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Use of intrapartum ultrasound before assisted vaginal delivery in a single hospital in Hong Kong

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Objectives: To investigate the use of intrapartum ultrasound (ITU) under different indications for assisted vaginal delivery, as well as the frequencies of assessment of various ITU parameters, by clinicians in a single hospital.
Methods: Medical records of women who underwent assisted vaginal delivery at Kwong Wah Hospital between 3 January 2023 and 2 January 2024 were retrospectively reviewed. Seven ITU parameters were recorded: spine position, head position, angle of progression (AoP), head-perineum distance (HPD), head direction, asynclitism, and size of caput succedaneum.
Results: In total, 113 assisted vaginal deliveries were included in the analysis, comprising ventouse extraction (n=94), forceps delivery (n=17), and sequential instrumental birth (n=2). There were no failed assisted vaginal deliveries. Of the 113 assisted vaginal deliveries, 70 (61.9%) had prior ITU for indications of prolonged second stage (n=46), fetal distress (n=20), and maternal medical conditions (n=4); the respective ITU use rates were 92.0%, 35.7%, and 57.1% (p<0.001). Among the 70 assisted vaginal deliveries with prior ITU, 29 (41.4%) had all seven sonographic parameters assessed before making the decision for assisted vaginal delivery. In terms of individual ITU parameters, HPD and AoP were assessed in all cases, followed by spine position (92.9%), size of caput succedaneum (80.0%), asynclitism (78.6%), head position (62.9%), and head direction (42.9%). The frequencies of assessment among parameters differed significantly (p<0.001). Asynclitism and size of caput succedaneum were assessed least frequently than head and spine positions, as well as station and descent (as measured by HPD, AoP, or head direction).
Conclusion: The rate of using ITU to assess labour progress prior to assisted vaginal delivery for prolonged second stage was high at our hospital under the opt-out protocol. Sonographic assessment of fetal spine position and head station (via HPD and AoP) was most commonly performed. The opt-out protocol may encourage ITU use, particularly in cases of delayed second stage, while preserving clinicians' independent judgement.

Keywords: Extraction, obstetrical; Labor stage, second; Ultrasonography

Introduction

Use of intrapartum ultrasound (ITU) before assisted vaginal delivery is gaining popularity. The Royal College of Obstetricians and Gynaecologists recommends using ultrasound to define fetal head position when there is uncertainty regarding clinical findings[1], whereas the International Society of Ultrasound in Obstetrics and Gynecology recommends ultrasound assessment of fetal head position and station before considering assisted vaginal delivery[2]. ITU provides a more objective and accurate assessment of labour progress, compared with digital vaginal examination. Ultrasound assessment before assisted vaginal delivery can reduce the incidence of incorrect diagnosis of head position without delaying delivery[3], as well as the incidence of deliveries in unexpected positions and associated neonatal morbidities[4]. Sonographic parameters of head station—such as angle of progression (AoP), head-perineum distance (HPD), and head direction—can predict the likelihood of success or failure of assisted vaginal delivery[5-9]. An algorithmic model incorporating both clinical and sonographic parameters can assist clinicians in deciding between assisted vaginal delivery and second-stage Caesarean section[10].

From the patient's perspective, ITU is better tolerated than digital vaginal examination for assessing labour progress[11-13]. Nevertheless, obstetricians are trained to monitor labour progress using digital vaginal examination, which remains essential in labour care. In a survey of Italian caregivers, ITU was most commonly used to assess fetal occiput position and less frequently for fetal head station and progression[14,15]. At our centre, ITU is highly recommended before making a decision regarding assisted vaginal delivery. In January 2023, an opt-out protocol was introduced, allowing clinicians to choose

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not to perform ITU before assisted vaginal delivery. This study aimed to investigate the use of ITU under different indications for assisted vaginal delivery, as well as the frequencies of assessment of various ITU parameters, by clinicians in a single hospital.

Methods

Medical records of women who underwent assisted vaginal delivery at Kwong Wah Hospital between 3 January 2023 and 2 January 2024 were retrospectively reviewed through the Clinical Data Analysis and Reporting System. Women who had a spontaneous delivery after the obstetrician's decision to allow assisted vaginal delivery were excluded, as were those with intrauterine fetal demise. Prerequisites for assisted vaginal delivery were met in all cases. All trials of assisted vaginal delivery were conducted by either trainees under supervision or obstetricians. The decision not to perform ITU was made jointly by the trainee and supervising obstetrician. A portable two-dimensional ultrasound machine (Samsung Ultrasound System HS50, Korea) was used. Seven ITU parameters were recorded: spine position, head position, AoP, HPD, head direction, asynclitism, and size of caput succedaneum.

Statistical analysis was performed using SPSS (Windows version 29.0; IBM Corp, Armonk [NY], United States). Based on the indication for assisted vaginal delivery, ITU use prior to delivery was analysed in three groups: prolonged second stage, fetal distress, and maternal medical conditions (eg, pre-eclampsia). Comparisons were made using the Chi-squared test or Fisher's exact test. A p value of <0.05 was considered statistically significant.

Results

During the study period, there were 1660 vaginal births and 809 Caesarean births in our obstetric unit. Of these, 113 (4.6% of all deliveries) were assisted vaginal deliveries, comprising ventouse extraction (n=94), forceps delivery (n=17), and sequential instrumental birth (n=2). There were no failed assisted vaginal deliveries. Three women underwent second-stage Caesarean section for cephalopelvic disproportion. Women with and without ITU were comparable in terms of baseline characteristics (Table 1).

Of the 113 assisted vaginal deliveries, 70 (61.9%) had prior ITU for indications of prolonged second stage (n=46), fetal distress (n=20), and maternal medical conditions (n=4); the respective ITU use rates were 92.0%, 35.7%, and 57.1% (p<0.001, Table 2). Among the 43 women who were opted out of ITU by obstetricians, the most common reason was the need for urgent delivery (n=31), whereas the remaining reasons were a busy labour ward (n=1), outlet delivery without perceived need for ultrasound assessment (n=1), maternal loss of consciousness (n=1), and no reason given (n=9).

Table 1. Characteristics of patients.

Characteristic	Intrapartum ultrasound*		p Value
	Performed (n=70)	Not performed (n=43)	
Age, y	33.1±4.7	31.7±4.6	0.12
Parity			0.14
Primigravida	70 (100)	41 (95.3)	
Multipara	0	2 (4.7)	
Pregnancy order			1.00
Singleton	69 (98.6)	42 (97.7)	
Twins (first twins)	1 (1.4)	1 (2.3)	
Pre-pregnancy body mass index, kg/m^2	21.9±3.3	21.6±3.6	0.70
Gestational age at birth, wk	39.4±1.2	39.3±1.5	0.52
Ethnicity			0.67
Chinese	67 (95.7)	40 (93.0)	
Non-Chinese Asian	3 (4.3)	3 (7.0)	
Use of synthetic oxytocin during labour			0.44
Yes	33 (47.1)	24 (55.8)	
No	37 (52.9)	19 (44.2)	
Head position at second stage			0.28
Occiput anterior	57 (81.4)	39 (90.7)	
Non-occiput anterior	13 (18.6)	4 (9.3)	
Head station at second stage			0.12
Mid-cavity	0	1 (2.3)	
Low	68 (97.1)	38 (88.4)	
Outlet	2 (2.9)	4 (9.3)	
Mode of delivery			0.11
Ventouse extraction	62 (88.6)	32 (74.4)	
Forceps	7 (10.0)	10 (23.3)	
Sequential	1 (1.4)	1 (2.3)	

* Data are presented as mean ± standard deviation or No. (%) of patients

Among the 70 assisted vaginal deliveries with prior ITU, 29 (41.4%) had all seven sonographic parameters assessed before making the decision for assisted vaginal delivery (Table 3). Based on the ISUOG Practice

Table 2. Use of intrapartum ultrasound for different indications of assisted vaginal delivery.

	Indication of assisted vaginal delivery			p Value
	Prolonged second stage (n=50)	Fetal distress (n=56)	Maternal medical condition (n=7)	
Intrapartum ultrasound				<0.001
Performed	46 (92.0)	20 (35.7)	4 (57.1)	
Not performed	4 (8.0)	36 (64.3)	3 (42.9)	
Reasons	Not given (n=2), busy labour ward (n=1), outlet delivery (n=1)	Urgent delivery (n=30), not given (n=6)	Urgent delivery (n=1), maternal loss of consciousness (n=1), not given (n=1)	

Table 3. Assessment of intrapartum ultrasound parameters before assisted vaginal delivery.

Variable	All seven parameters assessed (n=29)*	p Value
Indication for assisted vaginal delivery		0.34
Prolonged second stage (n=53)	22 (41.5)	
Fetal distress (n=13)	4 (30.8)	
Maternal medical condition (n=4)	3 (75.0)	
Parameter assessed within three groups based on the ISUOG Practice Guidelines[2]	n=70	<0.001
Head and spine position	65 (92.9)	
Station and descent (as measured by head-perineum distance, angle of progression, and head direction)	70 (100.0)	
Asynclitism and size of caput succedaneum	55 (78.6)	

* Data are presented as No. (%) of patients

Guidelines[2], we classified the ITU parameters into three groups: head and spine position, station and descent (as measured by HPD, AoP, or head direction), and asynclitism and size of caput succedaneum. The latter was assessed less frequently than the other parameters (p<0.001). In terms of individual ITU parameters, HPD and AoP were assessed in all cases, followed by spine position (92.9%), size of caput succedaneum (80.0%), asynclitism (78.6%), head position (62.9%), and head direction (42.9%). The frequencies of assessment among parameters differed significantly (p<0.001).

Discussion

The rates of ITU use before assisted vaginal delivery were 92.0% in cases of prolonged second stage and 35.7% in cases of fetal distress and 57.1% in cases of maternal medical conditions. The time required for ITU is approximately 10 minutes. The interval from decision of ultrasound assessment to delivery is not prolonged, compared with standard care, when ultrasound is used to assess fetal head position[3]. Measurement of HPD and/or AoP during rest and maternal pushing effort is typically completed within one or two uterine contractions. Therefore, ITU should not be considered unreasonable in cases of fetal distress, particularly when preparations for assisted vaginal delivery can be made simultaneously by supporting staff when urgent delivery is required. Clinicians may choose to assess specific ITU parameters based on findings from the vaginal examination to further reduce the ITU duration. Nevertheless, at our hospital, setting up the ultrasound machine in the delivery room may require additional minutes, which may not be preferable in the most urgent cases.

There were no cases of failed assisted vaginal delivery in our study. Failed instrumental delivery could increase the risk of neonatal morbidities, likely owing to delays in delivery and difficulty in delivery of the baby's head during Caesarean section[16]. In cases of high fetal head station in which the clinician is not confident in performing a mid-cavity delivery, ITU can provide objective information regarding labour progress and assist in the decision to attempt assisted vaginal delivery in the labour room or operating theatre, or to proceed directly to second-stage Caesarean section. This information is particularly relevant in cases of non-reassuring fetal status, in which the likelihood of successful assisted vaginal delivery must be carefully assessed to minimise neonatal morbidities.

Our hospital does not mandate the use of all seven ITU parameters, allowing flexibility. When ITU was performed prior to assisted vaginal delivery, head direction

was assessed in 42.9% of cases, whereas HPD and AoP were assessed in all cases. HPD and AoP have been found to predict failure of assisted vaginal delivery[5-9], although no consensus has been reached regarding definitive cut-off values[10]. They provide quantitative measurements and reduce errors during fetal head station assessment in the presence of a large caput succedaneum. Changes in HPD or AoP during maternal pushing also provide an objective estimation of head descent and facilitate communication among care providers. When the fetal head is in occiput posterior (OP) position, AoP increases during descent, whereas HPD remains high until flexion of the head occurs. These findings indicate that HPD and head direction might be more useful for assessing fetuses in OP position[17,18].

Head position was evaluated in 62.9% of cases when ITU was performed, probably because clinical suspicion of OP position is not common in practice. At our hospital, digital vaginal examinations to monitor labour progress are performed by obstetricians rather than midwives. The obstetrician making the decision of assisted vaginal delivery usually has assessed the woman during the first stage and is already aware of the head position. Moreover, OP position at the second stage is relatively uncommon[19]; the obstetrician may be confident confirming the head position by digital examination during the first stage alone, consistent with The Royal College of Obstetricians and Gynaecologists recommendations[1].

When occiput and spine positions are concordant, fetuses are mostly delivered in the same position without rotation, whereas when the occiput is posterior and the spine is anterior, no fetuses are delivered in the OP position[20]. Thus, ultrasound assessment of spine position alone can adequately reassure the OA position during vaginal examination. Spine position also predicts rotation of the fetal head during the delivery process and persistent OP position at delivery, which can guide the direction of traction during ventouse extraction[21]. In our study, spine position was checked in 92.9% of cases when ITU was performed. HPD, AoP, and spine position were most assessed during ITU, consistent with the International Society of Ultrasound in Obstetrics and Gynecology recommendations. In the five cases in which head position and spine position were not assessed, all were delivered in the OA position, consistent with findings from digital vaginal examinations.

Asynclitism is more prevalent in non-OA positions and can be associated with failed ventouse extraction secondary to incorrect vacuum cup placement[22,23]. However, extreme asynclitism is uncommon and usually evident on digital vaginal examination, although palpation of head position might be hindered. Correct cup placement may be aided by ultrasound confirmation of fetal head position. Similarly, the size of the caput succedaneum is conspicuous on digital examination. It is correlated with the duration of vacuum extraction but not with failure of assisted vaginal delivery[24]. When extensive caput succedaneum is present, forceps delivery is preferred over ventouse extraction to reduce cup slippage risk during traction.

Major limitations of our study included its retrospective design and single-centre setting. In our hospital, the frequent use of ITU facilitated the opt-out protocol. Most clinicians were familiar with ITU techniques and interpretation. Thus, our findings might not be generalisable to other hospitals without similar resources and expertise. Additionally, reasons for not performing ITU prior to assisted vaginal delivery were missing in some cases. Furthermore, maternal and neonatal outcomes were not investigated. Finally, we did not record whether clinicians were certain of the head position before performing ITU or proceeding with assisted vaginal delivery. Nonetheless, we examined clinicians' perspectives regarding the use of ITU under different indications before assisted vaginal delivery.

Conclusion

The rate of using ITU to assess labour progress prior to assisted vaginal delivery for prolonged second stage was high at our hospital under the opt-out protocol. Sonographic assessment of fetal spine position and head station (via HPD and AoP) were most commonly assessed. The opt-out protocol may encourage ITU use, particularly in cases of delayed second stage, while preserving clinicians' independent judgement.

Contributors

All authors designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

As an editor of the journal, WLL was not involved in the peer review process. Other authors have no conflict of interest to disclose.

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Data availability

All data generated or analysed during the present study are available from the corresponding author upon reasonable request.

Ethics approval

This study was approved by the Hospital Authority Central Research Ethics Committee (reference: CIRB-2024-581-5). All patients were treated in accordance with the tenets of the Declaration of Helsinki. The patients provided informed consent for all treatments and procedures.

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