Impact of body mass index on sonographic measurement of head perineum distance before operative vaginal delivery

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CLINICAL ARTICLE

Obstetrics

Impact of body mass index on sonographic measurement of head perineum distance before operative vaginal delivery

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Abstract

Objective: To evaluate the impact of body mass index (BMI) on sonographic measurement of head perineum distance (HPD) before operative vaginal delivery (OVD).

Methods: This was a single-center retrospective cohort study (Lille, France) conducted from March 1, 2019 to October 31, 2020 including all singleton and OVD. HPD measurement was systematically performed without and with compression on the perineum soft tissues. The level of station was defined by vaginal examination and three maternal BMI groups were defined (normal BMI [<24.9 kg/m^2] vs overweight [25–29.9 kg/m^2] vs obese [≥30 kg/m^2]). HPD measures were compared between BMI groups and compression, in distinct level of station, using a two-factor analysis of variance including BMI groups, the compression, and the interaction term BMI group compression.

Results: A total of 775 women were included: 488 with normal BMI, 181 overweight patients and 106 obese patients. The measurement of HPD before OVD without and with compression on the soft tissues was significantly different between the BMI groups only in the lower part, particularly between normal BMI and obese patients (mean difference (95% CI): 6.6 mm (4.0 to 9.2) without compression; 3.8 (1.1 to 6.4) with compression).

Conclusion: The values of HPD without and with compression on the soft tissues on the maternal perineum were different according to the maternal BMI concerning lower part station. Thus, it seems important to define thresholds of HPD measures corresponding to each head station levels according to maternal BMI.

KEYWORDS

head perineum distance, instrumental delivery, obesity, operative vaginal delivery, station, ultrasound

1 | INTRODUCTION

The current gold standard for the diagnosis of fetal head station and head position of presentation is the digital examination.[1,2] However, this is a subjective examination with significant intra- and interobserver variability, with error rates from 20% to 70% for head position of presentation, and from 30% to 34% for head station, regardless of the clinician's experience.[2–4] Therefore, for several years, ultrasound for fetal head position and station has become increasingly important in the prediction of spontaneous delivery or instrumental delivery or difficulty in cases of operative vaginal delivery (OVD). However, its addition to the digital examination is still debated, and is not a common practice in obstetrics. Although the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) recommends that an ultrasound for assessment of type of vertex presentation should be performed before an OVD, the measurement of station is more controversial.[3] Indeed, misjudgment of the head position or head station can lead to fetal and maternal injuries due to wrong choices of instruments and wrong traction axis or a wrong decision to proceed with OVD.[7,8]

Different ultrasound methods for measuring fetal head station have been described by ISUOG,[3] including the distance between the fetal head and the maternal perineum (head perineum distance [HPD]). The measurement is performed translabially and with compression on the soft tissues. However, in the various series evaluating HPD as a predictive factor for vaginal delivery or difficulties during OVD, HPD was measured with or without compression on the soft tissues.[9,10] Each measurement technique could have benefits: better reproducibility if performed without compression of soft tissues, versus better assessment of fetal head station by suppressing soft tissues with compression, particularly in obese women.

Thus, our hypothesis is that at the same level of station, HPD values are influenced by maternal body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) and that these differences are corrected by the compression during measurement. Therefore, the main objective of this study was to evaluate the impact of BMI on sonographic measurement of HPD before OVD.

2 | MATERIALS AND METHODS

This was a single-center retrospective cohort study (Lille, France) conducted from March 1, 2019 to October 31, 2020. All women who had an OVD (forceps, spatula or vacuum) during this period were included. All were singletons with fetuses in cephalic presentation. Multiple pregnancies, breech/transverse presentations, women who had a cesarean section, and those who had a non-instrumental spontaneous delivery were excluded. Data were obtained from OVD reports which were subsequently anonymized and were not subject to written consent.

The OVD operator was a resident under the systematic supervision of a senior. All were trained to perform the required ultrasound measurements during several classes organized at the beginning of each residency semester, consisting of training on low-fidelity models, as well as by companionship in the delivery room, in order to make HPD measures on the perineum and not translabially, as recommended by ISUOG guidelines. Before each OVD, a digital examination was performed to assess the head position and the level of station, which was defined according to the recommendations of the American College of Obstetricians and Gynecologists (ACOG): "high" corresponding to a non-engaged fetal presentation (−5, −4, −3, −2, −1), "mid" to an engaged upper part (0, +1), "low" to an engaged middle part (+2), and "outlet" to an engaged lower part (+3, +4).[11] After the digital examination, an ultrasound was performed before the OVD, in order to confirm the head position and to perform the measurements of HPD. The choice of the instrument was left to the operator and was made according to the context, the clinical examination and the ultrasound measurements.

The measurements were made with a SAMSUNG HM70A device. First, the head position was sought, with the probe placed on the patient's abdomen, by looking for the side of the back, then by looking for the anatomical elements allowing to deduce whether the head position was anterior or posterior; for example, the eyes or the posterior cerebral fossa. The distance between the ultrasound probe and the bone of the fetal skull was then measured by positioning the probe horizontally on the perineum (with sterile protection) without compression, then with compression on the soft tissues, without causing any discomfort to the patient.[3]

Data were extracted from computerized OVD reports and medical records. Three groups of patients were created according to the maternal BMI before the pregnancy: "normal BMI" group for a BMI below 24.9 kg/m^2, "overweight" group for a BMI from 25 to 29.9 kg/m^2 and "obese" group for a BMI from 30 kg/m^2.

2.1 | Statistical analysis

Categorical variables are described as frequency and percentage. Gaussian continuous variables are described as mean and standard deviation and non-Gaussian numerical variables as median and interquartile range. The normality of the numerical variables was checked graphically and tested using the Shapiro–Wilk test. Population characteristics, OVD, and neonatal outcome were compared between BMI groups using a Chi-square or Fisher exact test for categorical variables using an analysis of variance (ANOVA) for Gaussian numerical variables and using a Kruskal-Wallis test for non-Gaussian numerical variables. HPD measures (with or without compression separately) were compared between level of station using ANOVA. In case of significant results, post hoc tests were performed and Bonferroni correction were applied. HPD measures were compared between BMI groups and compression, in distinct level of station, using a two-factor ANOVA including BMI groups, the compression, and the interaction term BMI groups compression;

comparisons between BMI groups by population with and without compression were tested using linear contrasts. Correlations between HPD without and with compression on the soft tissues in the different populations were investigated via the Pearson correlation coefficient. Two-tailed tests were performed at the 5% significance level. Statistical analyses were performed using SAS software (SAS Institute version 9.4).

3 | RESULTS

During the study period, 9077 women gave birth in our center (Figure 1). Of the women who delivered vaginally, 1708 (18.8%) had an OVD, of whom 1198 (70.1%) had an ultrasound in the delivery room and only 775 (64.7%) had both station measurements without and with compression on the soft tissues and were included in the study.

Table 1 shows the characteristics of the population and details by BMI subgroups. Nulliparous women were more frequent in normal BMI than overweight and obese patients, respectively (82.9% vs 73.7% and 71.4%), and scarred uteri were less frequent in normal BMI (8.4%). Pre-existing hypertension, gestational diabetes, pre-eclampsia and those who had an induction of labor were more frequent in obese patients.

The values of HPD measurement, with or without compression, decreased significantly with the level of station (all $P<0.001$ after Bonferroni correction for post hoc tests) (Figure 2a,b).

The measurement of HPD without and with compression on the soft tissues according to BMI groups and level of station are shown in Table 2. Significant differences were found between BMI groups only in those with lower station, both with and without compression. HPD measurement without compression were higher in obese patients than normal patients with a mean difference of 6.6 mm (4.0–9.2), while with compression, the difference was 3.8 mm (1.1–6.4). However, these differences were not significantly different ($P_{heterogeneity}=0.13$). No significant difference was found between normal patients and overweight patients both with and without compression (1.3 mm [−0.8 to 3.3] and 0.9 mm [−1.1 to 3.0], respectively).

Table S1 describes the characteristics of OVD. There were no differences between the groups in the indication for the OVD, the head position, or the duration of the OVD. The level of station was different between the BMI groups. Finally, the type of instrument was different between the groups with preference for vacuum in

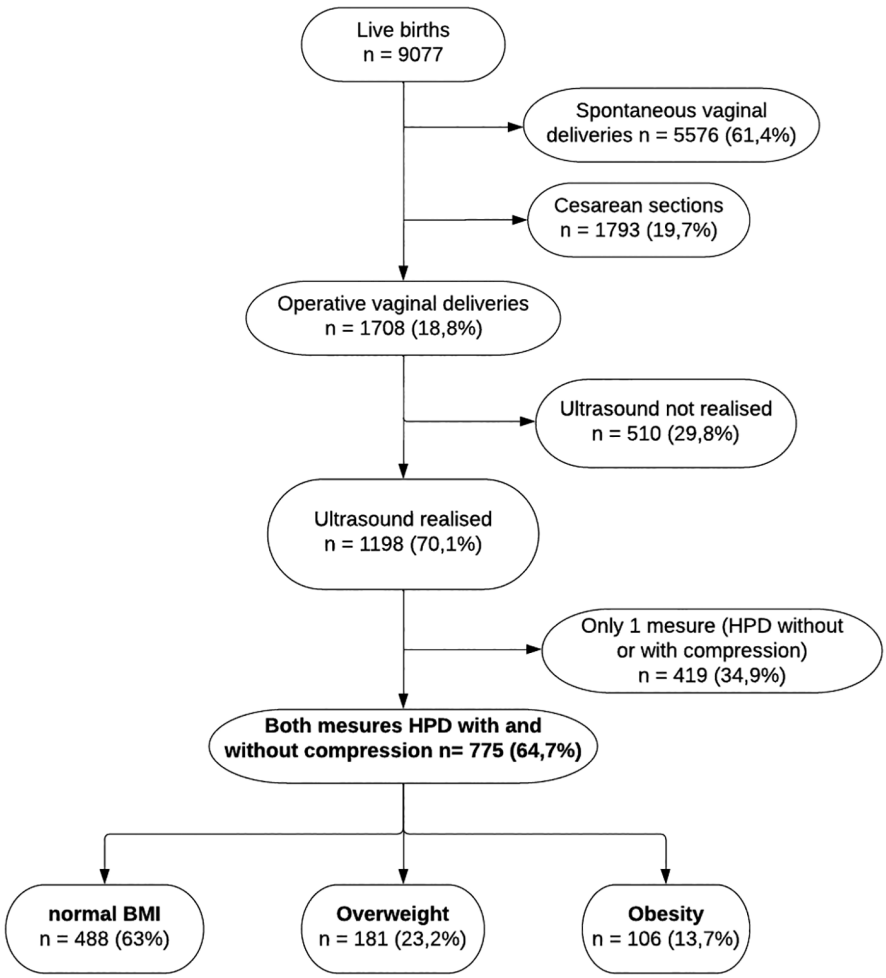

FIGURE 1 Flow chart.

TABLE 1 Population characteristics in the general population and BMI groups.

	General population $n=775$	Normal BMI $n=488$	Overweight $n=181$	Obese $n=106$	*P* value
Age, years	29.7 ± 5.0	29.6 ± 4.8	29.9 ± 5.0	29.6 ± 5.8	0.85
Nulliparous	610 (79.2)	403 (82.9)	132 (73.7)	75 (71.4)	0.004
Scarred uterus	80 (10.6)	40 (8.4)	24 (14.0)	16 (15.2)	0.032
History of LOSA	3 (0.4)	3 (0.7)	0 (0.0)	0 (0.0)	NA
Diabetes prior to pregnancy	11 (1.5)	7 (1.5)	1 (0.6)	3 (3.0)	0.35
Pre-existing hypertension	13 (1.8)	7 (1.5)	0 (0.0)	6 (5.9)	0.003
Gestational diabetes	126 (17.5)	58 (12.5)	32 (20.6)	36 (35.6)	<0.001
Pregnancy induced hypertension	3 (0.4)	1 (0.2)	0 (0.0)	2 (2.0)	NA
Pre-eclampsia	20 (2.8)	8 (1.7)	3 (1.9)	9 (8.9)	0.002
Streptococcus B carriage	35 (4.9)	19 (4.1)	12 (7.7)	4 (4.0)	0.17
Induction of labor	271 (37.5)	148 (32.4)	70 (42.4)	55 (53.0)	<0.001

Note: The results are presented as number (percentage) or mean ± standard deviation.

Abbreviations: BMI, body mass index; LOSA, Lesion of obstetric sphincter in jury; NA, not applicable.

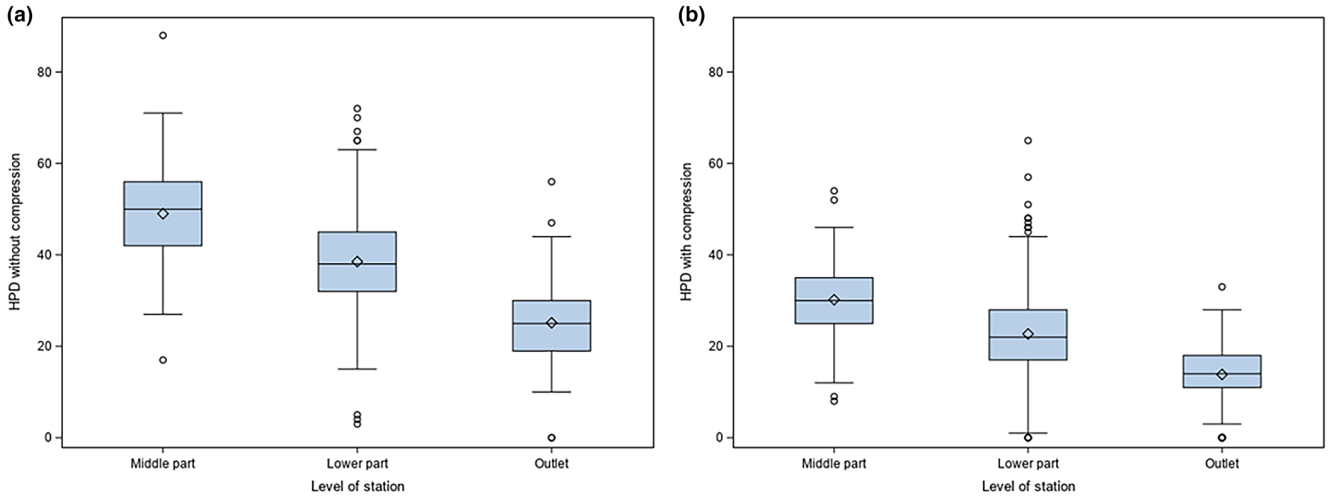

FIGURE 2 Head perineum distance (HPD) measurement (a) without and (b) with compression according to level of station.

obese patients. Concerning neonatal outcome (Table S2), only the rate of newborn with an Apgar score <7 at 5 min of life was different between groups: 0.6% in patients with normal BMI, 2.8% in overweight patients and 1.9% in obese patients, $P=0.048$.

4 | DISCUSSION

4.1 | Principal findings

The values of station with and without compression on the soft perineal tissues were significantly different according to the maternal BMI in lower station. The distance between the ultrasound probe and the bone of the fetal skull were higher in mm when HPD was measured without compression than with compression of soft tissues.

4.2 | Interpretation

Two ultrasound methods have been described in the literature for the diagnosis of fetal station by head-perineum measurement: with and without compression on the soft tissues.[3,13] In this study, we have shown that both methods provide concordant results: the greater the degree of station, the shorter the distance (with and without compression). In the literature, different thresholds have been proposed. In the 2018 ISUOG recommendations,[3] based on the prospective study by Kahrs et al.,[1] including 222 patients (data on mean BMI not available in all the population), the threshold of 35 mm (with compression of soft tissue) was retained as predictive of a successful vaginal delivery. In the descriptive study by Tutschek et al.,[4] including 106 nulliparous women at term (mean BMI = 31.6 kg/m^2 [23.7–48.5; median 30.1 kg/m^2])

TABLE 2 Comparison of HPD measurement between BMI level according to compression and level of station.

	BMI level				Mean difference (95% CI)	
Measurement (mm)	Normal	Overweight	Obese	*P* value	Overweight versus normal	Obese versus normal
In middle part	*N* = 66	*N* = 52	*N* = 37			
Without compression	47.9 ± 10.8	49.3 ± 8.7	50.6 ± 10.0	0.33	1.5 (−1.9 to 4.8)	2.7 (−1.0 to 6.4)
With compression	29.7 ± 7.5	30.8 ± 9.0	30.1 ± 7.7	0.82	1.1 (−2.3 to 4.4)	0.3 (−3.4 to 4.0)
				P het	0.87	0.37
In lower part	*N* = 362	*N* = 117	*N* = 62			
Without compression	37.6 ± 10.1	38.5 ± 11.0	44.1 ± 10.2	<0.001	0.9 (−1.1 to 3.0)	6.6 (4.0 to 9.2)
With compression	22.0 ± 8.3	23.3 ± 10.2	25.8 ± 9.5	0.014	1.3 (−0.8 to 3.3)	3.8 (1.1 to 6.4)
				P het	0.80	0.13
In outlet	*N* = 60	*N* = 12	*N* = 7			
Without compression	24.8 ± 8.8	25.5 ± 5.6	27.1 ± 13.8	0.77	0.7 (−4.4 to 5.8)	2.3 (−4.1 to 8.7)
With compression	14.0 ± 6.6	14.7 ± 6.1	10.9 ± 12.5	0.58	0.7 (−4.5 to 5.8)	−3.2 (−9.6 to 3.3)
				P het	0.99	0.23

Note: Values are expressed as mean ± standard deviation, unless otherwise indicated. *P* value for comparison in mean difference according to HPD support (*P* value for heterogeneity, *P* het) are reported.

Abbreviations: BMI, body mass index; CI, confidence interval; HPD, head perineum distance.

with a prolonged active phase of labor and ruptured membranes, a threshold of 36 mm was found corresponding to the middle part of the station when the measurement was carried out with compression on the soft tissues. Furthermore, according to ISUOG, this threshold is a good prognostic factor for vaginal delivery.[3] We note that these studies propose station thresholds in the general population disregarding the maternal BMI. However, our study found a variation in HPD with BMI in lower station whether compression is attempted or not.

On the other hand, several authors have evaluated the interest of HPD measurement in the prediction of a difficult OVD or in the occurrence of obstetric complications. Kasbaoui et al.[9] in their prospective study including 659 patients (mean BMI = 28.3 ± 5.51 kg/m^2) who had an OVD by vacuum, showed a link between the measurement of HPD (without compression of soft tissue) and the prediction of a difficult delivery according to a composite criteria (extraction judged difficult by the operator, and/or at least two vacuum releases, and/or change of instrument, and/or duration of extraction greater than 10 min, and/or occurrence of shoulder dystocia, and/or cesarean section for failed extraction). Their multivariate analysis made it possible to define thresholds of HPD (40, 50 or 60 mm) predictive of the occurrence of difficult extraction, by adjusting for parity, posterior or transverse head position, and fetal macrosomia. The odds ratios were respectively 2.38 (95% CI: 1.51–3.74, *P* = 0.0002), 2.16 (95% CI: 1.40–3.33, *P* = 0.0005) and 3.02 (95% CI: 1.68–5.43, *P* = 0.0002). Plurien et al.[6] performed a prospective study to identify factors associated with difficult extraction during OVD and found that HPD thresholds of 17 mm with compression and 37 mm without compression were significant. Garabedian et al.[5] performed a bicentric study (*n* = 671, 10.1% with BMI up to 30 kg/m^2) showing that higher values of HPD without compression were associated with a risk of double extraction (37.7 mm vs 42.6 mm, *P* = 0.002, OR = 1.19; 95% CI: 1.06–1.32), extraction duration >10 min (36.5 mm vs 41.9 mm, *P* = 0.013, OR = 1.12; 95% CI: 1.02–1.23) or the occurrence of shoulder dystocia (38.0 mm vs 44.0 mm, *P* = 0.019, OR = 1.20; 95% CI: 1.03–1.40). Finally, Sainz et al.[11] defined an ultrasound model combining the angle of progression and the fetal head circumference to predict 87% of difficult instrumental deliveries (*n* = 84, data on mean BMI not available in all the population). However, in all these studies, the analysis was done for all BMI. Thresholds of fetal stations are indeed higher in obese patients. Clinical decision making should be adapted to this information and it will be necessary to evaluate in a larger multicentric series specific threshold for predicting difficult OVD according to BMI.

4.3 | Strengths and limitations of the study

The originality of our study was the comparison of HPD measurements with or without compression of soft tissue according to maternal BMI. In addition, the number of women included was large.

The main limitation of our study was the external validity. Indeed, the vast majority of women were under epidural analgesia. It was therefore not possible to carry out the measurement with compression exactly under the conditions described by the ISUOG, that is, up to "maternal discomfort".[3] Therefore, future analyses should be stratified according to analgesia status, even if maternal discomfort will remain a subjective and a multifactorial feeling. The rate of forceps was also high in proportion to the rate of vacuum in our center compared to Anglo-Saxon or Scandinavian data. In addition, spatulas are used only in France. However, the choice of instrument does not impact upon the HPD measurement. In addition, the HPD

measurements were performed by many operators with different levels of experience (residents or seniors). However, Benediktsdottir et al.[12] have shown good reproducibility of the measurement between different operators. Another limit is that the gold standard to define the level of station was the digital examination. Indeed, Dupuis et al., using a simulator, observed a significant variability in the assessment of station even among attending physicians and it is possible that this error would vary according to BMI, even if the diagnosis is based on bone markers.

Last, this preliminary study provides a description of station measures but does not assess the prediction of vaginal delivery or complicated OVD based on these levels.

5 | CONCLUSION

The values of HPD with and without compression on the soft perineal tissues are significantly different according to the maternal BMI.

Thus, it seems important to define thresholds of HPD measures corresponding to each head station levels according to maternal BMI.

AUTHOR CONTRIBUTIONS

All those designated as authors meet all four criteria for authorship, according to the International Committee of Medical Journal Editors.

CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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