Can Intrapartum Ultrasound Assessment of Fetal Spine and Head Position Predict Persistent Occiput Posterior Position at Delivery?

Grace Pui-Yin TANG MBChB, MRCOG
Viola Ying-Tze CHAN MBBS, MRCOG, FHKAM (O&G)
Vivian Kwan-Sin NG MBChB, MRCOG, FHKAM (O&G)
Wai-Lam LAU MBBS, FRCOG, FHKAM (O&G)
Wing-Cheong LEUNG MD, FRCOG, FHKAM (O&G), Cert RCOG (Maternal and Fetal Med)
Department of Obstetrics and Gynaecology, Kwong Wah Hospital, Hong Kong

Objective: To investigate the predictive value of fetal spine and head position in the first and second stages of labour measured by intrapartum ultrasound for persistent occiput posterior position at delivery in Chinese women in Hong Kong.
Methods: This was a prospective cohort study. A total of 100 women with a singleton term pregnancy in cephalic presentation underwent transabdominal ultrasound during the first or second stage of labour to measure fetal spine and head position. Fetal head position at birth was also recorded.
Results: Ninety-four women were included, of whom 35 and 51 were assessed in the first or second stage of labour, respectively, and eight were assessed at both stages. At the first stage, nine out of 43 fetuses were in the occiput posterior position with eight having a posterior spine position; one baby was delivered in the occiput posterior position. At the second stage, nine out of 59 fetuses were in occiput posterior position, with seven having a posterior spine position. Two (28.5%) fetuses with both spine and occiput at posterior position were delivered in that position. As the majority of fetuses with occiput posterior position in the first stage were delivered in a non–occiput posterior position, data obtained at the second stage were used for analysis. The positive predictive value of fetal spine and head position was 25% and 22.2%, respectively, whereas negative predictive value of both positions was 98%.
Conclusions: Fetal spine and head position assessed using ultrasound during the second stage of labour may be helpful in cases of persistent occiput posterior position at delivery and thus allow manoeuvres to be performed to facilitate delivery.
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Introduction

Occiput posterior (OP) position is considered to be a common fetal malposition during labour[1]. It happens in about 15% to 20% of pregnancies in the first stage of labour[2-4]. At delivery, 5% of fetuses remain in the OP position, mainly due to failure of internal rotation or malrotation during descent[2-4].

Delivery in the OP position is associated with increased maternal and neonatal morbidiy[1]. Apart from a higher risk of prolonged labour and chorioamnionitis, the need for oxytocin augmentation, instrumental delivery or Caesarean section is also increased[5]. Third- or fourth-degree perineal tears, and excessive blood loss are also associated with OP deliveries[1]. Poorer Apgar scores, lower umbilical artery pH, higher risk of meconium-stained fluid and meconium aspiration syndrome, birth trauma, and need for neonatal intensive care support are more common among infants born in the OP position[6].

Intrapartum ultrasound may improve the accuracy of detecting fetal head position[7]. Blasi et al[8] demonstrated the accuracy of detecting fetal spine and head position by ultrasound during the second stage of labour. Both fetal spine and head position had a sensitivity of 100%, while specificity of fetal spine position was 99% and specificity of fetal head position being 78%[8]. Gizzo et al[9] investigated the role of fetal spine position detection during labour in predicting OP delivery and associated obstetric complications. Fetal spine position had a sensitivity of 93.7% and specificity of 100% when predicting OP

Correspondence to: Dr Grace Pui-Yin Tang
Email: tpy424@ha.org.hk

delivery[9]. Data of fetal head position were also included and had a sensitivity of 87.5% and a specificity of 86.5%[9].

This study aimed to determine the usefulness of intrapartum ultrasound assessment of fetal spine and head position to predict persistent OP position at delivery in Chinese women in Hong Kong. To the best of our knowledge, no similar local study has been performed in Hong Kong.

Methods

This was a prospective cohort study performed in the labour ward at Kwong Wah Hospital, Hong Kong from May 2011 to June 2012. A portable two-dimensional (2D) ultrasound machine (MyLab 25; Esaote, Florence, Italy) with transabdominal 2D probe was readily available in the labour ward and was used for intrapartum ultrasound in all women.

Women were enrolled when they were in the first or second stage of labour. Term (37-42 weeks of gestation), singleton pregnancies with cephalic presentation were included. Women who were already scheduled for Caesarean section before labour onset, or those with suspected fetal distress were excluded. All participants were informed of the principle and the procedure of the study. Verbal consent for examination was obtained from all of them before ultrasound, after approval by our hospital's ethics committee.

Maternal features and labour characteristics including maternal age, parity, spontaneous or induced labour, mode of delivery, and birth weight were recorded.

Stages of labour were established by labour ward staff. Onset of labour was defined as regular painful uterine contractions with cervical dilatation of ≥3 cm, and second stage of labour started at the time of full cervical dilatation.

The ultrasound examinations were performed by three researchers (two specialist trainees with 4-6 years of experience, and one specialist obstetrician with more than 6 years of experience). A workshop was conducted for all operators with supervision by the most senior operator (the fourth author). Women were in a supine position and the ultrasound transducer was placed longitudinally on the abdomen first to identify the cervical spine and occipital bone of the fetus, then transversely to obtain position of the fetal spine column, fetal cerebral echo, and fetal cerebellum. Other landmarks were also used to determine the fetal head position (fetal orbits for OP position, midline cerebral echo for occiput transverse [OT] position, and midpoint of cerebellum for occiput anterior [OA] position). The position of the fetal spine and occipital bone was recorded on a clock-like chart divided into 24 sections (Figure 1), each of 15 degrees (anterior: 9.30-2.29, left transverse: 2.30-3.29, posterior: 3.30-8.29, right transverse: 8.30-9.29). All images were checked and the findings verified offline by the most senior operator. Fetal head position at birth was also recorded by attending midwives or doctors with the same algorithm. All parties were blinded to each other's findings.

In our analysis, all spine and occiput positions were classified as posterior or non-posterior, the latter including anterior and bilateral transverse positions.

Statistical Analysis

The data were entered into an Excel file (Microsoft, US) by one of the researchers. The data were then analysed by Excel (Microsoft, US). Maternal features, labour characteristics and outcome were summarised using percentages, means, and medians. The sensitivity, specificity, predictive values, and likelihood ratios of intrapartum assessment of fetal spine and head position in predicting persistent OP position at delivery were calculated in 2 x 2 tables. 95% Confidence intervals were calculated by Wilson method and binomial exact (Clopper-Pearson) test. Likelihood test was also done in 2 x 2 tables.

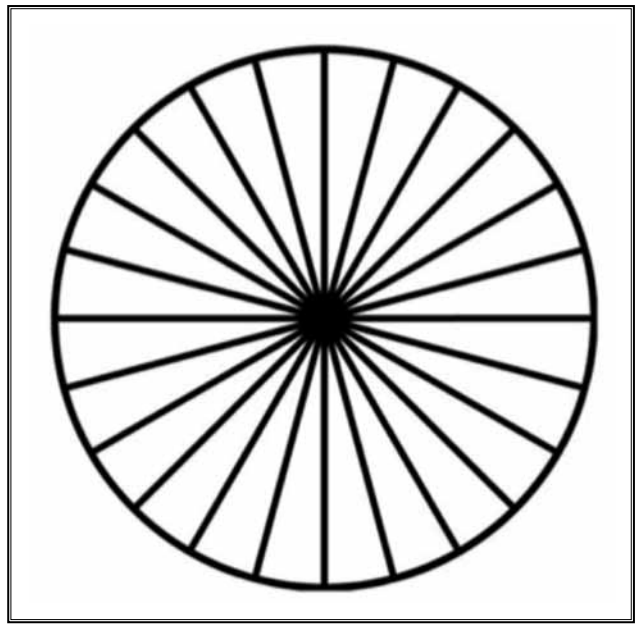

Figure 1. Clock-like chart with 24 divisions (each 15 degrees) used for fetal head and spine position determination

Results

A total of 100 eligible women were recruited. Six women were excluded as they underwent emergency lower segment Caesarean section during the first stage of labour. Ninety-four women were included for analysis: 35 of them were assessed during the first stage of labour, 51 were assessed in second stage, and eight were assessed during both first and second stages (Figure 2).

The maternal features and labour characteristics are summarised in Table 1. The median maternal age was 32 years and the median gestational age at assessment was 40 weeks. The median birth weight was 3.35 kg.

Among the fetuses of 43 women assessed during the first stage of labour, 29 (67.4%) fetuses were in OA position, whereas five (11.6%) in OT position and nine (20.9%) in OP position. Among these nine fetuses in OP position, eight were also in posterior spine position but only one (12.5%) delivered in OP position (Table 2).

When using fetal head position to predict persistent OP position at delivery, sensitivity was 100% and specificity was 80.95%. The positive predictive value (PPV) was 11.11% and negative predictive value (NPV) was 100%. Positive likelihood ratio (LR+) was 5.25 and negative likelihood ratio (LR-) was 0. When predicting persistent OP position at delivery by fetal spine position, sensitivity was 100% and specificity was 83.33%. The PPV was 12.5% and NPV was 100%; LR+ was 6 and LR- was 0.

For the fetuses of 59 women assessed during the second stage of labour, 46 (78.0%) fetuses were in OA position, whereas four (6.8%) in OT position and nine (15.3%) in OP position. Seven of these nine fetuses in OP position were also found to have posterior spine position. Two (28.6%) of these seven fetuses remained in OP position at delivery. One fetus presented with OA position

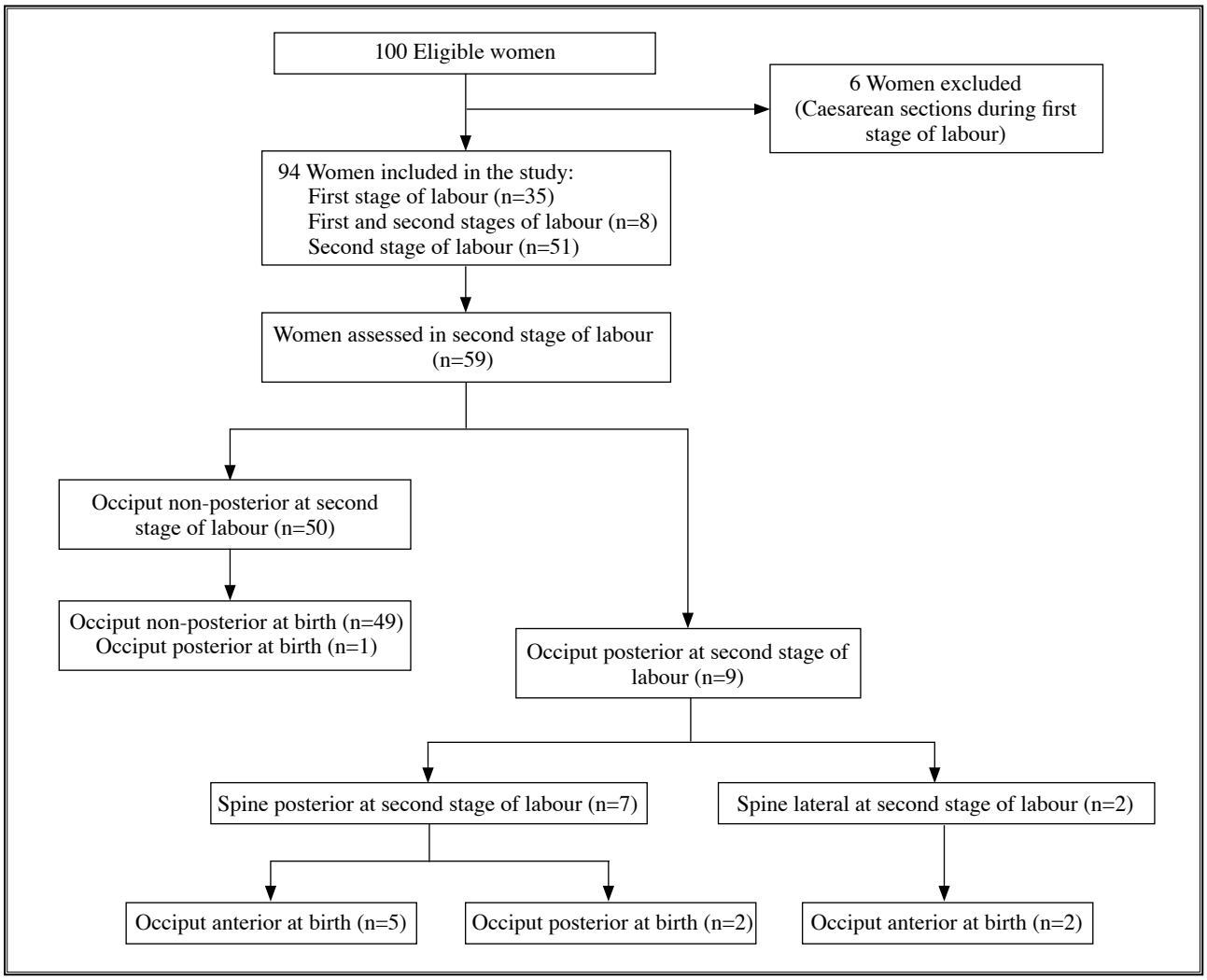

Figure 2. Flowchart showing occiput and spine positions of the patients in the study

Table 1. Maternal features and labour characteristics of the study subjects (n=94)

	No. (%) of women
Maternal age (years)	
<20	1 (1.1)
20-34	82 (87.2)
≥35	11 (11.7)
Parity	
Nulliparous	80 (85.1)
Parous	14 (14.9)
Labour	
Spontaneous	25 (26.6)
Induction	45 (47.9)
Augmentation	24 (25.5)
Mode of delivery	
Spontaneous	74 (78.7)
Vacuum	15 (16.0)
Forceps	1 (1.1)
Caesarean section	4 (4.3)
Birth weight (kg)	
<3	16 (17.0)
3-3.99	74 (78.7)
≥4	4 (4.3)

Table 2. Occiput and spine positions in the first and second stages of labour and at delivery*

Stage of labour	Position		
	Transverse	Anterior	Posterior
First stage (n=43)			
Occiput	5 (11.6)	29 (67.4)	9 (20.9)
Spine	8 (18.6)	27 (62.8)	8 (18.6)
Second stage (n=59)			
Occiput	4 (6.8)	46 (78.0)	9 (15.3)
Spine	9 (15.3)	42 (71.2)	8 (13.6)
At birth (n=94)			
Occiput	3 (3.2)	87 (92.6)	4 (4.3)

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

and transverse spine position in the second stage of labour but delivered in OP position. A total of four infants were born in OP position in our study group (Table 2).

Two of the three fetuses that delivered in OP position were noted to have OP position during ultrasound in the second stage of labour, resulting in a sensitivity of 66.7% for predicting OP position at birth. For 56 infants born in non-OP position, 49 were diagnosed with non-OP position on ultrasound during the second stage of labour, resulting in a specificity of 87.5%. The PPV was 22.2% and NPV was 98%. The LR+ was 5.34 while LR- was 0.38 (Tables 3 and 4).

Similar findings were noted for predicting OP position at delivery by detecting fetal spine position on ultrasound during the second stage of labour. Sensitivity of 66.7% and specificity of 89.3% were found. The PPV was 25% and NPV was 98%, whereas LR+ was 6.23 and LR- being 0.37 (Tables 3 and 4).

Discussion

In this study, the incidence of OP position in the first stage of labour (20.9%) and OP position at delivery (4.3%) was comparable with other studies[2-4].

Although most of our women assessed during the first and second stage of labour belonged to separate groups, we could deduce that the majority of fetuses with OP position during the first stage would change to non-OP position at second stage, and is compatible with previous studies[2-4,10]. After our analysis of data in both stages, we focused the prediction of persistent OP position at birth on the data of second stage only as it was more reliable.

Our results echoed those from previous studies[8,9]. When the fetal head was in OP position at the second stage, only two out of the seven fetuses with co-existing posterior

Table 3. Intrapartum ultrasound evaluation of occiput and spine positions in the second stage of labour in relation to occiput posterior position at delivery*

Ultrasound finding	Occiput position at birth		
	Posterior (n=3)	Non-posterior (n=56)	Total (n=59)
Occiput			
Posterior	2 (3.4)	7 (11.9)	9 (15.3)
Non-posterior	1 (1.7)	49 (83.1)	50 (84.7)
Spine			
Posterior	2 (3.4)	6 (10.2)	8 (13.6)
Non-posterior	1 (1.7)	50 (84.7)	51 (86.4)

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

Table 4. Sensitivity, specificity, PPV, NPV, LR+, LR-, and their 95% CIs for occiput and spine positions in the second stage of labour in predicting occiput posterior position at birth

Characteristic	Occiput position		Spine position	
	Value	95% CI	Value	95% CI
Sensitivity	0.667 (2/3)	0.094-0.992*	0.667 (2/3)	0.094-0.992*
Specificity	0.875 (49/56)	0.764-0.938	0.893 (50/56)	0.785-0.950
PPV	0.222 (2/9)	0.028-0.600*	0.25 (2/8)	0.032-0.651*
NPV	0.98 (49/50)	0.895-0.997	0.98 (50/51)	0.897-0.997
LR+	5.34	1.851-15.371†	6.23	2.069-18.709†
LR-	0.38	0.077-1.893†	0.37	0.075-1.854†

Abbreviations: 95% CI = 95% confidence interval; LR+ = positive likelihood ratio; LR- = negative likelihood ratio; NPV = negative predictive value; PPV = positive predictive value

* Calculated by binomial exact (Clopper-Pearson) test. Others are by Wilson method

† Likelihood test by 2 x 2 table

spine position were delivered in OP position. On the contrary, there was no case of delivery in OP position when the fetal spine was in non-posterior position. Nonetheless, it was uncommon for the fetus to be delivered in OP position when fetal head was in non-OP position.

Both fetal spine and head position had similar sensitivity and specificity. High specificity and NPV could help estimate the probability of persistent OP position at delivery. If fetal spine position is non-posterior, there is a higher chance of delivery in non-OP position.

To the best of our knowledge, this is the first such study of Chinese women in Hong Kong. When compared with the study by Blasi et al[8], our prevalence of OP position was lower and similar to the findings in other studies[2-4]. This might be related to lower epidural analgesia administration in our unit (about 1% from our departmental statistics within the study period)[11] than their study group (32%)[8]. Indeed, there were only two women with epidural analgesia in our group. Epidural analgesia is infrequent in our unit because many women choose other pain relief, e.g. massage, music therapy, birth ball, and opioid analgesics[12]. Also, epidural analgesia may not be always available round the clock due to lack of anaesthetist support, especially outside of office hours[12]. There is already evidence from earlier studies of a higher risk of persistent OP position at delivery when women receive epidural analgesia[10].

The limitations of our study included small sample size of persistent OP position at delivery. Further studies with larger sample size are required for better confirmation of our results. Our study mainly focused on the accuracy of intrapartum ultrasound to predict occiput position at delivery. Other aspects including associated clinical implications of persistent OP position, such as prolonged labour, need for operative vaginal delivery or Caesarean section, or adverse neonatal outcome should be explored in the future.

Prediction of persistent OP position at delivery is important for intrapartum management as it carries risk to both mother and infant[5,6]. Unfortunately, sometimes it is difficult to detect fetal head position accurately during active labour and correct identification by digital vaginal examination happens only in two thirds of women in general[13]. Intrapartum ultrasound can improve the accuracy of identifying those women who may anticipate difficulty in vaginal delivery and may need operative delivery. It may also provide more clinical information when considering manual rotation of the fetal head before delivery[9]. Intrapartum ultrasound is safe and easily accessible in most labour wards in developed areas around the world. The results of our study support the application of intrapartum ultrasound to predict persistent OP position at delivery to reduce maternal and neonatal morbidity and facilitate intrapartum management.

Declaration

All authors have disclosed no conflicts of interest.

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