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Original article

Prediction of Successful Normal Vaginal Delivery by Ultrasonographic Measurement of Occiput-Spine Angle during First Stage of Labor

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Abstract:

Background: Most pregnancies end in spontaneous vaginal birth without the need for obstetric intervention. Nonetheless, some women do not progress past the second stage of labor and require surgical delivery. This study aimed to quantify the degree of fetal head deflection via the use of sonography during the first stage of labor and determine whether a parameter derived from ultrasound examination (the occiput-spine angle) has a relationship with the course and outcome of labor. **Methods:** This prospective randomized clinical trial was conducted on 140 women. All studied cases were subjected to the following: General examination with special emphasis, investigation [Blood group (ABO) and Rh] and antenatal ultrasound examination. **Results:** there was a highly statistically significant higher mean value of Occiput-Spine Angle(o) in NVD group comparing to L.S.C.S group (p<0.001). Area under the ROC curve (AUC) = 0.839 with SE 0.0388(95% Confidence interval 0.762 – 0.922. Z statistic =8.738, p<0.001. Cutoff point>125o with sensitivity = 82.6%, specificity=84.6%, positive predictive value 73.6%, negative predictive value 96.1% and accuracy 84.3%. **Conclusion:** Measurement of the occiput-spine angle, by sonography is feasible, reproducible and an objective tool to assess the degree of fetal head deflexion during labor and to predict the mode of delivery. Occiput-spine angle less than 125 degrees correlates with a significant increase in the rate of cesarean delivery, prolongation of the active and second stage of labor and increase incidence of maternal complications.

Keywords: Normal Vaginal Delivery; Ultrasonographic Measurement; Occiput-Spine Angle; First Stage.

Introduction

Normal birth is defined by the World Health Organization (WHO) as "spontaneous in onset, low risk in the early stages of labor, and remaining so throughout labor and delivery." Between 37 and 42 weeks of pregnancy, the newborn is born spontaneously in the vertex position. Both mother and baby are healthy at the time of birth [(1)].

Most pregnancies end in spontaneous vaginal birth without the need for obstetric intervention. Nonetheless, some women do not progress past the second stage of labor and require surgical delivery. Primary Cesarean section and instrumental delivery are two management techniques (forceps or vacuum) [(2)].

The vertex is flexed so that the chin rests on the fetal chest in the vertex presentation, producing the suboccipito-bregmatic diameter of roughly 9.5 cm across the maternal pelvis to be the broadest diameter. The smallest of the diameters utilized to navigate the maternal pelvis is this one [(3)].

Deflexed cephalic presentation, which accounts for one-third of caesarean deliveries, is a common cause of obstructed labor as a result of labor arrest [(4)].

The degree of head extension has traditionally been used to classify three forms of deflexed cephalic mal-presentations: sinciput, brow, and face [(5)].

An essential factor of the efficient and secure use of vacuum and forceps in instrumental delivery is the accurate identification of the fetal head position and the required application of the instrument. The right fetal position is not recognized by the digital examination in a large percentage of cases prior to instrumental delivery [(6)].

Several ultrasound measures, such as progression angle, head-symphysis distance, and head-perineum distance, showed high and moderate relationships with the fetal head-station evaluation digital inspection in a recent study [(7)].

The angle of advancement over time can be used to forecast when spontaneous labor will begin. Women who went into labor spontaneously after seven days had a significantly larger angle of advance than those who went into labor later. A greater angle of advancement in the next 7 days indicates spontaneous labor. The length of the cervix is also inversely associated with the angle of advancement, while gestational age is favorably associated [(8)].

The fetal head attitude (fetal head-to-spin relationship) may have a substantial impact on the outcome of labor during the initial stage. Traditionally, the prognosis of fetal head deviation has been based on a digital labor examination, while ultrasonography has lately been shown to be utilized to support clinical diagnosis [(9)].

The purpose of this study was to quantify the degree of fetal head deflection via the use of sonography during the first stage of labor and determine whether a parameter derived from ultrasound examination (the occiput-spine angle) has a relationship with the course and outcome of labor.

Patients and methods

This prospective randomized clinical trial was conducted on 140 women. The study was conducted at Obstetrics and Gynecology Department, Faculty of Medicine, Benha University Hospitals from March until September 2023.

An informed written consent was obtained from the patients. The study was done after being approved by the Research Ethics Committee, of OB/GYN department, Benha University.

Inclusion criteria were ages: 18 - 35 years, BMI: <30 kg/m2, gestational age: 37-42 weeks (calculated using LMP or 1st trimesteric U/S), singleton pregnancy, history of one vaginal delivery, occiputo-anterior position and active phase first stage of labor.

Exclusion criteria were age: <18 or>35 years, primigravida, occiputo-posterior position, placenta previa, DM, previous C.S, multiple pregnancy and HTN.

All studied cases were subjected to the following: Complete history taking of clinical importance including [Personal history; age, residence, occupation, marital status and special habits as smoking, alcohol, Menstrual history, Obstetric history, Contraceptive history, medical history, surgical history, family history]. **General examination with special emphasis. Investigation including [**complete blood picture, liver and kidney function tests, coagulation profile “prothrombin time (PT), partial thromboplastin time (PTT) and international normalized ratio (INR)”, viral hepatitis markers: hepatitis B and C viruses, Blood group (ABO) and Rh]. **Antenatal ultrasound examination**.

General examination with special emphasis on:

Obstetric abdominal examination “Leopold maneuvers”. The Leopold maneuvers are used to palpate the gravid uterus systematically. It is used to determine the position, presentation, and engagement of the fetus in utero.

The first maneuver called the fundal grip assesses the uterine fundus to determine its height and which fetal pole—that is, cephalic or podalic—occupies the fundus. The first maneuver aims to determine the gestational age and the fetal lie.

The second maneuver, called the umbilical grip, involves palpation of the lateral uterine surfaces. It allows establishing if the fetus is in a longitudinal, transverse, or oblique situation, and to determine the position of the back and small parts.

The third maneuver is called the Pawlik grips. This maneuver aids in the confirmation of fetal presentation.

The fourth maneuver resembles the first maneuver; however, the examiner faces the maternal pelvis. This maneuver involves the examiner placing the palms of both hands on either side of the lower abdomen, with the tips of the fingers facing downward toward the pelvic inlet. This maneuver identifies which presenting part is in the lower uterine pole.

In the first stage of labor, antenatal ultrasound examination, which included ultrasound measurements of classical fetal biometric parameters that included biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) that were taken using A GE Logiq P5 ultrasound machine, 2–5 MHz wide band convex, curved array transducer., ultrasound was conducted on patients using. All cases were scanned with the patient lying in the dorsal supine position.

Occiput-spine angle:

When the anterior occiput is the fetal position and the vertex is the fetal presentation, in the ultrasound machine, the bi-dimensional sagittal image of the fetal head and the upper spine were acquired and processed.

The offline angle calculation of the tangential line to the occipital bone and the tangential line to the cervical spine of the first vertebral body (occiput-spine angle) was performed in this image to determine the degree of flexion of the fetal head relative to the trunk.

The sonographer was not engaged in the patient's treatment and blinded to the ultrasound findings and the occiput-spine angle by the obstetrician in charge.

All ultrasound examinations were done by an expert and professional medical personnel to ensure the accuracy of examination results.

Progress of labor was assessed using Partogram (cervical dilation, effacement, consistency, position and station) and mode of delivery was evaluated prospectively for each patient in the study group.

In multipara, extended first stage of labor was characterized as cervical dilatation <1.5 cm / h for 2 hours while the first stage arrest was characterized as non-progress of cervical dilatation for > 4 hours despite sufficient uterine activity (3-5 contractions per 10 minutes).

In multipara, extended second stage of labor was characterized as fetal head descent <2 cm / h, while the second stage arrest was characterized as no fetal head fall after one hour, or two hours with epidural analgesia in multipara.

Neonatal assessment and follow up were performed using Apgar score at 1 and 5 mins.

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Statistical analysis

Statistical analysis was done by SPSS version 23.0(SPSS Inc., Chicago, Illinois, USA). Quantitative variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test and ANOVA (F) test. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. Receiver operating characteristic (ROC curve) analysis was used to find out the overall predictivity of parameter A two tailed P value < 0.05 was considered statistically significant.

Results

Table 1 shows all parameters descriptive among study group.

There was no statistically significant difference between Angle ≤125 and Angle >125 according to Age, obstetric history about parity and previous mode of delivery and GA(wks) At delivery, with p-value (p>0.05). Table 2

There was no statistically significant difference between Angle ≤125 and Angle >125 according to gender, with p-value (p>0.05). There was a statistically significant higher frequency of complications in Angle ≤125o was 27 women (73%) comparing to Angle >125o was 31 women (30.1%), with p-value (p<0.001). There was a statistically significant difference between Angle ≤125 and Angle >125 according to type of complication, with p-value (p<0.001). Table 3

Table 1: All parameters descriptive among study group:

		Total (N=140)
Age (years)		24.89±3.93
Parity		2 (1-3)
GA (wks) At delivery		38.30±0.89
Previous Mode of delivery	NVD	140 (100.0%)
Occiput-Spine Angle (o)		125.61±1.36
Angle Group		
Angle ≤125^{o}		37 (26.4%)
Angle >125^{o}		103 (73.6%)
Mode of Delivery		
L.S.C.S		23 (16.4%)
NVD		117 (83.6%)
Gender		
Female		66 (47.1%)
Male		74 (52.9%)
Complication		
Cervical Tear		9 (6.4%)
Non		82 (58.6%)
Obstructed Labor		23 (16.4%)
Perineal tear		10 (7.1%)
Vaginal Tear		16 (11.4%)

Table (2): Comparison between Angle ≤125 and Angle >125 regarding to different parameters.

	Angle ≤125(n=37)	Angle >125(n=103)	Test value	P-value	Sig
Age(years)					
Mean±SD	24.84±3.91	24.90±3.96	0.007	0.932	NS
Range	19-35	18-35			
Obstetric history					
Parity					
Median (IQR)	2 (1-3)	2 (1-3)	0.327	0.569	NS
Range	1-4	1-5			
Previous mode of delivery					
NVD	37 (100%)	103 (100%)	0.000	1.000	NS
GA(wks) At delivery					
Mean±SD	38.22±0.92	38.33±0.88	0.447	0.505	NS
Range	37-40	37-40			
Gender					
F	13 (35.1%)	53 (51.5%)	2.910	0.088	NS
M	24 (64.9%)	50 (48.5%)			
Complication					
No	10 (27.0%)	72 (69.9%)	18.894	0.000	HS
Yes	27 (73.0%)	31 (30.1%)			
Type of complication					
Cervical Tear	2 (7.4%)	7 (22.6%)	20.231	0.001	HS
Obstructed Labor	19 (70.4%)	4 (12.9%)			
Perineal tear	3 (11.1%)	7 (22.6%)			
Vaginal Tear	3 (11.1%)	13 (41.9%)			

IQR: Interquartile range
Using: U=Mann-Whitney test for Non-parametric data “Median (IQR)”;
x^2: Chi-square test for Number (%) or Fisher’s exact test, when appropriate
t-Independent Sample t-test for Mean±SD;
NS: Non significant; S: Significant; HS: Highly significant

Table (3): Comparison between Angle ≤125 and Angle >125 regarding to duration.

Duration	Total	Angle ≤125(n=37)	Angle >125(n=103)	Test value	P-value	Sig
Arrest	23 (16.4%)	19 (51.4%)	4 (3.9%)	45.604	0.001	HS
Normal	79 (56.4%)	10 (27.0%)	69 (67.0%)			
Prolonged	38 (27.1%)	8 (21.6%)	30 (29.1%)			

x^2: Chi-square test for Number (%) or Fisher’s exact test, when appropriate
NS: Non significant; S: Significant; HS: Highly significant

There was a statistically significant higher frequency of Angle >125(o) in NVD in was 99 women (84.6%) comparing to LSCS was 4 women (17.4%), with p-value (p<0.001). there was highly statistically significant higher mean value of Occiput-Spine Angle(o) in NVD group was 125.99±1.04 comparing to L.S.C.S group was 123.71±1.19, with p-value (p<0.001).Table 4

Area under the ROC curve (AUC) = 0.839 with SE 0.0388(95% Confidence interval 0.762 – 0.922. Z statistic =8.738, p<0.001. Cutoff point>125o with sensitivity = 82.6%, specificity=84.6%, positive predictive value 73.6%, negative predictive value 96.1% and accuracy 84.3%. Figure 1

21 years old female, P1 VD, 38weeks, Medically and surgically free. Figure 2

Table (4): Comparison between L.S.C.S group and NVD group regarding to Occiput-Spine Angle$^{(o)}$.

	L.S.C.S (n=23)	NVD (n=117)	Test value	P-value	Sig
Level of occiput-spine angle(^{o})					
Angle ≤125$^{(o)}$	19 (82.6%)	18 (15.4%)	41.283	0.000	HS
Angle >125$^{(o)}$	4 (17.4%)	99 (84.6%)			
Occiput-Spine Angle(^{o})					
Mean±SD	123.71±1.19	125.99±1.04	9.383	0.001	HS
Range	122-126.3	123-129			

x^2: Chi-square test for Number (%) or Fisher's exact test, when appropriate
NS: Non significant; S: Significant; HS: Highly significant

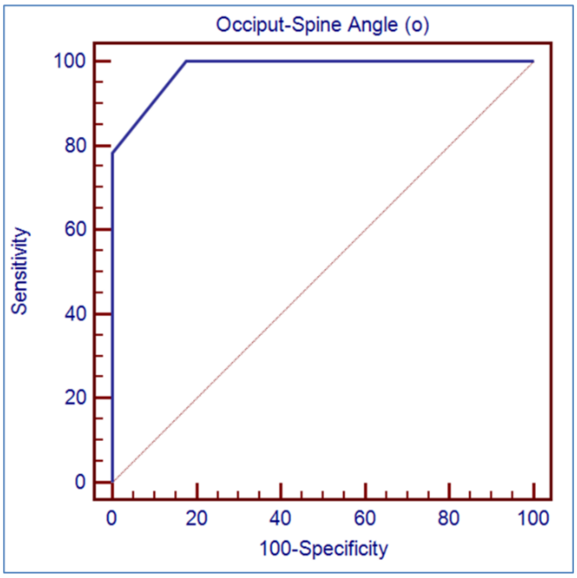

Figure 1: ROC curve analysis proved good discriminating power of the Occiput-Spine Angle(o) between Normal Vaginal delivery and LCS.

Figure 2: OSA= 124.8 degree, NVD, complicated by Perineal tear.

Discussion

During this study, 140 pregnant women were enrolled, after consenting each of them and divided into two groups after measuring of occiput-spine angle < or > 125 degree 37 (26.4%) and 103 (73.6%) respectively. Also, cases were divided into two groups as regards mode of delivery: lower segment caesarean section or normal vaginal delivery 23 (16.4%) and 117 (83.6%) respectively. Correlation between occiput-spine angle and duration of labor, mode of delivery and occurrence of maternal and fetal complications was done.

Most of the studies that disagreed with our results were due to several causes as different study methodology, outcomes, sample size and different medical conditions and gestational age of studied cases at time of enrollment.

Our study revealed that normal vaginal deliveries with mean ± SD of occiput-spine angle 125.99±1.04 were more frequent 99 (84.6%) vs. 18 (15.4%) and lower segment caesarean section with mean ± SD of occiput-spine angle 123.71±1.19 were less frequent 4 (17.4%) vs. 19 (82.6%) and maternal complications were less frequent 31 (30.1%) vs. 27 (73.0%) among cases with occiput-spine angle > 1250 compared with women with occiput-spine angle < 1250 with no differences between two groups as regard maternal age, parity, previous mode of delivery or gestational age at delivery.

Among cases with occiput-spine angle < 1250, obstructed labor was the most common adverse event 19 (70.4%) vs. 4 (12.9%) followed by perineal, vaginal and cervical tears 3 (11.1%), 3 (11.1%) and 2 (7.4%) respectively.

Finally, ROC curve analysis proved good discriminating power of the occiput-spine angle (o) between normal vaginal delivery and LCS. Cutoff point >125o with sensitivity = 82.6%, specificity=84.6%, positive predictive value 73.6%, negative predictive value 96.1% and accuracy 84.3%.

Shetty, agreed with us and reported that narrow occiput spine angle would alert the obstetrician about the tardy labor progress and less likelihood of vaginal delivery. This may be used as an adjunctive parameter when considering delivery mode. The prediction of operative delivery in first stage of labor by receiver–operating characteristics curve using OSA alone yielded an area under the curve of 0.95. At a cut-off of occiput spine angle $< 125°$, it predicts operative delivery due to labor dystocia with a sensitivity of 94%, and a specificity of 96%. The occiput-spine angle was significantly narrower in women who underwent obstetric intervention (Caesarean or forceps delivery) due to labor arrest ($120° \pm 6.2$ versus $131° \pm 5.7$ $P < 0.0001$) [10].

In agreement with our study, Sujatha et al., showed that mean occiput spine angle (OSA) of normal vaginal group was 126.53=11.1° and mean occiput spine angle (OSA) of caesarian section group was 116.25=^9.2° with high statistically significant difference between both groups as regard OSA [11].

Dall'Asta et al., reported that a wider OSA has been determined in cases that had VD in comparison with those of CS because of labor dystocia (126±14 versus 115±24) [12].

Ghi et al., was the first to present the valuation of OSA in literature in 2016, assessed 108 pregnancies in active labor. Of these, 79, 10 and 19 experienced spontaneous VD, surgical VD and CS, respectively. They revealed a smaller OSA in those who practiced CS or instrumental birth caused by arrest of labor. Cases with OSA <125 had an extended period of labor. They reported that births with narrow' OSA are more prone to surgical birth [9].

Akmal et al., studied the predictive value of occiput location noticed by US performed through active phase of labor as regard mode of birth. They revealed that the risk of CS could be detected via US of occipital location [13].

Gamal Abd El-Nasser et al., reported that the OSA was significantly narrower in cases who experienced CS birth because of labor arrest [14].

Furthermore. Fathy et al., found that OS A was statistically significantly lower in women experienced operative birth [15].

While, Mughal et al., demonstrated that OSA had a sensitivity and specificity of 92% and 98% respectively for prediction of operative birth [16].

This cutoff is comparable, but slightly lesser, that revealed by Maged et al., who stated a cutoff point of 126° with sensitivity, and specificity, was 78% and 93.8 resp [17].

In agreement with our study. Sujatha et al., demonstrated that the area under the curve in predicting VD was 0.79 (P<0.001). A cutoff value of 121° to discriminate between VD and CS in nulliparous cases with a sensitivity, specificity. PPV and NPV of 80.5%, 87.5%. 94.7%, and 54.53% respectively in prediction of VD in full-term nulliparous cases [11].

While Dall'Asta et al., reported that at the AUC was 0.67 (95% CL 0.538-0.812; P<01), and the best OSA cutoff value for the discrimination of women of VD and CS was 109° [12].

Conclusion

From our study we can conclude that measurement of the occiput-spine angle, by sonography is feasible, reproducible and an objective tool to assess the degree of fetal head deflexion during labor and to predict the mode of delivery. Occiput-spine angle less than 125 degrees correlates with a significant increase in the rate of cesarean delivery, prolongation of the active and second stage of labor and increase incidence of maternal complications. Occiput-spine angle at cut off point >125 had sensitivity = 82.6%, specificity=84.6%, positive predictive value 73.6%, negative predictive value 96.1% and accuracy 84.3% in prediction of possibility of vaginal delivery.

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