Original Article

Assessing Success Of Vaginal Birth After Cesarean By FLAMM Model In A Retrospective Observational Design

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Abstract: <u>Background:</u> After year 2000 cesarean rates have increased from 15% to 30-50% worldwide. Practice of Trial of labor after cesarean has decreased from last two decades of 20th century. Predictors of vaginal birth after cesarean are not uniform and not suitable equally for all populations. FLAMM model was tested in this study for its predictability for a successful vaginal birth after previous one cesarean. <u>Material And Methods:</u> For an observational, retrospective study 72 patient files admitted in 2018 in Obstetric Department of C R Gardi Hospital were included which fulfilled criteria of having second pregnancy after cesarean for non recurrent indications like fatal distress, failure of induction of labor, pre-eclampsia, eclampsia, twins and others. Indication of contracted pelvis, rupture uterus, previous classical cesarean section; and multiple pregnancy, medical complications and obstetric complications in this pregnancy were excluded. FLAMM score parameters; cervical dilatation, effacement, presence of previous vaginal birth before cesarean, indication of it and age of woman were used. Observations of successful and failed trial were done by scoring system. Chi square test was used to compare data. Study variables were success of trial in various FLAMM parameters. <u>Result:</u> Higher scores in cervical dilatation (p<0.001), effacement (p<0.001) and prior vaginal delivery (p=0.03) were significantly associated with a successful outcome. Higher the aggregate FLAMM score, higher were chances of successful trial. A non-recurrent indication other than non-progress of labor for previous cesarean had no statistical association with success of trial. Aggregate score of 6 and more has 100 % predictability for a successful vaginal birth. <u>Conclusion:</u> Prediction by FLAMM model resulted in 62.5% successful trial. FLAMM model may be used for near to accurate prediction of successful trial of labor after cesarean. [Mahadik K A Natl J Integr Res Med, 2021; 12(3):7-14]

Key Words: Trial Of Labor After Cesarean, Vaginal Birth After Cesarean, FLAMM Model, Non Recurrent Indication Of Cesarean

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Introduction: Cesarean section is the commonest surgical procedure in modern obstetrics which when indicated in life threatening conditions like obstructed labor, central placenta previa, fetal distress can reduce maternal and neonatal morbidity and mortality[1] As per WHO recommendation cesarean section (CS) rate should range between 5 to 15%, but the rates have inflated worldwide from 8.5% in 2005-06 to 17.2% in 2015-16[2,3]. Most significant contributing factor in rise of CS rate is repeat CS with insignificant indicatio[4]. Increased primary CS rate is associated with a number of factors including higher prevalence of obstetric indications for CS (maternal age, multiple gestation, diabetes, obesity and hypertensive disorders), increased access to modern health care services, improved economic status of population, changes in cultural and social factors and supply induced demand for CS[5-8]. It can be reversed by avoiding primary cesarean section which does not have a clear indication[9].

All post cesarean pregnancies do not require repeat cesarean section and a majority of them may have uncomplicated vaginal delivery.

Planned Vaginal Birth after Cesarean (VBAC) is appropriate for and may be offered to the majority of women with prior one lower segment cesarean section. Recently focus on Trial of Labor after Cesarean Section (TOLAC) has increased due to increasing rate of CS. But in last two decades increasing medico legal issues and concern about risk of uterine rupture (0.2-0.5%), the rate of attempted TOLAC continues to fall in United States and Australian countries[10,11]. In United Kingdom as such cesarean deliveries have increased and rate of VBAC decreased[12]. A large cohort study in Scotland highlights advantages of planned VBAC being more than Elective Repeat Cesarean Section[13]. Majority of women with first cesarean section done for modifiable indication, a clinically adequate pelvis, and no prior classical cesarean section are good candidates for

attempting VBAC trial provided that they are at an institution with adequate resources including physician and anesthesiologists[14,15]. VBAC offers distinct advantages over a repeat cesarean section since the operative morbidity and mortality are completely eliminated need of general or spinal anaesthesia is omitted, and there is less chance of infection, shorter hospital stays, early ambulation, better bonding and breastfeeding. Repeat cesarean section is commonly associated with placenta previa, placenta percreta, peripartum hysterectomy and maternal death due to excessive blood loss[16].

Later if hysterectomy is indicated in such women for gynecological indications it becomes difficult due to multiple adhesions. The present study was undertaken to re ascertain these facts with the hope that more obstetricians and midwives will be encouraged to avoid an unnecessary repeat cesarean section by opting for VBAC. The aim is to predict the chance of successful VBAC based on patient's pre existing clinical factors as was reported by many investigators[17-19]. FLAMM in 1997 suggested a predictive algorhythm for successful VBACs on basis of clinical parameters present at time of admission of woman to hospital. Better predictive features help us to decide which patient may successfully undergo vaginal delivery and who will not. Relevance of study is more due to scenario of poverty, illiteracy and difficult access to tertiary care in rural areas of India.

Material & Methods: A retrospective study was carried out after approval from IRB, on 72 women in C. R. Gardi Hospital, Ujjain, India from 1st January 2017 to 30th August 2018. This hospital caters to women mostly from rural area with low literacy and low socioeconomic status. Case records of all women who delivered in this hospital having one previous cesarean were searched. Selection criteria were a patient with one prior lower segment cesarean section (LSCS) for a non recurrent indication. Commonest non recurrent indications were fetal distress, failure of induction of labor, malpresentation, multiple pregnancy, post-dated pregnancy, oligohydramnios, eclampsia, preeclampsia, placenta previa and abruptio placentae. Previous classical cesarean section, inverted T uterine incision, rupture uterus, contracted pelvis, multiple pregnancy, medical complications and obstetric complications were excluded. We selected women for prediction model for trial of

vaginal birth by applying FLAMM model[20]. Flamm developed a scoring system to predict the likelihood of vaginal birth by attributing score according to certain clinical criteria at the time of admission to hospital. It comprised of cervical dilation and effacement at admission, history of prior vaginal delivery, maternal age and indication for previous cesarean other than non-progress of labor. Score for each variable is given from 0-4. Each woman was attributed score as per Table I.

Cervical effacement depends on good uterine contractions, adequate maternal pelvis in which descent of head and flexion causes efficient stretching of cervix followed by effacement and dilatation. Favorable cervical factors have been significantly associated with a successful trial of labor. The strongest factor predicting vaginal delivery is presentation during the advancing active stage of labor, after experiencing labor pains at home.

Prior vaginal delivery without any undue prolongation would show higher chance of success but previous history of instrumental delivery and prolonged labor would show less chance of success for VBAC. Higher the age of patient less chance of VBAC because of patient's psychology that precious child at this age should be delivered by a quick method, intolerance to bear labor pains, probably tough maternal pelvic soft tissues. Most of the indications for prior cesarean section like non reassuring fetal heart, macrosomia, malpresentation, maternal request, multiple gestation and placenta previa are modifiable and warrant reassessment in successive pregnancy.

All study files were containing a consent document about probability of vaginal birth, cesarean delivery if trial fails and were assured of best of care and vigilance. This was mentioned in patient indoor record as per routine protocol.

They were also counselled about best of care for fetal monitoring and outcome. Study variables considered were according to each component of the FLAMM model. Number of successful vaginal birth in each component of FLAMM model were compared with number of unsuccessful outcomes. Aggregate score and outcomes also were compared. After data collection statistical analysis was done with Chi-square test in SPSS software.

Table -1: Components Of FLAMM Score

Flamm Score	Clinical Variable
	Cervical Effacement
0	<25%
1	25-75%
2	>75%
	Cervical Dilatation
0	<4cm
1	>4cm
	History Of Prior Vaginal Birth
4	Vaginal birth before & after cesarean delivery
2	Vaginal birth after first cesarean delivery
1	Vaginal birth before cesarean delivery
0	No previous vaginal birth
	Maternal Age (In Years)
2	<40
0	>40
	Indication Of Previous Cesarean
0	Non progress of labor
1	Other reason

Results: During the study a total of 72 women with previous one cesarean section were recruited for VBAC, out of 72 women 45(62.5%) women underwent successful trial of vaginal birth and 27(37.5%) required cesarean section.

Table-2 shows parameters associated with successful VBAC. Out of 20 patients having the cervical effacement of <25% (score 0), 18 failed the TOLAC whereas out of 5 patients with cervical effacement of >75% (score 2) only one failed to achieve successful vaginal delivery. Hence with the increase in effacement, the likelihood of VBAC also increases.

Patients with cervical dilatation of <4 cm (score 0), 23(67.64%) patients out of 34 delivered by cesarean section, but at dilatation >4cm (score 1), 34 patients (89.47%) out of 38 delivered vaginally. Cervical dilatation is a significant factor in assessing the success.

Table 2: Showing Distribution Of Women According To Each Parameter Of FLAMM Score And Outcome

	Successful VBAC (n=45)	Failed VBAC (n=27)	P value
Cervical Effacement			
0(n=20)	10%	90.0%	0.000
1(n=47)	82.97%	17.02%	
2(n=5)	80.0%	20.0%	
Cervical Dilatation			
0(n =34)	32.35%	67.64%	0.000
1(n=38)	89.47%	10.52%	
History Of Prior Vaginal Birth			
Yes (n=18)	83.33%	16.66%	0.03
No(n=54)	55.55%	44.44%	
Maternal Age (In Years)			
2(n = 72)	62.5%	37.5%	
0(n=0)	0%	0%	
Indication of previous cesarean			
0(n= 5)	40.0%	60.0%	0.2813
1(n=67)	64.17%	35.82%	

Patients with history of vaginal delivery before and after cesarean section showed increased chances of successful VBAC.

In cases where indication of previous cesarean section was non progress of labor (score 0) out of 5 patients 2 (40%) delivered vaginally but in cases having indication other than non progress (score 1) 43 (64.17%) delivered vaginally and remaining 24 patients (35.82%) failed the TOLAC.

Cervical dilatation (p<0.00001), effacement (p<0.00001) and any prior vaginal delivery (p<0.03) were significantly associated with a successful outcome. Table (3) shows that higher the FLAMM score, higher were the chances of successful TOLAC and making it a useful tool in assessing the outcome of TOLAC. Table 3 shows higher the FLAMM score, higher the chances of success of VBAC; when score >6, success of VBAC is 100%.

Table 3: Success Rate Of VBAC By FLAMM Model Score-Wise

FLAMM Score	Total Subject (N=72)	Successful VBAC (N=45)	Failed VBAC(N=27)
0-2	0	0	0
3	18(25%)	02(11.11%)	16(88.88%)
4	13(18.0%)	06(46.15%)	07(53.84%)
5	34(47.22)	31(91.17%)	03(8.82%)
6	05(6.9%)	04(80%)	01(20.0%)
>6	02(2.7%)	02 (100%)	0(0.0%)

Discussion: A retrospective observational study was carried out on 72 pregnant women with previous one caesarean section in department of obstetrics and Gynecology, C. R. Gardi Hospital, Ujjain, over a period of one year. This study was conducted with the objective to assess the success rate of attempted TOLAC after one previous caesarean delivery based on FLAMM scoring system. Application of 5 parameters for prediction of successful VBAC is documented in FLAMM model. Many other studies have used various parameters but not like FLAMM's. This model appears to be more practical and concrete in setting like ours as we belong to socioeconomically backward population. TOLAC is a planned attempt to labor by a woman who has previously undergone a cesarean delivery and desires a subsequent vaginal delivery.

Management of subsequent labor in a previous scar on uterus is an unending dilemma for an obstetrician. Some suggest an elective CS for such cases, whereas others choose a trial of labor. Many take a middle route, that is, individualization of case. By far, the greatest problem for the attendant in subsequent labor is the integrity of the uterine scar. Uterine rupture has the potential of causing serious harm to the pregnant woman as well as the baby. This is the most important risk to be noted, but the advantage which the vaginal delivery imparts largely outweighs the risks associated with a repeat CS.

FLAMM et al conducted a prospective study of 5022 pregnant women and developed a scoring system to predict the likelihood of vaginal birth in California in 1997 [20]. In FLAMM's research, the variables were collected at the time of hospital admission. It was age of patient, history of previous vaginal delivery, indication of previous caesarean section, cervical dilatation, and cervical effacement. This scoring model provides reasonable predictability for VBAC and also consistent ability to identify women at risk for failed trial of labor. Assessment of individual risks and the likelihood of VBAC can help determine appropriate candidates for trial of labor.

Cervical Factors: As such Bishop score was suggested by Bishop in 1964 for predicting outcome of labour. It was based on cervical parameters. To date it is accepted as best predictor worldwide. The basic cervical features like effacement and dilatation are most predictive. In FLAMM model other parameters are added like age, prior vaginal delivery and indication for previous cesarean.

These three factors are reciprocation of normal bony pelvis, adequate and more physiological uterine action and a perfect psychological preparedness for accepting vaginal birth as natural and normal phenomenon by a woman who is in 4th decade of life. In this study 11.11% patients had cervical dilatation >4 cm at the time of admission and had 100% successful VBAC, while in 88.88% patients having cervical dilatation of <4cm success rate for VBAC was only 32.8%. Other authors have also reported the same predictors[21].

In a cohort consisting of 1 43 970 women the success rate for VBAC was 63.4%. They have documented better outcomes in women with higher Bishop scores, lower age and black ethnicity[22]. Another study from India using FLAMM model in 2018 reports that women having score less than 3 had emergency cesarean while those with score more than 4 had successful VBAC[23]. Considering active phase of labor as a best predictor a success rate of VBAC was reported to be 80%, as per another report from India[24].

Vaginal birth before and after previous cesarean
In this study successful VBAC was seen in 85% patients with history of vaginal delivery after previous cesarean and 66.7% patients with history of vaginal delivery before previous

cesarean. Only 57.4% patients had successful VBAC who were having no history of previous vaginal delivery, and still one previous cesarean as per recruitment criteria. Absence of history of previous vaginal birth is statistically related to low VBAC rate (p= 0.03) (Table-2).

In large multicentric study by Flamm history of vaginal delivery after cesarean section increased the likelihood of VBAC by 7.7% in subsequent pregnancy [20]. Other authors also found similar results among 13,532 women meeting eligibility criteria, VBAC success increased with increasing number of prior VBACs being 63.3%, 87.6%, 90.9% and 91.6% for those with prior VBACs of 0,1,2,3 and 4 or more, respectively with statistical significance (p<0.001)[25].

Presence of previous vaginal birth before and after CS, tripled the success of VBAC, as shown in a comprehensive research which included 94 eligible observational studies on 2 39 006 pregnant women with 1 63 502 successful VBACs. More over previous VBAC was a stronger predictor of successful VBAC than previous vaginal birth before CS[26].

Indication Of Previous Caesarean: The parameter "indication for previous cesarean" in FLAMM model gives a better guideline for success of VBAC. Score 0 for non-progress of labor is very assertive. These are the women who end in cesarean without any definitive diagnosis for delay in progress of labor in form of descent of denominator or dilatation of cervix. These are women with border line CPD or undiagnosed malposition in an android pelvis. He attributes score of 1 to those who have other indications like fetal distress, any degree of pre-eclampsia, placenta previa and many other non recurring indications.

Thus, all those with score 1 have better chance of good and productive uterine action, progressive cervical dilatation and a successful VBAC.

Considering indication for previous cesarean the score attributed in FLAMM model was 1 for 67 women. In this study 67 women attained score of 1 and out of it 64.17% had successful VBAC.

This group is not statistically different than the group with score 0 (p = 0.2813) (Table II). A recent report in a systematic review and meta-analysis of 2019 has documented the importance of indication for previous cesarean section in predicting successful VBAC[26].

Age: In this study all the 72 women who were recruited had age less than 40 years with 62.5% successful VBAC and 37.5% failed VBAC. As there were no subjects in age group 40 years or more, we could not find a comparative group for statistical purpose. Increased age decreases the likelihood of VBAC. Women with advanced age were more likely to have failed VBAC[26].

LAMM Score: The study revealed increase in success rate of TOLAC with the increase in FLAMM score. 91% of the patients with total FLAMM score ≥ 5 had successful VBAC and subsequently subjects with score of 6 and more than 6 had successful VBAC in 80% and 100% women respectively. A similar study reports mean FLAMM score for cesarean section was 3.62. For the score 3-4, emergency cesarean section rate was (52.09%) and for score 5-6, vaginal birth rate was 89.13% compared to emergency cesarean section rate (10.8). Chances of success of TOLAC was increased with increasing FLAMM score[27].

Some authors have reported cutoff score of 5 and more for successful VBAC. In their study the sensitivity of FLAMM score was 71% and specificity was 74% [28]. In the original study by FLAMMs and others, using a cut-off score of 5, found that the sensitivity and specificity for successful trial of labor were 69 and 65%, respectively. Increasing score was linearly associated with increasing probability of vaginal birth.

VBAC In Late Second Decade Of 21st Century: It was declared in October 2018 at Brazil in FIGO world congress that cesarean rates have increased to almost double from year 2000 to 2015[29]. Allover world the cry is for bringing down rates and this may be achieved by reducing primary sections[9]. TOLAC rates are reducing and for a way out more concentration is on predictors of successful VBACs. In a report Benjamin Harris et al in May 2019 concluded that Grobman 2007 and Metz 2013 models are most predictive[30].

The outcomes are population specific. Our study has addressed predictivity of FLAMM model in our setting. In another report using machine learning models real-time data acquired throughout the process of labor significantly

increased the prediction accuracy for vaginal delivery.

These models enable translation and quantification of the data gathered in the delivery unit into a clinical tool that yields a reliable personalized risk score and helps avoid unnecessary interventions[31].

Recently a machine learning model has been shown to be best calculators on basis of features which are more near to delivery than remote ones like in first trimester. Application of a machine-learning algorithm to assign a personalized risk score for a successful vaginal birth after cesarean delivery may help in decision-making and contribute to a reduction in cesarean delivery rates[32].

Implication: In countries where maternity care is supported by paramedical workers and non-specialist health-care workers this model is useful. Secondly by reducing financial cost and long-term morbidities in women undergoing repeat cesarean; this model can work as a clinical guide. Trying for trial of labor after cesarean and successful VBACs, is the main strategy to reduce rising cesarean rates around world.

Conclusion: Prediction of success of TOLAC by FLAMM model resulted in 62.5% successful VBAC. Aggregate score of 5 and above has 91.1% success rate. Majority of women who delivered vaginally had caesarean section done for non recurrent indication. The findings of this study indicate FLAMM model can be used in day-to-day practice for assessing success of VBAC.

Abbreviations: TOLAC--- Trial Of Labor After Cesarean, VBAC--- Vaginal Birth After Cesarean, CS--- Cesarean Section, LSCS--- Lower Segment Cesarean Section, CPD--- Cephalo-Pelvic Disproportion.

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