Simplified Bishop score including parity predicts successful induction of labor

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A B S T R A C T

Objective: Our objectives were to confirm the predictiveness of parity for successful labor induction and propose an improvement in the Bishop's score to take parity into account and simultaneously simplify the original Bishop score.
Study design: Retrospective study of 326 deliveries induced by oxytocin and amniotomy before prostaglandins between January 1, 1987, and June 30, 1988. We conducted a univariate and then a multivariate analysis of the relation between successful labor induction – defined by vaginal delivery- and the components of Bishop's score and parity.
Results: Nulliparous accounted for 38% of the studied population. The mean Bishop at induction was 5.75 ± 1.4. Fetal station, cervical effacement, and parity were the only factors associated with the success of induction in this study. Removing the cervical position and consistency from the score as well as adding parity significantly improved the prediction of success (ROC curves, AUC 0.88 vs 0.68, $p < 0.001$). By taking 5% as the maximum risk of induction failure, a cutoff point of 4 for the new score makes it possible to induce labor in 90% of the women that were considered in the study (vs 26% or 60%, according to whether the cutoff point of the original Bishop's score is set, respectively, at 7 or 6, $p < 0.001$).
Conclusion: Cervical position and consistency are not necessary for predicting successful labor induction by oxytocin and amniotomy. We confirmed the usefulness of a simplified Bishop score that considers parity.

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Introduction

In countries with high levels of perinatal health, labor is induced for approximately 20% of women [1,2]. As widely known, the induction of labor by oxytocin and amniotomy increases the risk of cesarean delivery when the cervix is not sufficiently ripened [3]. Numerous scores have been developed to predict the likelihood of a successful delivery after induction [4]; the most commonly used is the one described in 1964 by Bishop et al. [5]. This score assesses cervical ripeness using five components: cervical length, consistency, position, and dilatation as well as station (of the presenting fetal part).

Bishop's score has the advantage of being universally known. The cutoff point at which delivery can be induced without increasing the risk of cesarean delivery is generally 7 or 6, but this varies from one country to another depending on different local guidelines [6–8]. However, that point is rarely reached in reality. What's more, Bishop's score does not include parity, even though this variable is known for being closely associated with the induction success [4,9–13]. Last, several authors have shown that some components of Bishop's score have a low prognostic value for the success or the failure of the induction [14]; this has led some individuals to propose simplified scores [15].

These points all suggest that it might be useful to study a version of Bishop's score without some of the components and which takes parity into account. Such a study would require a series of patients induced with oxytocin and for whom each component of Bishop's score was measured before induction. Unfortunately, it has been difficult to conduct this type of study for more than 20 years from now, mainly because an induction by

	+0	+1	+2	+3
Cervical consistency	Firm	Intermediate	Soft	
Cervical position	Posterior	Median	Anterior	
Cervical dilatation	0	1-2 cm	3-4 cm	≥5 cm
Cervical effacement	0-30%	40-50%	60-70%	≥80%
Fetal station (relative to ischial spines)	-3 cm	- 2 cm	-1, 0 cm	+1, +2 cm
Parity	Nulliparas		Multiparas	

Brackets: 1. Original Bishop score; .Simplified Bishop; 3. Bishop + parity; 4. Simplified Bishop+ parity

Fig. 1. Components of the Bishop score and scores studied in this analysis.

oxytocin and amniotomy is so often preceded by a cervical ripening by prostaglandins when the cervix is unfavorable. This modifies the assessment of the cervical status and of the results interpretation.

By reviewing some local records, we found a series of patients whose cervical status was assessed before a labor induction by oxytocin and amniotomy and before prostaglandins were widely used. We conducted a retrospective study to confirm the role of parity in the success of inductions by oxytocin and amniotomy. We were aiming at proposing an improvement of Bishop's score that would take into account simultaneously the parity and the simplifications that were previously proposed in the literature.

Materials and methods

This retrospective study analyzes the women who gave birth after a labor induction by oxytocin and amniotomy (in the event of intact membranes) between January 1, 1987, and June 30, 1988 (date of the beginning of prostaglandin usage), in a university hospital maternity ward.

The case files were included in this study if they involved singleton pregnancies in cephalic presentation, with no uterine scar and no prenatal detection of a fetal malformation. Labor induction was considered for these pregnant women after 37 weeks of gestation, either in the event of a maternal or fetal disease, or because the patient had requested it. The induction must have been performed exclusively by the combination of oxytocin in the absence of active labor (and not used for speeding up labor and amniotomy in case of intact membranes. The level of oxytocin was progressively increased every 20 min if necessary and the amniotomy was done as soon as possible.

The cervical assessment was noted according to the five usual criteria used to describe Bishop's score (Fig. 1). The indications for an induction were noted in the obstetric records and were classified in four categories: prolonged pregnancy, premature rupture of the membranes, maternal-fetal disease (mainly pregnancy-related hypertension, preeclampsia, and uncontrolled diabetes, may they be pregnancy-related or predating the pregnancy, or meconium on amnioscopy) or an induction requested by the mother.

The success of the induction was arbitrarily defined as a vaginal delivery, regardless of the duration of labor and of whether the vaginal delivery was spontaneous or operative (instrumental). A cesarean delivery during labor was considered as a failure of induction, regardless of its indication. A cesarean for dystocia was defined as a 3-h cervical stagnation. The other maternal and neonatal indicators considered in this study were the woman's age,

parity, gestational age, epidural analgesia, the duration of labor, the mode of delivery, and the baby's weight and condition at birth. Nulliparous was defined as none previous birth.

The aim of the analysis was to study the role of parity and the different components of Bishop's score in the success of induction, and to establish – if possible – a more accurate predictive score than the standard Bishop's score [5]. This analysis was performed in five stages. First, we examined the relation between the components of Bishop's score—to which we added parity—and the success of the induction. At that stage, the percentages were compared with the Chi-2 or Fisher's exact test, whenever applicable. In the second stage, the variables that were significantly associated with the success of the induction in the univariate analysis ($p < 0.20$) were introduced by a forward stepwise procedure into a logistic regression model. Given that the selection of the variables depended on the sample, we used a bootstrap resampling procedure in the third stage to obtain a stable selection of variables. This procedure was artificially performed amongst 500 samples of the same size—326 patients—drawn from the initial population. The indicators that were selected in over 70% of the samples were retained in the construction of the new model [16]. In the fourth stage, we compared the new model to the different existing scores. We established the ROC (receiving operating characteristics) curves, calculated their areas under the curve (AUC), and compared them [17]. In the fifth and final stage, we arbitrarily agreed to use as the best cutoff point for each score the one that provided the highest proportion of women for whom it was possible to induce labor with a maximum risk of failure of induction arbitrarily set at 5% (positive predictive value (PPV) $\geq$ 95%). Each of these percentages was compared by a Chi-2 test for matched series.

The statistical analyses (comparisons of percentages, logistic regression) were performed with SAS software V9.2 (SAS Institute Inc., Cary, NC). The ROC curves were performed with SPSS software (SPSS 13.0 for Windows, Inc., Chicago, IL). The different AUCs were compared with MedCalc software v11.6.1, using the DeLong test [18] (MedCalcSoftware, Broekstraat, 52, 9030 Mariakerke, Belgium). Significance was set at 0.05.

Ethical approval was granted by the French Ethics Committee of research in Obstetrics and Gynecology (CEROG OBS 2015-11-08).

Results

Between January 1, 1987, and June 30, 1988, the hospital had 3861 deliveries, of which 368 (9.5%) happened after inducing labor (Fig. 2). We excluded 42 deliveries from the analysis: 24 because the data was incomplete (6.5%), 16 because they were induced