

EVALUATING THE EFFICIENCY OF MEASURING THE CERVICAL LENGTH AND FUNNELING BY TRANSVAGINAL SONOGRAM IN PREDICTION OF SPONTANEOUS PRETERM DELIVERY

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ABSTRACT

BACKGROUND

Preterm delivery is one of the common obstetric problems and is the major cause of perinatal mortality. Considering the positive relationship between short cervical length and increased rate of preterm labour incidence, measurement of cervical length can be suggested as an efficient way for predicting preterm labour. In comparison to other techniques, in transvaginal assessment, the quality and details of cervical canal can be observed better due to the closeness of the probe to the cervix.

MATERIALS AND METHODS

This was a prospective observational study conducted in pregnant patients from 16 - 24 weeks of gestation attending antenatal clinic at Maternity Hospital, Pudhucherry from June 2006 - June 2009. After taking detailed history including age, history of induced abortion, previous history of preterm delivery and vaginal bleeding, eligible patients were informed about the study and those who agreed to enter into the study, written consent was obtained from them. Cervical parameters (cervical length, dilatation of internal OS, presence of funneling) was assessed by transvaginal scan. The study population was divided based on the cervical length into 2 groups of < 25 mm and > 25 mm. Patients were followed up till delivery. The total number of deliveries < 37 weeks and > 37 weeks were recorded. The cervical length assessment was studied in primigravida and multigravida and in patients with and without history of induced abortion, previous history of preterm vaginal bleeding and the outcome was compared. Statistical analysis was done with chi-square test.

RESULTS

The measurement of cervical length provides accurate prediction of risk of preterm delivery. Open internal os is predictive of preterm delivery, especially in patients with cervical length < 25 mm. In patients with previous history of preterm birth, previous history of more than 2 induced abortions, history of vaginal bleeding and cervical length measurement is predictive of preterm delivery. The measurement of cervical length can be recommended as a screening procedure for prediction of preterm delivery.

CONCLUSION

The measurement of cervical length provides accurate prediction of risk of preterm delivery. Open internal os is predictive of preterm delivery, especially in patients with cervical length < 25 mm. In patients with previous history of preterm birth, previous history of more than 2 induced abortions, history of vaginal bleeding, cervical length measurement is predictive of preterm delivery. The measurement of cervical length can be recommended as a screening procedure for prediction of preterm delivery.

KEY WORDS

Cervical Length, Preterm, Transvaginal Assessment.

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BACKGROUND

Preterm delivery is one of the common obstetric problems with an annual worldwide incidence rate of 13,000,000 cases.⁽¹⁾ It is the major cause of perinatal mortality and is usually associated with recognised maternal and neonatal outcomes.⁽²⁻⁷⁾ Moreover, preterm labour imposes psychological and socio-economic pressures on both neonate's parents and the society.^(8,9) Spontaneous preterm labour accounts for approximately 72% of preterm delivery and several factors can increase the risk of this type of

preterm deliveries. Some of them are early threatened abortion in the current pregnancy, genetic factors, demographic features, behaviour features such as cigarette smoking, low maternal weight gain during pregnancy, consumption of illicit drugs, pregnancy in extremes of reproductive life, short stature, vitamin C deficiency, prolonged walking and standing, exhausting activities and psychophysical stresses. Early diagnosis of high-risk pregnancies from preterm labour and its outcomes has significant role in decreasing the mortality rates.

According to the previous studies, the risk scoring system for predicting preterm labour developed by Papiernik and its modified version by Creasy have not been efficient in the diagnosis of several cases leading to preterm labour.^(2,1)

Considering the positive relationship between short cervical length and increased rate of preterm labour incidence, measurement of cervical length can be suggested as an efficient way for predicting preterm labour.⁽³⁾ In comparison to other techniques, in transvaginal assessment the quality and details of cervical canal can be observed

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better due to the closeness of the probe to the cervix.⁽⁴⁾

So the present study was performed with the aim of evaluating the efficiency of measuring cervical length and funneling by transvaginal sonogram at gestational age of 16-24 weeks in screening of preterm delivery.

MATERIALS AND METHODS

This was a prospective observational study conducted in pregnant patients from 16 - 24 weeks of gestation attending antenatal clinic at Maternity Hospital, Pudhucherry from June 2006 - June 2009. After taking detailed history including age, history of induced abortion, previous history of preterm delivery and vaginal bleeding.

Inclusion Criteria

All pregnant patients from 16 - 24 weeks attending antenatal clinic in Maternity Hospital, Pudhucherry.

Exclusion Criteria

- Patients with multiple gestation.
- Previous cervical surgery.
- Pregnancy-induced hypertension.
- Patients with indicated preterm delivery.
- Patients with anomalous foetus.

Eligible patients were informed about the study and those who agreed to enter into the study, written consent was obtained from them. Cervical parameters (cervical length, dilatation of internal OS, presence of funneling) was assessed by transvaginal scan. The study population was divided based on the cervical length into 2 groups of < 25 mm and > 25 mm. Patients were followed up till delivery. The total number of deliveries < 37 weeks and > 37 weeks were recorded. The cervical length assessment was studied in primigravida and multigravida and in patients with and without history of induced abortion, previous history of preterm, vaginal bleeding and the outcome was compared. Statistical analysis was done with chi-square test and Fisher exact. Odds ratio, Sensitivity, Specificity, Positive predictive value and Negative predictive value were calculated.

RESULTS

A total of 530 women entered into the study and were divided into 2 groups based on cervical length measurement by endovaginal sonography (i.e.) cervical length < 25 mm (Group-A) and cervical length > 25 mm (Group-B). The numbers were 9.43% (n= 50) and 90.56% (n= 480) in Group-A and Group-B respectively. In Group-A 44% (n= 22) women had preterm delivery, whereas in Group-B only 3.54% (n=17) had preterm delivery.

Cervical Length	N	Term	Preterm
< 25 mm	50	28	22
> 25 mm	480	463	17

Table 1

Sensitivity- 56.4%
 Specificity- 94.3%
 Positive predictive value- 44%
 Negative predictive value- 96.5%

Cervical Length	N (%)	Term (%)	Preterm (%)	Fisher Exact Probability	P value
< 25 mm	27 (11.8%)	12 (44.44%)	15 (55.55%)	62.71	0.0001
> 25 mm	202 (88.2%)	192 (95.04%)	10 (4.95%)		

Table 2. Obstetric Outcome in Relation to Cervical Length in Primigravida

Odds ratio- 24.0 (8.07 - 73.52)
 Sensitivity- 60%
 Specificity- 94.1%
 Positive predictive value- 55.5%
 Negative predictive value- 95%

Obstetric outcome in primigravida shows that smaller the cervical length more the preterm birth. With cervical length <25 mm, out of 27 primigravida 44.4% (n= T2) delivered at term and 55.5% (n= T5) delivered at preterm. With cervical length > 25 mm, out of 202 primigravida 95.04% (n= 192) delivered term and 4.95% (n= 10) delivered preterm.

Cervical Length	N (%)	Term (%)	Preterm (%)	Fisher Exact Probability	P value
< 25 mm	23 (7.64%)	16 (69.56%)	7 (30.43%)	37.33	0.0001
> 25 mm	278 (92.35%)	271 (97.5%)	7 (2.51%)		

Table 3. Obstetric Outcome in relation to Cervical Length in Multigravida

Odds ratio- 16.94 (4.62 - 62.89)
 Sensitivity- 50%
 Specificity- 94.4%
 Positive predictive value- 30.4%
 Negative predictive value- 97.5%

With cervical length < 25 mm, among 23 multigravidas 69.56% (n= 16) and 30.43% (n= 7) delivered term and preterm respectively. With cervical length > 25 mm, among 278 multigravidas 97.5% (n= 271) and 2.51% (n= 7) delivered at term and preterm respectively.

Cervical Length < 25 mm	n	Term (%)	Preterm (%)	Chi-square	P value
Internal OS Closed	33	28 (84.85%)	5 (15.15%)	32.78	0.0001
Open	17	Nil	17 (100%)		

Table 4. Internal OS

Odds ratio- not applicable
 Sensitivity- 77.3%
 Specificity- 100%
 Positive predictive value- 100%
 Negative predictive value- 84.8%

Cervical Length > 25 mm	n	Term (%)	Preterm (%)	Fisher Exact Probability	P value
Internal OS					
Closed	440	440 (100%)	Nil	193.87	0.0001
Open	40	23 (57.5%)	17 (42.5%)		

Table 5. Correlation between Cervical Length and OS

Odd ratio- not applicable
 Sensitivity- 100%
 Specificity- 95%
 Positive predictive value- 42.5%
 Negative predictive value- 100%

All patients with open internal os (n= 17) delivered at preterm (100%), thereby specificity and positive predictive value being 100%.

In 480 patients with cervical length > 25 mm, there were 91.66% (n= 440) and 8.33 (n= 40) patients with internal OS closed and open respectively. In 440 patients with internal os closed, all of them delivered at term. Out of 40 patients with open internal OS, 42.5% (n= 17) of them delivered at preterm and 57.5% (n= 23) of them delivered at term.

Among 50 patients with cervical length < 25 mm, there were 66% (n= 33) and 34% (n= 17) patients with internal OS closed and open respectively. In patients with internal os closed, 84.85% (n= 28) patients delivered at term and 15.15% (n= 5) delivered at preterm.

Previous History of Preterm Birth	n	No. of Patients Delivered		Fisher Exact Probability	P value
		Term (%)	Preterm (%)		
Yes	7	4 (57.14%)	3 (42.85%)	13.11	0.0002
No	523	487 (93.11%)	36 (6.88%)		

Table 6. Previous History of Preterm Birth

Odds

ratio- 10.15 (1.72 - 56.47)

Among 530 patients, 1.32% (n= 7) patients gave history of previous preterm birth. Out of 7 patients, 57.14% (n= 4) were delivered at term and 42.55% (n=3) were delivered at preterm.

Cervical Length	Term	Preterm	Fisher Exact Probability	P value
> 25 mm n= 19 (79.1%)	17 (89.5%)	2 (10.5%)	5.87	0.042
< 25 mm n= 5 (20.9%)	2 (40%)	3 (60%)		

Table 7. Previous History of Abortion

Odds ratio- 12.75 (0.87 - 296.22)

Among 530 patients, 24 of them had history of more than one induced abortion. A short cervix was noted in 20.9% of all patients identified with more than 1 induced abortion. The incidence of spontaneous preterm birth in patients with a cervical length < 25 mm was 60% (3/5). For patients with a cervical length > 25 mm incidence of preterm birth was 10.5% (2/19).

Vaginal Bleeding	Spontaneous PTD		PPROM	Fisher Exact Probability	P Value
	N	%	%		
Trimester of Bleeding				2.42	0.297
I trimester only	35	7(20%)	4(11.4%)		
II trimester only	7	2(28.5%)	NIL		
Both trimester	3	3(100%)	NIL		
Bleeding Episode				0.10	0.634
Single	29	4(13.7%)	1(3.4%)		
Multiple	16	8(50%)	3(18.7%)	OR- 1.50	
Duration (Days)				(0.08-51.67)	
1-2	34	8(23.5)	2(5.88)	0.36	0.489
> 2	11	4(36.36)	2(5.88)	OR- 2.00	
Severity				(0.12-34.80)	
Spotting	32	4(12.5) ‘	3(9.37)	2.12	0.192
More than menstrual period	13	8(61.5%)	1(7.69%)	OR-0.17	
				(0.00-3.06)	

Table 8. Vaginal Bleeding and Risk of Preterm Delivery

Result revealed 8.49% (n= 45) of patients included in the study had vaginal bleeding. Out of 45 patients 77.7% (n= 35) had bleeding during first trimester only, 15.5% (n= 7) had bleeding during second trimester only and 6.6% (n= 3) experienced bleeding during both trimesters. All the patients 100% (n= 3) who had bleeding during both trimesters delivered preterm. Among patients who had bleeding during

first and second trimesters, 20% (n= 7) and 28.5% (n= 2) delivered preterm respectively.

The percentage of spontaneous preterm delivery was more in patients who had multiple episodes, more duration, more blood loss (50% vs. 13.7%, 36.36% vs. 23.5%, 61.5% vs. 12.5%). Among 35 patients who had bleeding only in first trimester, 11.4% (n= 4) had PPRM. Among 16 patients who

had multiple episodes, 8.7% (n= 3) had PPROM. There was no significant difference between number of days. PPROM was more in patients with spotting than more than menstrual period (9.37% vs. 7.69%).

DISCUSSION

Preterm delivery complicates 5-10% of pregnancies and accounts for 85% of perinatal morbidity and mortality. It represents major unsolved problems in obstetrics.⁽⁵⁾ The length of the cervix is correlated with the duration of pregnancy. The shorter the cervical length, the greater risk of preterm delivery. Progressive cervical changes begin at the internal cervical os and proceed to the external os. These changes are usually established before the dilatation of the external os and can begin as early as 16 to 24 weeks of gestation in patients who eventually deliver preterm. Many studies have shown that cervical length measured by transvaginal ultrasound is reproducible, safe and more accurate method than digital examination or transabdominal or transperineal ultrasound.⁽⁶⁾ There appears to be a relationship between risk of preterm delivery and a decreased length of cervix in the general population. Many studies have shown that cervical length assessment by endovaginal sonography at mid-trimester ultrasound predicts preterm birth.

The overall incidence of preterm delivery in the present study was 7.3%, whereas according to Hassan et al and Dilek et al it was 10% and 7.4% respectively.⁽⁷⁾ The mean cervical

length in our study was 31.2 mm, whereas in the study by Kore et al it was 36.4 + 7.98 mm. Kore found the values of cervical length in primigravidae and multigravidas were almost similar.⁽⁸⁾ A similar study conducted by Lams (39) showed a mean cervical length of 35.2 + 8, 3 mm at 24 weeks.⁽⁹⁾

Mean cervical length in participants with preterm labour was estimated to be 24.07 mm, which is approximately close to the estimated value in Lams et al,⁽¹⁰⁾ Berghella et al and Heath et al studies.

In the present study compared to Mahshidian et al⁽¹¹⁾ study, the percentage of spontaneous preterm delivery cases are higher (approximately 7.3% vs. 3.5%), while percentage of positive tunneling cases (1.3% approximately) was lower.

In the mentioned study participants were high-risk women for preterm labour that can explain higher percentage of funneling in them, but in regard to the reason of lower incidence of preterm labour in this group it is necessary to pay attention to the borderline pregnancy durations for determining preterm labour in the two studies. According to the results of other studies mentioned in the introduction, the results of both Mahshidian et al study and the present study seem to be logic.⁽¹²⁾

The findings of our study correlate well with the studies done by other authors. Short cervical length was associated with preterm delivery in the studies done by SJ Kore et al, Tongsong et al, lams et al, Fukami et al, Pires et al, Barber et al.⁽¹³⁾

Authors	n	GA at Testing	Outcome GA	Cut-Off Value (mm)	Sen (%)	Spec (%)	PPV (%)	NPV (%)
Our study	530	16-24	<37	<25	56.4	94.3	44	96.5
SJ Kore et al	115	22-24	<37	<30	76	56	25	93
Hassan et al	6877	14-24	<36	<15	8.2	99.7	47.6	96.7
Tongsong et al	730	28-30	<37	<35	65.9	62.4	19.4	92.8
Fukami	3030	16-19	22-31	<30	50	98.5	8.3	99.9
			32-33	<30	18.2	98.9	33.3	97.6
Pires et al	338	21-24	<37	<20	18	98.1	40	94.8
			<35	<20	27.3	97.9	30	97.6
Barber et al	2351	18-22	<37	<30	39	92	31	94
Lams et al	2915	24	<35	<30	54	76.3	9.3	97.4
			<35	<25	37.3	92.2	17.8	97
	2531	28	<35	<30	69.9	68.5	7	98.5
			<35	<25	49.4	86.8	11.3	98

Table 9. Studies of CL Measured by Transvaginal Ultrasonography to predict Preterm Birth

Funneling (or) the dilation of the cervical internal OS is an additional finding on cervical ultrasound scanning that has been associated with an increased risk of premature delivery.⁽¹⁴⁾ A short cervix on transvaginal ultrasound during the second trimester may occur for several different reasons. First, if a low risk population has the 10th percentile for cervical length established at 2.5 mm (or) less than some pregnant patients may have a short cervix that is a normal variation of natural cervical length in a given population. At 16 - 24 weeks in our study, there were 66% (n= 33) of patients with short cervical length and no funnel and among them 15.15% (n= 5) of patients were delivered preterm. At 24 weeks in NIH trial, 82.2% of patients with cervical length

2.5 mm (or) less delivered after 32 weeks in a population that had no funnel.

These similarities would suggest that a large portion of the patients with a short cervix, no funnel and delivery at term may constitute a normal variation of cervical length within a given population.

A cervix may shorten because of changes in the area of internal OS. These changes have been described as TYVU* progression of dilatation and effacement visualised by transvaginal ultrasound. These anatomical changes such as dilatation of internal OS, prolapse of foetal membranes into the endocervical canal shortening of distal cervical segment

have been suggested as a final common pathway for multiple pathophysiological process.



Figure 1. Short Cervix

The results of our study are similar to the work done by SJ Kors et al,⁽¹⁵⁾ who proved short cervical length and dilated Internal OS are associated with risk of preterm labour. Okitsu and co-workers⁽¹⁶⁾ found that a dilated internal os was associated with a 33% risk of preterm delivery. Riley and associates⁽¹⁷⁾ found that 16/31 (52%) of patients with an open internal os with funneling and a cervix of < 3 cm in length delivered preterm. Lams and colleagues,^(18,19) correlated funneling defined as protrusion of the amniotic membranes 3 mm (or) more into the internal os as measured along the lateral border of the funnel with a positive predictive value of 17% for risk of preterm delivery when the funnel was detected between 22 weeks and 24 weeks and 6 days in a population based study with an incidence of preterm delivery of 4%. The disruption of internal os, as documented by funneling is a significant risk factor for preterm delivery.



Figure 2. Transvaginal Image of Cervix with Closed Internal OS

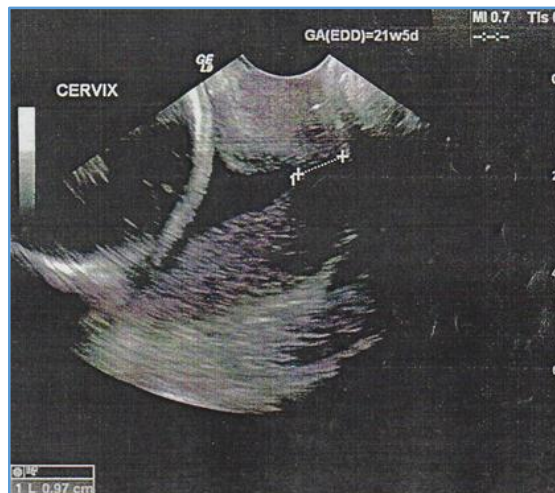


Figure 3 and 4. Transvaginal Image of Cervix with Open Internal OS

Previous History of Preterm Birth

Previous history of preterm birth is an important risk factor for preterm birth. The recurrence risk in women with a previous preterm delivery ranges from 15% to more than 50% depending on the number and gestational age of previous deliveries.⁽²⁰⁾ The mechanism for this has not been well understood; however, the likelihood of such experience among the women with prior spontaneous labour as well as those with inducing preterm birth is rising. Persisting or recurrent intrauterine infection during several pregnancies along with the disorders associated with preterm birth (eg. gestational diabetes, hypertension and obesity) that tend to last from one pregnancy to the next might explain many repetitive spontaneous and induced preterm birth.⁽²¹⁾

Mean cervical length who delivered term with a history of preterm birth is 29.25 mm. Screening programmers based only on obstetric history do not have a good accuracy. To improve the detection rate of preterm delivery we considered not only the previous obstetric history, but also two other predictive factors (Cervical length and funneling). For a pregnant woman with a cervical length < 25 mm, the positive predictive value of preterm increases if there was a previous history of preterm than in patients with a cervical length <25mm and no history of preterm.

Our results are consistent with the study done by several authors, Rahile Alijahan et al, OUJ Umera et al in Table 10.

Study	Year of Study	Odds Ratio
Our Study	2006-2009	
Rahile Alijahan et al	2010-2011	12.7
OJ Umera et al	2001-2002	4.92

Table 10. Comparative Study

Previous History of Abortion

A history of multiple induced abortion has been implicated as a risk factor for preterm birth.^(22,23) The majority of induced abortions are performed mechanically by cervical dilatation and suction curettage. There has been concern that mechanical dilatation may result in injury to cervix,⁽²⁴⁾ which may increase the risk of cervical insufficiency and preterm birth. A short cervix was noted in 20.9% of all patients identified with more than one prior induced abortion.

We have demonstrated that for women more than one induced abortion, a cervical length < 25 mm obtained by transvaginal ultrasound is predictive of spontaneous preterm birth.

Our results are consistent with the study done by Moreau et al, Zhou et al, Henri et al.

Study	Year	n	Odds Ratio
Our study	2006-2009	530	
Moreau et al	2005	2837	1.5
Zhou et al	1980-82	61753	1.8
Henri et al	1995	12432	1.4

Table 11. Comparative Study in Previous History of Abortion

History of Vaginal Bleeding

Vaginal bleeding complicates upto a quarter of all pregnancies.⁽²⁵⁾ About half of bleeding episodes during pregnancy have unknown causes⁽²⁶⁾ and thus the reason that vaginal bleeding predicts preterm birth is unclear. Vaginal bleeding and consequent thrombin generation lead to a proteolytic cascade capable of damaging the foetal membranes, which could result in PPROM.^(27,28) Thrombin also stimulates uterine contractions, which may promote preterm labour.⁽²⁹⁾ In addition to the effects of blood itself, bleeding could be a manifestation of subclinical or occult infection or inflammation in the uterus, which in turn is hypothesised to cause spontaneous preterm birth presenting as PPROM or preterm labour.⁽³⁰⁾

Our study found that vaginal bleeding was associated with 3 times increased risk of preterm delivery. In addition our finding showed that vaginal bleeding characteristics including more severe bleeding, multiple episodes and multiple days were associated with greater risk of preterm delivery, which was consistent with Hossain et al. The Odds ratio for other studies is as follows.

Study	Year	n	Odds Ratio
Hossain et al	2007	2678	2.10
Lykke et al	1978-2007	782287	1.65
Weiss et al	2004	16506	Light bleeding-1.3 Heavy bleeding-3

Table 12. Comparative Study in Vaginal Bleeding

Age

Both the extremes of reproductive life are associated with preterm risk. Teenage mothers are at increased risk of preterm birth compared to adult mothers and this risk is further increased in second time teen pregnancies.

The association between young maternal age and adverse pregnancy outcome has been attributed to gynaecological immaturity and the growth and nutritional status of the mother.

Several studies have investigated the effect of parity on adverse pregnancy outcome; however, the results are inconsistent. For example, Alikhashan et al suggested that teenage mothers are at higher risk of preterm birth in their first pregnancy compared to teenage mothers having their second baby and compared to adult women. In contrast, Smith and that first teenage pregnancies are not associated with adverse pregnancy outcomes at all, but second teenage pregnancies are associated with higher risk of preterm birth and stillbirth.

It is possible that the increased risk of poor pregnancy outcome is related to biological immaturity. It is also possible that the increased risk of poor pregnancy outcome in the second teenage pregnancy is related to less prenatal care in the second pregnancy than in the first. Teenage pregnant women, mainly those having second teenage pregnancy, are less likely to seek prenatal care than adult pregnant women. A first pregnancy may be the first and only time a pregnant teenager interacts with health services and this opportunity for health education and the promotion of contraception should not be overlooked. We had only 3 teenage patients and all of them delivered term. So we are not able to compare the outcome.

There is an increased risk of preterm birth with older maternal age. In our study, none of the patients were above 35 years and only 15 patients were above 30 years. Among them 3 patients delivered preterm, which is statistically not significant. Larger studies are needed to study about the influence of age on preterm labour.

CONCLUSION

- The measurement of cervical length provides accurate prediction of risk of preterm delivery.
- Open internal os is predictive of preterm delivery, especially in patients with cervical length < 25 mm.
- In patients with previous history of preterm birth, previous history of more than 2 induced abortions, history of vaginal bleeding, cervical length measurement is predictive of preterm delivery.
- The measurement of cervical length can be recommended as a screening procedure for prediction of preterm delivery.

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