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"Strategies to increase the accuracy and safety of OVD" (Clinical assessment skills and role of ultrasound, simulation training and new technologies to enhance instrument application)

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A B S T R A C T

Operative vaginal delivery (OVD) is commonly performed in the UK and Ireland. With skillful practice, the risks to mothers and babies are low. Caesarean section at full dilatation, particularly after failed OVD, can be more hazardous for mothers and babies. It is important to maintain and develop skills in OVD in order to provide it as a safe delivery option when the benefits outweigh the risks. As ultrasound machines have become more readily available on the labour ward, ultrasound assessment has been used to help clinicians diagnose the fetal head position and station, and also to try predict the success of the delivery. Simulation training has successfully been used in the setting of obstetric emergencies and is being developed to teach both technical and communication skills in OVD in order to improve maternal and neonatal outcomes. In this chapter we will discuss strategies to improve the accuracy and safety of OVD in more details.

Introduction

Operative vaginal delivery (OVD) is commonly performed in the UK and Ireland with rates remaining stable at 12–17% over the past decade [1,2]. However, this is not the case worldwide with

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falling rates in OVD and rising rates of caesarean section, particularly at full dilatation [3–7]. Caesarean sections at full dilatation are not without consequences-they have higher rates of maternal morbidity (major haemorrhage, extended hospital stay) and neonatal morbidity (higher rates of admission to the NICU) [8]. While there can also be complications to mothers and babies with OVD, with skillful practice, these risks are low. In fact, increased morbidity at OVD is mainly associated with excessive pulls, sequential use of instruments and caesarean section after a failed instrumental delivery [9]. It is imperative to maintain skilled OVD as a safe delivery option for mothers and babies when the benefits outweigh the risks.

It is important to know and adhere to rules that make OVDs safe. These are covered in the following sections with regards to indication/contra-indication, risk factors for failed OVDs, the importance of instrument placement and clinical assessment. Strategies to improve accuracy and safety of OVD will then be discussed in detail.

Indication

OVD is performed when delivery needs to be expedited and may be indicated for conditions affecting the mother or the fetus or both (Table 1). The commonest indication is inadequate progress in the second stage of labour [10,11]. Other indications, including suspected fetal compromise and maternal conditions such as maternal distress or fatigue, are also common indications for OVD. Less common medical conditions that preclude prolonged maternal effort include maternal cardiac disease, hypertensive crisis, cerebrovascular disease or respiratory compromise [10,11]. Most indications are relative and there may be more than one indication to perform an OVD, for example in cases where there is maternal fatigue with suspected fetal compromise after one hour of pushing. When to intervene is therefore a balance of risks and benefits and will depend on individual clinical circumstances and maternal preferences. [11].

Contraindications

OVD is contraindicated when the cervix is less than ten centimetres dilated and when the fetal head is not deeply engaged (station above the ischial spines and/or more than one fifth of the fetal head

Table 1
Indications and contra-indications for Operative Vaginal Delivery (OVD).

Type	Indication (relative)	Contra-indication (relative)	Instrument-specific contraindication
Inadequate progress	Nulliparous: lack of continuing progress for 3 h[a] with regional anesthesia or 2 h[a] without regional anesthesia Multiparous: lack of continuing progress for 2 h[a] with regional anesthesia or 1 h[a] without regional anesthesia	Suspected cephalo-pelvic disproportion	
Fetal	Presumed fetal compromise	Predisposition to fracture (e.g., osteogenesis imperfecta) Malpresentation (brow, face mento-posterior)	**Vacuum:** Gestation < 34–36 weeks Face presentation Fetal bleeding disorders **Mid-cavity/Rotational forceps:** Fetal bleeding disorders
Maternal	Fatigue/exhaustion Medical conditions that preclude maternal effort, such as cardiac disease, hypertensive crisis, and cerebrovascular disease	Refusal to consent	

[a] Adapted from the Royal College of Obstetrician and Gynaecologists Greentop Guideline No 26 (2005).

palpable abdominally) [11]. It is relatively contraindicated in cases of fetal bleeding disorders (e.g. suspected thrombocytopenia) or a predisposition of the fetus to fracture (e.g. osteogenesis imperfecta). However, in some circumstances, it may be more traumatic for the fetus to be delivered abdominally, for example in advanced labour with the fetal head deep in the pelvis [11]. In cases of blood-borne viral infections such as Hepatitis B/C and HIV, OVD is not contraindicated but as there is an increased risk of fetal abrasion or scalp trauma, it may be best to avoid potentially difficult mid-cavity or rotational procedures [11].

Forceps can be used for some malpresentations such as face presentation in a mento-anterior position or for the after-coming head of a breech [10,11]. In cases of brow or a mento-posterior face presentation, OVD should not be attempted unless the brow can be flexed to a vertex presentation or deflexed to a face presentation and the mento-posterior face presentation requires rotation to mento-anterior which can be achieved manually [10]. These procedures require specialist expertise and are not suitable for novice practitioners.

Vacuum deliveries are contra-indicated for preterm deliveries at gestations of less than 34 completed weeks as there is a risk of cephalhaematoma, intracranial haemorrhage, subgaleal haemorrhage and neonatal jaundice [11]. It has also been suggested that vacuum deliveries should be avoided at less than 36 completed weeks gestation because of the risk of subgaleal and intracranial haemorrhage [12,13]. However, there is insufficient evidence to establish the safety of the vacuum extractor at gestations between 34 and 36 weeks. As a general rule, most obstetricians avoid vacuum delivery at gestations less than 36 completed weeks.

Maternal consent is a prerequisite for instrumental delivery, therefore refusal to consent to instrumental delivery is a contra-indication [11].

Pre-requisites

The pre-requisites for a safe OVD are listed in Table 2 as detailed international guidelines [11,14,15]. A detailed explanation of the procedure including indication, advantages, risks, alternatives and the nature of the procedure should be provided to the woman and her partner in order to obtain informed consent [10,11].

A systematic abdominal and vaginal examination should be performed to establish the size of the fetus; engagement, position, station and attitude of the fetal head, the pelvic dimensions and the

Table 2
Pre-requisites operative vaginal delivery.[a]

Full abdominal and vaginal examination	• Head is no more than 1/5th palpable per abdomen. • Station at spines or below. • Cervix is fully dilated and membranes ruptured. • Diagnosis of the exact fetal head position (to ensure proper placement of instrument). • Assessment of caput and molding (irreducible molding may indicate cephalo-pelvic disproportion). • Pelvis is deemed adequate.
Preparation of mother	• Clear explanation should be given and informed consent obtained. • Appropriate anesthesia. • Maternal bladder should be emptied. In-dwelling catheter should be removed or balloon deflated. • Aseptic technique.
Preparation of staff	• Operator should have knowledge, experience, and necessary skill. • Adequate facilities are available (appropriate equipment, bed, and lighting). • Back-up plan in place in case of failure to deliver. When conducting mid-cavity deliveries, theatre staff should be immediately available to allow a caesarean section to be performed without delay (less than 30 min). A senior obstetrician competent in performing mid-cavity deliveries should be present if a junior trainee is performing the delivery. • Anticipation of complications that may arise (e.g., shoulder dystocia and postpartum haemorrhage). • Training of personnel in neonatal resuscitation.

[a] Adapted from the Royal College of Obstetrician and Gynaecologists Greentop Guideline No 26 (2005) [11].

adequacy of analgesia. Prior to the procedure, the bladder should be emptied by ‘in and out’ catheterisation to reduce the risk of urethral or bladder damage [11]. If an indwelling catheter is in situ, the bulb should be deflated.

The operator should have the appropriate knowledge, skills and experience required [11]. Trainees should be adequately supervised by more senior obstetricians, especially in cases of mid-cavity or rotational deliveries.

Risks factors for failed OVD

The likelihood of failed OVD increases with failure to identify fetal head malpositions (especially the occipito-posterior position) and/or misjudging the fetal size (especially neonatal head circumference >37 cm) or ignoring signs of cephalo-pelvic disproportion [16]. Furthermore, fetal head station and maternal obesity may also contribute to failed OVD [8]. The consequences of failed OVD are sequential use of instruments (the use of vacuum followed by forceps) or second stage caesarean section, which are both associated with increased maternal and neonatal morbidities [16].

Sequential use of instruments is associated with greater maternal morbidity when compared to the use of a single instrument. These include higher risk of anal sphincter tear (third and fourth degree tears), postpartum haemorrhage and urinary incontinence [16,17]. Additionally, sequential use of instruments is associated with greater neonatal morbidity, in particular low umbilical artery pH (<7.1), scalp trauma, intracranial haemorrhage, admission to the neonatal care unit and neonatal death [16–18]. Towner et al. reported an increased risk of intracranial haemorrhage of 1 in 277 births with sequential use of instruments compared to a risk of 1 in 854 with successful vacuum delivery alone [18]. They also reported an increased risk of seizures of 1 in 400 with sequential use of instruments compared to 1 in 854 with successful vacuum delivery alone [18].

Similarly, caesarean sections in the second stage are associated with increased risk of maternal and neonatal morbidity [8]. In particular, caesarean sections after a failed attempt at instrumental delivery can be extremely challenging with impaction of the fetal head and the risk of intra-operative trauma. This includes extension of the uterine incision, bladder and ureteric trauma [8,9,19]. There is also a higher risk of massive obstetric haemorrhage requiring blood transfusion and prolonged hospital stay with these deliveries [5,9]. Furthermore, there is a higher risk of perinatal asphyxia and admissions to the neonatal intensive care unit (NICU) in neonates delivered by caesarean section at full dilatation [8,19]. Towner et al. reported an increased risk of intracranial haemorrhage of 1 in 333 births at caesarean section after failed instrumental delivery compared to a risk of 1 in 854 with successful vacuum delivery [18]. They also reported the risk of seizures in babies delivered by caesarean section after failed instrumental delivery as increased to 1 in 142 births [18].

Importance of instrument placement at OVD

The choice of forceps or vacuum extractor will depend on the clinical circumstances and on the operator's competencies and personal preferences. The placement of the chosen instrument has been shown to be an important factor in the safety of the delivery. Suboptimally applying either a forceps or vacuum has been linked to longer decision to delivery intervals, higher rates of the use of sequential instruments and higher rates of caesarean section following a failed OVD [20]. Asymmetrical application of forceps blade has been suggested as an explanation for the higher incidence of skull fractures with forceps deliveries when compared to spontaneous vaginal births [21]. The factors contributing to suboptimal application of an instrument at OVD are fetal head malposition, midcavity station and the use of forceps as the primary instrument [20].

It is therefore crucial to correctly apply the chosen instrument in order to achieve a safe OVD.

Role of ultrasound prior to OVD

The use of ultrasound on the labour ward is increasing with ready access to portable ultrasound equipment [22].

Fetal head engagement and station

Clinical assessment of the fetal head engagement (abdominally) or station (vaginally) is not always accurate. A prospective study conducted in France investigated the reliability of vaginal assessment of the fetal head station and engagement by 32 residents and 25 attending physicians using a birth simulator and mannequin equipped with a real-time sensor [23]. All 11 stations as described by the ACOG classification were simulated and presented to each clinician in random order and the clinicians were asked to define the station and engagement in each case [23]. The main outcome was the rate of error between the real fetal head station (given by the sensor) and the clinically determined fetal head station. The mean error was 30% (95% CI 25–35%) for residents and was 34% (95% CI 27–41%) for attending physicians, showing that vaginal assessment of head station and engagement is not always reliable [23]. Various ultrasound methods are described in the literature to increase the accuracy of diagnosis of the fetal head station as described below.

Transabdominal ultrasound

A prospective study describes a method with high agreement of 85.6% (95% CI 80.8–90.3%) between ultrasound (gold standard) and vaginal examination to determine fetal head engagement and station [24]. In this study, a line demarcating the pelvic inlet was drawn by placing the ultrasound probe transversely over the suprapubic area and directing it towards the sacral promontory; the BPD was then obtained, and engagement was said to have occurred if the BPD was below this imaginary line. Interestingly, the majority of disagreements occurred with the fetal head at station −1 and no disagreements occurred at station +1 or lower [24].

Translabial ultrasound

Another technique described to assess engagement of the fetal head is intrapartum translabial/transperineal ultrasound (ITU). Henrich et al. evaluated the correlation between head descent evaluated on ITU during active pushing and successful vacuum extraction [25]. They assessed the widest fetal head diameter, fetal head movement (head descent) with respect to the 'infrapubic line' (an imaginary line perpendicular to the long axis of the symphysis pubis extending to the dorsal part of the pelvis) and the head direction with respect to the symphysis [25]. The authors found that objective head descent demonstrated by ITU below the infrapubic line and a 'head up' sign (head pointing ventrally) was a good prognostic factor for successful vacuum extraction (11 out of 20 cases), while no descent was associated with difficult or failed extraction [25].

A prospective study in Australia of 139 women between 35 and 40 weeks gestation assessed the validity and reproducibility of this technique with abdominal and vaginal examinations [26]. On translalabial ultrasound, head engagement was determined by two different methods which essentially measure the distance between the presenting part and the symphysis pubis. In the first method, a line was drawn through the inferoposterior symphyseal margin and the minimal distance between this line and the presenting part was measured; in the second method, a line vertical to the central axis of the symphysis pubis, placed through the symphyseal margin, was drawn and, again, the minimal distance between this line and the presenting part was measured [26]. This study found that fetal head engagement defined by ITU had a strong correlation with clinical assessment [26].

Several other studies have demonstrated that ITU can be used to diagnose station of the fetal head in labour accurately. An Italian study with 60 women in the second stage of labour found that the accuracy of fetal head station diagnosed by ITU was comparable to that of digital examination [27]. Another prospective study, with 50 labouring women, where ITU was used to determine head station, direction and angle of descent mostly in the second stage of labour, found this technique to be simple and reproducible [28].

Fetal head position

The likelihood of failed OVD increases with failure to identify fetal head malpositions especially the occipito-posterior position [16].

Transabdominal ultrasound

The reported accuracy of digital vaginal examination to diagnose the fetal head position ranges from 20% to 75% [29–36]. Ultrasound assessment of the fetal head position has been evaluated in the first and second stages in order to improve diagnosis of the fetal head position. Most studies in the literature use ultrasound as the gold standard with only a handful addressing error rates among novice ultrasonographers. Reported error rates of transabdominal ultrasound within a research setting of 6.8%and 7.9% respectively with another study reporting failure to diagnose the fetal head position in 15% [34,36,37]. Chou et al. reported an error rate of 8% for combined transabdominal and transperineal ultrasound versus 29% error rate for vaginal examination [35].

Interestingly, the authors of a prospective study of a hundred women which set out to evaluate the learning curves of digital examination and transabdominal ultrasound to determine the fetal head position in labour, reported that it was easier to become skilled in ultrasonography than digital examination [37]. Another prospective case series of 52 women in the second stage of labour found that a novice sonographer can acquire the ultrasound skills for accurate determination of the fetal head position quickly and easily. Accuracy of 90% was achieved after twenty consecutive scans and remained high showing that these skills are reproducible when a systematic approach is taken [38]. The scan was performed unobtrusively with little or no discomfort to the patient or inconvenience to the health professionals caring for her [38]. In this study, the method described to diagnose the fetal head position using ultrasound was as follows: with the woman in lying supine or in a left lateral tilt, the ultrasound tranducer is placed transversely over the suprapubic area and moved longitudinally to identify landmarks of the fetal spine and head position [38]. A sagittal view of the fetal spine is first obtained and then a transverse view was obtained by rotating the probe through 90°. Following this, the probe was slided towards the fetal head in order to view midline landmarks of the fetal cranium: midline cerebral echo, falx cerebri and thalamus and/or anterior or posterior cranial structures such as orbits, nuchal region [38]. The fetal head position could thus be classified as OA for direct occipito-anterior, ROA and LOA for right and left occipito-anterior respectively; OP for direct occipito-posterior, ROP and LOP for right and left occipito-posterior; ROT and LOT for right and left occipito-transverse respectively (Figs. 1 and 2).

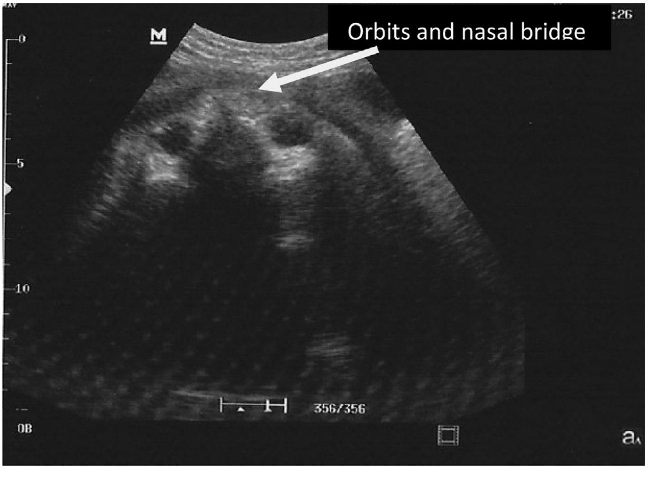

Fig. 1. Ultrasound image depicting the occipito-posterior (OP) position in the second stage of labor.*These images were taken on a portable ultrasound machine in the labor ward prior to OVD during the IDUS RCT and represent realistic intrapartum portable ultrasound images [20].

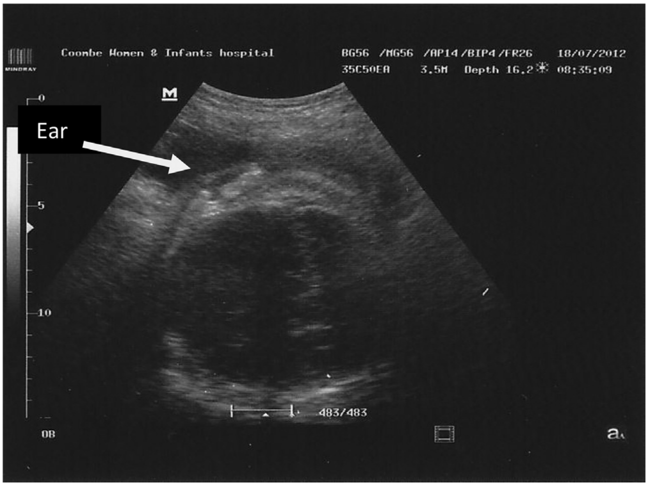

Fig. 2. Ultrasound image depicting the left occiput-transverse (LOT) position with a fetal ear visible anteriorly.*These images were taken on a portable ultrasound machine in the labor ward prior to OVD during the IDUS RCT and represent realistic intrapartum portable ultrasound images [20].

Fetal head position prior to OVD

Using the technique described above, ultrasound assessment prior to OVD can improve the diagnosis of the fetal head position [39]. In a randomised controlled trial of 514 nulliparous women undergoing OVD, those who had an ultrasound assessment in addition to clinical assessment had a of significantly lower incidence of incorrect diagnosis of the fetal head position compared to those who only had a clinical assessment (ultrasound 4/257, 1.6%; clinical assessment 52/257, 20.2%, adjusted odds ratio 0.06, 95% confidence interval (CI) 0.02 to 0.19, Numbers Needed To Treat (NNT) = 5, p value <0.001) [39]. In this study, the ultrasound assessment did not delay the delivery, but enhanced diagnosis of the fetal head position did not impact on maternal or neonatal morbidity, nor were there any differences in instrument choice or mode of delivery [39].

The use of transabdominal ultrasound has also been described to detect fetal head asynclitism and the occipito-transverse (OT) position in labour [40]. Malvasi et al. found ultrasonography superior at detecting both compared to vaginal examination. They reported two signs on ultrasound to diagnose asynclitism in the OT position. The ‘squint sign’ was classified as ‘anterior squint sign’ when the anterior orbit was visualised and when more parietal bone presented anteriorly to the suprapubic bone; and the ‘posterior squint sign’ when the posterior orbit was visualised and the parietal bone presented posteriorly to the suprapubic bone. They also nominated a ‘thalamus or cerebellum sunset sign [40].

Translabial and transvaginal ultrasound

Fuchs et al. first described the use of translabial ultrasound in a case report to diagnose the fetal head position prior to vacuum delivery by identifying fontanelles and suture lines of the fetal skull [41]. Since then, a prospective study was conducted in Italy which found that transabdominal and translabial ultrasound assessment of the fetal head position was better than vaginal examination, particularly in cases of occipito-transverse position [40].

One study compared a combined approach of transvaginal and transabdominal ultrasound assessments to vaginal examination to diagnose fetal head position in 60 women in the second stage of labour [36]. The overall inaccuracy rate of vaginal examination was 22%, but interestingly the authors reported that vaginal examination and transabdominal scan could not define the fetal head position in seven cases (12%) and in nine cases (15%) respectively [36].

Fetal head position to predict mode of delivery

It has been suggested that ultrasound assessment of the fetal head position at the start of labour can predict the mode of delivery. A systematic review looked at whether an ultrasound assessment of the fetal head position prior to, or at the beginning of, active labour can predict the mode of delivery [42]. Eleven cohort and cross-sectional studies were included. They found that ultrasound assessment of the fetal head position was 0.39 (95% CI 0.32–0.48) sensitive and 0.71 (95% CI 0.67 0 0.74) specific for a caesarean delivery. There is therefore as yet no role for routine ultrasonography in this context [42]. Other studies have investigated ultrasound parameters in labour, or a week prior to labour, in order to predict the risk of caesarean section compared to spontaneous vaginal delivery but not for OVD [43–45].

Descent of the fetal head as a predictor for successful OVD

Angle of progression

ITU has been used to measure the 'angle of progression' (angle between the symphysis pubis and the leading part of the fetal skull) during labour which is deemed a more physiological measure of head descent than head station [46]. As the maternal ischial spines are not visible on ultrasound, the angle between the pubic symphysis and the leading part of the fetal skull was measured [46]. Barbera et al. were the first to describe the use of translabial/transperineal ultrasound to define the angle of progression in order to predict mode of delivery [46]. The authors found that during the second stage, an increasing angle of progression was associated with vaginal deliveries, with an angle of 120 being associated with spontaneous vaginal deliveries [46].

A German study of 44 women in labour, with cephalic singleton pregnancies, demonstrated the reliability of ITU for measurement of angle of progression regardless of fetal head station or ultrasound expertise [47]. They compared the measurements obtained by experienced obstetricians to three midwives with no ultrasound experience and three obstetricians with less than five years' experience. In this study, only foetuses in direct occipito-anterior position were included and the angle of progression was quantified by measuring the angle between a line placed through the midline of the pubic symphysis along the pubic ramus and a line running from the inferior apex of the symphysis tangentially to the most anterior part of the fetal skull [47]. The authors found that measuring the angle of progression on translabial/transperineal ultrasound was reliable regardless of the fetal head station or the operator's level of ultrasound experience [47]. Using this measurement technique again, the same group looked at the relationship between fetal head station obtained on open magnetic resonance imaging (MRI) and the angle of progression measured by ITU in 31 women at term before labour [48]. They found a significant correlation between the two methods and suggested, through statistical assumptions, that an angle of 120º corresponded to station + 0 [48]. Kalache et al. also looked at the angle of progression in 41 women at term with failure to progress in the second stage of labour and found a strong relationship between angle of progression of 120° with successful vacuum extraction or spontaneous vaginal delivery [49].

An Italian group evaluated the reproducibility of three-dimensional (3D) transperineal ultrasound to measure head direction, head progression distance and angle, using a novel software (SonoVCAD labour) in 30 women in the second stage of labour [50]. They found that their measurements were reproducible but that this technique was only useful when the fetal head was below station +2 [50]. This greatly limits the practical application of the technique.

Fetal head to perineum distance

ITU has also been used to measure fetal head to perineum distance to determine head descent in labour in order to predict mode of delivery [51]. A total of 110 women were included with singleton cephalic fetuses, in all positions, with prolonged first stage of labour [51]. Each woman had a vaginal assessment of the fetal head station and an ultrasound assessment with two-dimensional (2D) and three-dimensional (3D) transperineal ultrasound; on ultrasound fetal head descent was quantified by measuring the shortest distance from the fetal head to the perineum and the angle between the pubic symphysis and the fetal head (as described by Barbera et al.) [51]. They found that when the fetal head-perineum distance was ≤40 mm, vaginal delivery was achieved in 93% cases of (95% CI 83–97%) and when angle of progression was ≥110º, vaginal delivery was achieved in 87% cases (95% CI 75–93%) with similar results from both 2D and 3D techniques [51].

In summary, although the above studies suggest that there may be a role for evaluating engagement, station and descent of the fetal head with ultrasound in labour, different techniques were used in each study and small numbers of patients were included. Ultrasound is not currently used in routine clinical practice to assess engagement, station and descent of the fetal head and the existing data do not support routine implementation of this approach. However, transabdominal ultrasound assessment prior to OVD helps correctly diagnose fetal head position and is a useful adjunct to clinical examination.

Simulation training and new technologies

Simulation training can provide a safe environment for acquiring technical and communication skills. It has already been shown to improve knowledge, performance and clinical outcomes in obstetric emergencies [52–54]. It is less established in the setting of teaching OVD and is not widely available yet, but it is being developed to increase trainees' competencies and safety in performing OVDs [55,56].

Simulators and mannequins can be used to teach the application of instruments. The *BirthSim* simulator which combines the mechanics of an anatomically correct pelvic model with modelled real-time birthing process also gives computer-generated feedback on a screen to the user [57]. When used to teach forceps delivery, the *BirthSim* simulator allows the trajectory of the forceps application and the subsequent delivery of the infant to be mapped out and its use has been shown to improve trainees's technique of forceps delivery [58].

Furthermore, simulators with computerised visual feedback can be used to teach obstetricians the appropriate force to use at OVD [59]. The maximum traction that could be generated using forceps in a standing and sitting position was evaluated in a descriptive study of 55 trainees. Visual feedback was then used to evaluate whether the trainees could be taught to reproduce an optimum traction range of 30–45 pounds. All trainees were able to easily adapt the force they used at forceps delivery [59].

In the UK, there is currently a structured training programme focused on OVD which uses simulation, realism, team learning and a comprehensive manual on OVDs in order to improve outcomes at OVD [55]. Evaluation of the impact of the course on clinical outcomes is currently under way [55].

Summary

It is important to maintain skilled OVD as a delivery option when the second stage of labour does not go to plan. Ultrasound can be used by obstetricians when there is difficulty or uncertainty in clinical assessment. While this has not been shown to improve outcomes, the additional information that may be obtained, particularly with regards to the fetal head position, may help obstetricians in a complex decision-making setting. Simulation training in OVD, while in its infancy, may also help trainees become familiar with technical and communication skills required for an OVD.

Practice points

- Operative deliveries (OVD and caesarean section) in the second stage of labour are challenging.
- Decision making and skills required for rotational OVDs are complex.
- Ultrasound assessment helps correctly diagnose fetal head position and is a useful adjunct to clinical examination.
- Training packages that include simulation should ideally be undertaken by trainees.

Research agenda

- Enhanced diagnosis of fetal head malpositions has not been shown to influence delivery, maternal and neonatal outcomes – future research should focus on enhancement of skills with regards to mid-cavity rotational instrumental deliveries when a fetal malposition has been identified.
- The effect of simulation training in OVD on maternal and neonatal outcomes should be evaluated.

Conflict of interest

The authors have no conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bpobgyn.2019.01.015.

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