Original Article

C-Section among Nulliparous

An Analysis of Predictors Associated with Intrapartum C-Section among Nulliparous Women

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ABSTRACT

Objective: To identify risk factors associated with cesarean section among nulliparous women presenting in labor at term with singleton cephalic fetus and to build a multiple logistic regression model for predicting its probability.
Study Design: It was a Case Control study.
Place and Duration of Study: This study was conducted at the Department of Obstetrics and Gynaecology Aga Khan University Hospital Karachi from April 2010 to January 2011.
Materials and Methods: Non-probability purposive sampling technique used, 280 nulliparous women of 18-45 years selected; 140 women who had caesarean section were taken as cases and 140 women who had vaginal delivery were taken as control.
Results: We evaluated 14 variables out of these seven (cervical dilatation and length, fetal station, history of miscarriage, maternal age, height and spontaneous rupture of membranes) were found to be statistically significant in Univariate analysis. The final model improved and predicted 70.0% of cases correctly. Of the variables evaluated, 5 variables remained significant in multiple logistic regression model which predicted the women at higher risk of for cesarean section. The receiver operating characteristic curve (ROC) analysis of risk status for predicting the probability of cesarean section had area under the curve of 0.729; suggesting it to be a good predictive model.
Conclusion: Final model included maternal history of miscarriage, maternal age and height, cervical dilatation and length at admission; and has the ability to identify women at risk of requiring cesarean section just at the time of presenting in labor.

Key Words: Primary emergency cesarean section, risk factors, cesarean delivery

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INTRODUCTION

Caesarean section rates have been rising progressively worldwide[1] with a wide variability amongst various countries and regions.[2] The Cesarean section rate worldwide has been reported as 15% of births.[3] Various factors associated with increase in caesarean section rates include nulliparity, extreme ages of reproductive life, height less than 150 cm, obesity, use of electronic fetal monitoring and fetal compromise.[4] The caesarean section rate is significantly higher among primigravida (27.26%) in Pakistan, even for each indication, the frequency of caesarean section is higher among primigravida ($P<0.05$).[5]

Due to the morbidity and mortality associated with cesarean section there is a need to identify the driving forces behind the global rise in cesarean rate in order to halt and reverse this trend. To achieve this, a detailed understanding of the factors contributing to the increasing rate is required.[6] A deeper understanding of the risk factors for first cesarean section is needed to identify modifiable and non-modifiable risk factors in order to reduce the rate of primary and subsequently repeat cesarean section. In the National Sentinel Caesarean Section Audit, of all cesarean section carried out in England and Wales the main reasons reported were fetal distress (22%) and Failure to progress (20%).[7] Various maternal and fetal factors can influence these two primary reasons for either emergency, urgent or scheduled cesarean sections.

The purpose of this study was to identify risk factors associated with cesarean section among nulliparous women presenting in labor at term with singleton cephalic fetus and to build a multiple logistic regression model for predicting its probability.

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MATERIALS AND METHODS

The objective of study is to identify risk factors (increased maternal age, short stature, obesity, maternal history of miscarriages, gestational age, spontaneous rupture of membranes (SROM), cervical dilation and effacement and fetal station) associated with cesarean section among nulliparous women presenting in labor at

term with singleton cephalic fetus. Numbers of women undergoing Caesarean section and normal vaginal delivery were taken as primary outcomes are dependent variable whereas secondary outcome were hypothesized risk factors at the time of admission to labor room and included history of miscarriage and other confounding variables like maternal age, height, weight, marriage-conception interval, cervical dilatation, cervical length, fetal station are independent variable. It was a Case Control study completed in 10 months in 2011 in the department of Obstetrics & Gynaecology at Aga Khan University Hospital, Karachi.

A sample size of 140 cases and 140 controls was identified with 80% power with a two-sided alpha of 0.05 to detect a difference in incidence of increased BMI of 25% in women with normal delivery as compared to 47% risk of increased BMI in caesarean section with an odds ratio of 2.0 or moderate effect of one-third or greater for a continuous risk factor.

A non-probability purposive sampling technique was used for 'case' or 'control' Inclusion criteria include all nulliparous women of reproductive age (i.e. 18 - 45 years) presenting in labour at term with singleton cephalic fetus. All nulliparous women who refuse to participate; who required induction of labor or presented in labor but were originally planned for elective caesarean section were excluded from study. Data was collected on a structured pre-tested and peer reviewed questionnaire form during a face-to-face interview with the study participant.

Entry of data and analysis was done using SPSS version 16. Descriptive statistics were computed for all variables of the study. Univariate analysis was done to identify the risk factors by analyzing categorical variables with Chi-square test and continuous variables by t-test. Multiple logistic regression analysis was performed by entry method to identify independent risk factors for cesarean section and to develop a prediction model.

For correctness of the model a clear hypothesis was defined as "Maternal and fetal factors are associated with risk of caesarean section among nulliparous women presenting in labor at term with singleton cephalic fetus." Variable selection was done on the basis of existing knowledge after building a hypothesized model which included history of miscarriage as the exposure variable and maternal age, height, weight, marriage-conception interval, history and treatment for infertility, cervical dilatation, cervical length, fetal station, spontaneous rupture of membranes (SROM), pre- pregnancy and gestational hypertension, pre-pregnancy and gestational diabetes, at the time of presentation to the labor room as the potential confounding factors. A subset of maternal age, weight, and height were considered as the factors having potential interaction with the primary exposure variable. Variable selection process included stepwise backward elimination to achieve hierarchically well formulated (HWF) model by first eliminating the insignificant interaction terms, followed by assessment of confounders and individual variables. Threshold of < 0.25 was kept at the time of Univariate analysis for inclusion in the multivariate model by entry method. Conformity to linear gradient was check for the continuous variables by quartile method. Collinearity was assessed by variable matrix and smaller value of standard error. This was further evaluated by using the linear regression technique with tolerance at value < 0.1 and VIF value > 10.

Effectiveness of the model was judged by goodness of fit and is reported as ROC curve analysis. Because of limited time and non-availability of additional data cross-validation was not performed, but will be done at a later stage.

Importance of each independent variable in the model is reported with statistical tests of significance with p-values and odds ratio. Binary variables were coded as '0' for reference category and '1' for the result of interest. Interactions were evaluated in the initial phase before clinical assessment of confounding variables.

RESULTS

Basic characteristics of the women are enlisted in Table-1. There were 14 variables evaluated, out of these seven were found to be statistically significant between the controls and cases in the Univariate analysis. Variables, Cervical dilatation, cervical length, fetal station, history of miscarriage, maternal age, spontaneous rupture of membranes (SROM) and maternal height were used in the initial model (Table-2) at the time of presentation in labor for admission. The final model had -2Log likelihood of 336.083 with Hosmer and Lemshow test non-significant at 0.260. The final model improved and predicted 70.0% of cases correctly.

Of the variables evaluated, 5 remained significant in the multiple logistic regression model which predicted the women at higher risk of for cesarean section (Table-3). There were 140 women who had undergone cesarean section and 140 women who had undergone vaginal delivery in the final model.

The receiver operating characteristic curve (ROC) analysis of risk status for predicting the probability of cesarean section in shown in Figure 1 with area under the curve of 0.729; suggesting it to be a good predictive model.

Table No.I: Characteristics of Cesarean section as Cases and Vaginal delivery as Controls. (n=140)

Variable	Controls (Vaginal delivery) Mean±SD	Cases (Cesarean section) Mean±SD	p-value
Maternal age (years)	24.6 ± 3.7	25.8 ± 3.2	.004
Height (cm)	159.1 ± 5.8	158.1 ± 5.3	.141
Weight (kg)	70.4 ± 10.7	71.6 ± 10.8	.318
Body mass index(BMI)	27.8 ± 3.8	28.7 ± 4.0	.064
Marriage-conception interval (months)	17.9 ± 15.5	16.7 ± 7.9	.419
Gestational age (weeks)	38.5 ± 1.3	38.7 ± 1.5	.295
Cervical dilatation (cm)	2.8 ± 1.5	1.9 ± 1.0	<.001
Cervical effacement (cm)	1.5 ± 0.7	1.8 ± 0.6	<.001
Fetal station (-3 to +3)	-2.5 ± 0.7	-2.8 ± 0.4	<.001
Spontaneous rupture of membranes (SROM), n (%)	37 (26.4)	51 (36.4)	.072
History of miscarriage, n (%)	5 (3.6)	19 (13.6)	.003
History of treatment for subfertility, n (%)	4 (2.9)	3 (2.1)	.702
Pre-pregnancy or gestational hypertension, n (%)	11 (7.9)	11 (7.9)	1.000
Pre-pregnancy or gestational diabetes, n (%)	6 (4.3)	6 (4.3)	1.000

Table No.2: Characteristics of variables at admission to labor room in Univariate analysis.

Variable	Odds ratio (95% Confidence interval)	P value	-2Log Likelihood ratio
Maternal age (years)	1.11 (1.03, 1.19)	.004	378.873
Height (cm)	.97 (.93, 1.01)	.141	385.959
Weight (kg)	1.01 (.99, 1.03)	.318	387.158
Body mass index(BMI)	1.06 (1.00, 1.13)	.064	384.700
Marriage-conception interval (months)	.99 (.97, 1.01)	.419	387.483
Gestational age (weeks)	1.09 (.93, 1.29)	.295	387.048
Cervical dilatation (cm)	.55 (.43, .69)	<.001	355.351
Cervical effacement (cm)	2.26 (1.53, 3.33)	<.001	369.179
Fetal station (-3 to +3)	.39 (.24, .64)	<.001	372.109
Spontaneous rupture of membranes (SROM),*n(%)*			
No	1.00		
Yes	1.60 (.96, 2.66)	.072	384.904
History of miscarriage, *n (%)*			
No	1.00		
Yes	4.24 (1.54, 11.70)	.003	378.689
History of treatment for subfertility, *n (%)*			
No	1.00		
Yes	.75 (.16, 3.39)	.702	388.015
Pre-pregnancy or gestational hypertension, *n (%)*			
No	1.00		
Yes	1.00 (.42, 2.39)	1.000	388.162
Pre-pregnancy or gestational diabetes, *n (%)*			
No	1.00		
Yes	1.00 (.32, 3.18)	1.000	388.162

Table No.3: Final Multiple logistic Model of the Case-Control Study(n=140)

Risk factors	Controls (Vaginal delivery) Mean±SD	Cases (Cesarean section) Mean±SD	Adjusted odds ratio(95% Confidence interval)
Maternal history of miscarriage, *n (%)*	5 (3.6)	19 (13.6)	4.671 (1.483, 14.71)
Cervical dilatation at admission (cm)	2.8 ± 1.5	1.9 ± 1.0	0.591 (0.453, 0.772)
Cervical length at admission (cm)	1.5 ± 0.7	1.8 ± 0.6	1.353 (0.854, 2.144)
Maternal age (years)	24.6 ± 3.7	25.8 ± 3.2	1.076 (0.997, 1.162)
Maternal height (cm)	159.1 ± 5.8	158.1 ± 5.3	0.960 (0.916, 1.005)

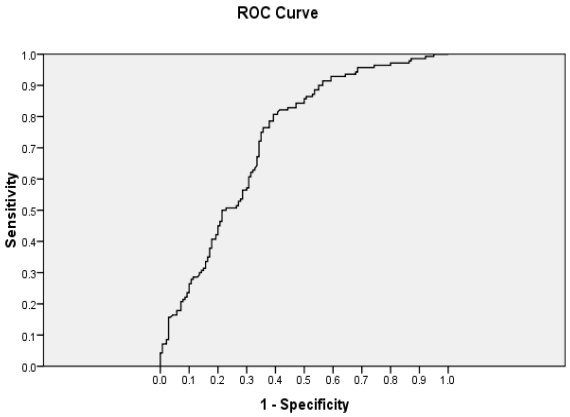

Figure No.1: Receiver operating characteristic curve (ROC) analysis

DISCUSSION

In this study we were able to identify risk factors which had statistical and clinical significance for prediction of nulliparous women requiring cesarean section when evaluated at the time of admission to labor room. The logistic regression model could identify 70.0% of women correctly which required cesarean section. One of the prime importance of this study is its ability to identify women at risk of requiring cesarean section just at the time of presenting in labor.

Increasing maternal age in primigravida has been significantly associated with cesarean delivery (53.7%) with mean age of case and control was 36.4 +/- 0.9 years and 23.1 +/- 1.6 years respectively.[8] Other published data showed cesarean rate in elderly (>35years) versus younger primigavida (<35years) were (58.1% vs. 32.1%, P = 0.001).[9] In our study the odds ratio were 1.076(CI 95% 0.997, 1.162). The risk of emergency cesarean section in labor lasting for more than 12 hours increased with increasing maternal BMI: OR 1.04 (1.01-1.06) (OR per 5-units BMI-increase)[10] similar results in other cohort studies were (36.2% vs. 22.1% in women with class III obesity versus women with normal BMI) (adjusted OR 1.46; 95% CI 1.23 to 1.73).[11] One study showed that more of the women in the study group (height <152 cm) had their delivery via caesarean section compared to those in the control group (height (>152 cm) with a ratio of 3:1 for the study and control group respectively, There was a statistical significant relationship between delivery vaginally and via caesarean section between study group (< 152 cm) and control (> 152 cm), P = 0.03.[12] In our study we find height as statistically significant factor with OR (0.960 (0.916, 1.005)) but BMI was not statistically significant in our final model.

There was a significantly higher rate of Caesarean section in the recurrent miscarriage group.[13] One study showed primigravida who had history of miscarriage, termination or stillbirth had odds of Caesarean section increased from 2- to 4-fold as compared to women who had previous live birth.[14] We also found it as a statistically significant risk factor with odd ratio of {OR 4.671(95% CI 1.483, 14.71)}, and p-value 0.003 in women with previous history of >2 miscarriage in our study.

It has been seen that medical and elective induction of labor in nulliparous women at term with a single fetus in cephalic presentation is associated with an increased risk of cesarean delivery, predominantly related to an unfavorable Bishop score at admission.[15] There is a statistically significant increase in cesarean delivery rate with high presenting part on clinical examination. Patients with an unengaged vertex had 12.4 times higher risk of cesarean delivery than the patients with an engaged vertex.[16] Similarly other study showed unengaged vertex in nullipara at the onset of active labour is associated with a higher risk of caesarean delivery due to arrest disorders and failure to descent of fetal head as compare to patients with engaged vertex.[17] In our study cervical dilation and cervical length was found to be statistically significant with {OR: 0.591(0.453, 0.772)} and {OR: 1.353 (0.854, 2.144)} respectively.

Rate of cesarean delivery increased as gestational age goes beyond 41 weeks of gestation (P < .001).[18] We did not found statistically significant relation between gestational age and cesarean section.

Our study adds to the existing knowledge and also critically evaluates the models suggested for nulliparous women presenting in labor at term with singleton cephalic fetus and having risk of cesarean section.[19]

CONCLUSION

Final model included maternal history of miscarriage, maternal age and height, cervical dilatation and length at admission and has the ability to identify women at risk of requiring cesarean section just at the time of presenting in labor.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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