The Egyptian Journal of Hospital Medicine (January 2022) Vol. 86, Page 78-84

Intrapartum Sonography versus Digital Vaginal Examination in the First Stage of Labor for Prediction of the Progress of Labor

Rasha Reda Abd-Alhady, Magdi Ragab Elsayed,
Esraa Nasef Abo-Elgheet Sator, Abdulmagid Mahmoud Sarhan
Department of Obstetrics and Gynecology, Faculty of Medicine, Zagazig University, Sharkia, Egypt.
***Corresponding author:** Esraa Nasef Abo-Elgheet Sator, **E-Mail:** Dr.esraa1987@gmail.com

ABSTRACT

Background: The research and advances in obstetrics are performed to overcome abnormal vaginal deliveries. The obstetrician's skill using digital vaginal examination (DVE) remains a personal skill with limitations.

Objective: Assessment of the ability of intrapartum ultrasound capability to observe the progression of normal labor in the first stage compared to DVE accurately and objectively.

Patients and methods: This prospective cohort study, was conducted on 62 singleton pregnancies in their 38-40 weeks of pregnancy at Obstetrics and Gynecology ultrasound unit and Maternity Hospital, during a period between 2018 to 2020. All cases received clinical examination including, general, abdominal, and obstetrical examination and ultrasonography examination including, transvaginal, transabdominal, and transperineal.

Result: The transvaginal ultrasound evaluated the rate of cervical dilatation at the first stage of labor and the length of the cervix showed a statistically significant negative correlation and statistically significant positive correlation between time of labor progress at first and cervical length. There was statistically significantly higher mean cervical dilatation by DVE than US findings (4.58 & 4.29, respectively).

Conclusion: Ultrasound usage possesses a potential role in predicting vaginal delivery success and helping the promotion of safe operative delivery.

Keywords: Intrapartum Sonography, Digital Vaginal Examination.

INTRODUCTION

Examination of the patient's vagina is considered an essential step in labor for evaluating the progress of labor, it has been used alone or as a part of a partogram at intervals [(1)].

Cervical Os dilatation which is evaluated by digital vaginal assessment considered the most widely used technique for the determination of labor progress. It is also used for other clinical purposes, the level and position of descending fetal head, also the cervical position and consistency. The results of vaginal examination (VE) are represented on a program used for labor decision-making [(2)].

DVE is a crucial technique in obstetrics, it remains a personal skill with limitations. Patients' dissatisfaction from feeling uncomforted with DVE is considered a disadvantage especially, without regional analgesia, and when repeated, and can result in psychological complications with so predisposed cases [(3)].

The risk of elevated vaginal infection is increased with repeated VE, performing VE twice was found to increase chorioamnionitis probability by 4%, while 13 VEs recorded a probability of 10%. A previous study reported a significant decrease in the latency period of labor in preterm membrane rupture caused by repeated VE [(4)]. The World Health Organization (WHO) suggested decreasing the number of DVE [(5)].

The potential role of Ultrasonography in the evaluation of labor progress has been reported in many previous studies. Despite, The application of ultrasonography to assess labor progress was reported for the first time in 1990, physical examination for labor progress is still used till now [(6)].

Many studies have documented a significant error rate of conventional obstetrical examination as intrapartum ultrasonography was not performed as a routine practice during labor. Fontanelle position and fetal head descent are considered difficult even for the experienced obstetrician. The usage of two-dimensional (2D) ultrasound accurately evaluates fetal head descent without the need for between ischial spines drawn line and also, measures the cervical dilatation [(6)].

Transperineal ultrasonography was used to evaluate the angle of progression (AOP) and fetal head direction and station and changes faced during labor [(7)], while transabdominal ultrasonography was used for head rotation and position [(8)].

Ultrasonography is considered noninvasive, reproducible, objective, and easy to assess the engagement of the fetal head. For accurate evaluation of fetal head station, AOP is considered the best as the higher AOP, the more probability of spontaneous delivery [(8)].

The cervical dilatation evaluation, a distance of head symphysis, and fetal head-perineum distance (FHPD) could be assessed by transperineal ultrasonography. Providing the maximal safety for the newborn and patient during labor is the real obstetrician role nowadays [(9)].

According to previous studies on labor-guided ultrasonography. It is considered an accurate and

Received: 21/8/2021
Accepted: 6/10/2021

effective technique for evaluation of head station and position of the fetus during labor, besides it is not a demanding experience, neither causes discomfort, nor an increasing rate of infection. A previous study suggested that routine use of intrapartum ultrasonography can elevate the rate of labor safety while decreasing cesarean section (CS) [10].

The current study aimed to evaluate the potential of intrapartum ultrasound to objectively and accurately observe the progression of normal labor in the first stage at the time of admission in comparison with DVE.

PATIENTS AND METHODS

This prospective cohort study was conducted at Obstetrics and Gynecology ultrasound unit and Maternity Hospital, Zagazig University Hospitals and comprised 62 singleton pregnancies in their 38-40 weeks of pregnancy during the period between 2018 to 2020.

Ethical Considerations:

As long as all participants signed informed consent forms and submitted them to Zagazig University's research ethics committee, the study was allowed (ZU-IRB#6270). We followed the World Medical Association's ethical code for human experimentation, the Helsinki Declaration.

Inclusion criteria: Pregnant women from 38th to 42nd week coming to the Maternity Hospital in the first stage of labor, Singleton pregnancy, No contraindication to vaginal delivery, and Cephalic/vertex presentation.

Exclusion criteria: Patients with amniotic fluid and/or placenta abnormalities, congenital fetal malformations, attempting vaginal birth after CS, pregnancies complicated with medical disorders, and maternal spine and/or pelvic fractures and/or diseases.

All cases included in the study were submitted to:

History: Full history with age, name, residence, occupation and special habits of medical importance, history of current pregnancy (Gravidity, parity, and history of previous pregnancy, first day of last menstrual period for estimation of gestational age and any medical disorders, surgery, blood transfusion or allergy) and family history.

Clinical examination: General examination including, general look and orientation of time and place, vital signs, cyanosis, jaundice, and edema. Abdominal and obstetrical examinations were also performed. DVE was carried out to evaluate the cervical dilatation, effacement, fetal station, status of the fetal membranes (intact or ruptured), fetal head position, and amniotic fluid.

Methods:

The ultrasonographic examination included; Transabdominal to assess fetal viability, weight, wellbeing, presentation, adequacy of amniotic fluid, placental site and to ensure adherence to inclusion and exclusion criteria. Transvaginal was used for cervical evaluation by measuring the posterior cervical angle and cervical length. 2D transperineal was used for the evaluation of cervical dilatation, fetal head-perineal distance, and angle of progression.

The cervical dilatation assessed in the transverse plane, oblique view using an abdominal probe (3.5-MHz) was covered with a sterile cover, at the level of the posterior fourchette the transducer was put in transperineaum in a sagittal position. Ultrasound evaluation of cervical dilatation was carried out in the anteroposterior plane. The cursors were placed on the inner part of the tissue of the cervix posteriorly and anteriorly.

The fetal head perineal distance was assessed using the same abdominal probe placed on the perineal part and was presented to the assessed part. The short distance between the perineal skin surface and fetal skull outer bony limit was evaluated by FHPD.

The shortest distance from the skin surface of the perineum and the outer bony limit of the fetal skull in a transverse view was measured to evaluate FHPD. Fetal head descent was evaluated using fetal head perineal distance. AOP was evaluated by a transducer parallel to labia majora and the clock wisely rotated from transverse position to longitudinal position, using the same method, the right probe was inferiorly placed in the perineal with the left-sided probe.

The pubic part will be distinguished on the left side. Using this method, the fetal head below the symphysis, with the vagina could be visualized and the cervical uterus was located in front of the fetal head. A little movement laterally of the transducer produced a sagittal view of symphysis of pubis on the long axis, also of the fetal head leading part. The distance between calipers which were placed at the two ends of the pubic symphysis long axis was represented by a drawn line, a second one represented the distance between the fetal skull contour and tangential pubic symphysis distant point.

Statistical analysis

IBM SPSS Statistics for Windows was used to examine the data (Version 22.0. Armonk, NY: IBM Corp). Numbers and percentages were used to describe qualitative data. Following the Kolmogorov-Smirnov test for normality, the median (minimum and maximum) and mean (standard deviation) were used to characterize quantitative data.

The (0.05) significance level was used to assess the significance of the findings. Non-normally distributed continuous and/or ordinal variables can be linked using Spearman's rank-order correlation, which measures the strength and direction of the linear relationship. Analysis of the Receiver Operating Characteristic (ROC) curve is used to evaluate the diagnostic performance of a test or the accuracy of a test to

distinguish between diseased and healthy cases. PPV, NPV, and accuracy were computed by cross-tabulating the curves for and specificity as well as sensitivity.

RESULTS

Study participants ranged in age from 18 to 35; 58.1 percent were multi-pregnant, and the average gestational age was 39.38 weeks. As a result, 80% of the analyzed patients were delivered vaginally. The mean time of progression is 5.51 ranging from1 to 16 h in the first stage of labor from the time of admission **(Table 1).**

There was a statistically significant positive correlation between the rate of cervical dilatation at the first stage of labor and the following; cervical dilatation (r=0.502), effacement (r=0.393), and fetal station (r=0.515) by digital vaginal examination. A statistically significant negative correlation is detected between the time of labor progress at the first stage of labor and the following; cervical dilatation (r=-0.764), effacement (r=-0.350), and fetal station (r=-0.623) by DVE **(Table 2)**.

There was a statistically significant negative correlation between the rate of cervical dilatation at the first stage of labor and length of the cervix by transvaginal ultrasound (r=-0.277) and a statistically significant positive correlation between time of labor progress at the first stage of labor and by transvaginal ultrasound (r=0.270) **(Table 3)**.

There was a statistically significant positive correlation between the rate of cervical dilatation at the first stage of labor and cervical dilatation by the transperineal US (r=0.416) and a statistically significant positive correlation between time of labor progress at the first stage of labor and FHPD by transperineal ultrasound (r=0.271) and statistically significant negative correlation between time of labor progress at the first stage of cervical dilatation by transperineal ultrasound (r=-0.613) **(Table 4)**.

The cervical length by transvaginal Ultrasound showed a statistically significant negative correlation with the following measures by digital vaginal examination cervical dilatation (r=-0.311), effacement% (r=-0.468), and fetal station (r=-0.350). Similarly , cervical dilatation by 2D Transperineal Ultrasound showed a statistically significant positive correlation with the following measures by digital vaginal examination cervical dilatation (r=0.864), effacement% (r=0.376), and fetal station (r=-0.518). In addition; a statistically significant positive correlation was detected between effacement % by digital vaginal examination and post cervical angle degree (r=0.525). Fetal head perineal distance by the transperineal US illustrates a statistically significant negative correlation with cervical dilation and fetal station by digital vaginal examination (r= -0.420 & r= -0.469, respectively) **(Table 5) (Figure 1)**.

There was a statistically significant higher mean cervical dilatation by DVE than US findings (4.58 & 4.29, respectively) **(Table 6)**.

Table (1): Obstetric history, mode of delivery, and time of progression among studied cases

bstetric history (n=62)		
Age/years Mean±SD (Range)	23.97±4.57 (18.0-35.0)	
Gravidity		
Primi	26	41.9
Muti	36	58.1
Gestational age /weeks Mean±SD (Range)	39.38±0.98 (37 -41)	
Mode of delivery (n=62)		
VD	50(80.61%)	
CS	12(24.2%)	
Time of progression		
Time/hr in 1st stage Mean±SD (Range)	5.51 ± 3.72 (1.0-16.0 hr)	
Time/ Min in 2nd stage Mean±SD (Range)	12.25±4.40 (5-20 min)	

Table (2): Correlation between digital vaginal examination results and progress of the first stage of labor

DVE		Rate of cervical dilatation (cm/hour)	Time of labor progress
Cervical dilatation/cm	rs	0.502	-0.764
	p	<0.001*	<0.001*
Effacement%	rs	0.393	-0.350
	p	0.002*	0.005*
Fetal station	rs	0.515	-0.623
	p	<0.001*	<0.001*

rs: Spearman correlation coefficient *statistically significant if p<0.05

Table (3): Correlation between transvaginal ultrasound findings progress of the first stage of labor

Transvaginal Ultrasound		Rate of cervical dilatation (cm/hour)	Time of labor progress
Cervical length	rs	-0.277	0.270
	p	0.032*	0.037*
Post-cervical angle/ degree	rs	0.113	0.007
	p	0.390	0.957

*statistically significant if p<0.05, rs: Spearman correlation coefficient.

Table (4): Correlation between transperineal ultrasound findings and progress of the first stage of labor

Transperineal US		Rate of cervical dilatation (cm/hour)	Time of labor progress
Cervical dilatation	rs	.416	-.613
	P	0.001*	<0.001*
Fetal head perineal distance	rs	-.137	0.271
	P	0.289	0.033*
Angle of progression degree	rs	.091	-.085
	p*	0.498	0.528
Progression distance/ cm	rs	.059	0.142
	p	0.731	0.41

*statistically significant if p<0.05, rs: Spearman correlation coefficient.

Table (5): Correlation between digital vaginal examination and ultrasound findings of the studied females.

		Cervical dilatation/cm	Effacement%	Fetal station
Transvaginal Ultrasound				
Cervical length/cm	rs	-.311	-0.468	-0.350
	p	0.016*	<0.001*	0.006*
Post cervical angle /degree	rs	-0.081	.525	.217
	p	0.538	<0.001*	0.096
2D Transperineal Ultrasound				
Cervical dilatation/cm	rs	**.0864**	**.0376**	**.0518**
	p	**<0.001***	**0.004***	**<0.001***
Fetal head perineal distance/cm	rs	**-0.420**	**-0.195**	**-0.469**
	p	**0.001***	**0.128**	**<0.001***
Angle of progression / degree	rs	**0.203**	**0.233**	**0.066**
	p	**0.126**	**0.078**	**0.623**
Progression distance /cm	rs	**-0.367**	**0.331**	**0.108**
	p	**0.027***	**0.048***	**0.531**

rs: Spearman correlation coefficient *statistically significant if p<0.05

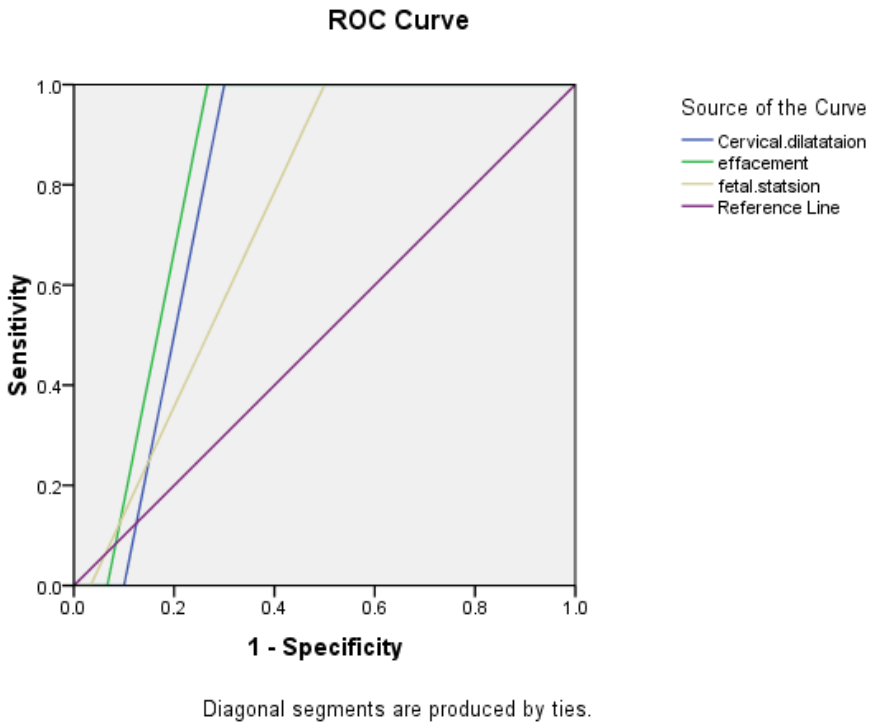

Fig. (1): ROC curve of cervical dilatation, effacement, and fetal station in predicting the progress of labor

Table (6): Comparison between digital vaginal examination and ultrasound findings among studied cases

	DE	**US**	**Test of significance**
Cervical dilatation/cm	4.58±1.43	4.29±1.59	t=2.13 p=0.04*

*statistically significant if p<0.05, t: Student t-test.

DISCUSSION

Although DVE is a crucial technique in obstetrics, it remains a personal skill with limitations. Patients' unsatisfaction from feeling uncomforted with DVE is considered a disadvantage especially, without regional analgesia, and when repeated, and can result in psychological complications with so predisposed cases [(3)].

Ultrasonography is considered noninvasive, reproducible, objective, and easy to assess the engagement of the fetal head. For accurate assessment of fetal head station, AOP is considered the best as the higher AOP, the more probability of spontaneous delivery [(8)].

The mean age of the studied cases is 23.97 years ranging from 18 to 35, 58.1% are multigravida, and the mean gestational age is 39.38 weeks ranging from 37 to 41weeks.

In this study, 80.61% of the studied cases have a vaginal delivery and 19.39% have CS. Following these results, the study of **Wiafe *et al.*** [(11)] reported that the mean age of cases was 26.8 years and ranged from 18 to 39 with an average gestation of 39 weeks and 4 days.

In agreement with these results, the study of **Khalil *et al.*** [(12)], revealed that the mean was 24.8 years and median gravidity was 2 with a range from G1 to G7, and the mean gestational age ranging from 37 to 41 weeks and the mean was 39.3 week.

While, in the study of **Chor *et al.*** [(13)], the patients were divided into group A which consisted of cases with vaginal delivery (60.0%), cases with instrumental delivery (21.8%), and cases with CS for reasons other than non-progressive labor (16.1%), while group B including cases with CS for non-progressive labor (16.1%).

However, in the study of **Dall'Asta *et al.*** [(14)], 109 cases included spontaneous vaginal delivery (36.7%) and obstetric intervention (63.3%).

The present results represented a statistically significant correlation positively between the rate of

cervical dilatation at the first stage of labor and the following; cervical dilatation (r=0.502), effacement (r=0.393), and fetal station (r=0.515) by digital vaginal examination.

There is a statistically significant negative correlation is detected between the time of labor progress at the first stage of labor and the following; cervical dilatation (r=-0.764), effacement (r=-0.350), and fetal station (r=-0.623) by DVE.

A significant negative correlation was detected between the time of labor progress at the first stage of labor and the angle of progression degree (r= -0.468) and positive between the rate of cervical dilatation at the first stage of labor and progression distance by US (r=0.538). There is a statistically significant negative correlation between the rate of cervical dilatation at the first stage of labor and cervical length evaluated by transvaginal ultrasound (r=-0.277) and a statistically significant positive correlation between time of labor progress at the first stage of labor and cervical length by transvaginal ultrasound (r=0.270). There is a statistically significant positive correlation between the rate of cervical dilatation at the first stage of labor and cervical dilatation by the transperineal US (r=0.416) and a statistically significant positive correlation between time of labor progress at the first stage of labor and Fetal head perineal distance by transperineal ultrasound (r=0.271) and statistically significant negative correlation between time of labor progress at the first stage of cervical dilatation by transperineal ultrasound (r=-0.613).

The cervical length by transvaginal Ultrasound showed a statistically significant negative correlation with the following measures by digital vaginal examination cervical dilatation (r=-0.311), effacement% (r=-0.468), and fetal station (r=-0.350).

Similarly, cervical dilatation by 2D Transperineal Ultrasound showed a statistically significant positive correlation with the following measures by digital vaginal examination cervical dilatation (r=0.864), effacement% (r=0.376), and fetal station (r=-0.518). In addition; a statistically significant positive correlation is detected between effacement % by digital vaginal examination and post cervical angle degree (r=0.525). Fetal head perineal distance by the transperineal US illustrated a statistically significant negative correlation with cervical dilation and fetal station by digital vaginal examination (r= -0.420 & r= -0.469, respectively). The current study reported statistically significantly higher mean cervical dilatation by DVE than ultrasound findings (4.58 & 4.29, respectively).

However, in the study of **Wiafe *et al.* [11]**, the correlation between ultrasound and DVE in their study was low and in comparison to previous results of **Sherer *et al.* [15],** who obtained a kappa value of 0.12, and **Shetty *et al.* [16],** who obtained a value of 0.15 in an Indian population. However, a moderate concordance of kappa 0.4 was calculated after excluding cases that could not be evaluated by VE.

Zimerman *et al.* [17], reported that ultrasound-guided cervical dilation is considered a problem. While**, Hassan *et al.*,** reported that the correlation between DVE and ultrasound assessments was high.

Furthermore, **Solaiman *et al.* [5]**, revealed that all cases applied to transperineal ultrasound felt more comport with decreased pain compared to DVE. There was a negative correlation between cervical dilatation and FHPD and recorded a positive correlation with fetal head descent angle. Both FHPD and angle of fetal head descent show a negative significant correlation [18].

CONCLUSION

Intrapartum ultrasound is a simple technique that enables the objective evaluation of labor progress and provides more specificity for evaluating labor. Ultrasound usage possesses a potential role in predicting vaginal delivery success and helping the promotion of safe operative delivery.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Lavender T, Hart A, Smyth R (2012):** Effect of partogram use on outcomes for women in spontaneous labor at term. In: The Cochrane Collaboration, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd. Pp. CD005461. https://doi.wiley.com/10.1002/14651858.CD005461.pub3
2. **Lavender T, Tsekiri E, Baker L (2008):** Recording labor: a national survey of partogram use. Br J Midwifery, 16(6):359–62.
3. **Dückelmann A, Bamberg C, Michaelis S *et al.* (2010):** 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 Off J Int Soc Ultrasound Obstet Gynecol., 35(2):216–22.
4. **Ferguson K, Rosen E, Rosario Z *et al.* (2019):** Environmental phthalate exposure and preterm birth in the PROTECT birth cohort. Environ Int., 132:105-109.
5. **Hassan W, Eggebø T, Ferguson M *et al.* (2013):** Simple two-dimensional ultrasound technique to assess intrapartum cervical dilatation: a pilot study. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol., 41(4):413–8.
6. **Dębska M, Kretowicz P, Dębski R (2015):** Intrapartum sonography - eccentricity or necessity? J Ultrason., 15(61):125–36.
7. **Barbera A, Pombar X, Perugino G *et al.* (2009):** A new method to assess fetal head descent in labor with transperineal ultrasound. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol., 33(3):313–9.
8. **Ghi T, Youssef A, Maroni E *et al.* (2013):** Intrapartum transperineal ultrasound assessment of

fetal head progression in the active second stage of labor and mode of delivery. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol., 41(4):430–5.

9. **Torkildsen E, Salvesen K, Eggebø T *et al.* (2011):** Prediction of delivery mode with transperineal ultrasound in women with the prolonged first stage of labor. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol., 37(6):702–8.
10. **Erlik U, Wolman I (2013):** Intrapartum Sonographic Assessment of Labor. J Obstet Gynecol India, 63(5):297–300.
11. **Wiafe Y, Whitehead B, Venables H *et al.* (2019):** Comparing intrapartum ultrasound and clinical examination in the assessment of fetal head position in African women. J Ultrason., 19(79):249–54.
12. **Khalil O, Elbadawi E, Abdelnaby M *et al.* (2012):** Assessment of the progress of labor by the use of intrapartum ultrasound. Alex J Med., 48(4):295–301.
13. **Chor C, Poon L, Leung T (2019):** Prediction of labor outcome using serial transperineal ultrasound in the first stage of labor. J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean Perinat Soc Int Soc Perinat Obstet., 32(1):31–7.
14. **Dall'Asta A, Angeli L, Masturzo B *et al.* (2019):** Prediction of spontaneous vaginal delivery in nulliparous women with a prolonged second stage of labor: the value of intrapartum ultrasound. Am J Obstet Gynecol., 221(6): 1-13.
15. **Sherer D, Miodovnik M, Bradley K *et al.* (2002):** Intrapartum fetal head position I: comparison between transvaginal digital examination and transabdominal ultrasound assessment during the active stage of labor. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol., 19(3):258–63.
16. **Shetty J, Aahir V, Pandey D *et al.* (2014):** Fetal Head Position during the First Stage of Labor: Comparison between Vaginal Examination and Transabdominal Ultrasound. ISRN Obstet Gynecol., 14: 1–5.
17. **Zimerman A, Smolin A, Maymon R *et al.* (2009):** Intrapartum measurement of cervical dilatation using translabial 3-dimensional ultrasonography: correlation with digital examination and interobserver and intraobserver agreement assessment. J Ultrasound Med Off J Am Inst Ultrasound Med., 28(10):1289–96.
18. **Solaiman S, Atwa K, Gad A *et al.* (2020):** Transperineal ultrasound of fetal head progression in prolonged labor: women's acceptance and ability to predict the mode of delivery. Egypt J Radiol Nucl Med., 51(1):94-99.