OBSTETRICS

Vacuum extraction is successful in 95% of cases with an occiput posterior position: the results of a prospective, multicenter study

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BACKGROUND: Occiput posterior position is associated with labor arrest, need for operative delivery, and failed instrumental vaginal delivery, with resulting adverse peripartum outcomes. Vacuum extraction is the most commonly performed type of instrumental delivery worldwide.

OBJECTIVE: This study aimed to investigate the outcome of vacuum extraction in fetuses with sonographically confirmed occiput posterior position before the procedure.

STUDY DESIGN: Singleton pregnancies at term with sonographically confirmed fetal occiput posterior position before the vacuum extraction were enrolled in 3 academic maternity units. Fetal head station was assessed using transperineal sonography measuring the angle of progression and the head—perineum distance. The primary outcome was failed vacuum extraction, defined as the need for cesarean delivery. Secondary outcomes included adverse maternal and/or adverse neonatal outcomes and complicated vacuum extraction, with the latter defined as failed vacuum extraction or at least 3 out of the following 6 parameters: 5-minute Apgar score <7, neonatal acidemia, admission to the neonatal intensive care unit, neonatal trauma, postpartum hemorrhage, and obstetrical anal sphincter injuries.

RESULTS: Among the 98 patients included in the study, vacuum extraction was successful in 94 (96%). Logistic regression analysis showed that the measurement of the head—perineum distance was the only factor independently associated with failed vacuum extraction (odds ratio, 1.25; 95% confidence interval, 1.02—1.55; *P*=.03), with an area under the curve of 0.79 (*P*=.04). A head—perineum distance cutoff value of 38.5 mm discriminated between successful and failed vacuum extraction, yielding a sensitivity of 75.0% (3/4), specificity of 84.0% (79/94), positive likelihood ratio of 4.7, and negative likelihood ratio of 0.3.

CONCLUSION: Vacuum extraction is successful in 95% of fetuses with occiput posterior position confirmed at ultrasound. The head—perineum distance measured at transperineal ultrasound has a significant albeit weak association with the outcome of vacuum extraction.

Key words: angle of progression, failed instrumental delivery, head—perineum distance, head station, occiput posterior, second stage of labor, ultrasound in labor, vacuum extraction

Introduction

Persistent occiput posterior (OP) position occurs in approximately 5% of women in the second stage of labor[1] and is a risk factor for labor complications. These complications include a 50% rate of labor arrest during the second stage,[2] an over 60% rate of cesarean or instrumental vaginal delivery,[2] and an almost 20% incidence of obstetrical anal sphincter injuries.[3,4] Persistent OP position is among the strongest risk factors for failed instrumental vaginal delivery[5] and is also associated with increased frequency of neonatal complications, such as a 3% rate of neonatal acidemia,[6] a 10% rate of neonatal morbidity,[6,7] and an 80% higher risk of birth trauma mostly due to failed operative delivery.[7]

Digital vaginal examination is considered the standard of care in the assessment of fetal position in labor. However, clinical examination has demonstrated limited accuracy in diagnosing occiput position, particularly in cases of non—occiput anterior position[8,9] and before performing an instrumental delivery.[10—12]

Intrapartum sonography can be used to assist the assessment of the correct fetal head position and hence support clinical decision-making before considering or performing an operative delivery in the second stage of labor given its objectivity and reliability in the diagnosis of the head position.[10,11] Thus, some international guidelines endorse the use of transabdominal sonography before instrumental delivery to confirm the fetal occiput position in case of uncertainty after vaginal examination.[13,14] Furthermore, the assessment of the fetal head station with transperineal sonography has been shown to be more accurate than clinical evaluation in predicting the outcome of instrumental delivery.[15—17] These latter studies have been conducted on unselected cohorts including all types of fetal position.[15—17] However, to date, there have been no data on the role of intrapartum sonography in predicting the outcome of instrumental vaginal delivery by vacuum extraction (VE) in fetuses with sonographically confirmed OP position. This study aimed to investigate the outcomes of VE in fetuses with sonographically confirmed OP position before the procedure.

Methods

Study design and eligibility criteria

This was a prospective, observational cohort study conducted at 3 academic

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AJOG at a Glance

Why was this study conducted?

This study aimed to investigate the outcome of vacuum extraction in fetuses with occiput posterior position confirmed on ultrasound before the procedure.

Key findings

Vacuum extraction is successful in 95% of fetuses with occiput posterior position confirmed on ultrasound. The head–perineum distance measured by transperineal ultrasound plays a role, albeit modest, in predicting the outcome of vacuum extraction.

What does this add to what is known?

In fetuses with sonographically confirmed occiput posterior position subjected to vacuum extraction, the head–perineum distance, but not the angle of progression, is associated with the outcome of the procedure.

maternity units in Italy (University of Parma and University of Rome Tor Vergata) and Israel (Helen Schneider Hospital for Women at Rabin Medical Center, Petah Tikva, Israel). For study purposes, a nonconsecutive series of singleton pregnancies at ≥37 weeks of gestation with cephalic-presenting fetuses and sonographically confirmed OP position at the time of VE were considered eligible, regardless of the indication for VE. All operative deliveries were performed with the same model of vacuum cup (flexible-stem Kiwi OmniCup, Laborie Medical Technologies Corp., Portsmouth, NH).

Diagnosis of posterior occiput position in transabdominal sonography

Following the confirmation of full cervical dilatation and the decision to expedite delivery by means of VE, the clinician conducting the operative delivery confirmed the OP head position by transabdominal sonography. This was defined as fetal occiput position located between 3.30- and 8.30-o'clock.[13]

Assessment of fetal station with the angle of progression and head–perineum distance

A clinical researcher with experience in intrapartum sonography performed a transperineal scan to evaluate the fetal head station by measuring the angle of progression (AoP) and the head–perineum distance (HPD). These measurements were performed between uterine contractions. The AoP was defined as the angle between the long axis of the symphysis pubis and a line reaching the fetal skull[18] tangentially. The HPD was evaluated using the transverse transperineal approach and measuring the shortest distance between the transducer and the fetal skull, as described by Eggebø et al.[19] The obstetrician conducting the operative delivery was blinded to the AoP and HPD measurements collected by the clinical research team.

Data extraction

The medical history and maternal characteristics were retrieved from patients' clinical records. Maternal prepregnancy body mass index, parity, gestational age at delivery, induction of labor, episiotomy, and postpartum hemorrhage (defined as postpartum cumulative blood loss >1000 mL[20]) were recorded. The following parameters and outcomes were also evaluated in each case: labor length, HPD, and AoP before VE; clinical indication for VE; failed VE; episiotomy; obstetrical anal sphincter injuries; birthweight; Apgar score at 1 minute and 5 minutes; admission to neonatal intensive care unit (NICU); umbilical artery pH and base excess; arterial cord blood acidemia, defined as pH <7.00 or base excess ≥−12; neonatal trauma, which included skull or upper limb fracture and/or cephalohematoma, intracranial hemorrhage, and shoulder dystocia. Shoulder dystocia was defined as the need for additional maneuvers to deliver the anterior shoulder after routine axial traction of the fetal head.[21]

Exclusion criteria

Exclusion criteria for the study were preterm birth, multiple pregnancy, and congenital fetal structural anomalies. Incomplete data sets without HPD and AoP measured before VE were excluded from the study.

End points

The primary outcome of the study was failed VE, defined as cases in which an attempted VE ultimately required a cesarean delivery. Secondary outcomes included adverse maternal and/or neonatal outcomes and complicated VE. The latter was defined as failed VE or the presence of at least 3 of the following: 5-minute Apgar score <7, neonatal acidemia, transfer to the NICU, neonatal trauma, postpartum hemorrhage, and grade 3 to 4 obstetrical anal sphincter injuries, in accordance with the definition proposed by Sultan.[22]

Ethics approval

The study was approved by the local ethics committee of the participating units. Data were recorded and stored in a Microsoft Excel (Microsoft, Redmond, WA) secured, pseudonymized database, which was accessible only by the members of the research team.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics, Version 28 (IBM Corp, Armonk, NY). Data were presented as mean±standard deviation, median (interquartile range), median (range), or number (percentage), as appropriate. Categorical variables were compared using the chi-square or Fisher exact test. Continuous variables were compared using independent samples *t* tests, 2-tailed *t* tests, or the Mann–Whitney U test, as appropriate. Logistic regression analysis was used to control for potential confounding variables, and receiver operating characteristic (ROC) curve analysis was performed to evaluate the area under the

curve for the outcomes of interest of the study. The study was performed following the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.[23]

Results

Demographics and clinical characteristics

From January 2021 to March 2023, 119 women with sonographically confirmed fetal OP position underwent VE at the 3 participating units. Because of missing sonographic data concerning the HPD and AoP, 21 cases were excluded. This resulted in 98 cases with confirmed OP position undergoing VE included in the data analysis (Figure 1). Of these, 62 were recruited at the University of Parma, 16 at the University of Rome Tor Vergata, and 20 at the Helen Schneider Hospital for Women at Rabin Medical Center, Petah Tikva, Israel. At the time of clinical decision to perform a VE, the mean HPD length was 33±8 mm, and the mean AoP width was 133°±16°. The features of the included cases are summarized in Table 1.

Primary outcome

Overall, 4 cases (4.1%) of failed VE were recorded, namely 2 at the University of Parma, 1 at the University of Rome Tor Vergata, and 1 at the Helen Schneider Hospital for Women. Rotation from OP to non-OP position at delivery was recorded in 44 of 94 (46.8%) cases of successful VE.

In 67 out of 98 women (67.3%), an episiotomy was performed, and 3 cases (3.1%) were diagnosed with grade 3 to 4 obstetrical anal sphincter injuries. The median estimated postpartum blood loss was 300 (50−1500) mL, and postpartum hemorrhage was recorded in 14 (14.1%) women. Regarding perinatal outcomes, in 3 neonates (3.1%), the 5-minute Apgar score was ≤7, and 3 of 92 cases (3.3%) had arterial cord blood acidemia as defined by pH <7.00 or base excess >−12. Furthermore, 12 neonates (12.2%) were transferred to the NICU following delivery, whereas shoulder dystocia and neonatal trauma (ie, skull fracture) were recorded in 3 cases (3.1%) and 1 case (1.0%), respectively.

Overall, favorable maternal and neonatal outcomes were recorded in the cases having a failed VE (Table 2), with no difference compared with the cases with successful VE.

Logistic regression analysis showed that only the HPD was independently associated with failed VE (odds ratio [OR], 1.256; 95% confidence interval [CI], 1.019−1.549; *P*=.03). At ROC curve analysis, the area under the curve was 0.794 (95% CI, 0.539−1.000; *P*=.047). A cutoff value of 38.5 mm was found to best discriminate between the cases with successful and failed VE, yielding a sensitivity of 75.0% (95% CI, 19.4−99.4), specificity of 84.0% (95% CI, 75.1−90.8), positive likelihood ratio of 4.7 (95% CI, 2.3−9.8), negative likelihood ratio of 0.3 (95% CI, 0.1−1.6), positive predictive value of 16.7% (95% CI, 3.6−41.4), and negative predictive value of 98.8% (95% CI, 93.2−99.9).

Secondary outcomes

Complicated VE was recorded in 8 (8.2%) cases (Table 3). Logistic regression analysis showed that only the HPD was independently associated with complicated VE (OR, 1.180; 95% CI, 1.038−1.342; *P*=.01). At ROC curve analysis, the area under the curve for complicated VE was 0.642 (95% CI, 0.399−0.884; *P*=.19).

Discussion

Principal findings

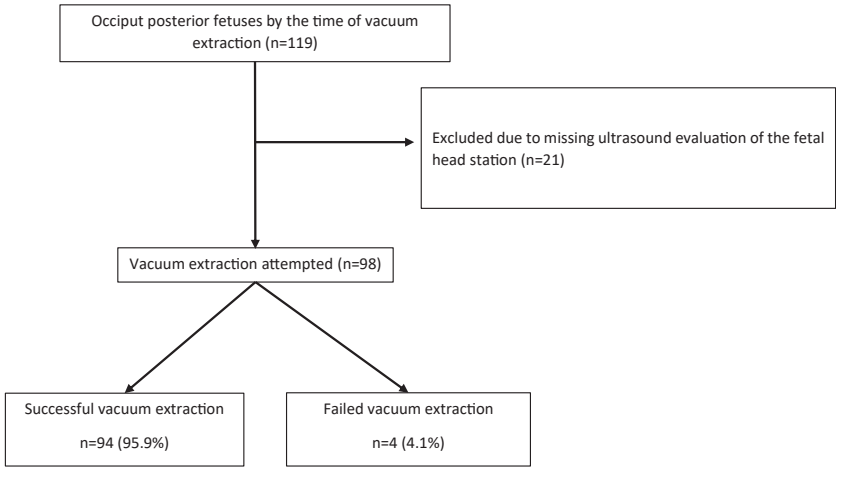
VE is successful in 95% of fetuses with OP position confirmed by ultrasound. Furthermore, the HPD measured by transperineal ultrasound plays a role, albeit modest, in predicting the outcome of VE, whereas AoP has no association with the success of the instrumental delivery.

In practice, using a cutoff value of 38.5 mm, the HPD would identify 3 of the 4 cases of failed VE (sensitivity, 75%). However, it would incorrectly predict failure in 16 cases (specificity, 84%), which is 12 more than the actual number of failed VEs in the study group (n=4).

Results in the context of what is known

Fetal head malposition in the second stage of labor is among the leading causes of arrest of descent.[1,5] Malposition is a common indication for instrumental delivery[5,24] and remains one of the strongest predictors of failed and complicated instrumental delivery.[5,10,11,24] Fetal OP position at birth is associated with a

FIGURE 1
Flowchart of enrollment of fetuses in occiput posterior position delivered by vacuum extraction



Falcone. Vacuum extraction in occiput posterior position is associated with a high success rate. Am J Obstet Gynecol 2024.

TABLE 1
Demographic features and labor outcomes of the included cases

Variable	N
Ethnicity N (%)	White 82 (83.8%) African 8 (8.1%) Asian 8 (8.1%)
Maternal age, y Mean±SD	31.5±5.8
Height, cm Mean±SD	164±5
Nulliparity N (%)	79 (80.6%)
Gestational age, wk^{+d} Mean±SD	$39^{+3}\pm1^{+5}$
Prepregnancy body mass index, kg/m^2 Mean±SD	24.1±4.6
Obesity at conception N (%)	12 (12.2%)
Induction of labor N (%) (data on 79 patients)	35/79 (44.3%)
Epidural N (%)	78 (79.6%)
First stage length, min Median (interquartile range) n=82	475 (295–630)
Second stage length, min Median (interquartile range)	144 (98–180)
Total labor length, min Median (interquartile range) n=82	619 (404–757)
Indication for vacuum extraction N (%)	Dystocia 73 (74.5%) Fetal distress 25 (25.5%)
Head–perineum distance, mm Mean±SD	33±8
Angle of progression, degrees Mean±SD	133±16
Digital station, cm Median (range)	+1 (0 to +4)
Occiput posterior position at delivery N (%)	54 (55.1%)
Estimated blood loss, mL Median (range)	300 (50–1500)
Postpartum hemorrhage N (%)	14 (14.1%)
Episiotomy N (%)	67 (67.3%)
Obstetrical anal sphincter injury N (%)	3 (3.1%)
Vacuum extraction failure N (%)	4 (4.0%)

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higher likelihood of incorrect placement of the vacuum cup or forceps, which is considered to contribute to the increased risk of failed and complicated instrumental vaginal delivery.[25] Notably, in the existing literature reporting on the outcomes of instrumental vaginal delivery, the fetal position is assessed clinically rather than sonographically before the procedure.[7,26,27] This is a major limitation given that observational[8,9] and randomized trials[10,11] have demonstrated that vaginal digital examinations are often incorrect (from 12% to 50% of the cases) and less accurate than transabdominal sonography in diagnosing OP before performing an instrumental delivery. Knowledge of the actual fetal occiput position is considered a prerequisite for a safe instrumental delivery in all clinical guidelines.[1,4,28] Sonographic assessment of the fetal head position before performing a VE is associated with improved diagnosis of head position and hence optimized cup placement over the flexion point.[29]

In our study of cases with sonographically confirmed OP position before VE, the rate of failed VE and peripartum complications was low and consistent with the rates of failed instrumental delivery reported by studies including all types of fetal occiput position.[5,10,29–33]

Our current study was not designed to reliably predict whether intrapartum ultrasound confirmation of fetal OP position before starting VE is associated with a higher VE success rate. However, given that OP position in labor was an entry criterion for our study, we speculate that the low failure rate of VE in our study may be influenced by the fact that the obstetrician conducting the instrumental delivery was aware of the OP position before performing the procedure.

A recent retrospective study with propensity score matching showed reduced composite neonatal morbidity following the implementation of a safety bundle for instrumental vaginal delivery. This bundle included recommending routine intrapartum ultrasound to confirm fetal head position and a routine team time-out and structured procedural checklist for all operative vaginal

TABLE 1
Demographic features and labor outcomes of the included cases *(continued)*

Variable	N
Birthweight, g Mean±SD	3343±535
1-min Apgar score Median (range)	9 (2–9)
5-min Apgar score Median (range)	9 (7–10)
Arterial pH Median (range) n=92	7.23 (7.00–7.42)
Arterial base excess, mmol/L Median (range) n=92	−4.7 (−1.0 to −25.1)
Neonatal acidemia[a] N (%) n=92	3 (3.3%)
5-min Apgar score ≤7 N (%)	3 (3.1%)
Neonatal intensive care unit admission N (%)	12 (12.2%)
Shoulder dystocia N (%)	3 (3.1%)
Neonatal trauma N (%)	1 (1.0%)

[a] Neonatal acidemia defined as pH ≤7.00 or base excess ≥−12 mmol/L.

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deliveries.[34] Conversely, one previous sonographic study in which the operator was blinded to the sonographic position of the fetal head reported an over 20% rate of failed VE in OP fetuses.[35]

Previous data have shown that transperineal sonography is reproducible in assessing the fetal head station[36,37] and more valuable than clinical examination in predicting the success of instrumental delivery.[38–40] In these studies, which included mixed populations of fetuses in occiput anterior (OA) and non-OA positions, the degree of descent of the station of the presenting part was mostly assessed by measuring the HPD[17,40,41] or the AoP,[17,39] or by evaluating the direction of the fetal head relative to the maternal pubis.[15] Specifically, an HPD <35 mm,[17] an AoP >145.5°,[39] and an upward direction of the fetal head,[15] as evaluated by transperineal sonography, have been reported to be associated with a higher likelihood of successful instrumental delivery. According to the findings of this study, the HPD has a small but significant correlation with the outcome of VE, whereas the AoP has no correlation with the success of the operation. Our findings suggest that sonographic predictors of failed VE may differ between fetuses presenting in OA and OP positions.

This might be explained by observations from serial intrapartum transperineal ultrasound during the second stage of labor, which indicate that the fetal head follows a different direction of descent into the birth canal depending on its position (OP vs OA).[41,42] At midcavity, while in OA position, the fetal head has a horizontal or upward direction (ie, toward the pubis); in fetuses in OP position, the fetal head has a downward orientation (ie, toward the sacrum). On transperineal sonography, the downward direction of the fetal head in fetuses in OP position leads to a larger measurable HPD compared with fetuses in OA position. Notably, AoP measurements are much more similar between OP- and OA-presenting fetuses.

Indeed, the measured width of the AoP is not only influenced by the actual level of the head in the birth canal but also by the direction of the descending head into the birth canal (upward in OA vs downward in OP position). Therefore, cases with similar width of the AoP may exhibit different HPD values, determined by whether the occiput position is anterior (ie, upward direction of descent and shorter HPD) or posterior (ie, downward direction of descent and longer HPD) (Figure 2). This may explain why in our series of fetuses in OP position, the HPD but not the AoP was weakly correlated with the outcome of VE. The HPD primarily reflects the actual distance of the fetal occiput (ie, the actual fetal head station) from the perineum at the outlet of the birth canal.

A longer HPD may also hinder the correct placement of the vacuum cup on the flexion point,[25] contributing to the higher incidence of failed instrumental vaginal delivery in fetuses with persistent OP position at midcavity. For fetuses in OP position, the head must complete a flexion movement at the level of the lower edge of the pubis to progress from the midcavity to the low cavity. When this occurs successfully, the direction of the fetal head in the birth canal turns from downward to upward, which leads to a shorter HPD. This is expected to make the flexion point closer to the perineum and offers the operator an easier access for optimal cup placement and a less difficult extraction of the fetal head. Studies with stronger statistical power are needed to investigate whether the use of transperineal ultrasound in labor is valuable in predicting the outcome of VE in OP-presenting fetuses. Future research should focus on identifying optimal cutoff values for HPD and AoP and determining which cutoffs are associated with higher VE success rates in both OP- and non-OP-presenting fetuses.

Our data also show favorable neonatal outcomes in terms of Apgar score at 5 minutes and blood gas analysis, and a frequency of shoulder dystocia

TABLE 2
Comparison of demographic features and labor outcomes between cases with successful and those with failed instrumental delivery by vacuum extraction

Parameter	Successful vacuum extraction N=94	Failed vacuum extraction N=4	*P* value
Ethnicity N (%)	White 78 (83.0%) African 8 (8.5%) Asian 8 (8.5%)	White 4 (100%) African 0 (0%) Asian 0 (0%)	.67
Maternal age, y Mean±SD	31.3±5.3	33.5±3.3	.42
Height, cm Mean±SD	162±6	158±2	.21
Prepregnancy body mass index, kg/m^2 Mean±SD	24.3±4.3	28.2±2.9	.12
Obesity at conception N (%)	10 (10.6%)	2 (50%)	.02
Nulliparity N (%)	77 (81.9%)	2 (50.0%)	.11
Gestational age, wk^{+d} Mean±SD	$39^{+5}\pm1^{+3}$	$40^{+6}\pm0^{+4}$	.08
Induction of labor N (%) (data on 79 patients)	34/77 (44.2%)	1/2 (50.0%)	.87
Epidural N (%)	74 (78.7%)	4 (100%)	.30
First stage length, min Median (interquartile range) (data on 82 patients)	475 (289–630)	570 (420–720)	.44
Second stage length, min Median (interquartile range)	140 (98–180)	161 (59–206)	.75
Total labor length, min Median (interquartile range) (data on 82 patients)	619 (402–761)	663 (580–745)	.78
Indication for vacuum extraction N (%)	Dystocia 70 (74.5%) Fetal distress 24 (25.5%)	Dystocia 3 (75.0%) Fetal distress 1 (25.0%)	.98
Head–perineum distance, mm Mean±SD	33±8	47±15	<.01
Angle of progression, degrees Mean±SD	140±15	130±23	.22
Digital station, cm Median (range)	+1 (0 to +4)	+1 (0 to +2)	.41
Occiput posterior position at delivery N (%)	50 (53.2%)	4 (100.0%)	.07
Postpartum hemorrhage N (%)	14 (14.9%)	0 (0.0%)	.40
Episiotomy N (%)	66 (70.2%)	0 (0.0%)	<.01
Obstetrical anal sphincter injury N (%)	3 (3.2%)	0 (0.0%)	.72
Birthweight, g Mean±SD	3332±470	3710±531	.12

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TABLE 2
Comparison of demographic features and labor outcomes between cases with successful and those with failed instrumental delivery by vacuum extraction *(continued)*

Parameter	Successful vacuum extraction N=94	Failed vacuum extraction N=4	*P* value
1-min Apgar score Median (range)	9 (1–9)	9 (7–9)	.56
5-min Apgar score Median (range)	10 (3–10)	10 (8–10)	.55
Neonatal acidemia[a] N (%) n=92	3/88 (3.4%)	0/4 (0.0%)	.68
5-min Apgar score <7 N (%)	3 (3.2%)	0 (0.0%)	.72
Neonatal intensive care unit admission N (%)	11 (11.7%)	1 (25.0%)	.43
Shoulder dystocia N (%)	3 (3.2%)	0 (0.0%)	.72
Neonatal trauma N (%)	1 (1.1%)	0 (0.0%)	.84

[a] Neonatal acidemia defined as pH ≤7.00 or base excess ≥−12 mmol/L.

Falcone. Vacuum extraction in occiput posterior position is associated with a high success rate. Am J Obstet Gynecol 2024.

comparable to that reported in previous studies of unselected populations.[43] Instrumental delivery[26,28] and OP position[3,4] are also considered risk factors for obstetrical anal sphincter injuries. However, our study has shown a 3% rate of third- or higher-degree perineal tears, which is consistent with the findings from an unselected population undergoing instrumental delivery reported by Ampt et al.[44] In this context, it needs to be highlighted that the rate of obstetrical anal sphincter injuries may vary depending on obstetrical training, practice, and documentation.[45]

Clinical implications

This study shows that in cases of OP position diagnosed by sonography before performing VE, the extraction procedure is successful in most cases. Such data support the recommendation of some international guidelines[13,14] to complete sonographic confirmation of the fetal occiput position before an instrumental vaginal delivery.

Furthermore, using transperineal ultrasound to assess the fetal head station, the HPD has a significant but weak correlation with the outcome of VE, whereas the AoP has no correlation with the success of the procedure. Thus, for fetuses with OP position confirmed by ultrasound, transperineal measurement of the HPD is preferred to that of the AoP in assessing the feasibility and likelihood of a successful VE. However, the currently available data indicate that the accuracy of HPD in predicting the outcome of the procedure is weak. Indeed, although an HPD >38.5 mm was recorded in 3 of the 4 cases of failed VE, our results indicate that the same cutoff value would incorrectly predict failure in 16% of cases (specificity, 84%), resulting in 12 more cases compared with the true prevalence of failed VE in our cohort. Thus, if our findings were implemented into clinical practice, this approach could result in additional unnecessary cesarean deliveries while attempting to reduce the relatively small number of failed VE procedures.

Strengths and limitations

The main strengths of our study include its prospective and multicenter design, which ensures generalizability and reproducibility of the results. Furthermore, the data were collected by operators with experience in the field of intrapartum sonography. Additionally, the obstetricians conducting the operative delivery were blinded to the findings of the transperineal ultrasound but not to the occiput position of the fetal head. Finally, all vacuum deliveries were performed using the same type of vacuum cup—the Kiwi OmniCup—which has been associated with a higher incidence of detachment and failed procedures compared with other types of instruments, such as the Malmstrom metal cup,[46] which remains in use in several units.

A limitation of this study is the relatively small number of cases recruited at 3 large maternity units, likely reflecting the natural incidence of persistent OP position in approximately 5% of second-stage labors.[47] Furthermore, obstetricians may be less inclined to perform VE in cases of OP position, and may opt for cesarean delivery for other confounding factors. Information potentially influencing the delivery outcome, such as spine position[48] and head flexion,[49,50] was not collected as per the design of the study. Regarding head station, other authors have proposed different

TABLE 3
Comparison of demographic features and labor outcomes between cases with uncomplicated and those with complicated instrumental delivery by vacuum extraction

Parameter	Uncomplicated vacuum extraction N=90	Complicated vacuum extraction N=8	*P* value
Ethnicity N (%)	White 75 (83.3%) African 7 (7.8%) Asian 8 (8.9%)	White 7 (87.5%) African 1 (12.5%) Asian 0 (0%)	.63
Maternal age, y Mean±SD	31.3±5.4	32.4±4.6	.59
Height, cm Mean±SD	162±6	156±3	.01
Prepregnancy body mass index, kg/m^2 Mean±SD	24.2±4.2	27.1±4.6	.12
Obesity at conception N (%)	9 (10.0%)	3 (37.5%)	.03
Nulliparity N (%)	74 (82.2%)	5 (62.5%)	.18
Gestational age, wk^{+d} Mean±SD	$39^{+5}\pm1^{+3}$	$40^{+0}\pm1^{+3}$	.53
Induction of labor N (%) (data on 79 patients)	33/74 (44.6%)	2/5 (40.0%)	.84
Epidural N (%)	70 (77.8%)	8 (100%)	.14
First stage length, min Median (interquartile range) (data on 82 patients)	470 (272–630)	585 (420–900)	.10
Second stage length, min Median (interquartile range)	134 (98–180)	165 (151–208)	.10
Total labor length, min Median (interquartile range) (data on 82 patients)	600 (402–759)	745 (600–1019)	.20
Indication for vacuum extraction N (%)	Dystocia 66 (73.3%) Fetal distress 24 (26.7%)	Dystocia 7 (87.5%) Fetal distress 1 (12.5%)	.38
Head–perineum distance, mm Mean±SD	33±8	40±14	.04
Angle of progression, degrees Mean±SD	139±14	135±22	.43
Digital station, cm Median (range)	+1 (0 to +4)	+2 (0 to +4)	.52
Occiput posterior position at delivery N (%)	48 (53.3%)	6 (75.0%)	.24
Episiotomy N (%)	63 (70.0%)	3 (37.5%)	.06
Birthweight, g Mean±SD	3342±446	3340±772	.75

Complicated vacuum extraction (VE) is defined as failed VE or at least 3 of the following: 5-minute Apgar score <7, neonatal acidemia, transfer to the neonatal intensive care unit, neonatal trauma, postpartum hemorrhage, and grade 3 to 4 obstetrical anal sphincter injury. Neonatal acidemia is defined as pH <7.00 or base excess >−12 mmol/L.

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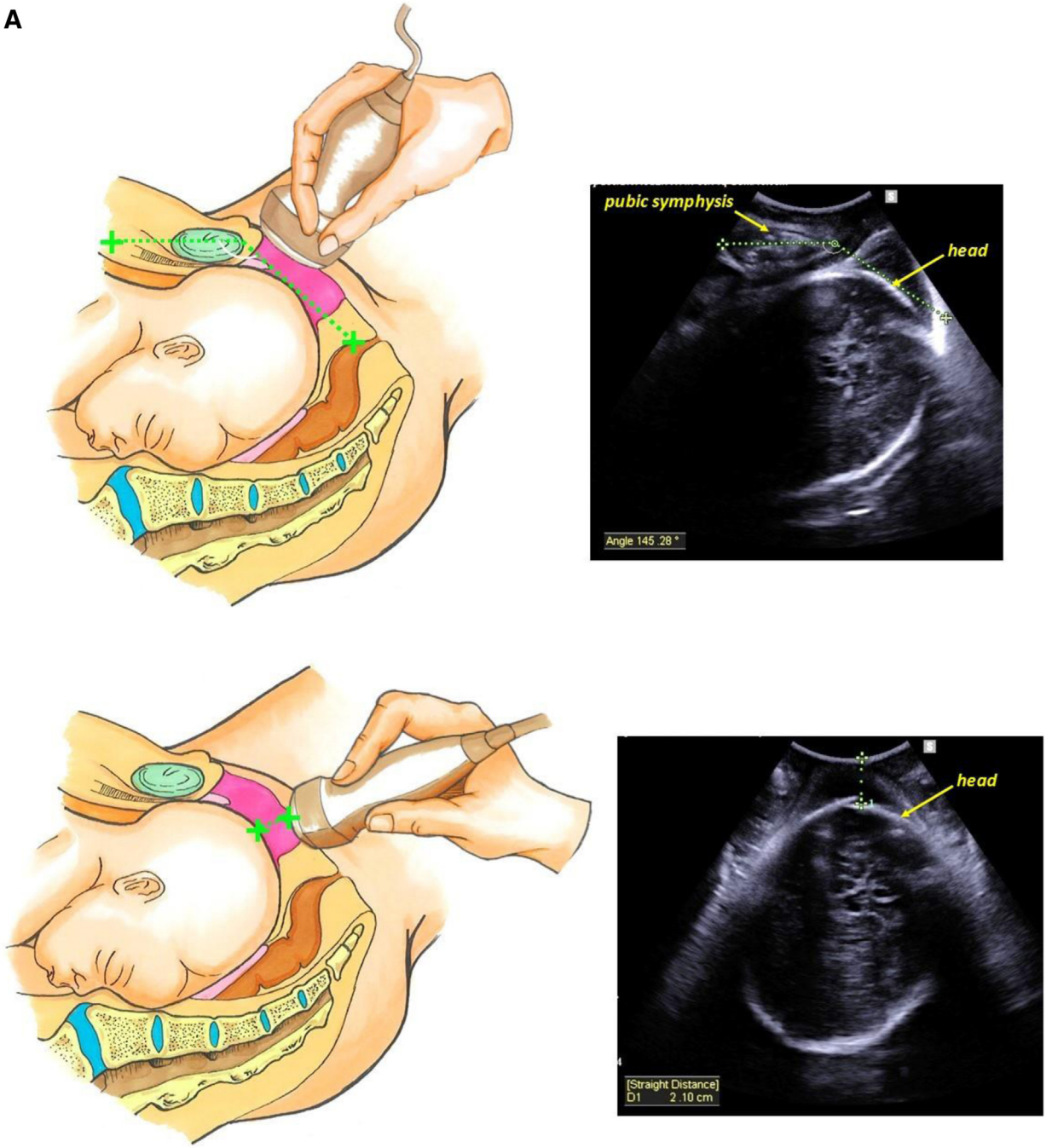
FIGURE 2
Sonographic assessment of the head station (A) in a fetus in occiput anterior and (B) in occiput posterior position

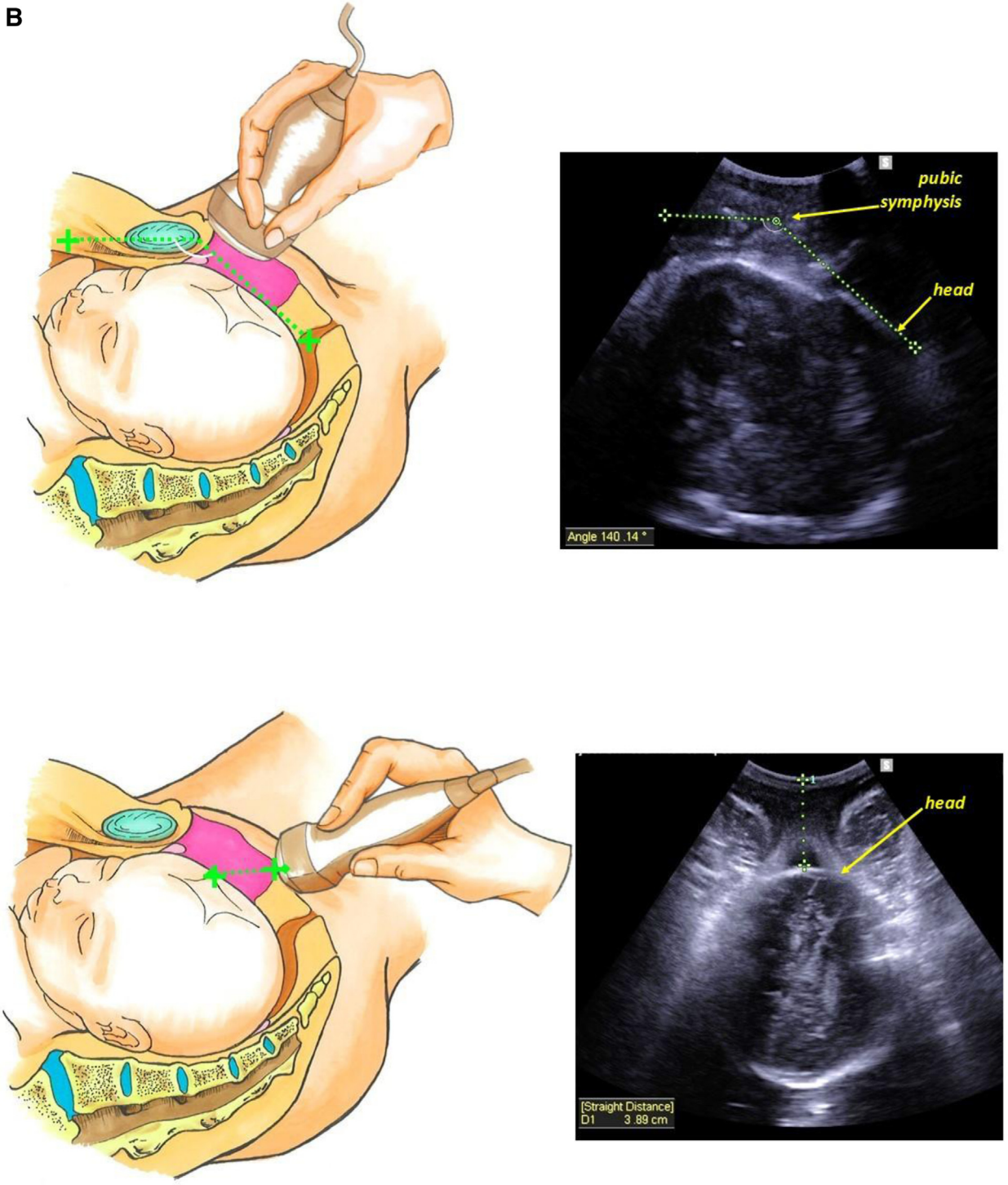


A, Measurement of the AoP and of the HPD in a fetus in non—occiput posterior position (AoP=145°; HPD=21 mm). **B,** Measurement of the AoP and of the HPD in a fetus in occiput posterior position (AoP=140°; HPD=39 mm). For a similar width of the AoP, the HPD appears remarkably longer in fetuses in occiput posterior position compared with those in non—occiput posterior position. This is due to the fact that the width of the AoP is not only dependent on the actual level of the head in the birth canal but also on the direction of the fetal head descent in the birth canal. In midcavity occiput posterior fetuses, the downward direction of the fetal head often results in AoP measurements that correspond to low fetal station in fetuses with a non— occiput posterior position and an upward direction. Therefore, cases with similar width of the AoP may show quantitative differences in HPD length, depending on whether the occiput position is anterior (ie, shorter HPD) or posterior (ie, longer HPD).

AoP, angle of progression; *HPD,* head—perineum distance.

Falcone. Vacuum extraction in occiput posterior position is associated with a high success rate. Am J Obstet Gynecol 2024.

FIGURE 2
Continued



Falcone. Vacuum extraction in occiput posterior position is associated with a high success rate. Am J Obstet Gynecol 2024.

indicators, either qualitative (eg, head direction[15]) or quantitative (eg, head−symphysis distance[51]), which were not evaluated in the present study. Finally, information concerning challenging fetal extractions in terms of number of traction attempts and cup detachments was also not collected for the purposes of the present study.

Conclusions

We report a high success rate of VE and low maternal and fetal complication rates in fetuses with sonographically diagnosed persistent OP position in the second stage of labor. Furthermore, we demonstrate that HPD measured by transperineal ultrasound has a statistically significant but weak association with failed and complicated VE procedures, whereas AoP has no correlation with the success of the procedure. These data can be useful for intrapartum management of laboring women with fetuses diagnosed with OP position and requiring an instrumental delivery during the second stage of labor.

CRediT authorship contribution statement

Veronica Falcone: Writing − original draft. **Andrea Dall'Asta:** Writing − original draft; Writing, review & editing. **Asaf Romano:** Investigation. **Ilenia Mappa:** Investigation. **Yossi Geron:** Investigation. **Priscilla Bontempo:** Investigation. **Marinunzia Salluce:** Investigation. **Elvira Di Pasquo:** Investigation. **Giovanni Morganelli:** Investigation. **Maurizio Di Serio:** Investigation. **Stefania Fieni:** Investigation. **Yinon Gilboa:** Methodology, Investigation. **Giuseppe Rizzo:** Methodology, Investigation. **Tullio Ghi:** Writing − review & editing, Conceptualization. ■

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