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Full length article

Intrapartum ultrasound in maternal lateral versus semi-recumbent posture. A repeated measures study

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ABSTRACT

Objective: This study aimed to assess whether intrapartum ultrasound (ITU) measurements in maternal lateral posture are superimposable to ITU measurements in semi-recumbent position.

Study design: A single-center, repeated measures design was used. Women in the second stage of labor were randomized to ITU first in semi-recumbent followed by ITU in side-lying posture without and with contraction, or inversely.

The angle of progression (AOP) and the head-perineum distance (HPD) between contractions (AOP1 and HPD1) and with contraction (AOP2 and HPD2) were measured in each maternal posture. The differences between AOP1 and AOP2 (dAOP), and between HPD1 and HPD2 (dHPD) were calculated.

Results and conclusions: Forty-two women participated in the study. A generalized estimating equation model showed that AOP1 (-3.00°; 95 % CI −5.77 to −0.23; p = 0.03) and AOP2 (-4.14°; 95 % CI −7.20 to −1.08; p = 0.008) were lower in semi-recumbent compared to maternal lateral posture. HPD1 (+1.43 mm; 95 % CI 0.05–2.81; p = 0.042) and HPD2 (+1.53 mm; 95 % CI 0.17–2.89; p = 0.03) were higher in semi-recumbent position.

Differences in the ITU measurements in maternal lateral posture compared to semi-recumbent position are small. Monitoring the second stage of labor with ITU in lateral maternal posture is possible.

Introduction

Intrapartum ultrasound (ITU) has arisen as an attempt to improve the results of the study of labor through digital vaginal examinations, since these are imprecise and not very accurate [1,2]. Also important, digital vaginal exams are painful, while ITU is well accepted and tolerated by most women [3,4].

ITU is mainly performed with the mother in a semi-recumbent position. However, flexible sacrum postures, such as maternal lateral posture, may provide some benefits in labor. Many mothers feel more comfortable in flexible sacrum postures, and a shorter second stage in maternal lateral posture has been reported [5–8].

Several measurements have been described for ITU scans. For studying the progression of the fetal head in the birth canal, the angle of progression (AOP) (the angle between the long axis of the pubis and a tangential line to the deepest bony part of the fetal skull from the anterior edge of the pubis) and the head-perineum distance (HPD) (the shortest distance from the outer bony limit of the fetal skull to the perineum) are the most common parameters [9–11]. This is because they are accurate, reliable, and easy to learn and interpret [1,2]. In addition, ITU makes it possible to know the precise position of the fetal head [1,2].

This study aimed to assess whether ITU measurements in maternal lateral posture are superimposable to ITU measurements in semi-

Abbreviations: ITU, Intrapartum Ultrasound; AOP, Angle of progression; HPD, Head-perineum distance; GEE, generalized estimating equation.

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recumbent position and whether there is greater mobility of the fetal head within the birth canal in a flexible sacrum birthing posture.

Material and methods

A single-center, repeated measures design was used. Women in the second stage of labor were randomized with an allocation ratio of 1:1 to ITU first in semi-recumbent followed by ITU in side-lying posture without and with contraction, or inversely. The study was approved by the Ethics Committee of Hospital Universitario La Paz in July 2021 (PI-4853).

Monitoring of eligible pregnant women was performed in the birthing unit. All participating women gave their written informed consent. Inclusion criteria were: 1) low-risk singleton term pregnancies; 2) over 18 years of age; 3) adequate epidural anesthesia; 4) no trial of labor after cesarean (TOLAC); 5) ruptured membranes.

Demographic and birth data were recorded, including maternal age, gestational age, height, body mass index (BMI), obstetric history, method of birth, neonatal weight, umbilical artery pH value and Apgar score at 1 and 5 min.

ITU was performed according to the following instructions: 1) the transducer is placed on the perineum in the frontal plane and then rotated to the midsagittal plane (in this step, the position of the fetal head is determined by looking at the choroid plexus); 2) AOP in the midsagittal plane is measured; 3) the transducer is rotated back to the frontal plane, and the HPD is measured; 4) the above steps are repeated with contraction. A curved array transducer (GE Voluson *P*6, General Electric, USA) was used.

ITU in semi-recumbent position was performed following the ITU clinical guidelines [1,2]. ITU in maternal lateral posture was performed following the technique previously described by our study group: women were in a side-lying posture and had to grab their upper knee and flex it during the scan [12]. The women freely adopted a left or right side-lying posture.

The position of the fetal head was classified according to the direction of divergence of the choroid plexus as if it were the hour hand on a clock face. Direction between 02:30 and 03:30 (both included) were recorded as left occiput transverse (LOT) and between 08:30 and 09:30 (both included) as right occiput transverse (ROT). Direction between 03:30 am and 08:30 were classified as occiput posterior (OP) and between 09:30 am and 02:30 as occiput anterior (OA). The OA and OP positions were recorded as left, right, or direct.

AOP and HPD between contractions were recorded as AOP1 and HPD1, and AOP and HPD with contraction were recorded as AOP2 and HPD2. The differences between AOP1 and AOP2, and HPD1 and HPD2 were calculated and recorded as dAOP and dHPD.

The sample size was calculated to prove a difference of at least 8° in AOP1 depending on the maternal posture. We estimated that with a variance of 171.6°, 42 women would be needed with a confidence level of 0.95 (1- α) and a statistical power of 0.80. The difference of 8° was decided as it is the intraobserver error described for the AOP [13].

The Shapiro-Wilk test and the visual appraisal of histograms were used to verify the distribution of the variables. Qualitative variables were stated as proportions (absolute and relative frequencies). Numerical variables were expressed as mean (standard deviation, SD) or median (interquartile range, IQR) as adequate. For normally distributed ITU measurements, the 95 % CI for the mean was also stated.

A generalized estimating equation (GEE) approach was used to account for dependencies between the repeated observations.

The level of significance was set at 95 % ($P < 0.05$). All analyzes were performed in R software, version 4.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

From August 2021 to March 2022, 42 women participated in the study. Only one woman declined to join the study because she feared ultrasound side effects. Demographic and birth data are shown in Table 1.

The fetal head position, AOP, and HPD with and without contraction in semi-recumbent and maternal lateral posture were recorded in all women. Head position was occiput anterior in 26 (61.9 %) of the ITU scans in semi-recumbent position and in 27 (64.3 %) in maternal lateral posture (a babýs head rotated from occiput transverse to anterior when the mother changed from semi-recumbent to maternal lateral posture). The head position was occiput posterior in 4 (9.5 %) women. The maternal lateral posture was left side-lying in 29 (69.0 %) and right side-lying in 13 (31.0 %) women. ITU data (AOP1, AOP2, dAOP, HPD1, HPD2, or dHPD) are shown in Table 2.

After GEE, including first posture at randomization; the semi-recumbent position had a significantly lower AOP1 (-3.00°; 95 % CI −5.77 to −0.23; P = 0.03) and AOP2 (-4.14°; 95 % CI −7.20 to −1.08; P = 0.008) compared to the maternal lateral posture. HPD1 (+1.43 mm; 95 % CI 0.05–2.81; P = 0.042) and HPD2 (+1.53 mm; 95 % CI 0.17–2.89; P = 0.03) were higher in the semi-recumbent position. There were no differences in dAOP (-1.41°; 95 % CI −3.78 to 0.97; P = 0.25) and dHPD (-0.10 mm; 95 % CI −1.48 to 1.28; P = 0.89) in semi-recumbent position with respect to maternal lateral posture.

Discussion

In maternal lateral posture, the AOP results are higher, and the HPD results are lower than in semi-recumbent position. However, the differences are small and less than the intra-observer error described for these measurements [13]. Regarding the progression of the fetal head within the birth canal in the second stage of labor with contraction, no

Table 1
Demographic and birth data.

	First semi-recumbent (n = 21)	First Lateral (n = 21)	Overall (n = 42)
GA	40.1 (1.06)	39.5 (1.38)	39.8 (1.25)
Height (m)	1.65 (0.0564)	1.63 (0.0648)	1.64 (0.0610)
BMI (kg/m2)	24.6 (3.13)	23.0 (3.38)	23.8 (3.32)
Maternal age	33.0 [30.0, 35.0]	35.0 [32.0, 36.0]	34.0 [31.0, 36.0]
Nulliparous	14 (66.7 %)	16 (76.2 %)	30 (71.4 %)
Race			
Asian	1 (4.76 %)	1 (4.76 %)	2 (4.76 %)
Black	0 (0 %)	1 (4.76 %)	1 (2.38 %)
Hispanic	1 (4.76 %)	3 (14.3 %)	4 (9.52 %)
White	19 (90.5 %)	16 (76.2 %)	35 (83.3 %)
Cesarean	1 (4.76 %)	0 (0 %)	1 (2.38 %)
Instrumental	4 (19.0 %)	6 (28.6 %)	10 (23.8 %)
Apgar 1́			
6	0 (0 %)	1 (4.76 %)	1 (2.38 %)
7	0 (0 %)	1 (4.76 %)	1 (2.38 %)
8	3 (14.3 %)	4 (19.0 %)	7 (16.7 %)
9	17 (81.0 %)	13 (61.9 %)	30 (71.4 %)
10	1 (4.76 %)	2 (9.52 %)	3 (7.14 %)
Apgar 5́			
8	0 (0 %)	2 (9.52 %)	2 (4.76 %)
9	6 (28.6 %)	4 (19.0 %)	10 (23.8 %)
10	15 (71.4 %)	15 (71.4 %)	30 (71.4 %)
Umb. Art. pH	7.31 [7.21, 7.34]	7.30 [7.26, 7.35]	7.31 [7.22, 7.34]
Newborn weight (g)	3300 (366)	3060 (357)	3180 (377)

Data are presented as mean (SD) for continuous variables and absolute and relative frequencies for qualitative variables.
BMI (Body Mass Index), GA (Gestational age). Umb. Art. pH (Umbilical artery pH).

Table 2
ITU Data.

	Semi-recumbent (n = 42)	Lateral (n = 42)
AOP1 (°)	139 (95 % CI 134–144) (15.5)	142 (95 % CI 138–146) (13.1)
AOP2 (°)	148 (95 % CI 143–153) (15.2)	153 (95 % CI 149–157) (12.7)
dAOP (°)	8.1 [5.5, 11.0]	9.0 [6.0, 15.5]
HPD1 (mm)	21.2 (95 % CI 18.7–23.7) (7.9)	19.8 (95 % CI 17.2–22.4) (8.3)
HPD2 (mm)	16.3 [10.3, 19.3]	12.0 [8.9, 19.3]
dHPD (mm)	5.4 [3.2, 7.5]	5.0 [2.3, 7.9]
dOA	15 (35.7 %)	15 (35.7 %)
LOA	8 (19.0 %)	8 (19.0 %)
ROA*	3 (7.1 %)	4 (9.5 %)
LOT	9 (21.4 %)	9 (21.4 %)
ROT*	3 (7.1 %)	2 (4.8 %)
LOP	2 (4.8 %)	2 (4.8 %)
ROP	2 (4.8 %)	2 (4.8 %)

Data are presented as mean (95 % CI for the mean) (standard deviation) for normally distributed continuous variables, as median [Q1, Q3] for non-normally distributed variables and as absolute and relative frequencies for qualitative variables.
dOA (direct occiput anterior), LOA (left occiput anterior), ROA (right occiput anterior), LOT (left occiput transverse), ROT (right occiput transverse), LOP (left occiput posterior) and ROP (right occiput posterior).
*A babýs head rotated from ROT to ROA when the woman changed from semi-recumbent to maternal lateral posture.

differences were observed between the maternal postures studied.

Performing ITU in maternal lateral posture is easy to learn as the technique differs little from the one described for the semi-recumbent position [1,2]. Not having to change the women's posture for each labor progression examination is possible with ITU. However, there is no formula for converting HPD and AOP results to the different fetal head stations in maternal postures other than semi-recumbent [13,14]. As the differences between the measurements in the different maternal postures are small, the conversion formula to fetal head stations may be similar but requires independent studies.

Regarding dHPD and dAOP, it is significant that no differences were observed. Both dHPD and dAOP were unaffected by maternal posture, either semi-recumbent or lateral. Additionally, dAOP and dHPD did not follow a normal distribution, unlike the other ITU measurements studied. This is likely due to the small sample size and the fact that these measurements may vary depending on the fetal head station. Birth is a dynamic process, and changes in maternal posture are often necessary if an inadequate progression occurs [5,8]. ITU may allow maternal postural changes during labor and compare dHPD and dAOP to assess whether the new maternal posture favors labor progression. Flexible sacrum postures in the second stage of labor may be slightly superior in important markers such as operative birth or cesarean birth rate [6–8,15].

Performing ITU in different maternal postures may offer a more realistic view of labor progression. When we modify a womańs posture to perform an examination, we are altering the biomechanical interactions between the baby and the mother [16]. In addition, once the examination is over, the woman usually returns to the posture she had before. In our study, the measurements in maternal lateral posture were slightly more favorable. We do not know if moving the mother to perform the study had an influence on labor progression.

Although it was not one of the outcomes of our study, we did not find differences in the discomfort perceived by women when performing ITU in the different maternal postures. One advantage of the side-lying posture was that women could look directly at the screen of the ultrasound machine and better understand the progression of labor. Improvements in experience and ability to push through ultrasound feedback have been reported [17]. Every woman appreciated viewing the fetal head in the birth canal and its progression with contraction.

The main strength of our study is the repeated measures design that makes it possible to evaluate the relationship between ITU measurements in different maternal postures without being affected by the possible progression differences due to interpersonal pelvic or fetal variations. Another strength is studying the dAOP and dHPD since it allowed us to check if the differences in AOP and HPD were related to increased mobility of the fetal head in the different maternal postures. Regarding weaknesses, we studied women in the second stage of labor with different positions of the fetal head, which may imply different mechanical interactions of the fetal head within the birth canal. Another weakness is the lack of blinding of the operators to the results of the ITU in the alternative posture. Blinding of the operators was not possible because priority was given to taking the shortest possible time and the fewest number of contractions between measurements in one posture and another in order for them to be comparable. Finally, despite the sample size calculation, the sample may be small to achieve all the objectives. We believe that future larger studies are necessary, especially to assess fetal head mobility in different maternal postures.

Conclusions

In conclusion, there are small differences in the ITU measurements in maternal lateral posture compared to semi-recumbent position. These differences do not appear to be clinically relevant. We have failed to show that maternal lateral posture implies greater mobility of the fetal head during the second stage of labor, although the ITU measurements were slightly more favorable. The progression of labor and the mobility of the fetal head in the birth canal during the second stage of labor can be studied with ITU in maternal lateral posture as in semi-recumbent position.

CRediT authorship contribution statement

Marcos Javier Cuerva: Writing – original draft, Data curation. **Elena Rodriguez:** Data curation. **Marta Perez De Aguado:** Data curation. **Maria del Mar Gil:** Validation, Writing – review & editing. **Valeria Rolle:** Data curation, Writing – review & editing. **Francisco Lopez:** Data curation, Writing – review & editing. **José Luis Bartha:** Validation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References:

[1] Rizzo G, Ghi T, Henrich W, Tutschek B, Kamel R, Lees CC, et al. Ultrasound in labor: clinical practice guideline and recommendation by the WAPM-World Association of Perinatal Medicine and the PMF-Perinatal Medicine Foundation. J Perinat Med. 50(8), 1007–1029.
[2] Ghi T, Eggebø T, Lees C, et al. ISUOG Practice Guidelines: intrapartum ultrasound. Ultrasound Obstet Gynecol 2018 Jul;52(1):128–39.
[3] Chan YT, Ng KS, Yung WK, Lo TK, Lau WL, Leung WC. Is intrapartum translabial ultrasound examination painless? J Matern Fetal Neonatal Med 2016 Oct;29(20): 3276–80.
[4] Seval MM, Yuce T, Kalafat E, et al. Comparison of effects of digital vaginal examination with transperineal ultrasound during labor on pain and anxiety levels: a randomized controlled trial. Ultrasound Obstet Gynecol 2016 Dec;48(6): 695–700.
[5] Berta M, Lindgren H, Christensson K, Mekonnen S, Adefris M. Effect of maternal birth positions on duration of second stage of labor: systematic review and meta-analysis. BMC Pregnancy Childbirth 2019 Dec 4;19(1):466.
[6] Walker KF, Kibuka M, Thornton JG, Jones NW. Maternal position in the second stage of labour for women with epidural anaesthesia. Cochrane Database Syst Rev. 2018 Nov 9;11(11):CD008070.
[7] Zang Y, Lu H, Zhao Y, Huang J, Ren L, Li X. Effects of flexible sacrum positions during the second stage of labour on maternal and neonatal outcomes: A systematic review and meta-analysis. J Clin Nurs 2020 Sep;29(17–18):3154–69.
[8] Wright A, Nassar AH, Visser G, Ramasauskaite D, Theron G. FIGO Safe Motherhood and Newborn Health Committee. FIGO good clinical practice paper: management of the second stage of labor. Int J Gynaecol Obstet 2021;152(2):172–81.

[9] Barbera AF, Pombar X, Perugino G, Lezotte DC, Hobbins JC. A new method to assess fetal head descent in labor with transperineal ultrasound. Ultrasound Obstet Gynecol 2009 Mar;33(3):313–9.
[10] Eggebø TM, Gjessing LK, Heien C, et al. Prediction of labor and delivery by transperineal ultrasound in pregnancies with prelabor rupture of membranes at term. Ultrasound Obstet Gynecol 2006 Apr;27(4):387–91.
[11] Boulmedais M, Monperrus M, Corbel E, et al. Predictive value of head-perineum distance measured at the initiation of the active second stage of labor on the mode of delivery: A prospective cohort study. Eur J Obstet Gynecol Reprod Biol 2023; 280:132–7.
[12] Cuerva MJ, Rodriguez E, Lopez F, Bartha JL. Intrapartum Ultrasound in Maternal Lateral Position. A Prospective Observational Study. Clin Exp Obstet Gynecol 2022; 49(9):197.
[13] Tutschek B, Braun T, Chantraine F, Henrich W. A study of progress of labour using intrapartum translabial ultrasound, assessing head station, direction, and angle of descent. BJOG 2011 Jan;118(1):62–9.
[14] Tutschek B, Torkildsen EA, Eggebø TM. Comparison between ultrasound parameters and clinical examination to assess fetal head station in labor. Ultrasound Obstet Gynecol 2013 Apr;41(4):425–9.
[15] Gupta JK, Sood A, Hofmeyr GJ, Vogel JP. Position in the second stage of labour for women without epidural anaesthesia. Cochrane Database Syst Rev. 2017 May 25;5 (5):CD002006.
[16] Borges M, Moura R, Oliveira D, Parente M, Mascarenhas T, Natal R. Effect of the birthing position on its evolution from a biomechanical point of view. Comput Methods Programs Biomed 2021 Mar;200:105921.
[17] Youssef A, Dodaro MG, Montaguti E, et al. Dynamic changes of fetal head descent at term before the onset of labor correlate with labor outcome and can be improved by ultrasound visual feedback. J Matern Fetal Neonatal Med 2021 Jun;34(12): 1847–54.