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CLINICAL ARTICLE

Validation of the close-to-delivery prediction model for vaginal birth after cesarean delivery in a Middle Eastern cohort

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ABSTRACT

Objective: To validate a prediction model for vaginal birth after cesarean (VBAC) that incorporates variables available at admission for delivery among Middle Eastern women. **Methods:** The present prospective cohort study enrolled women at 37 weeks of pregnancy or more with cephalic presentation who were willing to attempt a trial of labor (TOL) after a single prior low transverse cesarean delivery at Al-Jahra Hospital, Kuwait, between June 2013 and June 2014. The predicted success rate of VBAC determined via the close-to-delivery prediction model of Grobman et al. was compared between participants whose TOL was and was not successful. **Results:** Among 203 enrolled women, 140 (69.0%) had successful VBAC. The predicted VBAC success rate was higher among women with successful TOL ($82.4\% \pm 13.1\%$) than among those with failed TOL ($67.7\% \pm 18.3\%$; $P < 0.001$). There was a high positive correlation between actual and predicted success rates. For deciles of predicted success rate increasing from $>30\%$ – 40% to $>90\%$ – 100% , the actual success rate was 20%, 30.7%, 38.5%, 59.1%, 71.4%, 76%, and 84.5%, respectively ($r = 0.98$, $P = 0.013$). **Conclusion:** The close-to-delivery prediction model was found to be applicable to Middle Eastern women and might predict VBAC success rates, thereby decreasing morbidities associated with failed TOL.

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1. Introduction

The increasing incidence of cesarean delivery is a global issue. In the USA, the rate of cesarean delivery reached 32.3% in 2008 [1], representing an increase of more than 50% since 1996. This sharp rise in cesarean delivery is due to a steady increase in primary cesarean delivery, coupled with a decrease in vaginal birth after cesarean (VBAC) from 28.3% in 1996 to 8.5% in 2005 [2]. In Al-Jahra Hospital, Jahra, Kuwait, the monthly labor-ward statistics indicate a similarly high rate of cesarean delivery, at approximately 32% in 2011.

Multiple cesarean deliveries are associated with operative complications such as dense adhesions, blood transfusion, and hysterectomy. In addition, placenta previa and accreta occur more frequently as the number of prior cesarean deliveries increases [3]. On the basis of the American College of Obstetricians and Gynecologists recommendations, counseling regarding VBAC and trial of labor (TOL) should be offered to eligible women with a prior single low transverse cesarean delivery with the aim of decreasing the rate of cesarean [4]. Similarly, the National Institutes of Health Consensus Development Conference, which was held to examine maternal and neonatal outcomes of TOL after cesarean

delivery, concluded that TOL remains a reasonable option for many women with a prior cesarean delivery [5]. A key aspect of the counseling process involves a discussion not only about the risk and benefits of TOL, but also about the likelihood of success [6].

Constructing a reliable prediction model to evaluate the success rate and individual specific risks of TOL after cesarean delivery has proved difficult. On the basis of data from over 8000 women, Grobman et al. [7,8] derived two models to predict the probability of VBAC. In 2007, their first model included six variables—maternal age, body mass index (BMI; calculated as weight in kilograms divided by the square of height in meters), ethnic origin, prior vaginal delivery, prior VBAC, and indication for prior cesarean delivery—that can be obtained at the first prenatal visit [7]. In 2009, their second model was based on these six variables plus additional data that are available at or close to delivery, including the estimated gestational age at delivery, labor induction, and information from vaginal examination such as effacement, dilatation of the cervix, and fetal head station [8]. The additional variables in the second model improved the accuracy of predicting VBAC. The two models form the basis of an easy-to-use calculator to predict success rate of VBAC [9].

The aim of the present study was to validate the second or “close-to-delivery” model and its accuracy in a Middle Eastern cohort in an attempt to improve the success rate of VBAC among women with one previous lower-segment cesarean delivery.

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2. Materials and methods

The present prospective cohort study enrolled pregnant Middle Eastern women with a single prior low transverse cesarean delivery who attended the labor ward in Al-Jahra Hospital, Jahra, Kuwait, between June 1, 2013, and June 30, 2014. Eligible women had a singleton pregnancy of at least 37 weeks with cephalic presentation, and were willing to undergo a TOL. Cases of intrauterine fetal death and for which TOL was brought to an end owing to fetal distress, intrapartum bleeding, or cord prolapse were excluded. Ethical approval was obtained from Al-Jahra Hospital's ethical committee. All patients gave consent to participation after verbal and written explanations of the study were provided.

On the admission of each patient, a specific form was used to collect information on the close-to-delivery prediction model variables of Grobman et al. [8]: maternal age, BMI at admission for delivery, ethnic origin, prior vaginal delivery, any vaginal delivery since last cesarean delivery, indication for prior cesarean delivery, estimated gestational age of the fetus at delivery, pre-eclampsia, cervical effacement, dilatation, fetal head station, and induction of labor. Patients' BMIs were calculated on the basis of weight and height.

The predicted rate of VBAC success was calculated for each participant by entering their data into the regression formula. To facilitate data analysis, the predicted success rates were divided into decile groups (e.g. >40%–50%, >60%–70%), and the 95% confidence interval (CI) for a successful outcome in each of these deciles was determined [6].

A calibration curve was generated by plotting the predicted rates of VBAC success (represented by the midpoint of each decile) against the actual rates of VBAC success on a scattergram. The points were then smoothly connected to form a curve (with 95% CIs), which was compared visually with the ideal calibration (represented by a 45° straight line).

The primary outcome measure was the mode of delivery. Secondary outcomes included an indication of operative delivery, and neonatal (birth weight, Apgar scores at 1 and 5 min, and admission to neonatal intensive care unit) and maternal (blood transfusion, puerperal fever, wound infection, operative injury, uterine rupture, and hysterectomy) outcome measures.

The study data were analyzed using SPSS version 16 (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean \pm SD; qualitative data were expressed as number (percentage). The Student *t* test was used to compare quantitative variables and the χ^2 test to compare qualitative variables. $P < 0.05$ was considered to be statistically significant.

3. Results

Overall, 203 women who met the inclusion criteria were enrolled in the study, and 140 (69.0%) had successful VBAC. The characteristics of the study patients are shown in Table 1. The study cohort included women from different countries across the Middle East: 116 (57.1%) were Kuwaiti, 38 (18.7%) Egyptian, 16 (7.9%) Libyan, 14 (6.9%) Syrian, 12 (5.9%) Sudanese, and 7 (3.4%) were from other countries in the region.

Among the 140 women who had a successful TOL, the mean probability of success was been $82.4\% \pm 13.1\%$ (range 38.1%–98.3%). By comparison, the mean probability of a successful TOL among the 63 women who had a failed TOL was $67.7\% \pm 18.3\%$ (range 30.3%–96.6%; $P < 0.001$). The predicted success rates were partitioned into deciles, which showed that the actual VBAC success rate rose with the increase in decile of predicted success (Table 2). However, the actual VBAC success rate was less than the predicted VBAC success by approximately 10%–15% for deciles up to >50%–60%, and by approximately 0%–5% for decile >60%–70% (Table 2).

The actual VBAC success rates were highly and positively correlated with the midpoints of the deciles of predicted VBAC success rate. For the >30%–40%, >40%–50%, >50%–60%, >60%–70%, >70%–80%, >80%–90%, and >90%–100% deciles of predicted success rate, the actual success

Table 1

Characteristics of study patients (n = 203).

Characteristics	Value ^a
Maternal age, y	30.1 \pm 4.9 (19–43)
Parity	2 (1–3)
Maternal height, cm	159 \pm 6 (152–177)
Maternal weight, kg	80 \pm 14 (52–129)
Body mass index ^b	32.8 \pm 5.2 (22–51)
Any prior vaginal delivery	113 (55.7)
Any prior vaginal delivery since last cesarean	72 (35.5)
Indication for previous cesarean ^c	30 (14.8)
Estimated length of pregnancy at delivery, wk	39.4 \pm 1.4 (37–42)
Pre-eclampsia	4 (2.0)
Cervical effacement, %	50 (30–60)
Cervical dilatation, cm	2 (1–4)
Fetal head station	–3 (–3 to –2)
Induction of labor	47 (23.2)

^a Values are given as mean \pm SD (range), median (interquartile range), or number (percentage).

^b Calculated as weight in kilograms divided by the square of height in meters.

^c Failure to progress or cephalopelvic disproportion.

rates were, respectively, 20.0%, 30.7%, 38.5%, 59.1%, 71.4%, 76%, and 84.5% ($r = 0.98$, $P < 0.005$). In addition, the actual VBAC success curve was very close to the ideal curve (projected as a straight line of 45°). The narrowness of the 95% CIs ranges further confirmed adequate calibration of the model (Fig. 1).

4. Discussion

The present study found that use of the “close-to-delivery” model for predicting the success of VBAC after one lower-segment cesarean delivery is valid for, and applicable to, women from a Middle Eastern background, and that the actual rate of VBAC success rose as the predicted rate of success increased.

Previous studies from the Middle East region have attempted to study the predictors of success or failure of VBAC. Predictors of success included cervical dilation of 7 cm or more before caesarean, a previous history of successful VBAC, and a parity of two or more [10], whereas those of failure included BMI of 25 or higher, pregnancy of 40 weeks or more, and fetal head station of 2 or higher on admission [11,12]. No agreement currently exists among obstetricians regarding the best predictors to use in anticipation of VBAC success.

Attempts to use different models to decrease the rate of cesarean delivery among women with a prior cesarean procedure are numerous. All these models use variables related to maternal characteristics and pregnancy-related features. However, several methodologic limitations prevent the widespread clinical use of these models: e.g. neither the magnitude/weight of each variable in relation to the VBAC outcome,

Table 2

Actual VBAC success rate by decile of predicted VBAC success rate.

Predicted probability of VBAC success, %	No. of patients (n = 203)	Actual VBAC success	
		No. of patients (n = 140)	Mean rate, % (95% confidence interval)
0–10	0	0	0
>10–20	0	0	0
>20–30	0	0	0
>30–40	5	1	20 (–15 to 55)
>40–50	13	4	30.7 (5.7 to 55.9)
>50–60	13	5	38.5 (12 to 64.9)
>60–70	22	13	59.1 (38.5 to 79.6)
>70–80	42	30	71.4 (57.8 to 85.1)
>80–90	50	38	76 (64.2 to 87.8)
>90–100	58	49	84.5 (75.2 to 93.8)

Abbreviation: VBAC, vaginal birth after cesarean.

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