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CLINICAL ARTICLE

Obstetrics

Is sonographic measurement of head-perineum distance useful to predict obstetrical anal sphincter injury in case of vacuum delivery?

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Abstract

Objective: Determine if head-perineum distance (HPD) measurement before vacuum extraction (VE) was predictive of an obstetric anal sphincter injury (OASIS) occurrence.

Methods: Retrospective, bicentric (Lille and Poissy, France) cohort study conducted from January 2019 to June 2020. All VE in singleton pregnancies of ≥34 weeks were included. HPD measurement was performed without compression of the tissues before each VE. The judgment criterion was the occurrence of an OASIS.

Results: Of 12 568 deliveries, VE was performed in 1093 (8.6%). Among these 1093 women undergoing VE, 675 (61.7%) with HPD measurement were included. OASIS was found in 6.5% of women (n = 44; 95% CI 4.5–8.7). HPD was not associated with OASIS (38.5 ± 12.6 mm in women with OASIS vs 37.4 ± 12.0 mm in women without; adjusted OR [aOR] per 5 mm increase = 0.92; 95% CI 0.79–1.06). Increased HPD was associated with higher risk of sequential extraction (aOR = 1.19; 95% CI 1.06–1.32), extraction duration >10 min (aOR = 1.12; 95% CI 1.02–1.23) and shoulder dystocia (aOR = 1.20; 95% CI 1.03–1.40).

Conclusion: Ultrasound-measured head-perineum distance does not predict the occurrence of obstetric anal sphincter injury during a VE. The interest of HPD is more about predicting the success or difficulty of VE rather its specific complications.

KEYWORDS
head-perineum distance, OASIS, perineal tears, ultrasound, vacuum extraction

1 | INTRODUCTION

Obstetric anal sphincter injury (OASIS) is a potential complication of vaginal delivery associated with possible long-term complications such as anal incontinence.[1,2] Nulliparity and operative vaginal delivery (OVD) represent the main risk factors of OASIS but other risk factors have also been reported such as advanced maternal age, past history of OASIS, macrosomia, midline episiotomy, posterior cephalic positions, and prolonged labor.[3]

During the last decade, ultrasound has been proposed as a new method to assess fetal head descent in labor and prediction of vaginal delivery, especially in cases of OVD.[4-12] Available data suggest that ultrasound outweighs the digital examination in the assessment of the fetal head station, and is currently endorsed as an adjunct to the clinical

evaluation in conditions of operative delivery.[5] The sonographic indicators of the fetal head station, including the head-perineum distance (HPD) and the angle of progression (AoP), have been shown to be more accurate than the digital examination in predicting the occurrence of cesarean delivery or difficult OVD.[4,6,8] Indeed, in a European prospective study, transperineal ultrasound and the duration of vacuum extraction (VE) in a cohort of women with slow progress in the second stage of labor were assessed.[4] Among the 222 women included, the duration of the extraction procedure was significantly shorter in those with HPD (measured with compression of soft tissues) ≤25 mm versus >25 mm. Kasbaoui et al. also showed that an HPD (measured without compression of soft tissues) ≥40 mm was significantly associated with a difficult VE (defined on a composite criterion), after adjustment for parity, presentation type, and fetal macrosomia.[8]

Therefore, high values of HPD could be an indirect marker of risk of OASIS due to the higher difficulty associated with the OVD procedure. Indeed, our hypothesis is that the higher the presentation, the greater is the risk of OASIS due the difficulty of VE. To our knowledge, this hypothesis has not yet been studied.

Thus, the main objective of our study was to determine if HPD measurement before VE was predictive for the risk of OASIS. Our second objective was to evaluate if HPD could predict difficult VE.

2 | METHODS

2.1 | Study and eligibility criteria

This retrospective, bicentric cohort study was conducted from February 2019 to May 2020 in Lille and Poissy, at two tertiary hospitals in France. We included all VE in singleton pregnancies of ≥34 weeks' gestation. Multiple pregnancies and singleton pregnancies <34 weeks' gestation were excluded.

2.2 | Operative vaginal delivery (OVD)

Before each OVD, the birth attendant performed a digital examination to determine fetal head presentation by palpating the sagittal suture and the anterior and posterior fontanels. Fetal head station was assessed based on the relationship between the most distal cranial point and the level of ischial spines. The choice of appropriate delivery mode (vacuum, forceps, or cesarean section) was selected by the same birth attendant, based on the digital examination. In both centers, obstetricians are asked to systematically perform an ultrasound assessing the fetal head station before performing an OVD in routine practice (not only for this study). There were no strict criteria of measurement regarding whether or not to attempt instrumental delivery. It depended on the context (parity, labor, FHR), fetal head station and position.

Only women who underwent VE were included in this study. Cases of forceps extraction were excluded to allow good external validity of our results. Were also excluded cases of cesarean section associated with failed OVD.

2.3 | Measurement method

Ultrasonography was carried out using a portable machine (Samsung HM70A in Lille and Versana Essential [GE Healthcare] in Poissy). Fetal presentation was determined by an abdominal approach to determine the head and spine positions.[5] Then, the abdominal transducer was covered with a sterile glove and positioned horizontally on the perineum, between the labia majora in the posterior fourchette, to achieve a coronal view without intruding into the genital tract.[5] HPD was performed without compression of the tissues as described by Kasbaoui et al.[8] The image obtained was a transverse view of the perineum and maternal pelvis, enabling visualization of the external bony limit of the fetal skull. HPD was measured in a frontal transperineal scan as the shortest distance from the outer bony limit of the fetal skull to the perineum.[5] OVD was performed by the birth attendant, either a resident under the supervision of the senior physician, or directly by the senior physician.

2.4 | Assessment criteria

The judgment criterion was the occurrence of an OASIS (third- or fourth-degree perineal tears). A 3rd-degree tear was defined as injury to the perineum involving the anal sphincter muscles[13] and 4th-degree tear was defined as injury to the perineum involving the anal sphincter muscles and the rectal mucosa.[1] Cases of third- or fourth-degree tears were systematically confirmed and managed by the senior physician present at the time of the OVD.

2.5 | Statistical analysis

Demographic, medical, and obstetric data were prospectively documented and stored in a computerized database (same in both centers).

Quantitative variables are expressed as mean (standard deviation, SD) in the case of normal distribution or median (interquartile range) otherwise. Categorical variables are expressed as number (percentage). Normality of distributions was assessed using histograms and the Shapiro–Wilk test. OASIS rate was calculated with exact 95% confidence intervals by using the Clopper-Pearson method. Maternal, delivery and neonatal characteristics were described according to OASIS groups (primary outcome) and the between-group differences were assessed by calculating the absolute standardized differences (ASD); an ASD >20% was interpreted as meaningful difference.

We assessed the association of HPD with study outcomes (rates of OASIS, sequential use of vacuum and forceps, extraction duration [defined as time between the start of vacuum extraction to the fetal delivery] >10 min, postpartum hemorrhage, shoulder dystocia, Apgar 5 min <7 and neonatal arterial pH ≤7.05) using logistic regression models with a prespecified adjustment for center, nulliparous status, episiotomy, neonatal weight (≤4000 vs > 4000 g), and fetal head position. Odds ratios (ORs) of each outcome with their 95%

confidence intervals (CIs) derived from logistic regression models were calculated per 5 mm increase in HPD. We assessed the shape of associations using restricted cubic spline function, and no deviation in log-linearity assumption was observed.[14]

Statistical testing was performed at the two-tailed α level of 0.05. Data were analyzed using the SAS software package, release 9.4 (SAS Institute).

2.6 | Ethics approval

As required by French law and regulations, the study and the database were approved by the national committee of research in gynecology and obstetrics (CEROG #2020-OBST-0301, May 1, 2020).

3 | RESULTS

Among the 12568 living births that occurred in the two participating centers between February 2019 to May 1, 2020,631 (13%) operative vaginal deliveries (OVD) were performed with a similar rate between the two centers (13.4% and 12.4% in Lille and Poissy, respectively). Among these OVD, 1093 VE were performed and of these, 675 women (61.7%) with HPD measurement were included in the present study (Figure 1).

Mean age of mothers was 30.3 ± 5.0 years and 10.1% (n = 68) of them had a BMI > 30 kg/m^2. Nulliparity represents 79.6% of the study population and only three women had a history of OASIS.

Mean HPD was 38.4 ± 12.5 mm (median 38; range 2–88). An extraction duration up to 10 min occurred in 375 women (66.7%). Sequential use of vacuum and forceps occurred in 15.8% of cases (n = 107), and postpartum hemorrhage in 7.4% of women (n = 48). Shoulder dystocia occurred in 7.7% of cases (n = 52), 73 (11.1%) neonates had a pH ≤7.05, and only 12/662 (1.8%) had an Apgar 5 min <7.

OASIS was found in 6.5% of women (n = 44; 95% CI 4.5%–8.7%). Maternal, delivery and neonatal characteristics are described according to OASIS status in Table 1. OASIS seemed to occur more often in Lille than in Poissy (8.1% in Lille vs 4.0% in Poissy, ASD = 35.6%), and rates of nulliparous, history of OASIS, sequential use of vacuum and forceps, shoulder dystocia, and transverse position were higher in women with OASIS than in those without (all ASD > 20%), while episiotomy rate was lower in OASIS women (4.5% vs 16.3%, ASD = 39.3%).

As shown in Table 2, HPD was not associated with OASIS (38.5 ± 12.6 mm in women with OASIS vs 37.4 ± 12.0 mm in women without; adjusted OR [aOR] per 5 mm increase = 0.92; 95% CI 0.79–1.06). Regarding other outcomes, an increased HPD was significantly associated with higher risk of sequential used of vacuum and forceps (aOR, 1.19; 95% CI 1.06–1.32), extraction duration >10 min (aOR 1.12; 95% CI 1.02–1.23) and shoulder dystocia (aOR, 1.20; 95% CI 1.03–1.40). No significant association was found between HPD and the risk of postpartum hemorrhage, Apgar 5 min <7, or abnormal neonatal pH (≤7.05).

4 | DISCUSSION

4.1 | Main findings

Our initial hypothesis was that the occurrence of an OASIS would be related to a higher HPD due to a difficult extraction. Our results confirm that the greater is the distance, the greater are the rate of instrument change, long extraction time, and shoulder dystocia, indicating difficult operative extraction. However, our hypothesis is not confirmed with an absence of prediction of the occurrence of OASIS by performing an ultrasound measurement of fetal head station using HPD measurement before performing a VE.

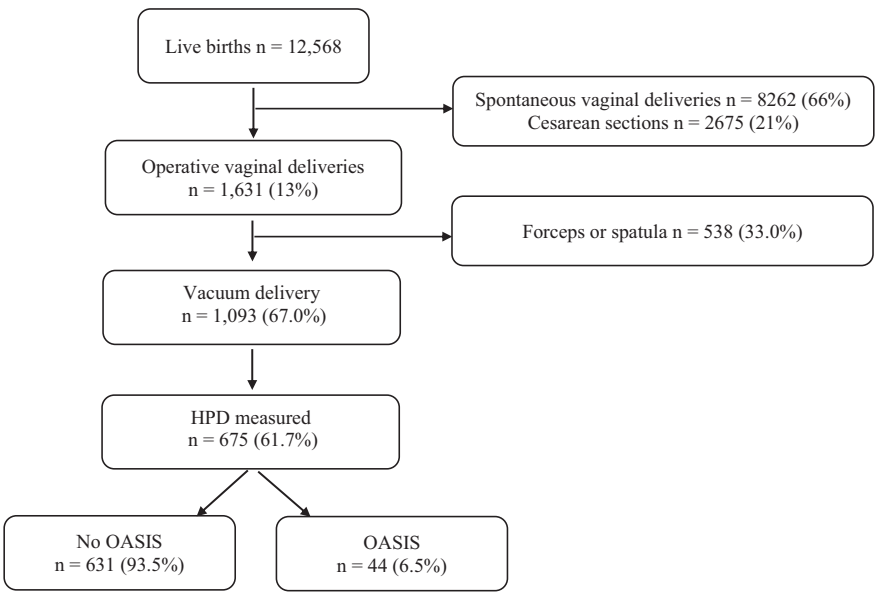

FIGURE 1 Flow chart. HPD, head perineum distance; OASIS, obstetrical anal sphincter injury

TABLE 1 Characteristics of the population

	No OASIS group *N* = 631	With OASIS group *N* = 44	ASD
Maternal characteristics			
Age (years)	30.3 ± 5.0	29.9 ± 4.9	8.8
Nulliparous	499/631 (79.1)	38/44 (86.4)	19.3
BMI > 30 kg/m^2	63/627 (10.0)	5/44 (11.4)	4.3
Previous C-section	64/631 (10.1)	3/44 (6.8)	11.9
History of OASIS	1/626 (0.2)	2/43 (4.7)	29.6
Delivery characteristics			
Epidural	602/610 (98.7)	41/43 (95.3)	19.7
Indication of OVD			
Non progression	261/630 (41.4)	20/44 (45.5)	8.1
FHR abnormalities	369/630 (58.6)	24/44 (54.5)	
Episiotomy	103/631 (16.3)	2/44 (4.5)	39.3
Shoulder dystocia	46/631 (7.3)	6/44 (13.6)	20.8
Duration of extraction (minutes)	8.0 (5.0–12.0)	10.0 (6.5–17.0)	
Postpartum hemorrhage >500 ml	40/609 (6.6)	8/43 (18.6)	36.9
Change of instrument	90/631 (14.3)	17/44 (38.6)	57.5
Neonatal characteristics			
Gestational age (weeks of gestation)	39.5 ± 1.2	39.7 ± 1.1	10.5
Position			41.4
Anterior position	474/628 (75.5)	31/44 (70.5)	
Transverse position	62/628 (9.9)	10/44 (22.7)	
Posterior position	92/628 (14.6)	3/44 (6.8)	
Neonatal weight >4000 g	36/540 (6.7)	3/39 (7.7)	4.0
Apgar (5 mn) <7	11/619 (1.8)	1/43 (2.3)	3.9
Arterial pH ≤7.05	68/614 (11.1)	3/38 (7.9)	2.6

Note: Values are presented as number (percentage), median (interquartile) or mean ± standard deviation unless otherwise indicated.

Abbreviations: ASD, absolute standardized difference; BMI, body mass index; C-section, cesarean section; FHR, fetal heart rate; HPD, head perineum distance; IQR, interquartile range; OASIS, obstetric anal sphincter injuries; OVD, operative vaginal delivery; SD, standard deviation.

TABLE 2 Association between HPD (mm) and main outcomes

Outcomes	Absence	Presence	Unadjusted OR (95% CI)	Adjusted[a] OR (95% CI)	*P*-value
OASIS	38.5 ± 12.6	37.4 ± 12.0	0.96 (0.85–1.09)	0.92 (0.79–1.06)	0.25
Change of instrument	37.7 ± 12.7	42.6 ± 10.8	1.17 (1.08–1.27)	1.19 (1.06–1.32)	0.002
Duration of extraction >10 min	41.9 ± 11.2	36.5 ± 12.9	1.19 (1.11–1.28)	1.12 (1.02–1.23)	0.013
Postpartum hemorrhage	38.5 ± 12.8	38.4 ± 10.8	0.99 (0.88–1.12)	0.94 (0.82–1.08)	0.39
Shoulder dystocia	38.0 ± 12.3	44.0 ± 13.9	1.20 (1.08–1.34)	1.20 (1.03–1.40)	0.019
Apgar (5 mn) <7	38.4 ± 12.5	41.2 ± 11.3	1.09 (0.87–1.37)	NA	NA
Arterial pH ≤7.05	38.3 ± 12.7	40.0 ± 10.5	1.06 (0.96–1.16)	1.04 (0.9–1.19)	0.54

Note: Values are expressed as mean ± SD (mm). OR calculated per 5 mm increase of HPD.

Abbreviations: 95% CI, 95% confidence interval; OASIS, obstetric anal sphincter injuries; OR, odds ratio; SD, standard deviation.

[a]Adjusted on pre specified factors: center, nulliparous status, neonatal weight >4000 g, episiotomy and fetal head position.

4.2 | Results and interpretation

In our study, we made the hypothesis that the fetal station may play a role in the occurrence of a perineal tear. Indeed, the higher is the fetal head, the more difficult the VE may be, and therefore, OASIS occurrence may subsequently increase. Interestingly, we did not find any published data regarding the fetal head station diagnosed with digital examination and the occurrence of OASIS. Considering that HPD was demonstrated to be predictive of a difficult OVD, since HPD reflects fetal head station,[8] we therefore wanted to

assess the potential predictive role of HPD measurement in OASIS occurrence.

We did not demonstrate a role of HPD measurement in this specific setting despite a large sample of HPD measurements, with a reproductive methodology, and a clear definition of OASIS systematically confirmed by a senior obstetrician. These results may be due to the fact that fetal head station is simply not associated with the occurrence of OASIS, whatever the mode of assessment (clinical examination or with ultrasound). Moreover, the HPD represent a straight measurement and does not reflect the physiologic curvature of the pelvis.

Besides, higher HPD measurement was significantly associated with a higher occurrence of changes of instrument, a longer duration of operative delivery, and an increased occurrence of shoulder dystocia. These results are in accordance with previous published data.[4,8,15–17]

Finally, even if it was not the objective of our study, we have confirmed some important information about risk factors of OASIS occurrence: history of OASIS, fetal head position (transverse or posterior), and shoulder dystocia,[1,18] thus reinforcing the external validity of our study. Interestingly, we also confirmed a potential protective role of episiotomy regarding the risk of OASIS during VE.[19]

4.3 | Strengths and limitations

Our study has several strengths. First, this study is original, with no previous report relating HPD and OASIS (either for vacuum or non-vacuum delivery). We have also provided a large sample of HPD measurements. To our knowledge, our HPD database represents one of the major published series using the HPD measurement during VE. Second, our study was bicentric and included two French tertiary hospitals, performing 10 000 deliveries a year. Interestingly, OVD rate was relatively similar (13.4% and 12.4% in Lille and Poissy, respectively). Many ultrasound measurements can be performed, but we have only chosen the HPD as it is easy to measure and shows less variation among examiners. This measurement can be universally achievable.

Regarding our results, several limitations must be highlighted. First, HPD measurement was not performed in all VE (61.7%). Even if the number of HPD measurements is quite important, the missing data might have introduced a bias in the interpretation of our results. This information is also rarely described in series on intrapartum ultrasound but reflects real practice in centers with policies of systemic ultrasound before OVD. It might have "excluded" the cases for whom "fast" vacuum extraction was needed, a situation at risk of occurrence of OASIS because physicians must rush to deliver the infant. Second, in comparison with available data in the literature, our general rate of OASIS after VE was found to be low. These results may be partially explained by the mediolateral incision that is performed in France.

This low rate of OASIS might have led to a non significant difference of HPD between the two groups of OASIS/no OASIS. However, we have to pinpoint that all suspicion of OASIS was subsequently confirmed (or invalidated) by a senior obstetrician, giving us a very precise rate of real OASIS. Indeed, recently, Alexander et al. confirmed a real discrepancy in OASIS prevalence, mainly due to three factors: insufficient diagnosis in settings with very low prevalence, geographical variations in elasticity of the perineum, and variations in the management of the perineum at birth.[20] We also observed a difference in prevalence between the two centers. This may be to the formation of all residents and midwife on animal models performed in one center (Lille) which could reinforce quality of diagnosis.[21] Even if ethnicity were to influence the OASIS rate, we did not collect these data in our database, based on French law.

Finally, we were not able to use a sample size calculation for this study due to the absence of data in the literature on HPD and OASIS. Therefore, it was not possible to define an a priori difference in the two groups.

5 | CONCLUSION

Head-perineum distance measured by ultrasound does not predict the occurrence of obstetric anal sphincter injury during vacuum delivery. The interest in HPD relates to predicting the success or difficulty of VE than their specific complications.

Further studies are warranted to better assess the predictive role of HPD measurement during labor and delivery.

CONFLICTS OF INTEREST

The authors report no conflict of interest.

AUTHOR CONTRIBUTIONS

PB, CT, CG conceived the study idea; PB, CG, AP designed the search strategy, screened abstracts and full texts; LB, AP, MS, AT acquired the data; MK and CT performed the data analysis; PB, CG, AP, CT and PR wrote the manuscript. All authors interpreted the data analysis and critically revised the manuscript. All authors had the opportunity to review the manuscript and all provided their permission to publish the manuscript. All authors agree to take responsibility for the work. The corresponding author attests that all listed authors meet authorship criteria, and that no others meeting the criteria have been omitted.

DATA AVAILABILITY STATMENT

No. Research data are not shared.

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