISS at 41.3% ($p<0.001$). The most percent agreement was observed in the fetus with left occiput anterior position at 72.7% ($p<0.001$). The lowest percent agreement was found in the direct occiput posterior at 14.3% ($p=0.243$). Parity, gestational age, current body mass index, epidural analgesia, cervical effacement, caput succedaneum, molding, and station did not significantly affect the discrepancy between DVE and ISS.

Conclusion: The agreement between DVE and ISS for evaluating the fetal head position was low. The ISS might be considered for evaluating the fetal head position.

Keywords: Fetal head position, Intrapartum sonographic sign, Digital vaginal examination

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The most common malposition is occiput posterior (OP)[1-3] occurring more frequently in the second stage of labor at 30%. Five to twenty percent of OP fetuses persist until delivery[4,5]. The malposition can cause dystocia, instrumental delivery, and cesarean delivery[5]. There are many complications affecting mothers and fetus, such as deep episiotomy wound, postpartum hemorrhage, puerperal infection, prolonged hospitalization, fetal distress[6].

The digital vaginal examination (DVE) assessing the fetal presentation, fetal head position, station, cervical position, dilatation, and consistency is essential in the management of labor. This examination is performed for monitoring the progression of labor and assisting successful instrumental deliveries. The assessment of the fetal head position and station during labor has been traditionally performed by DVE, which is highly subjective and dependent on the operator's experience. Many factors cause an error of DVE such as swelling of the fetal head (caput succedaneum) and change in the shape of the head (molding). A previous study[4] demonstrated that the DVE determining the fetal head position had an error up to 64%. At present, intrapartum transabdominal ultrasound is widely used for assessment of the fetal head position and asynclitism. Moreover, improvement of accuracy in fetal head position determination has been shown[7-9]. The correct determination of fetal head position is crucial before instrumental delivery. An error

Correspondence to:

Bumrungphuet S.

Department of Obstetrics and Gynecology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Phone: +66-2-2011412, **Fax**: +66-2-2011416

Email: sommart.bum@mahidol.ac.th

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in the fetal head position evaluation may result in inappropriate vacuum or forceps placements, which increase the potential for fetal injury and the failure rate of the procedure[10]. However, the previous study suggested that the intrapartum ultrasound for determining fetal head position, station, and attitude should be used as an adjective method and not as a substitute for clinically indicated DVE.

Therefore, the authors studied comparing intrapartum sonographic signs (ISS) and DVE for the assessment of fetal head position in the fetus with cephalic presentation. The DVE was performed by well-trained third-year obstetrical residents having the same level of experiences in labor and delivery care. DVE performed by doctors at the same level of education could limit the variation of DVE results. Intrapartum ultrasound for assessing ISS was performed in pregnant women with active labor at 4 to 8 cm dilated cervix. Any pregnant women with more than 8 cm dilated cervix were excluded.

Materials and Methods

The present cross-sectional study was conducted at Ramathibodi Hospital, Mahidol University, Thailand. The study was approved by the Research Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University. The present study was undertaken between May 2018 and February 2019. The inclusion criteria were singleton term pregnant women with the fetal cephalic presentation in active labor, cervical dilatation of 4 to 8 cm, without contraindications for DVE such as placenta previa or vasa previa. The exclusion criterion was the failure to obtain ISS. The sample size was calculated by one proportion formula based on the previous study[5] considering a data loss of 20%, alpha at 0.05, and power at 80% (β=0.8). The sample size was about 200 participants. Informed consent was obtained at the enrollment. DVE was performed by a third-year obstetrical resident to determine cervical dilatation, effacement, station, fetal head position, asynclitism, and molding. The fetal head position was determined by palpation of the sagittal suture, anterior and posterior fontanel. After the completion of DVE, transabdominal ultrasonography via 1.5 to 5 MHz transducer (GE Voluson® S6 model) was performed immediately to capture the fetal head images by the first researcher. The transducer was placed in the transverse plane at the suprapubic area above pubic symphysis between anterior superior iliac spines as shown in Figure 1. The ISS was the viewing of midline intracranial structure[10] (cavum septum pellucidum, falx cerebri, thalamus, fetal occiput position, and fetal orbits position). The fetal head position was classified into eight positions according to ISS as described in Figure 2.

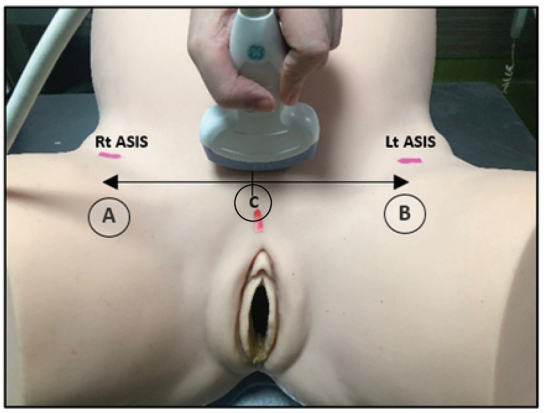

Figure 1. Transabdominal ultrasound probe placement: (A) Right anterior superior iliac spine, (B) Left anterior superior iliac spine, (C) The center of pubic symphysis.

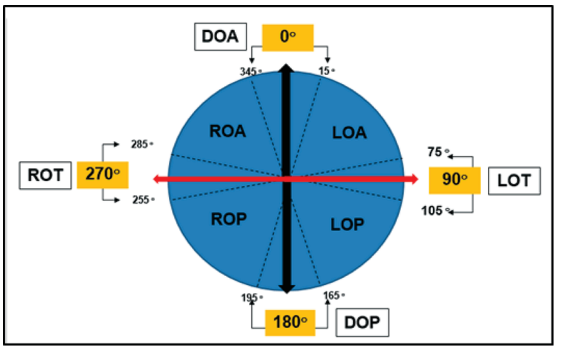

Figure 2. Fetal head position determination by using ISS.

Direct occiput anterior (DOA): The landmarks depicting fetal occiput anterior position is occiput itself and the cervical spine for the occiput-anterior position[11]. Anteroposterior axis in vertical or fetal orbit directed to six o'clock equivalent to 180 degrees.

Left occiput anterior (LOA): The landmarks depicting was occiput itself or cerebral echo, choroid plexus echo and both fetal thalamus echo, which diverged toward the occiput to the left upwards of the pelvis (Figure 3).

Left occiput transverse (LOT): The landmarks depicting was the midline cerebral echo for occiput transverse and choroid plexus, which diverged towards the occiput to the left side of the pelvis (Figure 3).

Right occiput anterior (ROA): The landmarks

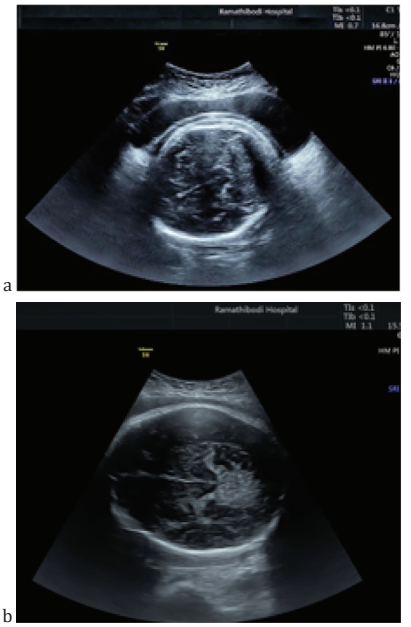

Figure 3. The intrapartum sonographic signs of fetal head: (a) LOA, (b) LOT.

depicting was occiput itself or cerebral echo, choroid plexus echo and both fetal thalamus echo, which diverged toward the occiput to the right upwards of the pelvis (Figure 4).

Right occiput transverse (ROT): The landmarks depicting was the midline cerebral echo for occiput transverse and choroid plexus, which diverged towards the occiput to the right side of the pelvis (Figure 4).

Direct occiput posterior (DOP): The landmark depicting was fetal orbits directed upwards (Figure 5).

Left occiput posterior (LOP): The fetal orbits were directed right upwards or cerebral echo, choroid plexus and both thalamus, which diverged toward the occiput to the left downwards of the pelvis (Figure 6). In sagittal scan, third ventricle and corpus callosum may be seen.

Right occiput posterior (ROP): The fetal orbits were directed left upwards or cerebral echo, choroid plexus, and both thalamus, which diverged toward the occiput to the right downwards of the pelvis. In sagittal scan, third ventricle and corpus callosum may be seen.

Cervical dilatation, effacement, station, fetal head position, asynclitism, and molding obtained by DVE were recorded separately. All ultrasound images were captured to a hard drive. The second researcher, blinded to the DVE result, independently interpreted the fetal head position via ISS (Figure 7). The primary outcome was the agreement of fetal head position

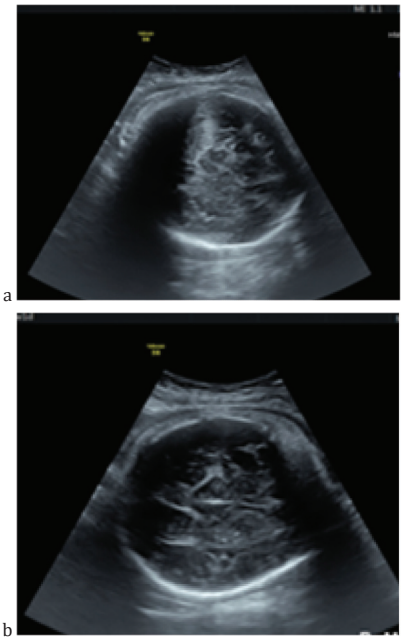

Figure 4. The intrapartum sonographic signs of fetal head: (a) ROA, (b) ROT.

Figure 5. The intrapartum sonographic signs of fetal head in DOP.

obtained by DVE and ISS. The secondary outcome was findings regarding the factors influence on the discrepancy between fetal head position indicated by DVE and ISS.

Statistical analysis

Data were analyzed using PASW Statistics, version 18.0 (SPSS Inc., Chicago, IL, USA). Mean and SD were used for describing the data in continuous fashion. Pearson chi-square, Fisher's exact test were calculated to examine the agreement of fetal head position obtained by DVE and ISS. The p-value of less than 0.05 was considered statistically significant.

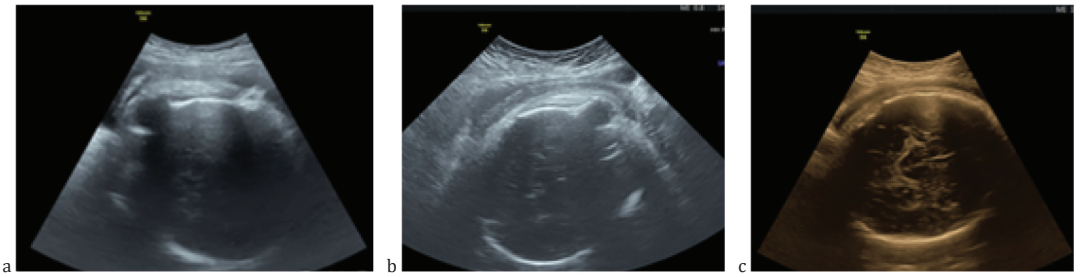

Figure 6. The intrapartum sonographic signs of fetal head: (a) LOP, (b) ROP (orbits landmark), (c) ROP (occiput landmark).

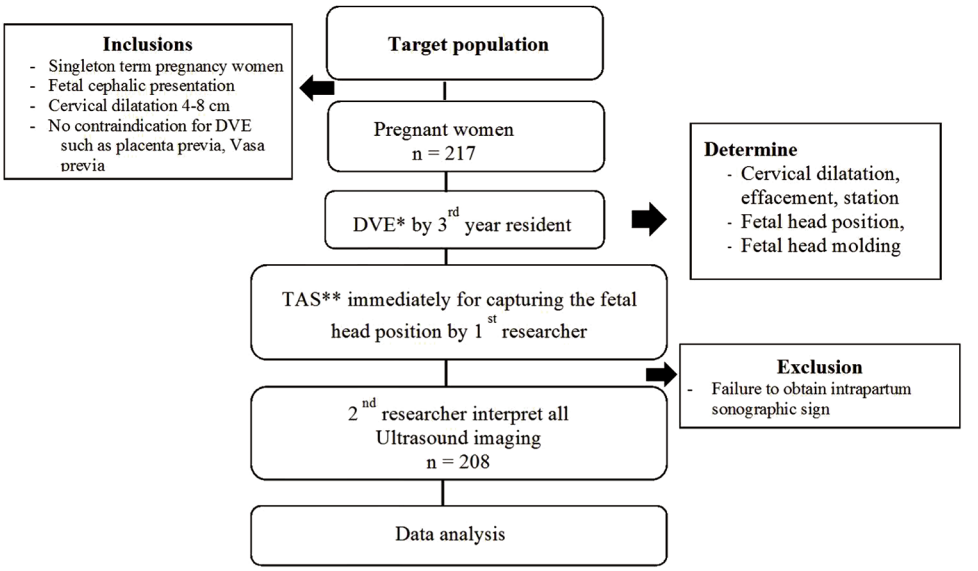

Figure 7. Flow chart.

* Digital vaginal examination, ** Transabdominal ultrasound

Results

Two hundred seventeen pregnant women were included in the present study. Nine women were excluded because the ISS could not be evaluated due to the deep engagement of fetal head. Therefore, 208 participants remained for analyses. The baseline characteristics of participants are demonstrated in Table 1. The mean age was 29.4 years, and the mean gestational age was 39.1 weeks. Fifty-five percent of the participants were nulliparous. DVE results revealed no fetal caput succedaneum at 91.2%, and no fetal head molding at 91.8%. More than half of the participants had station upper than 0 and only 4.3% were anesthetized by epidural anesthesia.

Transabdominal ultrasound detecting ISS was performed immediately after the completion of DVE. ISS was successfully assessed in 208 participants (95.8%). Approximately 60% of the participants showed discrepancy of the fetal head position determination. Only 41.3% of the participants were found concordant for the fetal head position assessed by DVE when compared to ISS. The highest statistical significance agreement was observed in the fetus with LOA position at 72.7% ($p<0.001$). The percentage agreement of fetus in ROA, ROP, LOP, LOT, and ROT position were 66.7% ($p=0.201$), 61.2% ($p=0.001$), 25.0% ($p=0.004$), 22.9% ($p=0.015$), and 22.7% ($p=0.06$), respectively, as described in Table 2. The fetus in the DOP position were the lowest non-significant agreement at 14.3% ($p=0.243$). Unfortunately, no fetus in the DOA position was observed in the present study. Maternal age, parity, body mass index, gestational age, cervical dilatation, effacement, fetal station, caput succedaneum, molding, epidural anesthesia, birth weight, and mode of delivery did not significantly affect the percent

Table 1. Baseline characteristics

Variables	n (%)
Age (year); mean±SD	29.4±5.9
Current BMI (kg/m^2); mean±SD	27.3±4.4
Gestational age (week); mean±SD	39.1±1.1
Parity	
Nulliparous	116 (55.8)
Multiparous	92 (43.3)
Epidural analgesia	
Yes	9 (4.3)
No	199 (95.7)
Cervical dilatation (cm)	
4	53 (25.5)
5	65 (31.3)
6	38 (18.3)
7	32 (15.4)
8	20 (9.6)
Cervical effacement (%)	
≤80	56 (26.9)
>80	152 (73.1)
Station	
≥0	98 (47.1)
<0	110 (52.9)
Caput succedaneum	
Yes	19 (9.1)
No	189 (90.9)
Molding	
Yes	17 (8.2)
No	191 (91.8)
Route of delivery	
Normal labor	148 (71.2)
Operative vaginal delivery	10 (4.8)
Cesarean section	50 (24.0)

SD=standard deviation; BMI=body mass index

agreement of fetal head position assessed by DVE and ISS as shown in Table 3.

Discussion

Fetal head position refers to the relationship between an arbitrarily chosen part of the fetus and its presentation in the right or the left side of the birth canal[12]. The fetal occiput is the determining point in cephalic presentation. The relationship of a given portion of the presenting part to the anterior, transverse, or posterior position of the maternal pelvis is also considered. The accurate intrapartum

Table 2. The percent agreement of fetal head position obtained by DVE compared to ISS categorized by fetal position

Fetal head position	ISS n (%)	DVE Concordance; n (%)	Percent agreement (%)	p-value
LOA	33 (15.9)	24 (72.7)	72.7	<0.001
LOP	56 (26.9)	14 (25.0)	25.0	0.004
LOT	35 (16.8)	8 (22.9)	22.9	0.015
OA	0 (0.0)	0 (0.0)	0.0	N/A
OP	7 (3.4)	1 (14.3)	14.3	0.243
ROA	6 (2.9)	4 (66.7)	66.7	0.201
ROP	49 (23.6)	30 (61.2)	61.2	0.001
ROT	22 (10.6)	5 (22.7)	22.7	0.061
Total	208 (100)	86 (41.3)	41.3	<0.001

ISS=intrapartum sonographic signs; DVE=digital vaginal examination; LOA=left occiput anterior; LOP=left occiput posterior; LOT=left occiput transverse; OA=occiput anterior; OP=occiput posterior; ROA=right occiput anterior; ROP=right occiput posterior; ROT=right occiput transverse; N/A=not available

Table 3. The percent agreement of fetal head position obtained by DVE compared to ISS categorized by maternal characteristics, cervical examination and fetal head findings

Variables	Concordance n (%)	Discordance n (%)	p-value
Parity			0.785
Nulliparous	47 (54.7)	69 (56.6)	
Multiparous	39 (45.3)	53 (43.3)	
Gestational age (week); mean±SD	39.1±1.1	39.1±1.1	0.561
Current BMI (kg/m^2); mean±SD	27.5±3.5	27.3±4.9	0.677
Epidural analgesia			0.739
Yes	3 (3.5)	6 (4.9)	
No	83 (96.5)	116 (95.1)	
Cervical dilatation (cm)			
4	23 (26.7)	30 (24.6)	0.726
5	20 (23.3)	45 (36.9)	0.156
6	21 (24.4)	17 (13.9)	0.054
7	14 (16.3)	18 (14.8)	0.764
8	8 (9.3)	12 (9.8)	0.898
Cervical effacement (%)			0.714
≤80	22 (25.6)	34 (27.9)	
>80	64 (74.4)	88 (72.1)	
Caput succedaneum			0.364
Yes	6 (7.0)	13 (10.7)	
No	80 (93.0)	109 (89.3)	
Molding			0.988
Yes	7 (8.1)	10 (8.2)	
No	79 (91.9)	112 (91.8)	
Station			0.676
<0	44 (51.2)	66 (54.1)	
≥0	42 (48.8)	56 (45.9)	

SD=standard deviation; BMI=body mass index

determination of the fetal head position is considered essential for the management of both normal and abnormal labors. To identify the fetal head position, the DVE is a necessary procedure that all obstetricians are accustomed to it. However, the DVE has a high rate of error even performed by experienced obstetricians that might lead to an incorrect interpretation and mislead the management strategy. Previous studies[13] have shown that the percentage agreement between DVE and ISS in the detection of fetal head position was 81.5% in nulliparous and 90.3% in multiparous groups, while the percentage agreement in the present study was only 41.3% ($p<0.001$). All DVEs in the present study were conducted by third-year obstetrical residents, unlike the previous research where the DVEs were performed by experienced obstetricians. Consequently, the substantial difference in percentage agreement was demonstrated.

The authors recognized a higher percentage agreement between DVE and ISS in the LOA fetuses than in others position. In the fetuses with LOA position, the fetal head position finding by DVE could be determined easily through the palpation of the lambdoid suture, the sagittal suture, and posterior fontanelle. Moreover, most examiners might be aware of LOA position due to the LOA position is the most common position of fetus presenting in laboring women. Interestingly, the ROP fetuses showed a high degree of agreement compared to the fetus in LOP position. In the ROP fetuses, the sagittal suture lies close to the maternal left side allowing easier palpation by sweeping fingers counter-clockwise (internal rotation of right wrist) from posterior part toward sagittal suture anteriorly when compared to the palpation of the sagittal suture in LOP fetus. Besides, the present study described that no factor showed a statistically significant relation to the discrepancy between DVE and ISS results. It might be caused by insufficient sample size in subgroup analysis.

The present study has strengths in several areas. Firstly, the distinct definition of fetal head position noted by ISS was described. Additionally, after the completion of the DVE, the ISS was immediately achieved by transabdominal ultrasound to minimize the error in identification of the fetal head position changed after fetal movement. Moreover, all DVE for the fetal head position was performed by third-year obstetrical residents having the same level of experience in DVE. In addition, the assessment of the fetal head position by ISS was reviewed separately by the second researcher who was blinded to the DVE results to minimize the bias. However, several drawbacks of the present research were considered. The present study was a cross-sectional design so the examiners who performed DVE could not be blinded. Therefore, the examiners might modify their awareness of what was being observed. They might have increased their efforts and attentions while they were performing DVE resulting in positive or negative effect on the DVE results.

Conclusion

The percentage agreement between ISS and DVE performed by third-year obstetrical resident for detecting the fetal head position was low. The fetal head position was incorrectly determined in more than half of the fetuses. The benefit of ISS might be considered in evaluating the fetal head position.

What is already known on this topic?

The assessment of the fetal head position and station during labor has been traditionally performed by DVE, which is highly subjective and dependent on the operator's experience. Many factors can cause an error of DVE. Therefore, intrapartum ultrasound for determining fetal head position should be used as an adjunctive method for evaluating the fetal head position.

What this study adds?

The fetal head position evaluated by third-year obstetrical residents was erroneously determined in more than 50% of the fetuses. The intrapartum ultrasound might be considered for evaluating the fetal head position.

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Conflicts of interest

The authors declare no conflict of interest.

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