

Diagnostic Accuracy of Cervical Length in Prediction of Emergency Cesarean Section Due to Massive Hemorrhage in Women with Placenta Previa

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ABSTRACT

Objective: To determine the diagnostic accuracy of cervical length in prediction of emergency Cesarean section in women with massive hemorrhage and Placenta Previa taking observed delivery outcome as a gold standard.

Study Design: A cross-sectional validation study.

Place and Duration of the Study: Department of Obstetrics and Gynecology, Saidu Medical College, Swat from 6th May 2026 to 6th August 2026.

Methodology: A consecutive sample of 124 pregnant women aged 18–45 years was enrolled, having singleton pregnancy, gestation of 28–36 weeks and placenta previa. Cervical length was assessed through transvaginal ultrasonography and a value of ≤ 31 mm was considered suggestive of emergency caesarean section. Participants were monitored through delivery, with the eventual delivery mode serving as the reference standard. Sensitivity, specificity, diagnostic accuracy, positive predictive value and negative predictive value were derived from a 2×2 contingency table.

Results: The mean age was 30.08 ± 4.81 years, gestational age 31.82 ± 1.78 weeks, cervical length 33.49 ± 4.78 mm and body mass index 24.14 ± 1.77 kg/m². Emergency caesarean section was performed in 24 (19.4%). Cervical length showed sensitivity of 83.33%, specificity of 77.00%, diagnostic accuracy of 78.23%, positive predictive value of 46.51% and negative predictive value of 95.06%.

Conclusion: A cervical length of ≤ 31 mm demonstrated satisfactory sensitivity and negative predictive value in anticipating emergency caesarean section resulting from massive haemorrhage associated with placenta previa.

Keywords: Cervical length, Diagnostic accuracy, Emergency caesarean section, Massive haemorrhage, Placenta previa, Transvaginal ultrasound.

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1. INTRODUCTION

Placenta Previa is a significant condition in obstetrics where the placenta is implanted partially or totally over the internal os of the cervix.¹ This condition is usually either asymptomatic or may be associated with sudden onset of painless vaginal bleeding, especially during the late part of the pregnancy.² The condition poses risks for both mother and baby since there is a risk of having a severe hemorrhage that is very difficult to control.³ There may be variability in the volume of blood lost and antepartum bleeding is associated with frequent admissions to hospitals, blood transfusions and even emergency delivery of the baby.⁴ The risk of having severe hemorrhage is also dependent on the extent of coverage of the placenta, previous surgeries involving the uterus and abnormal attachment of the placenta.⁵

The caesarean section is the most common way of delivery in patients with placenta previa if the placenta is covering or near the cervical os as vaginal delivery may result in placental separation and massive maternal bleeding.⁶ Although the preference for caesarean section is done in case of stability, some patients may have a lot of vaginal bleeding even before the planned surgery and require an emergency caesarean section.⁷ The emergency operation in presence of massive bleeding may be linked with the increased risk of maternal morbidities such as severe anaemia, requirement for large volume blood transfusion, coagulopathy, hysterectomy and intensive care admission.⁸

Cervical length assessment through transvaginal ultrasonography is a simple, relatively objective test that can be performed in pregnant women.⁹ In women with placenta previa, cervical length assessment may be related to the risk of vaginal bleeding and emergency delivery, but there is still doubt about the usefulness of cervical length assessment in prediction of severe bleeding.¹⁰ Short cervical length may be indicative of increased cervical changes and possible separation or vaginal bleeding, while long cervical length may be related to stable pregnancy in some cases.¹¹

It becomes important to assess the cervical length in patients with placenta previa since massive bleeding can occur suddenly and might necessitate an emergency caesarean section without any adequate time for preparations. Identification of women who are at high risk would make it possible to observe them, make the necessary referrals and arrange the necessary blood products and facilities for performing the caesarean section. Currently, the cervical length is not being assessed alone for prediction of emergency caesarean section due to massive hemorrhaging in placenta previa. Thus, the assessment of the diagnostic utility of cervical length in such patients could be helpful.

2. METHODOLOGY

This cross-sectional validation study was conducted from 6th May 2026 to 6th August 2026 at the Department of Obstetrics and Gynecology, Saidu Medical College, Swat. The study population comprised women with Placenta Previa. Placenta Previa was diagnosed during 3rd trimester by transvaginal ultrasound when the lower placental edge was partially or completely covering the internal cervical os. A non-probability consecutive sampling technique was used. The sample size was calculated by using a sensitivity sample size calculator, taking sensitivity of cervical length ≤ 31 mm as 83.3%,¹² specificity as 76.6%,¹² confidence level of 95%, absolute precision of 15% and prevalence of Emergency C section as 20.3%.¹³ The calculated sample size was 124 women with Placenta Previa.

Ethical approval was secured from the institutional ethical review committee under certificate No. 182/ERB/024. The study included women aged 18 to 45 years having a singleton pregnancy with gestational age ranging from 28 to 36 weeks. Gestational age was determined according to the last menstrual period and confirmed through ultrasonography. Women experiencing massive haemorrhage secondary to placenta previa were recruited as per the predefined study criteria. Exclusion criteria comprised threatened preterm labour, premature rupture of membranes, bleeding during the current pregnancy, polyhydramnios, previous cervical cone biopsy, cerclage, vaginal progesterone use, suspected fetal anomaly or growth restriction on ultrasound, maternal disease, or hypertensive disorders complicating pregnancy.

The purpose of the study, involved procedure, possible risks and expected benefits were explained to the eligible women before enrolment and written informed consent was obtained. Demographic and baseline information was then recorded.

Data included age, gestational age and parity. Body mass index was calculated by dividing weight in kilograms by height in metres squared.

After enrolment, all women underwent transvaginal ultrasound examination for assessment of cervical length. The cervical length was measured during the ultrasound examination and a value of ≤ 31 mm was considered as prediction of emergency C section, whereas a value >31 mm was considered as not predicting emergency C section. The women were then followed until delivery. During the follow-up period, the amount of blood loss was assessed by weighing dry and soaked pads on a digital weight scale, with 100 grams difference in weight considered equal to 100 ml of blood. The mode of delivery was decided according to the clinical condition and amount of blood loss by a consultant gynecologist having 2 or more years of experience. The final delivery outcome including NVD, elective C section or emergency C section was documented in the proforma along with cervical length and demographic variables.

Massive hemorrhage was considered when blood loss was 1500 ml or more during the relevant clinical period, as measured from the difference between dry and soaked pad weight using a digital weight scale. The observed mode of delivery at the time of delivery was taken as the gold standard, where emergency cesarean section was considered when cesarean delivery was performed because of uncontrollable antepartum or intrapartum bleeding in a patient with Placenta Previa, as decided by the attending consultant obstetrician.

Data were entered and analysed using Statistical Package for Social Sciences (SPSS) version 24. Mean $\pm$ standard deviation was computed for age, gestational age, cervical length and BMI. Frequencies and percentages were determined for parity and emergency caesarean section. Sensitivity, specificity, positive predictive value and negative predictive value were calculated from a 2 $\times$ 2 contingency table, considering mode of delivery as the gold standard. Potential effect modifiers, namely age, gestational age, parity and BMI, were evaluated by stratification using 2 $\times$ 2 tables, with mode of delivery serving as the reference standard.

3. RESULTS

A total of 124 women were included in this study. The mean age of the participants was 30.08 ± 4.81 years, mean gestational age was 31.82 ± 1.78 weeks, mean cervical length was 33.49 ± 4.78 mm and mean BMI was 24.14 ± 1.77 kg/m². Regarding parity, majority of the patients had parity 3 with 35 (28.2%) cases, followed by parity 2 with 27 (21.8%) cases, parity 4 with 24 (19.4%) cases, parity 1 with 18 (14.5%) cases, parity 0 with 15 (12.1%) cases and parity 5 with 5 (4.0%) cases. (Table-I).

Table-I: Patient Demographics.
n=124

Demographics	Mean $\pm$ SD / n (%)
Age (years)	30.08 $\pm$ 4.81
Gestational Age (weeks)	31.82 $\pm$ 1.78
Cervical Length (mm)	33.49 $\pm$ 4.78
BMI (kg/m ²)	24.14 $\pm$ 1.77
Parity	
0 n (%)	15 (12.1%)
1 n (%)	18 (14.5%)
2 n (%)	27 (21.8%)
3 n (%)	35 (28.2%)
4 n (%)	24 (19.4%)
5 n (%)	5 (4.0%)

On overall results, cervical length was found positive in 43 (34.7%) cases and negative in 81 (65.3%) cases. Emergency caesarean section was performed in 24 (19.4%) cases whilst 100 (80.6%) cases did not required emergency caesarean section (Table-II).

Table-II: Overall Results of Cervical Length and Emergency C-Section.
n=124

Variables	Cervical Length	Emergency C-Section
Positive	43 (34.7%)	24 (19.4%)
Negative	81 (65.3%)	100 (80.6%)
Total	124 (100%)	124 (100%)

On crosstabulation, amongst the women with positive cervical length (≤ 31 mm), 20 (46.5%) were true positive and 23 (53.5%) were false positive. Amongst the women with negative cervical length (>31 mm), 4 (4.9%) were false negative and 77 (95.1%) were true negative (Table-III).

Table-III: Comparison of Cervical Length versus Emergency C-Section due to Massive Hemorrhage.
n=124

Cervical Length	Emergency C-Section		Total
	Yes	No	
Positive (≤ 31 mm)	20 (46.5%) (TP)	23 (53.5%) (FP)	43 (100%)
Negative (> 31 mm)	4 (4.9%) (FN)	77 (95.1%) (TN)	81 (100%)
Total	24 (19.4%)	100 (80.6%)	124 (100%)

Key: TP = True positive, FP = False positive, FN = False negative, TN = True negative

The diagnostic performance of cervical length for predicting emergency caesarean section secondary to massive haemorrhage was assessed. Sensitivity was 83.33%, while specificity was 77.00%. The diagnostic accuracy was 78.23%, with a positive predictive value (PPV) of 46.51% and a negative predictive value (NPV) of 95.06% (Table-IV).

Table-IV: Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of Cervical Length in prediction of Emergency C-Section due to Massive Hemorrhage.
n=124

Diagnostic Parameter	Result
Sensitivity	83.33%
Specificity	77.00%
Diagnostic Accuracy	78.23%
PPV	46.51%
NPV	95.06%

On stratification, sensitivity, specificity, diagnostic accuracy, positive predictive value and negative predictive value were 81.82%, 74.00%, 75.41%, 40.91% and 94.87% in women aged ≤ 30 years, compared with 84.62%, 80.00%, 80.95%, 52.38% and 95.24% in those aged > 30 years. For gestational age ≤ 32 and > 32 weeks, the respective values were 76.47%, 90.74%, 87.32%, 72.22%, 92.45% and 100.00%, 60.87%, 66.04%, 28.00%, 100.00%. For parity ≤ 2 and > 2 , these were 100.00%, 76.36%, 78.33%, 27.78%, 100.00% and 78.95%, 77.78%, 78.13%, 60.00%, 89.74%, respectively. For BMI ≤ 25 and > 25 kg/m², the corresponding values were 75.00%, 75.71%, 75.58%, 41.38%, 92.98% and 100.00%, 80.00%, 84.21%, 57.14%, 100.00%, respectively (Table-V).

Table-V: Stratified Analysis of Sensitivity, Specificity, Diagnostic Accuracy, PPV and NPV of Cervical Length in prediction of Emergency C-Section with Age, Gestational Age, Parity and BMI.
n=124

Variables	Groups	Diagnostic Parameter	Result
Age (years)	≤ 30	Sen	81.82%
		Spec	74.00%
		DA	75.41%
		PPV	40.91%
		NPV	94.87%
	> 30	Sen	84.62%
		Spec	80.00%
		DA	80.95%
		PPV	52.38%
		NPV	95.24%
Gestational Age (weeks)	≤ 32	Sen	76.47%
		Spec	90.74%
		DA	87.32%
		PPV	72.22%
		NPV	92.45%
	> 32	Sen	100.00%
		Spec	60.87%
		DA	66.04%
		PPV	28.00%
		NPV	100.00%
Parity	≤ 2	Sen	100.00%
		Spec	76.36%
		DA	78.33%
		PPV	27.78%

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	>2	NPV	100.00%
		Sen	78.95%
		Spec	77.78%
		DA	78.13%
		PPV	60.00%
		NPV	89.74%
BMI (kg/m ²)	≤25	Sen	75.00%
		Spec	75.71%
		DA	75.58%
		PPV	41.38%
		NPV	92.98%
	>25	Sen	100.00%
		Spec	80.00%
		DA	84.21%
		PPV	57.14%
		NPV	100.00%

4. DISCUSSION

In the present study, the sensitivity and specificity of cervical length was found to be 83.33% and 77.00% respectively, with diagnostic accuracy of 78.23%, PPV of 46.51% and NPV of 95.06%. These findings were comparable to those reported by Yue *et al.*¹⁴ who found that cervical length <30 mm had sensitivity of 86.53%, specificity of 83.94%, PPV of 82.43% and NPV of 87.74% in predicting massive haemorrhage in placenta accreta spectrum disorders. However, the PPV in the present study was notably lower than that reported by Yue *et al.*¹⁴ which may be attributed to the difference in study population, as placenta accreta spectrum disorders inherently carry a higher risk of massive haemorrhage as compared to placenta praevia alone.

Kahramanoğlu *et al.*¹⁵ similarly reported that cervical length <25 mm was associated with increased risk of postpartum haemorrhage and emergency caesarean delivery in placenta praevia totalis, which is in agreement with the present study where negative cervical length (≤31 mm) was found in 43 (34.7%) cases and was associated with higher rate of emergency caesarean section. The difference in cut-off values between the two studies may be due to variation in study design and inclusion criteria. Tiriyaki *et al.*¹⁶ reported an AUC of 0.999 with sensitivity of 96.2% and specificity of 99.9% at a cut-off of ≤26.5 mm for predicting peripartum hysterectomy, which was considerably higher than the present study, possibly because peripartum hysterectomy represents a more extreme clinical outcome and therefore the discriminatory ability of cervical length may be more pronounced in such cases.

Maymon *et al.*¹⁷ found that rate of cervical shortening >0.7 mm/week produced sensitivity of 86.7%, specificity of 53.8%, PPV of 68.4% and NPV of 77.8%, showing lower specificity and NPV as compared to the present study. This difference may be due to the distinct pathophysiology of vasa praevia as compared to placenta praevia, where static cervical length may be a more reliable predictor.

Ruiter *et al.*¹⁸ reported that 93 out of 214 (43.5%) women required emergency caesarean delivery, which was considerably higher than the 24 (19.4%) cases in the present study. The higher rate may be related to inclusion of multiple indications including antepartum haemorrhage, early onset labour and non-reassuring fetal status, whilst the present study focused specifically on massive haemorrhage. Ruiter *et al.*¹⁸ also identified previous caesarean section and repeated antepartum bleeding episodes as independent predictors, suggesting that cervical length should be considered alongside other clinical risk factors.

The ADoPAD Study Group¹⁹ reported that cervical length <25 mm was associated with emergency caesarean delivery (OR 3.89, 95% CI 1.33–11.33; p=0.01) though with low diagnostic accuracy, which is partially consistent with the present study findings of moderate diagnostic accuracy of 78.23%, further supporting the need for multiparametric assessment.

Yang *et al.*²⁰ reported that cervical length <3.0 cm was one of five independent predictors of cervical placenta accreta spectrum involvement, with the combined ultrasound-MRI model achieving AUC of 0.892, sensitivity of 87.60% and specificity of 81.49%, which was higher than the present study, likely due to use of combined imaging modalities rather than single parameter assessment.

Chan *et al.*²¹ investigated cervical length in women with antepartum haemorrhage of unknown origin and found cervical length <25 mm strongly associated with preterm birth (aOR 25.16). Although the clinical context differed, the findings

collectively suggest that shorter cervical length is a reliable marker of adverse obstetric outcomes across various aetiologies of antepartum haemorrhage.

There are a number of limitations associated with the current study which need to be taken into account during the interpretation of the results. It is a single-centre study that might have influenced the generalizability of its results. The sample size was quite low with only 124 patients which may have influenced the power of the stratified analysis. The design of the study was retrospective which means that there is a risk of selection bias and inadequate data recording. Cervical length was measured statically rather than dynamically which may have influenced the interpretation of cervical status. Also, it was not adjusted for the possible confounders such as placental grading, placenta accreta spectrum and number of bleeding events.

5. CONCLUSION

It can be concluded from the current study that cervical length is moderately reliable in prediction of emergency caesarean delivery for massive haemorrhage in pregnant women with placenta praevia. It has reasonably good sensitivity and a very high negative predictive value. Thus, cervical length can be said to have utility as a clinical predictor in women with placenta praevia during antenatal period, though its combined usage with other clinical and radiological predictors is advised.

Ethical Approval

Ethical clearance to conduct the study was obtained from the Institutional Ethical Committee of the concerned hospital before commencement of the research.

Patients' Consent

Written informed consent was obtained from all participants prior to their enrolment in the study.

Competing Interests

The author declared no conflict of interest concerning this study.

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