

Evaluation of Power of Intrapartum Ultrasonography to Predict Obstetric Outcomes in Pregnant Women with a Prolonged Second Stage of Delivery

Dr. Sibel Üstünel Tan¹, Prof. Dr. Emin Üstünyurt²

¹Assistant Professor Altınbaş University, Department of Obstetrics and Gynecology

sibel.ustnl@gmail.com, ORCID: 0000-0002-4096-0562

²Bursa City Hospital

dreminustunyurt@yahoo.com.tr, ORCID: 0000-0001-5602-6785

ABSTRACT

Introduction-Aim: Digital pelvic examination (DPE), which is used to monitor the progression of delivery; has 5 parameters: dilation, effacement, consistency and position of cervix and level-or station, of the fetal head. All these parameters are subjective and unrepeatable. In this study, it was aimed to evaluate the success of using intrapartum ultrasonography (IUSG) in the second stage of delivery to predict the obstetric outcomes.

Materials and Methods: 811 pregnant women, aged between 17 and 45 were included in the study. A detailed VM was made to all participants, who reached full cervical opening. After the effacement, position and consistency of the cervix, the level and the position of the fetal head and the state of the membranes were determined, these VE findings were confirmed by intrapartum ultrasonography. IUSG evaluations were performed by translabial and / or suprapubic method. Fetal occiput-spin angle (OSA) was evaluated by the suprapubic method and head-symphysis distance (HSD), head-perineum distance (HPD), head rotation (HR), head direction (HD), progression angle (AoP), progression distance (PD) and pelvic arch angle (PAA) were evaluated by translabial method. DPE and IUSG evaluations of all 810 participants were made by a single observer.

Results: A total of 810 participants were included in the study, including 494 primiparas and 316 multiparas; 520 were Turkish, 258 Syrian and 32 Meskhetian. There was no statistically significant difference in the distribution of parity by races or in the rates of delivery types between races. The duration of the second stage of delivery was significantly longer in Turkish and Syrian primiparas and multiparas women who underwent operative delivery (OD), including IVD and CS. In all three races, the most frequent fetal head position was left occiput transverse (LOT), and fetal head position was significantly associated with the type of delivery in primiparas subgroups.

Some of the eight intrapartum ultrasonographic parameters we examined were found to have clinical significance in predicting clavicle fracture. HR, HD, PD, and OSA were successful in predicting clavicle fracture in spontaneous vaginal delivery; HR and AoP were successful in predicting clavicle fracture in instrumental vaginal delivery. For spontaneous vaginal delivery, increased HR and PD, and decreased HD and OSA were associated with an increased incidence of clavicle fracture. In instrumental vaginal delivery, increased HR and AoP were observed to be associated with increased clavicle fracture rates.

Conclusion: In our study it was concluded that performing IUSG, regardless of DPE, can be very useful in clinical practice. The data obtained through IUSG, especially in the second stage of delivery; enabled visualization of complex positional changes occurring at the fetal head during its progress in the birth canal and made it possible to be a more objective follow-up for delivery process compared to the VM. It is thought that the standardization of the data obtained with ITU and IUSG can provide a clearer illumination of the pathophysiology of abnormal delivery. Thus, especially in complicated by dystocia delivery, clinical advantage can be gained in predicting delivery arrest and operative delivery, and maternal and neonatal adverse outcomes can be prevented during and after the delivery.

Keywords: Cesarean Delivery, Dystocia, Intrapartum USG, Instrumental Vaginal Delivery, Translabial USG, Vaginal Examination

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1. INTRODUCTION

Delivery is the period from the onset of regular uterine contractions to the expulsion of the placenta. When this process develops normally, it is called delivery action (DA). Dystocia, meaning difficult delivery, is characterized by an abnormal slowing of delivery. Today, dysfunctional delivery is the most frequent indication for primary cesarean delivery, followed by abnormal fetal cardiocography, fetal malpresentation, multiple pregnancy, and suspected fetal macrosomia (1).

The Bishop scoring, a quantitative method used to predict the outcome of delivery induction, consists of five parameters of the digital pelvic examination (DPE), which is globally accepted for monitoring the progress of delivery. These parameters are cervical dilation, cervical effacement, cervical position, cervical consistency, and the level of the presenting fetal portion in the birth canal. In addition to DPE being a method requiring experience, the subjective nature of all the aforementioned parameters leads to differences among clinicians when it comes to examination findings. Findings on DPE are not reproducible and even the findings of the same patient examined by the same clinician may differ. Studies using birth simulators have shown that vaginal examination (VE) findings not only vary among clinicians but also that one-third of the examinations are inaccurate (2).

DPE, especially when repeated frequently, can be distressing for the patient and may have negative psychological effects in the presence of predisposing conditions such as vaginismus. The frequency of VE has been associated with increased infection-related morbidity, particularly in cases of premature rupture of membranes (3-6). In addition, DPE is a method requiring high experience, and all findings obtained through examination are subjective. The lack of reproducible characteristics of VE findings leads to differences in examination even among patients evaluated by the same clinician. Furthermore, in determining the level of the presenting part of the fetus, the long axis of the birth canal above and below the spine is divided into three by some clinicians and into five by others. Studies have revealed that the definitions used to determine the level of the fetus in the birth canal show worrying individual differences, and that one-third of the examination findings are incorrect (2,7). The fact that the diversity and accuracy of findings obtained with VE are experience-dependent and vary among clinicians raises questions about the reliability.

Recently, the use of intrapartum ultrasound in the management of delivery has come to the forefront. Studies exist that demonstrate that standardized intrapartum ultrasound imaging techniques provide an objective approach to positional changes of the fetal head in the birth canal (2, 8, 9, 10-14). Intrapartum ultrasonographic imaging can predict spontaneous vaginal delivery and operative delivery to a certain extent (15, 16, 17-21). In addition, evidence emphasizing the effectiveness of ultrasound in predicting the success and outcomes of instrumental vaginal delivery is increasing every day (22-26).

USG can provide more objective delivery monitoring compared to VE, especially by visualizing the complex positional changes in the fetal head during its progression through the birth canal in the second stage of delivery (SSD) (25). This study aimed to investigate the success of using IUSG in predicting birth outcomes in SSD. Monitoring the delivery process and determining fetal head position with IUSG has higher accuracy rates compared to SSD, which is highly subjective and experience-dependent (25). Standardizing the data obtained with ITU and IUSG can provide a clearer understanding of the pathophysiology of dysfunctional DA. Thus, clinical advantages can be obtained in delivery management and predicting operative delivery, especially in births complicated by dystocia, and maternal and fetal adverse outcomes can be prevented during and after DA.

2. MATERIALS AND METHODS

2.1 Methods

Our study is an open (uncontrolled), double-blind, cross-sectional prospective study designed to investigate the success of using intrapartum USG in the second stage of delivery (SSD) for predicting delivery outcomes. The study included 811 pregnant women aged 17-45 years who were admitted to our clinic for vaginal delivery between October 1, 2019 and March 31, 2020. Our study was ethically approved on September 18, 2019, with decision number 2011-KAEK-25 2019/09-20. All participants were informed about the study and only who signed the Informed Consent Form were included in the study.

In our study, vaginal delivery follow-up plan and active delivery status were accepted as inclusion criteria. Exclusion criteria included vaginal delivery after cesarean delivery, presentation anomalies, multiple pregnancies, cases with detected fetal anomalies, intrauterine ex fetus cases and vaginismus cases.

2.2 Study Group and Study Procedure

All participants had a gestational age of 39⁺° - 40⁺° weeks. Pregnant women who had never given birth and those with a previous birth history were examined in two groups as primipara and multipara. All participants underwent

induction/augmentation during SSD.

The participants, whose full cervical dilation was determined by DPE, underwent detailed VE to determine cervical effacement, cervical position and consistency, fetal head level, fetal head position, and membrane status. These VE findings were confirmed by intrapartum USG. Ultrasonographic evaluations were performed transabdominally and suprapubically using a SonoScape S40 (China) device with a 3.5-5.0 MHz transabdominal convex probe.

DPE and intrapartum ultrasonographic evaluations were all performed by a single researcher. The researcher's predictions and forecasts regarding the mode of delivery, based on ultrasonographic data, were not shared with the clinician performing the delivery, nor with the clinician's VE findings. The decision regarding the mode of delivery was made solely by the clinician performing the delivery, and the researcher did not interfere with this decision.

Mode of delivery and related maternal outcomes were obtained by retrospectively reviewing the patient's birth and surgery notes, postnatal delivery findings and discharge summaries recorded in our hospital's data system. APGAR scores and neonatal outcomes related to the mode of delivery were recorded by retrospectively reviewing the newborn's footprint sheets and the birth and surgery notes and discharge summaries found in our hospital's data system.

2.3 Statistical Analysis

The Shapiro-Wilk test was used to examine whether the data showed a normal distribution. Data showing a normal distribution were examined using the t-test and one-way analysis of variance. For non-normally distributed data, the Mann-Whitney U test and the Kruskal-Wallis test were used. The Bonferroni test was used for multiple comparison tests. Relationships between variables were examined using Pearson correlation and Spearman correlation coefficients. Pearson Chi-square test, Fisher's Exact Chi-square test, and Fisher-Freeman-Halton test were used to examine categorical data. In the study, the threshold value for the duration of the second stage according to the mode of birth was examined separately for race and parity using "ROC analysis (receiver operator characteristic)". Along with the ROC analysis, the threshold value, area under the curve, sensitivity, and specificity values were calculated. The significance level was set at $\alpha=0.05$. Statistical analysis of the data was performed using the IBM SPSS 23.0 statistical software package (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.).

3. RESULTS

In our study, a total of 810 participants were included, comprising 494 primiparas and 316 multiparas women. Of these, 520 were Turkish, 258 were Syrian and 32 were Meskhetian. Average age was 23 (17-41) in Turkish pregnant women, 21 (17-37) in Syrian, and 22 (18-39) in Meskhetian and a statistically significant relationship was found in terms of age distribution by races ($p < 0.001$). There was no significant difference between races in terms of rates of the types of delivery ($p = 0.794$).

There was no statistically significant difference in parity distribution among the racial groups ($p = 0.390$). In terms of the relationship of the parity with the types of delivery; there was no significant difference between Syrian and Meskhetian participants. In Turkish participants, spontaneous vaginal delivery (SVD) rates were observed to increase with the increase in parity and the difference was found statistically significant ($p = 0.006$).

For primipara group; the average duration of the second stage in Turkish pregnant women was 50.0 ± 36.6 min, in Syrians - 48.5 ± 32.0 min and in Meskhetians - 50.0 ± 36.6 min. It was determined that the duration of the second stage in Turkish and Syrian primipara subgroups was significantly longer in those who underwent OD, including IVD and CS (for Turkish participants; SVD: 45 ± 12.3 min, IVD: 100 ± 37.1 min, CS: 110 ± 36.7 min, $p < 0.001$; for Syrian participants; SVD: 45 ± 11.0 min, IVD: 126.5 ± 36 min, CS: 108 ± 27.9 min, $p < 0.001$). Cut-off values for delivery arrest and SVD were 60 min. (95% CI: 0.932-0.978; $p < 0.0001$; sensitivity: 93.4%; specificity: 94.8%) and 70 min. (95% CI: 0.962-1.000, $p < 0.0001$; sensitivity: 94.8%; specificity: 100.0%) respectively; for Turkish and Syrian primiparas.

For multipara group; the average duration of the second stage was 35.0 ± 37.8 min in Turkish pregnant women, 35.0 ± 26.2 min in Syrians and 45.0 ± 43.9 min in Meskhetians. It was determined that the duration of the second stage in Turkish and Syrian multipara subgroups was significantly longer in those who underwent OD, including IVD and CS (for Turkish participants; SVD: 32 ± 14.4 min, IVD: 92.5 ± 35.5 min, CS: 111.5 ± 30.2 min, $p < 0.001$; for Syrian participants; SVD: 35.0 ± 13.1 min, IVD: 75.0 ± 31.8 min, CS: 91.0 ± 26.6 min, $p < 0.001$). Cut-off values for LA and SVD were 54 min. (95% CI: 0.966-0.999; $p < 0.0001$; sensitivity: 100.0%; specificity: 95.3%) and 55 min. (95% CI: 0.835-0.954, $p < 0.0001$; sensitivity: 85.7%; specificity: 95.4%) respectively; for Turkish and Syrian multiparas.

For all 3 races; in both primipara and multipara groups, the highest frequency in fetal head position was determined as left occiput transverse (LOT) [45.7% in Turkish primipara subgroup, 46.7% in Syrians, 36.4% in Meskhetians and 40.9% in

Turkish multipara subgroup, %40,7 in Syrians, %30,0 in Meskhetians]. In all 3 races, there was no significant difference between primipara and multipara groups in terms of distribution of fetal head position frequency according to parity ($p=0,213$; $p=0,164$; $p=0,786$ respectively; for Turkish, Syrian and Meskhetian participants). In Turkish primipara subgroup, fetal head position with the highest rate of SVD was LOT (61.9%) of IVD was left occiput posterior (LOP) (30.0%) and of CS was occiput posterior (OP) (31.4%) position. In Syrian primipara subgroup, fetal head position with the highest rate of SVD was LOT (62,2%), of IVD was LOP (35.0%) and of CS was OP (26,3%) position. In Meskhetian primipara subgroup, fetal head position with the highest rate of SVD was LOT (46,7%), of IVD was LOP, OP, occiput anterior (OA) and left occiput anterior (LOA) and of CS was right occiput posterior (ROP) (26,3%) position.

As HSD increases; OD (including IVD and CS) rates were observed to increase and the relationship between HSD and the type of delivery was statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,039$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p=0,001$ respectively for Turkish and Syrian multiparas). As HPD increases; OD (including IVD and CS) rates were observed to increase and the relationship between HPD and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,048$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p=0,001$ respectively for Turkish and Syrian multiparas). As HR increases; OD (including IVD and CS) rates were observed to increase and the relationship between HR and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,001$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p <0,001$ respectively for Turkish and Syrian multiparas).

As HD decreases; OD (including IVD and CS) rates were observed to increase and the relationship between HD and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,001$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p <0,001$ respectively for Turkish and Syrian multiparas). As AoP decreases; OD (including IVD and CS) rates were observed to increase and the relationship between AoP and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,001$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p <0,001$ respectively for Turkish and Syrian multiparas). As PD decreases; OD (including IVD and CS) rates were observed to increase and the relationship between PD and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,001$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p <0,001$ respectively for Turkish and Syrian multiparas).

As OSA decreases; OD (including IVD and CS) rates were observed to increase and the relationship between OSA and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,011$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$, $p <0,001$ respectively for Turkish and Syrian multiparas). As PAA decreases; OD (including IVD and CS) rates were observed to increase and the relationship between PAA and the type of delivery was also statistically significant for all 3 races in primiparas and for Turkish and Syrian participants in multiparas ($p <0,001$, $p <0,001$, $p=0,002$ respectively; for Turkish, Syrian and Meskhetian primiparas and $p <0,001$ for Turkish multiparas). There was no significant relationship between PAA and the type of delivery in Syrian multiparas ($p = 0,327$). Due to the insufficient number of data in Meskhetian multiparas; HSD, HPD, HR, HD, AoP, PD, OSA and PAA could not be compared statistically with type of delivery.

Cut-off values of the USG parameters calculated for the risk of LA and OD (including IVD and CS) in Turkish primiparas were 24mm, 45mm, 48°, 121°, 126°, 31mm, 127° and 126° respectively; for HSD, HPD, HR, HD, AoP, PD, OSA and PAA. 21mm, 39mm, 45°, 125°, 124°, 30mm, 124° and 128° were the cut-off values for Turkish multiparas; 27mm, 41mm, 43°, 123°, 126°, 30mm, 126° and 130° for Syrian primiparas and 21mm, 57mm, 44°, 120°, 122°, 30mm, 125° and 127° for Syrian multiparas respectively; for HSD, HPD, HR, HD, AoP, PD, OSA and PAA (Tablo 1-Tablo 2).

USG parameters that are statistically significant in predicting clavicular fracture for SVD are HR, HD, PD and OSA (OR: 1,175; 95% CI: 1,094-1,261; $p <0,001$ for HR; OR: 0,894; 95% CI: 0,885-0,931; $p <0,001$ for HD; OR: 1,033; 95% CI: 1,008-1,059; $p = 0,010$ for PD and OR: 0,971; 95% CI: 0,948-0,995; $p = 0,020$ for OSA). It was determined that the increase of HR and PD and the decrease of HD and OSA increases the rates of clavicular fracture. IUSG parameters that were found statistically significant for IVD in predicting the clavicular fracture were HR and AoP (OR: 1,278; 95% CI: 1,135-1,439; $p <0,001$ for HR and OR: 1,108; 95% CI: 1,002-1,225; $p = 0,046$ for AoP). In IVD; increased HR and AoP were associated with an increased rates of clavicular fracture (Table 3-Table 4).

For all 3 races; in both primiparas and multiparas pregnant women, USG parameters, which showed the best correlation with the level of fetal head in the birth canal, were determined as HSD and HPD and the difference was found statistically

significant [in primiparas; in all 3 races, both HSD (r: -, 869; r: -, 925; r: -, 887 respectively; for Turkish, Syrian and Meskhetian participants) and HPD (r: -, 940 r: -, 965; r: -, 919 respectively; for Turkish, Syrian and Meskhetian participants) $p < 0.001$; for HSD in multiparas (r: -, 871; r: -, 9.7; r: -, 891 respectively; for Turkish, Syrian and Meskhetian participants); $p < 0.001$ in both Turkish and Syrian patients; $p = 0.001$ in Meskhetians and for HPD (r: -, 907; r: -, 889; r: -, 907 respectively; for Turkish, Syrian and Meskhetian participants) $p < 0.001$ in all 3 races].

In Turkish and Syrian primiparas; adverse neonatal outcomes such as 1st and 3rd minute APGAR scores, shoulder dystocia and calvicular fracture, were observed to increase with the increase in OD (including IVD and CS) rates, and the difference was found statistically significant ($p < 0,001$; $p < 0,001$; $p < 0,001$ respectively for 1st min APGAR score, 3rd min APGAR score, shoulder dystocia and calvicular fracture in Turkish primiparas and $p < 0,001$; $p = 0,004$; $p = 0,044$ ve $p = 0,042$ respectively in Syrian primiparas). In Meskhetian primiparas; due to the insufficient number of data, 1st and 3rd min. APGAR scores could not be compared statistically with the type of delivery. In terms of shoulder dystocia and claviclar fracture, no statistically significant difference was found between type of delivery and neonatal outcomes in Meskhetian primiparas ($p = 0,499$; $p = 0,545$ respectively for shoulder dystocia and claviclar fracture). Adverse neonatal outcomes (1st and 3rd minute APGAR scores, shoulder dystocia and calvicular fracture) were observed to increase with the increase in OD (including IVD and CS) rates in Turkish and Syrian multiparas and the difference was also found statistically significant ($p < 0,001$; $p < 0,001$; $p < 0,001$ and $p = 0,001$ respectively for 1st min APGAR score, 3rd min APGAR score, shoulder dystocia and calvicular fracture in Turkish multiparas and $p < 0,001$; $p = 0,002$; $p = 0,001$ ve $p = 0,002$ respectively in Syrian multiparas). In Meskhetian multiparas; due to the insufficient number of data, 1st and 3rd mi. APGAR scores could not be compared statistically with the type of delivery. In terms of shoulder dystocia and claviclar fracture, no statistically significant difference was found between type of delivery and neonatal outcomes in Meskhetian multiparas ($p = 0,200$ for both shoulder dystocia and claviclar fracture).

In primiparas; episiotomy and 3rd degree perineal laceration (DPL) rates were observed to increase in all 3 races in IVD, and the difference was found statistically significant ($p < 0,001$; $p < 0,001$; $p = 0,004$ respectively for Turkish, Syrian and Meskhetian primiparas for episiotomy and $p < 0,001$; $p = 0,002$; $p = 0,039$ respectively; for 3rd DPL). It was found that the rates of 4th DPL and postpartum hemorrhage (PH) in Syrian primiparas increased with IVD (Instrumental vaginal delivery) and the difference was statistically significant ($p = 0,004$; $p = 0,017$ respectively for 4th DPL and PH). In Turkish primiparas, the rate of 4th DPL was higher in patients giving birth with SVD, and the difference was found statistically significant ($p < 0,001$). There was no statistically significant relationship between PH and type of delivery in Turkish primiparas ($p = 0.552$). In multiparas, for Turkish and Syrian participants; episiotomy, 3rd DPL and 4th DPL rates were observed to be increased with IVD, and the difference was found statistically significant (for episiotomy $p < 0,001$; $p < 0,001$ respectively for Turkish and Syrian multiparas, for 3rd DPL $p < 0,001$; $p < 0,002$ and for 4th DPL $p < 0,001$; $p < 0,001$ respectively for Turkish and Syrian multiparas). Between PH and type of delivery; no statistically significant relationship was found in both Turkish and Syrian multiparas ($p = 0,101$; $p = 0,246$ respectively for Turkish and Syrian multiparas).

4. DISCUSSION

HSD, an IUSG parameter that represents the distance between the lower edge of the maternal symphysis pubis and the fetal occipital bone, is expected to shorten as the fetal head progresses through the birth canal towards the introitus. Youssef A. et al. (27) concluded that the fetal head shortened as it progressed through the birth canal in SVD patients, while it maintained its initial length in participants who gave birth with OD (28). In our study, it was also found that HSD was shorter in both primiparas and multiparas patients who gave birth with SVD, and that the incidence of OD increased with increasing HSD.

A shorter HPD, which represents the shortest distance between the outermost edge of the fetal occipital bone and the perineum in the translabial transverse plane, has been associated with reduced need for epidural anesthesia, shorter DE and reduced SD rates (14,16,17). In a study conducted by Eggebø TM et al. in 2008; They have shown that short HPD is associated with increased SVD rates (15). In our study, short HPD was also found to be associated with a high SVD incidence, and it was observed that with increasing HPD, OD rates increased in both primiparas and multiparas pregnant women.

Henrich W. et al., noted that the rates of SVD and successful IVD increased in the head-up position (29). Our study also showed that the incidence of SVD was higher in the head-up position and that OD rates increased with decreasing HD angle. Barbera AF et al., revealed that the AoP was $\geq 120^\circ$ in all pregnancies that gave birth by SVD (15). Ghi T et al. found that the AoP angle was wider in patients who gave birth by SVD (30). The results of our study also showed that in both primiparas and multiparas participants, a wide AoP was associated with an increased incidence of SVD and OD rates increased as the AoP narrowed.

In a study Nishmura K. et al. found that a PD of < 35 mm was associated with an increased incidence of EA. In our study,

it was also determined that a shortened PD was associated with increased OD and consequently increased EA rates. The results of a study conducted by Ghi T. et al. in 2016 on 108 singleton pregnancies showed that the risk of OD was increased in cases where the OSA was $<125^\circ$ (31). In our study, it was observed that a wide OSA increased the probability of SVD, and a narrow OSA was found to be associated with an increased incidence of OD. Gilboa Y. et al. observed that a PAA of $<110^\circ$ was associated with an increased risk of OD, perineal laceration, and malrotation (32). In our study, it was also determined that the OD rates increased as the PAA narrowed.

To our knowledge, there is no study investigating the role of intra-abdominal ultrasound (IUSG) in predicting clavicle fracture, a common birth complication. In our study, the success of intrapartum ultrasonographic parameters in predicting clavicle fracture was examined separately for SVD and IVD patients. In pregnant women who gave birth via SVD, it was observed that an increase in HR and PD, and a decrease in HD and OSA, increased the incidence of clavicle fracture. The parameters that increased the clavicle fracture rates in participants who gave birth via IVD were identified as HR and AoP. In their study examining HD, PD and AoP, Nishmura K. et al. stated that AoP was the USG finding that showed the best correlation with the fetal head level determined by VE. In our study, all ultrasonographic parameters, including HSD, HPD, HD, HR, AoP, PD, OSA and PAA, were examined separately for primiparas and multiparas patients according to race. Accordingly, it was observed that the ultrasonographic parameters showing the best correlation with the fetal head level determined by VE were HSD and HPD in both primiparas and multiparas patients.

Nishmura K. et al., examined HD, PD, and AoP in their study; they stated that the USG finding showing the best correlation with the fetal head level determined by VM was AoP (12). In our study, all ultrasonographic parameters, including HSD, HPD, HD, HR, AoP, PD, OSA, and PAA, were examined separately for primiparas and multiparas patients according to race. Accordingly; In both primiparas and multiparas patients, the ultrasonographic parameters showing the best correlation with the fetal head level determined by VM were observed to be HSD and HPD.

Rouse DJ et al. noted that 5-minute APGAR scores, umbilical artery pH values, intubation, need for neonatal intensive care unit and neonatal sepsis rates were not related to the duration of SSD (33). The results of our study, however, found that OD and consequently EA (prolonged SSD duration) in primiparous pregnancies were associated with poor neonatal outcomes, and that in births resulting in OD (IVD and SVD), 3rd and 5th minute APGAR scores were lower, and the incidence of obstetric complications, including shoulder dystocia and clavicle fracture, was higher. Cheng YW et al. found that prolonged SSD duration was associated with low 5-minute APGAR scores and increased need for neonatal intensive care (28). The results of our study also found that OD and consequently EA in multiparous pregnancies were associated with poor neonatal outcomes.

Prolonged second-stage puerperal infection rates are associated with the incidence of 3rd and 4th DPL postpartum hemorrhage (1). Furthermore, each hour of SSD prolonged increases the risk of OD by 30-50% for both nulliparous and primiparous patients (33). Similar to these results, we concluded that prolonged DPI and consequently increased OD rates increased maternal complications, including episiotomy, 3rd and 4th DPL, and postpartum atony, in both primiparous and multiparous pregnant women.

5. CONCLUSION

Our study have shown that monitoring labor independently of digital pelvic examination, using sonopartogram recording of intrapartum ultrasonography findings, can be quite beneficial in clinical practice. Our results suggest that standardizing data obtained from intrapartum suprapubic and translabial ultrasonography may provide a clearer understanding of the pathophysiology of dysfunctional delivery. Thus, clinical advantages may be gained, particularly in predicting labor arrest and operative delivery in labor complicated by dystocia and adverse maternal and fetal outcomes during and after delivery may be prevented.

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TABLES

Table 1. ROC analyses and cut-off values for the success of USG parameters in predicting labor arrest and mode of delivery in primiparas pregnant women

USG Parameters	Turkish (n=322)				Syrian (n=150)			
	EAA	95% GA	P	cut-off	EAA	95% GA	P	cut-off
<i>HSD</i>	0,860	0,817-0,896	<0,0001	>24 mm	0,902	0,843-0,945	<0,0001	>27 mm
<i>HPD</i>	0,854	0,810-0,890	<0,0001	>45 mm	0,902	0,843-0,945	<0,0001	>41 mm
<i>HR</i>	0,968	0,942-0,984	<0,0001	>48°	0,958	0,913-0,984	<0,0001	>43°
<i>HD</i>	0,956	0,927-0,976	<0,0001	≤121°	0,984	0,949-0,997	<0,0001	≤123°
<i>AoP</i>	0,968	0,943-0,985	<0,0001	≤126°	0,992	0,962-1,000	<0,0001	≤126°
<i>PD</i>	0,926	0,892-0,952	<0,0001	≤31 mm	0,958	0,913-0,984	<0,0001	≤30 mm
<i>OSA</i>	0,929	0,894-0,955	<0,0001	≤127°	0,962	0,916-0,987	<0,0001	≤126°
<i>PAA</i>	0,835	0,790-0,874	<0,0001	≤126°	0,900	0,841-0,943	<0,0001	≤130°

Table 2. ROC analyses and cut-off values regarding the success of USG parameters in predicting labor arrest and mode of delivery in multiparas pregnant women

USG Parameters	Turkish (n=198)				Syrian (n=108)			
	EAA	95% GA	P	cut-off	EAA	95% GA	P	cut-off
<i>HSD</i>	0,749	0,683-0,808	<0,0001	>21 mm	0,747	0,654-0,826	<0,0001	>21 mm
<i>HPD</i>	0,716	0,647-0,777	<0,0001	>39 mm	0,731	0,637-0,812	<0,0001	>57 mm
<i>HR</i>	0,956	0,917-0,980	<0,0001	>45°	0,995	0,958-1,000	<0,0001	>44°
<i>HD</i>	0,952	0,912-0,977	<0,0001	≤125°	0,993	0,954-1,000	<0,0001	≤120°
<i>AoP</i>	0,995	0,971-1,000	<0,0001	≤124°	0,984	0,938-0,998	<0,0001	≤122°
<i>PD</i>	0,942	0,900-0,971	<0,0001	≤30 mm	0,936	0,872-0,974	<0,0001	≤30 mm
<i>OSA</i>	0,934	0,888-0,966	<0,0001	≤124°	0,977	0,926-0,996	<0,0001	≤125°
<i>PAA</i>	0,789	0,725-0,843	<0,0001	≤128°	0,605	0,506-0,698	<0,0001	≤127°

Table 3. The role of ultrasonographic parameters in predicting clavicle fracture in SVD

<i>Ultrasonographic parameters</i>	<i>OR¹</i>	<i>95% CI²</i>	<i>P</i>
Head-symphysis distance (HSD)	1,008	0,915-1,110	0,876
Head-perineum distance (HPD)	0,956	0,874-1,047	0,335
Head rotation (HR)	1,175	1,094-1,261	<0,001
Head direction (HD)	0,894	0,858-0,931	<0,001
Progression angle (AoP)	1,012	0,979-1,046	0,467
Progression distance (PD)	1,033	1,008-1,059	0,010
Occiput-spin angle (OSA)	0,971	0,948-0,995	0,020
Pelvic arch angle (PAA)	1,040	0,990-1,093	0,118

¹OR: Odds Ratio. ²CI: Confidence interval

Table 4. The role of ultrasonographic parameters in predicting clavicle fracture in IVD

<i>Ultrasonographic parameters</i>	<i>OR¹</i>	<i>95%CI²</i>	<i>P</i>
Head-symphysis distance (HSD)	0,888	0-757-1,043	0,149
Head-perineum distance (HPD)	1,079	0,939-1,240	0,282
Head rotation (HR)	1,278	1,135-1,439	<0,001
Head Direction (HD)	1,039	0,942-1,146	0,442
Progression angle (AoP)	1,108	1,002-1,225	0,046
Progression distance (PD)	0,898	0,748-1,080	0,254
Occiput-spin angle (OSA)	1,028	0,976-1,082	0,295
Pelvic arch angle (PAA)	1,012	0,948-1,081	0,723

¹OR: Odds Ratio. ²CI: Confidence interval