

SONOGRAPHIC EVALUATION OF THE MECHANISM OF LABOR-OUR PRELIMINARY EXPERIENCE

**Chibisheva Vesna, Antovska Vesna, Kochoski Goran, Pejkovska-Ilieva Maja,
Bushinovska Gabriela, Kijajova Ivana**

University Clinic for Obstetrics and Gynecology, Faculty of Medicine, Ss. Cyril and
Methodius University in Skopje, Republic of North Macedonia
e-mail: vesna_cibiseva@yahoo.com

Abstract

Introduction: Intrapartum ultrasound evaluation is a contemporary diagnostic tool that provides insight into the process of normal labor and assists in its monitoring. Standardized mathematical parameters are used to assess the relationship between defined landmarks on the fetal head and structures of the soft and bony tissues of the birth canal.

Aim: This study was designed to show that intrapartum sonographic parameters, primarily the angle of progression and the distance between the fetal head and maternal perineum, are equally effective in the management of labor progress, as vaginal digital examinations.

Material and methods: A prospective cohort study was conducted involving 50 laboring women who were admitted at the delivery department of the University Clinic for Obstetrics and Gynecology in Skopje. They were all in the active stage of labor and were evaluated with intrapartum ultrasound, both transabdominal and transperineal, during the first, second and third hours after admission.

Results: An increase in the angle of progression and a decrease in the distance between the fetal head and the maternal perineum can help in predicting the mode of delivery and the time interval to delivery.

Conclusion: Introducing intrapartum ultrasound as a complementary tool to the digital vaginal examinations, offers new perspectives in the perinatology, with a unique opportunity for modification and modernization of the traditional protocols for management of labor and delivery, still used across the modern countries worldwide.

Keywords: intrapartum ultrasound, angle of progression, fetal head-perineum distance, time of delivery

Introduction

Historically, the progress of normal labor and delivery was traditionally observed solely by serial transvaginal digital examinations, which are associated with a certain degree of subjectivity, inter- and intra-observer variability, and a high probability of assessment errors. Accurate estimation of descent and position of the fetal head is a critical component of the clinical evaluation of a laboring woman, while also helping predict every further step until normal delivery, or the need for a safer operative vaginal delivery.

Healthcare professionals, who work in labor and delivery departments have, over the past 10 years, continuously faced with obstacles in the proper management of normal delivery, particularly due to frequent individualization in the approach resulting from the lack of

standardized national protocols. This, in turn, has led to a higher incidence of cesarean sections, complicated or unsuccessful operative vaginal deliveries, and high perinatal mortality and morbidity rates. In an effort to find a more appropriate method for managing women in labor, modern delivery departments worldwide have explored the use of ultrasound in a completely novel field of clinical application. The intrapartum ultrasound has been presented as a helpful method during labor, which through transabdominal and transperineal examinations, provides precise and useful mathematical parameters that can improve the management of normal deliveries. Using simple and easily transportable ultrasound machines, evaluation can be performed directly in the labor room with a convex transabdominal probe. According to the literature, there are two official protocols that can be used for intrapartum ultrasound evaluation of patients and interpretation of parameters (The International Society of Ultrasound in Obstetrics and Gynecology- ISUOG, 2018; Ultrasound in labor: clinical practice guideline and recommendation by the WAPM-World Association of Perinatal Medicine and the PMF-Perinatal Medicine Foundation, 2022). Various parameters can be applied, but the angle of progression and the distance between the fetal head and maternal perineum are most frequently used.

Many scientific arguments and evidence available today show that intrapartum ultrasound can be incorporated as an additional and complementary method to the digital vaginal examinations, and it can become a routine practice in the modern labor units. Ultrasound evaluation during the process of labor does not require modern ultrasound machines; it can be easily performed and at the same time it provides precise and reproducible results. An important aspect of this type of clinical evaluation is the patient perspective; the majority of patients prefer the sonographic approach. First of all, it is completely painless and noninvasive, but patients also reported feeling less ashamed and upset. Intrapartum ultrasound evaluation can regain trust in the medical personnel and legally speaking, it also presents its superiority with digitalization of results, photo records and reports, making them available for possible further quality control. Still, there are no strictly defined clinical scenarios where intrapartum ultrasound should be applied, although it can be used in routine clinical practice, especially in situations of protracted and prolonged labor, inter-observer biases and dilemmas related to labor and delivery management^[1].

Introducing intrapartum ultrasound in labor and delivery units poses a serious challenge for the modern perinatology. The incidence of cesarean sections is rising constantly during the last decade, reflecting that the management of normal labor is inappropriate, especially in cases of malpresentations and malrotations, associated with a high rate of errors in assessment, which leads to wrong clinical decisions, protracted labor and poor perinatal outcomes. Sonographic assessment during labor can provide an objective evaluation of asynclitism and precise evaluation before application of forceps or vacuum. When dystocia occurs, which happens in approximately 40% of deliveries, early recognition of the cause can assure appropriate management^[2].

Monitoring labor progress with intrapartum ultrasound can play an essential and revolutionary role in contemporary clinical protocols and in the development of national guidelines. The sonopartogram, a digital tool for monitoring the different stages of labor, is an objective method for graphical follow-up and offers improved accuracy in assessing fetal position and descent. Improvement and modernizing the approach to the management of laboring women in labor and delivery units can increase the number of properly managed spontaneous deliveries and reduce perinatal and neonatal morbidity and mortality rates^[3].

Aim of the study

To show the reliability of intrapartum sonographic parameters, such as the angle of

progression and distance between the fetal head and the maternal perineum, in the process of labor and delivery management.

Material and methods

This study was designed as a prospective cohort study and was conducted at the labor and delivery department of the University Clinic for Obstetrics and Gynecology in Skopje. A total of 50 laboring women in the active stage of labor was analyzed.

The sonographic evaluations were made in the laboring room by one examiner. Ultrasound parameters were collected as image data in the software, and quantitative data were collected in a previously designed database. After delivery, every single sonographic parameter was compared with clinical outcomes.

Inclusion criteria:

- Singleton pregnancy;
- Viable fetus, cephalic presentation;
- ≥ 37 weeks of gestation;
- Ruptured membranes;
- Active phase of labor, defined as cervical dilatation ≥ 7 cm and 3-5 spontaneous uterine contractions in a 10-minute interval;
- Number of previous cesarean sections ≤ 1 .

Exclusion criteria:

- Multiple pregnancies;
- Fetal death *in utero*;
- < 37 gestational weeks;
- Non-cephalic presentation;
- Absolute indication for cesarean section;
- Fetal distress.
- After primary selection of patients, demographic and descriptive data were collected from the clinical file, such as:
 - Age,
 - Ethnicity,
 - Familial and personal medical history,
 - Obstetric history
 - Sociomedical issues.

Procedure

Serial ultrasound examinations were conducted in the laboring suite, in a relaxing and private atmosphere. Examinations were performed at one-hour interval, completing a total of three consecutive ultrasound evaluations, or until delivery occurred. Sonographic evaluation was performed during operative vaginal delivery, including ultrasound-assisted forceps or vacuum delivery.

At the University Clinic for Obstetrics and Gynecology, the ultrasound machine Voluson S6 series (GE Healthcare) is used. This device, despite having larger dimensions than recommended, has an ergonomic design, is easily transported and has a high quality battery that can last up to 30-minutes without electrical supply. It has an 19 inch high-resolution LCD monitor. We use an abdominal convex probe, with wide spectrum and low insonation frequency. Sonographic markings in the birth canal and fetal presenting part can be evaluated using additional tools as SRI (Speckle reduction imaging) and CrossXBeam. Technical characteristics of the software and modern technology used for probe design provide high

quality images that can be reproduced at any time and also memorized in the archive files, for further usage.

Two ultrasound approaches are used at the Clinic - transabdominal and transperineal, both performed with the same convex probe. The patient is positioned supine, on sterile bed covers. The examination is performed after emptying the urinary bladder. The transabdominal evaluation is performed first. Fetal presentation and position, the amount of amniotic fluid and placental location are assessed. In the sagittal plane, fetal body parts, position and degree of fetal spine flexion, and the position of the fetal heart are identified. On the other hand, the transverse plane is used for evaluation of different landmarks of the fetal head, such as the fetal occiput, orbits and choroid plexus. The transabdominal examination is used to confirm or rule out dorso-posterior position and/or deflexions.

The transperineal approach is performed when the patient is in a semi-reclining position, with her legs flexed at the hips and knees to 45° and 90°, respectively. The same convex probe with a sterile cover is placed interlabially on the perineum, just behind the vaginal introitus. Examinations are made in both planes, transverse and sagittal. The transducer is rotated clockwise and the mark on the probe is directed from the right side to upward.

In the transverse plane, the transducer marker is pointed to the right hip and the probe is pressed against the bony pelvic structures and the soft tissue of the pelvic floor. In this plane, the distance between the fetal head and the perineum and the angle of rotation - midline angle can be measured. These parameters are the best predictors of successful instrumental vaginal delivery. On the ultrasound monitor, the fetal head with intracranial structures should be visualized, and they are important for spatial orientation. The choroid plexus is an ultrasound landmark used for orientation in this plane. The distance from the lowest point of the fetal cranium to the lowest point of the perineal soft tissue is measured. This plane allows evaluation of the presence of *caput succedaneum* or molding. The angle of rotation is measured between two lines: the first one marking the sagittal suture or the middle of fetal cranium, and the other one through imaginary antero-posterior plane of the pelvic cavity. This parameter enables observation of the progress in fetal rotation and it can be used as an additional tool for proper birth positioning during the second phase of labor and pushing.

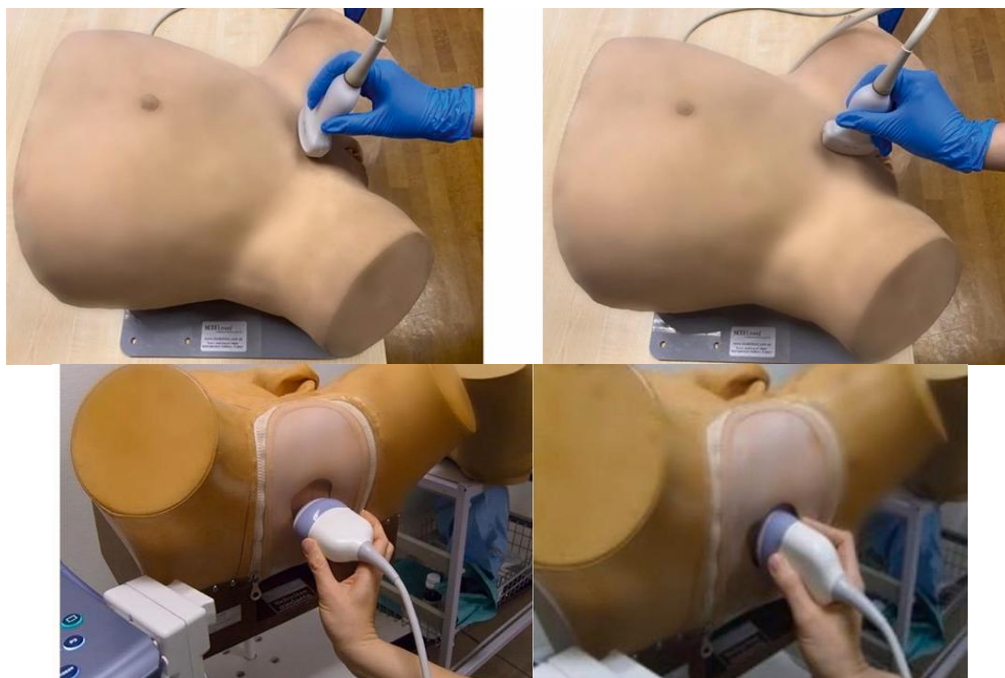


Fig. 1. Positioning of the ultrasound probe, transabdominal and transperineal

The next maneuver is clockwise rotation of the ultrasound probe in the longitudinal plane. The pubic symphysis with her long axis can be seen, presented on the upper right side of the monitor. In this plane, the fetal head beneath the symphysis can be visualized, and the angle of progression can be measured, as well as the distance between the fetal head and the symphyseal body. The angle of progression is a direct sight into fetal descent; it is being measured between two lines: the first one marking the lowest point of the fetal cranium, and the other one going through the midline of the pubic symphysis. This parameter has its direct correspondence to the interspinal line. The distance between the fetal head and the symphysis is measured with calipers on the posterior margin of the symphysis and closest point of the fetal cranium. This parameter is used for proper evaluation of fetal head orientation and flexion status, as a landmark of normal labor mechanism.

All sonographic parameters were incorporated into a specially designed sonopartogram and in the classical partogram as part of the obstetric clinical record.

For every patient monitored with ultrasound parameters during labor, in addition to the mathematical data, information regarding the delivery outcome were also collected. For the purpose of this article, we analyzed two sonographic parameters: the angle of progression and the distance between the fetal head and the perineum in relation to the time interval until delivery.

Results

We collected and analyzed data from 50 laboring women, which were hospitalized at the labor and delivery department of the University Clinic for Obstetrics and Gynecology in Skopje. Ultrasound monitoring was initiated during the active phase of labor, with a cervical dilatation of 7 cm and ruptured membranes. Three consecutive measurements were obtained, and patients who delivered within two hours, or had emergency cesarean section, were excluded from the study.

The youngest patient was 18 and the oldest one was 45 years of age. The maximal number of previous vaginal deliveries recorded was two, the number of nulliparas was 23 (46%) and the number of multiparas (≥ 1 delivery) was 27(54%).

Table 1. Distribution of patients' age

| | AGE |
|----------------|-------|
| Mean | 30.42 |
| Std. Deviation | 7.34 |
| Minimum | 18 |
| Maximum | 45 |

Table 2. Distribution of ultrasound values

| | AoP (0) | AoP (1) | AoP(2) |
|----------------|---------|---------|--------|
| Mean | 103.08 | 124.02 | 138.4 |
| Std. Deviation | 13.78 | 13.13 | 12.43 |
| Minimum | 80 | 85 | 105 |
| Maximum | 145 | 145 | 165 |

AoP: angle of progression

| | HPD (0) | HPD (1) | HPD (2) |
|----------------|---------|---------|---------|
| Mean | 46.52 | 34.26 | 24.22 |
| Std. Deviation | 9.01 | 8.26 | 8.71 |
| Minimum | 25 | 20 | 15 |
| Maximum | 65 | 55 | 50 |

HPD: head-perineum distance

Ultrasound parameters, the angle of progression and the distance between the fetal head and maternal perineum, were evaluated using transperineal (interlabial) approach at 0, 1 and 2 hours.

Table 3. Number of laboring women in each group

| AoP | Hour 0 | Hour 1 | Hour 2 |
|-----------------|--------|--------|--------|
| < 90° | 16 | 2 | 0 |
| 90-120° | 24 | 10 | 5 |
| >120° | 10 | 38 | 45 |
| <i>HPD (mm)</i> | | | |
| 15-20 | 0 | 0 | 35 |
| 20-30 | 0 | 26 | 15 |
| >30-35 | 50 | 24 | 0 |

AoP: angle of progression, HPD: head-perineum distance

When the angle of progression is <90°, the fetal head is still positioned high in the maternal pelvis and the chances of vaginal delivery are still very low; the remaining time until delivery is at least 120 minutes. This happens due to inappropriate degree of fetal presenting part descent. When the angle of progression is 90-120°, the fetal head is in the middle plane of the maternal pelvis, thereby the time until delivery is shortened below 120 minutes, expecting rapid progression in the second phase of labor. Lastly, values >120° present cases where the fetal head is on the perineal plane and spontaneous vaginal delivery happens in the next 60 minutes. If the angle of progression is ≥ 135°, the crowning process begins, which means that the fetal head can be completely visible at the vaginal introitus.

Table 4. Correlation between angle of progression and remaining time until delivery

| AoP | Time interval |
|---------|---------------|
| < 90° | >3 hours |
| 90-120° | 1-3 hours |
| >120° | ≤1 hour |
| ≥135° | ≤ 30 minutes |

Widening of the angle of progression, that is, increasing its values, presents the process of descent of the fetal head toward the pubic symphysis, going below its plane and progressing toward the pelvic floor. Therefore, it is a quite valuable marker for evaluating and monitoring the progress of normal labor.

The distance between the fetal head and the maternal perineum is measured in millimeters and represents the remaining soft tissue distance in the birth canal that should be passed in order to complete a successful spontaneous birth. Its sensitivity is higher during the second phase of labor and during the process of pushing. Shortening of this distance in a defined time interval is positively correlated with shorter time to delivery.

Table 5. Correlation between fetal head-perineum distance and remaining time until delivery

| HPD (mm) | Position of the fetal cranium | Remaining time |
|----------|-------------------------------|----------------|
| <15-20mm | Vaginal introitus | <30 minutes |
| 20-30mm | Below symphysis | 30-90 minutes |
| >30-35mm | Above symphysis | >90 minutes |

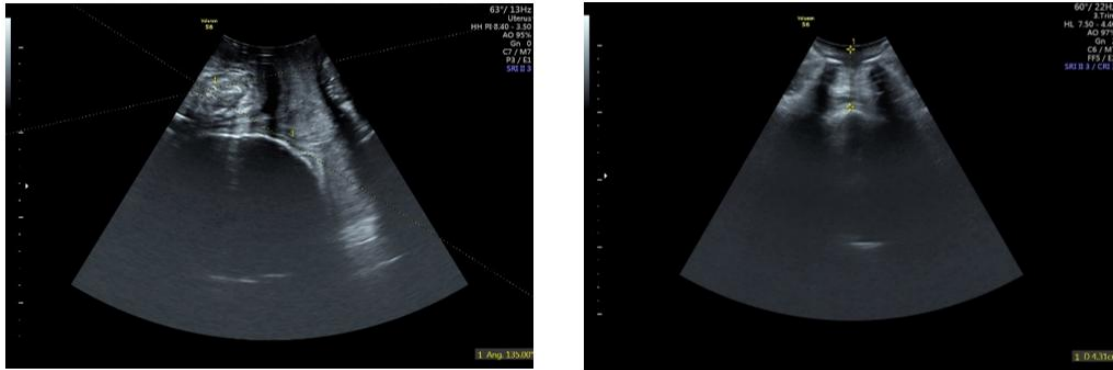


Fig. 2. Sonographic images of angle of progression and fetal head-perineum distance

Table 6. Distribution related to time interval until delivery

| HPD (mm) | Probability rate for vaginal delivery in the next 60 minutes |
|----------|--|
| 15 mm | 85% |
| 20 mm | 70% |
| 25 mm | 45% |
| 30 mm | 22% |
| 35 mm | 10% |

The distance between the fetal head and maternal perineum can be used as an important parameter for monitoring the process of labor, especially during the second phase, which makes it a valuable marker during assisted vaginal births. This parameter, unlike the angle of progression, depends on other circumstances such as oxytocin use, regional analgesia, biparietal diameter and maternal body mass index.

Discussion

Four decades have passed since Ian Donald presented the idea of diagnostic application of ultrasound in obstetrics and gynecology and today we can witness enormous and exponential improvement in this field. Ultrasound machines are an essential part of the perinatology practise and every pregnant woman in the United States has at least one ultrasound evaluation during pregnancy. Calculating the due date, detecting fetal anomalies even in the first trimester, assessing high risk pregnancies, and many others, are benefits of the sonographic approach in everyday clinical practise. During the past 10 years, ultrasound machines have rapidly become part of the labor and delivery departments, presenting a completely novel concept of sonographic diagnostic approach in labor^[4]. The first scientific reports, related to intrapartum ultrasound, were published in the 1990s. Despite this, even today vaginal examination during labor remains the method of choice in the modern obstetric units. Digital examinations are subjective in nature and many experienced obstetricians can face major difficulties during evaluation of the fetal head descent in the birth canal and marking the position of the fontanels. This can be seen even in one third of the cases. Modern perinatology should strive to a higher number of vaginal deliveries while ensuring the highest possible level of well-being for both the mother and her newborn. In order to achieve this goal, obstetricians have to develop modern labor models that enable the timely differentiation of women who are likely to deliver spontaneously and those who may require cesarean section. Making rapid and appropriate clinical decisions should be a process based on a complete clinical obstetric evaluation, unique for every case, with digital examinations and intrapartum ultrasound complementary methods. Intrapartum ultrasound and its mathematically precise parameters have significantly higher sensitivity in evaluating the progress of labor. Furthermore, they are

easy to learn, do not need previous technical knowledge, are associated with a lower incidence of ascending infections and are highly acceptable to patients^[5].

Traditionally, the progress of labor is being followed by serial vaginal digital examinations. Many studies related to clinical evaluation of women in labor were conducted and they reported that digital examinations are descriptive and subjective, with a high degree of inter- and intraobserver variability. They are associated with a high error rate, are difficult to be learnt and depend heavily on the observers' experience. On the other hand, patients perceive them as invasive and painful. A comparative analysis of 508 patients was made, which evaluated the accuracy of vaginal examinations, both for residents and fellow obstetricians. Matching in findings between two groups was reported in 250 cases and the inaccuracies were mainly related to evaluating the degree of descent for the fetal head^[6]. A birth simulator was used in order to estimate the precision of transvaginal examinations, especially in defining the degree of descent. Fellow obstetricians were included in this study and the error rate was 30%. Inaccurate evaluation increases the risk of early maternal pushing efforts and the performance of risky and unsuccessful operative vaginal deliveries. Digital vaginal examinations and their descriptive findings require prolonged training substantial clinical experience in order to make proper assessment. The learning curve is with a longer plateau, compared to ultrasound evaluation. The accuracy for detecting the position of the fetal head in the birth canal is greater with intrapartum ultrasound method, even in situations where measures are being made by medical students without any previous practical experience^[7,8].

Clinical digital evaluation for monitoring the progress of labor is subjective, insensitive approach, nonetheless it can not be completely replaced in the everyday obstetric practice but supplemented by a novel, more precise and noninvasive method of intrapartum ultrasound. A study was conducted during the first stage of labor and patients were evaluated with serial vaginal and sonographic examinations in order to establish the fetal descent. In only 31.5% of cases the fetal position detected with digital examination was consistent with the ultrasound finding. The chances of inaccurate evaluation are higher in cases with extensive overlapping of the fetal cranial bones or presence of caput succedaneum. A distance of 55 mm or less between the fetal head and the maternal perineum indicates engagement of the fetal head within the maternal pelvis. The International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) recommends intrapartum ultrasound as a complementary tool for managing the laboring process. It is indicated in cases with slow or absent progress of labor during the first and second stages, proper evaluation before instrumental vaginal delivery and objectivization of malpresentations. The transabdominal approach is used for determination of the fetal habitus and measuring of two angles: toracomental and occipitospinal. The transperineal approach is used for a close look at the fetal presenting part, the fetal head, which has been engaged in the birth canal. The angle of progression or descent angle, distance between the fetal head and maternal perineum, angle of rotation or midline angle and distance between the fetal head and pubic symphysis are measured. Additionally, the direction of the fetal head, progress distance, cervical length, posterior cervical angle, maternal suprapubic angle and width of the levator hiatus can be evaluated^[9-11].

Vaginal examination and ultrasound evaluation were made in 50 laboring women during the second phase of labor and the following parameters were evaluated: direction of the fetal head, angle of rotation, angle of progression and distance between the fetal head and maternal perineum. In 66% of cases, vaginal examinations failed to properly evaluate the position of the fetal head; in some cases with errors above 45°. The angle of progression was shown as the most sensitive parameter, with the highest inter-observer correlation. A clinical study led by an experienced perinatologist, using intrapartum ultrasound in 444 patients, showed that sonographic markers, especially the angle of progression and distance between the fetal head and the maternal perineum were mathematically precise and confidential parameters,

which can be safely used in managing of the laboring process. These parameters are not directly related to the experience of the observer. Modern approach in the management of labor and delivery means complete understanding of the ultrasound imaging for pelvic bony and soft parts. Intrapartum ultrasound is a simple technique that helps in understanding of every segment of the mechanism of spontaneous labor, making it more clear and objective to follow^[12-15].

Over the past several years, due to the growing popularity of intrapartum ultrasound, its indication field has expanded. In addition to predicting the progress of labor, it can also be used as an additional tool during instrumental vaginal deliveries. The angle of progression, as an individual parameter, can be measured before placing the vacuum cup or forceps, but also before cesarean sections. A prospective observational study was conducted in women with term singleton pregnancies, all with prolonged second phase of labor. From a total number of 143 patients, 116 experienced successful operative vaginal deliveries and 27 gave birth with cesarean section. The angle of progression was measured during and between pushing efforts. Predictive values associated with successful operative vaginal delivery include an angle of progression of 138° in the absence of contractions and 160° during contractions. The values of angle of progression enable successful prediction of instrumental vaginal delivery in 80% of cases. Complicated operative vaginal deliveries are related to a high incidence of neonatal morbidity, mortality and maternal trauma, especially in cases where the procedure has been protracted and the delivery is completed by cesarean section. Measuring the angle of progression, angle of rotation and the distance between the fetal head and maternal perineum even before indicating operative vaginal delivery, can be used as a predictive model for the success of the procedure^[16,17].

Transperineal ultrasound has a high sensitivity in evaluating nuliparas with protracted labor. A prospective study involving 110 nuliparas showed that distance between the fetal head and maternal perineum with values < 40 mm helped in predicting vaginal delivery in 93% of cases. On the other hand, when the angle of progression was >110°, 87% of patients delivered vaginally^[18,19]. Ghi *et al.* found an association between fetal head direction and angle of rotation <45° with spontaneous vaginal delivery in 95% of cases. Kalahe *et al.* reported that the angle of progression ≥120° was associated with a large number of vaginal deliveries. Additionally, Cuerva *et al.* showed that the angle of progression >138° can assure that instrumental vaginal delivery would be performed without any complication^[20-22]. A prospective study including 222 patients reported that when head-perineum distance was >35 mm on two consecutive examinations, it was related with 22% need of cesarean section. Another study showed that head-perineum distance ≥ 40 mm was significantly associated with prolonged extraction^[23,24].

Theoretical and practical training courses for healthcare personal working in labor and delivery departments have a great positive impact on the modernization of protocols related to implementation of ultrasound intrapartum evaluation, even as a standard method. Positive attitudes of experienced perinatologists toward new and modern tools for management of spontaneous labor contribute to a reduced incidence of cesarean births and unsuccessful operative vaginal deliveries^[25].

From the patients' perspective, intrapartum ultrasound, including the transperineal approach, is rated as completely painless compared to vaginal examinations. Many scoring systems have been created to evaluate pain perception by laboring women. Intrapartum ultrasound has been reported as superior and more acceptable. A clinical study conducted on 94 women, in whom labor progress was monitored with vaginal examinations and intrapartum ultrasound, evaluated results related to pain perception. Scoring systems 0-10 points were used, and the mean pain score was 0 for translabial ultrasound and 4.5 for vaginal examinations. Pain related to digital evaluation was reported as intensive in 81.9% of cases. A longitudinal study conducted in Romania also evaluated the acceptability of intrapartum ultrasound among laboring women; 200 patients were included, of whom 67% agreed that the sonographic

approach was more acceptable and safer, and that it increased their level of confidence and sense of active participation in the labor process. After completing the study, 97% of patients selected intrapartum ultrasound as their preferred method for every future delivery, even though they experienced the procedure for the first time. The archiving of complete photo documentation from sonographic evaluation obtained during labor is very important from a legal aspect, especially for the legal protection of healthcare professionals working in labor and delivery departments^[26-28].

Intrapartum ultrasound is a valuable tool for the objective assessment of the labor process and for rapid and effective detection of factors associated with prolonged labor. The angle of progression and head-perineum distance are parameters characterized by great sensitivity, accuracy and high reproducibility rate, particularly in detection of the degree of fetal head descent. Unlike other sonographic parameters, the angle of progression can be used even before the active phase of labor; however, it is primarily related to evaluation of prolonged labor during the first stage and is positively correlated with vaginal delivery and a shorter time to delivery. During the second stage of labor, the angle of progression can be used to predict the mode of delivery and to avoid complicated instrumental vaginal deliveries^[29].

The measurement of precisely defined mathematical parameters as part of intrapartum evaluation is a very important innovation and a significant improvement in modern obstetrics.

Conclusion

Labor and delivery are complex and multifactorial processes, which mainly depend on continuous interaction between maternal, fetal and external factors. Intrapartum ultrasound or sonographic evaluation of labor progression can improve the safety of deliveries and reduce the incidence of cesarean sections. Ultrasound parameters, particularly the angle of progression and distance between the fetal head and maternal perineum, are additional tools for predicting the time of delivery, mode of delivery, but it is also a helpful factor in decision making process during labor management. The rapid increase in the cesarean section rates causes high perinatal and maternal morbidity rates, and poses a serious financial burden on the healthcare system. This is one of the motives for implementing new and modern protocols for appropriate management of the laboring process.

Conflict of interest statement. None declared.

References

1. Siergiej M, Sudoł-Szopińska I, Zwoliński J, Śladowska-Zwolińska AM. Role of intrapartum ultrasound in modern obstetrics – current perspectives and literature review. *J Ultrason* 2019; 19: 295–301. doi: 10.15557/JoU.2019.0044.
2. Sainz-Bueno JA, Fernandez-Conde C, Castro L, García-Jiménez R, García-Mejido JA, Borrero C. Methodology and utility of intrapartum ultrasound. *Clínica e Investigación en Ginecología y Obstetricia* 2024; 51(4): 100995. <https://doi.org/10.1016/j.gine.2024.100995>.
3. Usman S, Hanidu A, Kovalenko M, Hassan WA, Lees C. The sonopartogram. *Am J Obstet Gynecol* 2023; 228(5S): S997-S1016. doi: 10.1016/j.ajog.2022.06.027.
4. Hobbins JC. Overview of imaging in pregnancy: history to the present, including economic impact. *Semin Perinatol* 2013; 37(5): 290-291. doi: 10.1053/j.semperi.2013.06.002.
5. Dębska M, Kretowicz P, Dębski R. Intrapartum sonography - eccentricity or necessity? *J Ultrason* 2015; 15(61): 125-136. doi: 10.15557/JoU.2015.0011.
6. Buchmann EJ, Libhaber E. Accuracy of cervical assessment in the active phase of labour. *BJOG* 2007; 114(7): 833-837. doi: 10.1111/j.1471-0528.2007.01386.x.

7. Dupuis O, Silveira R, Zentner A, Dittmar A, Gaucherand P, Cucherat M, et al. Birth simulator: reliability of transvaginal assessment of fetal head station as defined by the American College of Obstetricians and Gynecologists classification, *Am J Obstet Gynecol* 2005; 192(3): 868-874. doi: 10.1016/j.ajog.2004.09.028.
8. Rozenberg P, Porcher R, Salomon LJ, Boirot F, Morin C, Ville Y. Comparison of the learning curves of digital examination and transabdominal sonography for the determination of fetal head position during labor. *Ultrasound Obstet Gynecol* 2008; 31(3): 332-337. doi: 10.1002/uog.5267.
9. Shetty J, Aahir V, Pandey D, Adiga P, Kamath A. Fetal head position during the first stage of labor: comparison between vaginal examination and transabdominal ultrasound. *ISRN Obstet Gynecol* 2014; 2014: 314617. doi: 10.1155/2014/314617.
10. Dimassi K, Ben Amor A, Belghith C, Ben Khedija MA, Triki A, Gara MF. Ultrasound diagnosis of fetal head engagement. *Int J Gynaecol Obstet* 2014; 127(1): 6-9. doi: 10.1016/j.ijgo.2014.04.008.
11. Ghi T, Eggebø T, Lees C, Kalache K, Rozenberg P, Youssef A, et al. ISUOG Practice Guidelines: intrapartum ultrasound. *Ultrasound Obstet Gynecol* 2018; 52(1): 128-139. doi: 10.1002/uog.19072.
12. Molina FS, Terra R, Carrillo MP, Puertas A, Nicolaides KH. What is the most reliable ultrasound parameter for assessment of fetal head descent? *Ultrasound Obstet Gynecol* 2010; 36(4): 493-499. doi: 10.1002/uog.7709.
13. Dückelmann AM, Bamberg C, Michaelis SA, Lange J, Nonnenmacher A, Dudenhausen JW, et al. Measurement of fetal head descent using the 'angle of progression' on transperineal ultrasound imaging is reliable regardless of fetal head station or ultrasound expertise. *Ultrasound Obstet Gynecol* 2010; 35(2): 216-222. doi: 10.1002/uog.7521.
14. 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; 118(1): 62-69. doi: 10.1111/j.1471-0528.2010.02775.x.
15. Nishimura K, Yoshimura K, Kubo T, Hachisuga T. Objective diagnosis of arrested labor on transperineal ultrasound. *J Obstet Gynaecol Res* 2016; 42(7): 803-809. doi: 10.1111/jog.12967.
16. Chan VYT, Lau WL, So MKP, Leung WC. Measuring angle of progression by transperineal ultrasonography to predict successful instrumental and cesarean deliveries during prolonged second stage of labor. *Int J Gynaecol Obstet* 2019; 144(2): 192-198. doi: 10.1002/ijgo.12712.
17. Sainz JA, García-Mejido JA, Aquise A, Borrero C, Bonomi MJ, Fernández-Palacín A. A simple model to predict the complicated operative vaginal deliveries using vacuum or forceps. *Am J Obstet Gynecol* 2019; 220(2): 193.e1-193.e12. doi: 10.1016/j.ajog.2018.10.035.
18. Eggebø TM, Hassan WA, Salvesen KÅ, Lindtjørn E, Lees CC. Sonographic prediction of vaginal delivery in prolonged labor: a two-center study. *Ultrasound Obstet Gynecol* 2014; 43(2): 195-201. doi: 10.1002/uog.13210.
19. Torkildsen EA, Salvesen KÅ, Eggebø TM. Prediction of delivery mode with transperineal ultrasound in women with prolonged first stage of labor. *Ultrasound Obstet. Gynecol* 2011; 37(6): 702-708. doi: 10.1002/uog.8951.
20. Ghi T, Farina A, Pedrazzi A, Rizzo N, Pelusi G, Pilu G. Diagnosis of station and rotation of the fetal head in the second stage. Second stage fetal head descent and mode of delivery. *Obstet Gynecol* 2009; 33(3): 331-336. doi: 10.1002/uog.6313.
21. Kalache KD, Duckelmann AM, Michaelis SA, Lange J, Cichon G, Dudenhausen JW. Transperineal ultrasound imaging in prolonged second stage of labor with

- occipitoanterior presenting fetuses: how well does the ‘angle of progression’ predict the mode of delivery? *Ultrasound Obstet Gynecol* 2009; 33: 326-330. <http://dx.doi.org/10.1002/uog.6294/>.
22. Cuerva MJ, Bamberg C, Tobias P, Gil M, De la Calle M, Bartha JL. Intrapartum ultrasound, a predictive method for complicated operative forceps delivery in non-occiput posterior deliveries. *Ultrasound Obstet Gynecol* 2014; 43: 687– 92.
 23. Kasbaoui S, Severac F, Aïssi G, Gaudineau A, Lecointre L, Akladios C, et al. Predicting the difficulty of operative vaginal delivery by ultrasound measurement of fetal head station. *Am J Obstet Gynecol* 2017; 216(5): 507.e1-507.e9. <https://doi.org/10.1016/j.ajog.2017.01.007>.
 24. Bellussi F, Di Mascio D, Salsi G, Ghi T, Dall’Asta A, Zullo F, et al. Sonographic knowledge of occiput position to decrease failed operative vaginal delivery: a systematic review and meta-analysis of randomized controlled trials. *Am J Obstet Gynecol* 2021; 226(4): 499-509. doi: 10.1016/j.ajog.2021.08.057.
 25. Youssef A, Kamel R: Ultrasound in labor: impact of a theoretical and practical course on caregiver’s perspective and accuracy. *J Matern Fetal Neonatal Med* 2019; 30(20): 1-7. doi: 10.1080/14767058.2019.1570113.
 26. Chan YT, Ng KS, Yung WK, Lo TK, Lau WL, Leung WC. Is intrapartum translabial ultrasound examination painless? *J Matern Fetal Neonatal Med* 2016; 29(30): 3276-3280. doi: 10.3109/14767058.2015.1123241.
 27. Iliescu DG, Tudorache S, Cara ML, Dragusin R, Carbuvaru O, Florea M, et al. Acceptability of intrapartum ultrasound monitoring – experience from a Romanian Longitudinal Study. *Curr Health Sci J* 2015; 41(5): 355-360. doi: 10.12865/CHSJ.41.04.10.
 28. Malvasi A, Montanari Vergallo G, Tinelli A, Marinelli E. Can the intrapartum ultrasonography reduce the legal liability in distocic labor and delivery? *J Matern Fetal Neonatal Med* 2018; 31(8): 1108-1109. doi: 10.1080/14767058.2017.1306514.
 29. Jung JE, Lee YJ. Intrapartum transperineal ultrasound: angle of progression to evaluate and predict the mode of delivery and labor progression. *Obstet Gynecol Sci* 2024; 67(1): 1-16. doi: 10.5468/ogs.23141.