Journal of Obstetrics, Gynecology and Cancer Research | ISSN: 2476-5848

Value of Transvaginal Sonographic Cervical Length Measurement to Predict Duration of Second Trimester Pregnancy Termination

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Article Info

10.24200/jogcr.11.4.297

Received: 2025/10/01
Accepted: 2025/11/07
Published Online: 23 Mar. 2026

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ABSTRACT

Background & Objective: Second-trimester pregnancy termination is a common procedure where predicting its duration remains a clinical challenge. Measuring Transvaginal Sonographic (TVS) Cervical Length (CL) is a validated predictor for labor induction at term, its role in medical abortion is less defined. The present study was conducted with aim to evaluate the value of TVS CL measurement in predicting the induction-to-expulsion interval in second-trimester Termination Of Pregnancy (TOP) using misoprostol.

Materials & Methods: This prospective study was conducted on 45 women between 13–26 weeks of gestation undergoing second-trimester termination specifically for fetal demise (missed abortion). TVS CL was measured prior to induction. Patients received misoprostol per FIGO (2023) guidelines. The primary outcome was the correlation between CL and the induction-to-expulsion interval. Secondary outcomes included correlations with total misoprostol dose and parity. Data was analyzed using SPSS software. $P<0.05$ was considered statistically significant.

Results: The mean cervical length (31.96 mm) was a significant determinant of the induction-to-expulsion interval (21.27 hours), demonstrating a moderate positive correlation ($r=0.374$, $P=0.011$). A near-linear relationship was observed between cervical length and the total misoprostol dose ($r=0.972$, $P<0.0001$). Conversely, parity exhibited a moderate inverse correlation with expulsion time ($r=-0.337$, $P=0.023$).

Conclusion: Transvaginal sonographic measurement of cervical length is a significant predictor of both the duration of second-trimester medical abortion and the required misoprostol dose. A longer cervix is associated with a prolonged abortion process and a higher medication requirement. Incorporating CL assessment into pre-procedure planning can enhance patient counseling and potentially guide individualized dosing protocols to improve the efficiency of medical abortion care.

Keywords: Cervical length, Transvaginal ultrasound, Second trimester, Medical abortion

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1. Introduction

Induced abortion, with a global incidence of 73 million procedures annually, is a cornerstone of reproductive healthcare **(1)**. While most of these abortions occur in the first trimester, approximately 10-15% are performed in the second trimester (13 to 26 weeks of gestation) **(2)**. This statistic belies to a significant clinical disparity: although second-trimester abortions are less common, they account for a disproportionately high rate of serious complications and two-thirds of all abortion-related mortality **(3)**. This elevated risk profile underscores the critical need for developing and optimizing safe, effective, and efficient termination protocols for this gestational period.

The clinical challenge in second-trimester Termination of Pregnancy (TOP) often lies in the inherent resistance of cervix and relative uterine unresponsiveness to contraction-inducing agents compared to term labor **(4)**. Various methods are employed, ranging from surgical procedures like Dilatation and Evacuation (D&E) to medical induction using prostaglandin analogues. Misoprostol, a synthetic prostaglandin E1 analogue, has become a cornerstone of medical management due to its efficacy, stability, low cost, and wide availability **(5)**. However, the interval between initiation of misoprostol and expulsion of fetal products can be highly variable and

unpredictably prolonged, leading to increased patient anxiety, discomfort, and resource utilization **(6)**.

Transvaginal Sonographic (TVS) measurement of cervical length has emerged as a robust, objective tool for cervical assessment, and its utility is well-established in predicting spontaneous preterm birth and, more recently, in forecasting the outcome of labor induction at term **(7,8)**.

A shorter pre-induction cervical length is a well-established predictor of faster delivery and a higher chance of vaginal birth **(8,9)**. This is because it directly quantifies cervical readiness, a key factor for successful dilation. Given this established physiological principle, can this objective sonographic parameter be translated from the context of term labor to predict outcomes in medically induced abortion? While the end goal of cervical dilation is shared, the pathways and patient populations differ significantly. This study was conducted with aim of investigating that pre-procedural TVS cervical length measurement can serve as a reliable predictor for the duration of the abortion process in second-trimester medical TOP using misoprostol, thereby offering a potential tool for personalized patient management and improved clinical forecasting.

2. Materials and Methods

This prospective observational study was conducted at the Department of Obstetrics and Gynecology, Ain Shams University Maternity Hospital in a period from January 2025 till September 2025. The study population comprised 45 pregnant women between 13 and 26 weeks of gestation who were scheduled for second-trimester termination of pregnancy due to confirmed fetal demise (missed abortion). Only singleton pregnancies were included. All cases were non-viable pregnancies with absent fetal cardiac activity on ultrasound, and no women undergoing elective termination for fetal anomalies or maternal indications were included.

Exclusion criteria included

Multiple gestations, known uterine anomalies, history of uterine surgery (including previous cesarean section), signs of active labor or cervical dilation, placenta previa covering the internal os, and any contraindication to misoprostol therapy. The demographic profile and indications for termination were recorded for all participants.

Sample size determination was performed using Power Analysis and Sample Size software (PASS 15, version 15.0.10). The calculation was based on a correlation coefficient of 0.931 derived from previous research by Esawy et al., **(6)**, which examined the relationship between cervical length and abortion duration. With an alpha error set at 0.05 and power at 95%, the initial calculation yielded a requirement of 38 participants. This was increased to 45 participants to accommodate an anticipated 20% dropout rate, ensuring adequate statistical power for the final analysis.

All participants underwent comprehensive pre-procedure assessment including detailed history taking, complete clinical examination, and baseline investigations. History encompassed personal, obstetric, medical, surgical, and current pregnancy details. Clinical examination involved assessment of vital signs, general physical examination, abdominal examination for fundal height and uterine activity, and local vaginal examination to establish baseline cervical status. Laboratory investigations included complete blood count, liver function tests, and kidney function tests, while transabdominal ultrasound confirmed gestational age, fetal status, and placental location.

Measurement of transvaginal sonographic cervical length was performed by trained sonographers following a standardized protocol. With participants in the dorsal lithotomy position and an empty bladder, a high-frequency transvaginal transducer was carefully introduced to obtain a sagittal view of the cervix. The cervical length was measured as the linear distance between the internal and external os, with three consecutive measurements taken and the shortest value recorded for analysis.

The termination protocol followed established FIGO (2023) guidelines for second-trimester abortion using misoprostol tablets. A 400-mcg misoprostol was administered vaginally every 4 hours and maintained until fetal expulsion. The primary outcome measure, induction-to-expulsion interval, was defined as the time from first misoprostol administration to complete fetal expulsion. Post-expulsion management included oxytocin infusion for placental delivery, with surgical evacuation reserved for cases of excessive bleeding or retained placenta beyond 60 minutes. Patients were discharged following a minimum 6-hour observation period after complete expulsion of products of conception.

Data was analyzed using SPSS software version 26. Continuous data are shown as mean±SD, and categorical data as n (%). Pearson's correlation and linear regression were used to assess the relationships between key variables (e.g., cervical length, abortion duration, misoprostol dose), with significance at $P<0.05$.

3. Results

The final analysis included 45 women undergoing second-trimester medical termination of pregnancy. Their demographic and clinical characteristics are summarized in Table 1. The mean age of participants was 26.04±5.84 years, with a range from 15 to 45 years. The obstetric history revealed a low mean parity of 0.64 (±1.05) and a mean number of previous abortions of 0.44±0.97. The mean gestational age at the

time of termination was 20.78±3.76 weeks, with a range spanning the entire second trimester from 13 to 26 weeks. The key predictor variable, the pre-induction cervical length, had a mean value of 31.96 mm±5.49, with individual measurements ranging from 25 to 45 mm. The primary outcome, the induction-to-expulsion interval, demonstrated considerable variability, with a mean duration of 21.27±6.96 hours and a range from 6 to 48 hours. All 45 participants had a diagnosis of missed abortion. Comorbidities were present in a minority of patients, including hypertension (n=4), anemia (n=2), and diabetes mellitus (n=1). No thyroid disorders or other significant medical conditions were reported (Table 2).

The analysis revealed a statistically significant, moderate positive correlation between the pre-induction transvaginal sonographic cervical length and the total duration of the abortion process. The Pearson's correlation coefficient (r=0.3739, P=0.0114), indicatined a significant relationship where a longer cervix was associated with a longer abortion duration. The coefficient of determination (R^2) was 0.1398, meaning that approximately 14% of the variability in the time to fetal expulsion can be attributed to the measured cervical length. The 95% confidence interval for this correlation ranged from 0.090 to 0.601. The linear regression analysis produced the equation: Duration of Abortion (hours)=0.5877×Cervical Length (mm)-2.842. The model predicts that for every additional millimeter in cervical length, the duration of the abortion increases by approximately 35 minutes (Table 3). The scatter plot illustrating this relationship is presented in Figure 1.

A remarkably strong and highly statistically significant positive correlation was found between the initial cervical length and the total dose of misoprostol required to achieve complete fetal expulsion. The correlation coefficient was (r=0.9721, P<0.0001). The coefficient of determination (R^2) was 0.8806, demonstrating that cervical length alone accounted for 88% of the variation in the total misoprostol dose administered. The 95% confidence interval was narrow, ranging from 0.949 to 0.985, indicating high precision in this estimate. The linear regression equation derived was: Total Misoprostol Dose (mcg)=124.6×Cervical Length (mm)- 2491 (Table 4). This finding underscores the potential of cervical length as a primary determinant for dosing in medical termination protocols. The scatter plot for this correlation is shown in Figure 2.

The analysis of the influence of obstetric history showed a statistically significant, moderate negative correlation between parity and time to fetal expulsion. The correlation coefficient was (r= -0.3374, P=0.0234). This inverse relationship indicates that women with higher parity experienced shorter abortion durations. The coefficient of determination (R^2) was 0.0869, indicating that parity explained approximately 8.7% of the variability in the expulsion time. The 95% confidence interval for the correlation was -0.580 to -0.040. The relationship was described by the linear regression equation: Time to Fetal Expulsion (hours)= -1.830×Parity+18.86 (Table 5). The corresponding scatter plot is presented in Figure 3.

Table 1. Demographic and clinical characteristics of the participants

Characteristic	Mean±SD	Range
Age (Years)	26.04±5.84	15.00-45.00
Parity	0.64±1.05	0.00-4.00
Previous Abortions	0.44±0.97	0.00-3.00
Gestational Age (Weeks)	20.78±3.76	13.00-26.00
Cervical Length (mm)	31.96±5.49	25.00-45.00
Time to Fetal Expulsion (Hours)	21.27±6.96	6.00-48.00

Table 2. Medical history and indications for termination

Condition	Number (N) and percentage of patients
Missed Abortion	45(100%)
Diabetes Mellitus	1(2.2%)
Hypertension	4(8.8%)
Anemia	2(4.4%)
Thyroid Disorders	0(0%)
Other Conditions	0(0%)

Table 3. Pearson's correlation analysis of cervical length and abortion duration

Statistical Parameter	Value
Pearson's Correlation Coefficient (r)	0.3739

Coefficient of Determination (R^2)	0.1398
95% Confidence Interval	0.090 to 0.601
P-value	0.0114
Linear Regression Equation	Y=0.5877*X - 2.842
Interpretation	Moderate Positive Correlation, Statistically Significant

Table 4. Pearson's correlation analysis of cervical length and misoprostol dose

Statistical Parameter	Value
Pearson's Correlation Coefficient (r)	0.9721
Coefficient of Determination (R^2)	0.8806
95% Confidence Interval	0.949 to 0.985
P-value	<0.0001
Linear Regression Equation	Y=124.6*X-2491
Interpretation	Strong Positive Correlation, Highly Statistically Significant

Table 5. Pearson's correlation analysis of parity and time to fetal expulsion

Statistical Parameter	Value
Pearson's Correlation Coefficient (r)	-0.3374
Coefficient of Determination (R^2)	0.0869
95% Confidence Interval	-0.580 to -0.040
P-value	0.0234
Linear Regression Equation	Y= -1.830*X+18.86
Interpretation	Moderate Negative Correlation, Statistically Significant

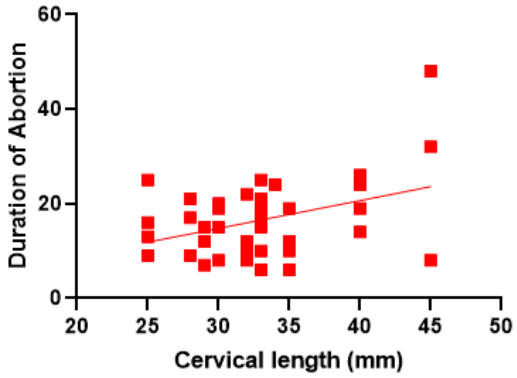


Figure 1. Scatter Plot showing Pearson`s Correlation Analysis of Transvaginal Sonographic Measurement of Cervical Length as A Predictor of Duration of Abortion

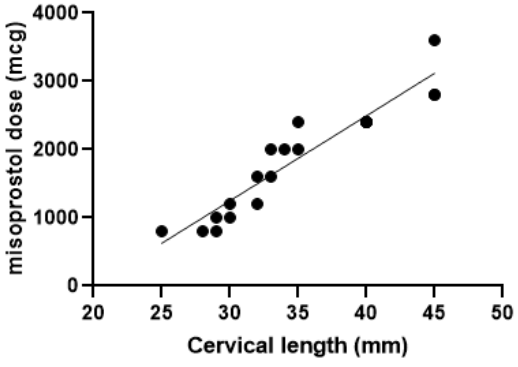


Figure 2. Scatter Plot showing Pearson`s Correlation Analysis of Transvaginal Sonographic Measurement of Cervical Length to Misprostol Dose

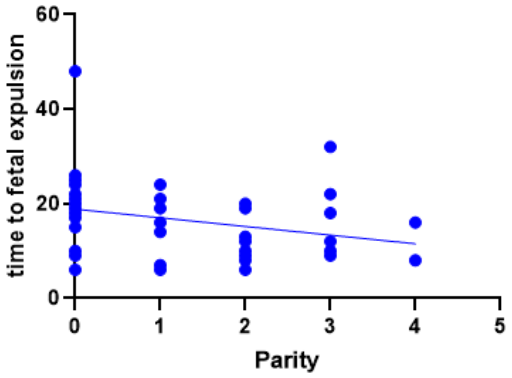


Figure 3. Scatter Plot showing Pearson`s Correlation Analysis of Parity to Time to Fetal Expulsion

4. Discussion

The principal findings of this prospective cohort study confirmed transvaginal sonographic cervical length as a significant and clinically relevant predictor in the context of second-trimester medical abortion. Our results delineate a clear relationship between pre-induction cervical status, as quantified by TVS, and the subsequent course of the termination process. It is critical to note that all participants in this study presented with fetal demise (missed abortion), and the findings should be interpreted strictly within this clinical context. The underlying pathophysiology in missed abortions including possible early cervical softening and inflammatory changes may not reflect the cervical or uterine conditions seen in elective second-trimester terminations of live fetuses for maternal or fetal indications.

This narrow population scope was intentional to minimize clinical heterogeneity and ensure pathophysiological consistency in evaluating the relationship between cervical length and medical abortion dynamics. However, it should be noted that findings from this study may not directly extrapolate to second-trimester terminations involving live fetuses, given potential differences in cervical readiness and prostaglandin responsiveness.

The core finding of a statistically significant moderate positive correlation (r=0.3739, P=0.0114) between cervical length and the total duration of abortion is physiologically intuitive and aligns with the fundamental mechanism of labor and abortion. A longer, uneffaced cervix represents a greater mechanical and biological barrier that must be overcome before sufficient dilation for fetal expulsion can occur. This finding is consistent with the extensive body of literature on term labor induction.

Anikwe et al., **(8)** demonstrated that a shorter cervical length was a key predictor of successful vaginal delivery within 24 hours. More directly, our results corroborate the work of Esawy et al., **(6)**, who also found a significant positive correlation in a similar patient population. The linear regression model derived from our data (Duration=0.5877 * CL-2.842) provides a tangible, quantitative framework for clinicians. It suggests that for every additional millimeter of cervical length, the abortion process can be expected to prolong by approximately 35 minutes. This level of prediction, while not absolute due to other influencing factors, is invaluable for setting realistic patient expectations, allocating clinical resources, and managing patient anxiety during what is often a stressful experience.

The most robust and potentially practice-changing finding of the present study is the remarkably strong positive correlation (r=0.9721, P<0.0001) between cervical length and the total dose of misoprostol required to achieve complete abortion. The cervical length alone accounted for 88% of the variability in the medication dose. This powerful relationship suggests that clinicians may be able to move beyond standardized, one-size-fits-all misoprostol regimens towards more personalized, anatomy-based dosing. A patient with a cervix measuring 45 mm could be anticipated to require a significantly higher cumulative dose than a patient with a cervix of 25 mm. Such an approach has the potential to optimize efficacy ensuring sufficient dosing for a prolonged cervix while simultaneously minimizing the side effects and patient discomfort associated with unnecessarily high doses in women with a more favorable cervical status. This finding contrasts to a study by Agostini et al., **(10)** in the terms of first-trimester pregnancy failure, which found no such correlation, potentially indicating that the relationship between cervical architecture and prostaglandin response becomes more pronounced and critical as pregnancy advances into the second trimester.

Our analysis also reaffirmed the well-documented influence of obstetric history, demonstrating a significant moderate negative correlation between parity and the time to fetal expulsion. This finding, supported by previous research such as that of Nilas et al., **(11)**, is readily explained by the concept of "cervical priming" from prior vaginal births. The multiparous cervix has undergone significant remodeling and stretching, which appears to confer a lasting predisposition to more efficient dilation in subsequent uterine events, including induced abortion.

It is important to contextualize our reported mean induction-to-expulsion interval of 21.27 hours. This is longer than intervals reported in studies utilizing mifepristone for pre-sensitization, such as Goh and Thong **(12)**, who reported a median of 6.7 hours. This discrepancy is not a limitation but rather a critical clarification; it underscores that our findings are specifically applicable to misoprostol-only protocols, which are common in settings where mifepristone is unavailable or restricted. The predictive models we developed are thus most relevant for this specific clinical scenario.

The literature on Cervical Length (CL) and pharmacologic induction focuses on term pregnancies, however, emerging evidence supports its relevance in second-trimester medical abortion contexts as well. Kuusela et al., **(13)** conducted a prospective study involving second-trimester medical abortions using a misoprostol-only protocol and found that a longer cervical length was associated with prolonged induction-to-expulsion intervals, supporting our findings. Similarly, Wikström et al., **(14)** observed that pre-procedural cervical characteristics could meaningfully stratify patients in terms of abortion duration and misoprostol requirement.

Although Cheung et al., **(15)** primarily focused on cervical length as a predictor of preterm birth, they confirmed that shorter CL was associated with greater uterine sensitivity and earlier delivery a physiological mechanism likely shared with misoprostol responsiveness during abortion. Wang et al., **(16)** also highlighted the predictive utility of second-trimester CL, though in the context of spontaneous labor. These studies reinforce the utility of cervical length as a cross-contextual predictor of uterine response whether in spontaneous labor, labor induction, or abortion. However, most studies have focused on spontaneous outcomes or mixed methods. Our study uniquely isolates misoprostol-only protocols in non-viable pregnancies, adding novel data to this evolving area of reproductive care.

Finally, our study contributes to an ongoing debate in the literature regarding the comparative value of sonographic versus digital cervical assessment. While some studies have found TVS CL superior to the Bishop score **(17)**, others have found it less predictive **(18)**. Our data, showing a significant correlation between an objective TVS measurement and clinical outcomes, adds weight to the argument for incorporating this reproducible tool into pre-procedure assessment, particularly as it can be performed by any trained sonographer and is less subject to inter-observer variability than a digital examination.

Given the strong linear relationship between cervical length and required misoprostol dose in this study, a critical next step is to evaluate the feasibility and effectiveness of a CL-stratified misoprostol dosing protocol. Further randomized controlled trial could compare standard fixed-dose regimens against a dosing algorithm adjusted based on measured cervical length. Such a study would help determine whether this approach reduces time to expulsion, minimizes drug exposure, and improves patient satisfaction and resource utilization. Importantly, it would also clarify whether personalized protocols can be safely implemented across diverse clinical settings.

5. Conclusion

As evidenced by the results of the present study, transvaginal sonographic cervical length measurement serves as a significant predictor for both duration and misoprostol requirements in second-trimester terminations for fetal demise. A longer cervical length correlates strongly with prolonged abortion duration and increased medication needs, while higher parity predicts shorter expulsion times. These results are specifically applicable to pregnancies with intrauterine fetal death and may not apply to elective terminations involving live fetuses. Incorporating cervical length assessment into clinical protocols for fetal demise may enhance patient counseling, improve workflow efficiency, and support more personalized misoprostol dosing strategies. Future researchs are required to explore CL-guided misoprostol dosing in prospective trials to evaluate its safety, efficiency, and impact on patient outcomes.

6. Declarations

Acknowledgments

We thank the medical staff of Ain Shams University Maternity Hospital for their assistance during the study. We are also grateful to the patients who agreed to participate in this research.

Ethical Considerations

The research protocol received formal approval from the Institutional Research Ethics Committee (Approval code: MS463/2024), and written informed consent was secured from all enrolled participants in compliance with ethical standards for human research. All patient data were anonymized prior to analysis. Confidentiality was maintained throughout the research process in compliance with institutional data protection policies.

Authors' Contributions

Abdel Rahman Mohamed Saleh: Conceptualization, study design, supervision, data interpretation, manuscript drafting, and final revision. Mohamed Taha Ismail: Study design, clinical supervision, and critical revision of the manuscript. Rania Hamdy Ali: Data collection, patient recruitment, and clinical follow-up. Mai Medhat Nawara: Data acquisition, statistical analysis, and results interpretation. Ahmed Atef Ali: Methodology development, ultrasound assessment standardization, and manuscript editing. Ahmed Mohamed Salah Kora: Data management, literature review, and manuscript preparation. All authors contributed substantially to the work, reviewed the manuscript critically for important intellectual content, approved the final version for publication, and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declare that they have no conflicts of interest related to this study.

Fund or Financial Support

This study received no external funding or financial support from any public, private, or non-profit organization.

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How to Cite This Article:

Mohamed Saleh AR, Ismail MT, Hamdy Ali R, Medhat Nawara M, Atef Ali A, Mohamed Salah Kora A, et al. Value of Transvaginal Sonographic Cervical Length Measurement to Predict Duration of Second Trimester Pregnancy Termination. J Obstet Gynecol Cancer Res. 2026;11(4):297-304.

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