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Prediction of time to delivery: Elective induction versus Spontaneous Labor

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ABSTRACT

Objective To predict time to delivery after in labor between elective induction and spontaneous labor.

Study design Retrospective cohort study.

Setting Ramathibodi Hospital, a 800-beds medical school hospital in Bangkok.

Study Population All patients who visited at antenatal care clinic and delivered at Ramathibodi Hospital, Bangkok, during the calendar year 1997.

Subjects The study factor was the mode of in labor, elective induction and spontaneity. Two-hundred and thirty patients for each group were randomly selected from the registration. All patients were single fetus, gestational aged 37 to 41 weeks, regular menstrual cycle with accurate last menstrual period, and cephalic presentation. We excluded patients who had previous or current obstetric/medical complications.

Main outcome The outcome variable was the time elapsed between labor onset and delivery. Vaginal delivery resulted in a completed time and cesarean section was the censoring event.

Analysis Kaplan-Meier was applied to determine the probability of vaginal delivery after labor was initiated. Cox hazard model was used to estimate the risk of vaginal delivery after adjusting for confounding variables.

Result There were 381 patients who delivered via vagina and 50%of patients delivered at 7.3 hours after in labor. The medians of vaginal delivery time were about 6 hours and 9 hours for induce and spontaneous group. For induce group, the probability of vaginal delivery at 4, 8, and 12 hours after initiating labor were 26.1% (95% CI 20.9% - 32.2%), 71.8% (95% CI 65.3% - 77.9%), and 90.1% (95% CI 83.5% – 94.9%). These were much higher than finding in spontaneous group, the corresponding probability were 7.8% (95% CI 5.0% - 12.1%), 41.6% (95% CI 35.6% - 48.3%), and 53.4% (95% CI 47.1% - 60.1%) respectively. After adjusting for confounding variables, elective induction was more likely to have vaginal delivery than in spontaneous group (HR = 2.4, 95% CI 1.8 –3.1).

Conclusion When compared to spontaneous labor, elective induction appears to have much shorter time to delivery.

Key words: prediction, time to delivery, elective induction, spontaneous labor

Elective induction of labour is defined as an initiation of labour, either by mechanical or pharmacologic means, at a time earlier than nature with regardless to a medical or obstetric indication.[1-4] Some authors are not enthusiastic in elective induction since they think that unnecessary elective induction increases the risk in maternal and fetal morbidity.[4] The morbidity event that should be mostly avoided in neonates is prematurity which results in pulmonary immaturity.[4-5] However, the ability to assess fetal and maternal risks has recently increased, as has obstetricians understanding of the mechanism of labour. As a result of this, elective induction is more likely to end in a successful and safe outcome.

Ideally, labor should be allowed to occur spontaneously. Currently, most patients and also obstetricians prefer elective induction rather than spontaneous labour. Patients give reasons such as a greater knowledge of the exact date of birth, which allows them to make arrangements regarding their work commitments, care of other children during hospitalization, family members, and also leads to more peace of mind. From an obstetrician's point of view, they prefer to set the delivery time during the daytime of workday when related teams such as obstetrician staff, anesthetists, pediatricians, and nursing teams are more likely to be available, rather than at after hours or during the weekend.

After in labor, time to delivery is an interested outcome for patients and also obstetricians. Some studies had estimated and compared the length of labor between two modes of labor (MOL),[2-3, 6-8] elective induction and spontaneous labor, but did not estimate the probability of delivery in hourly with this regard. Bremme et al[9] conducted study to predicted time to delivery only one group of labor, induction. We, therefore, conducted a retrospective cohort study in order to predict time to delivery in hourly between elective induction and spontaneous labor.

Methods

A retrospective cohort study was conducted which included women who had visited an antenatal care clinic and delivered at Ramathibodi Hospital, Bangkok, Thailand, between January 1 to December 31 1997. Ramathibodi Hospital is a governmental tertiary hospital and medical school. There were 5879 deliveries during the study time period, of which 1400 (23.8%) births were induced and 4495 (76.2%) were spontaneous. Women were eligible for the study if they had a single fetus with a gestational age of between 37 to 41 weeks and cephalic presentation, and had a regular menstrual cycle with accurate LMP. Also excluded were all patients who had previous or current obstetric/medical complications, or were induced because of medical indication.

The focus of this study was mode of labor (MOL), either elective induction or spontaneous labor. Prior sample size calculations indicated a random sample of 230 women from each group. These were selected randomly by computer generation of random numbers. The method of induction consisted of amniotomy following about one to three hours after Oxytocin infusion, or intravenous Oxytocin infusion followed by amniotomy, or prostaglandin E2 gel suppositories, or any combination thereof. Oxytocin dosage was 5 units, diluted in 5% dextrose in 1000 ml of water. The start rate was 10 drops per minute and this could be increased through 20 and 40 to a maximum of 60 drops per minute every 30 minutes until the intensity of uterine contraction was moderate and with duration of about 30 seconds. For the control group, spontaneous labor was defined as the onset of pain and regular uterine contraction every 10 minutes or less, with or without mucous bloody show or rupture of membranes. During their stay in a delivery room, these women may have received stimulation by intravenous Oxytocin infusion. The protocol of Oxytocin infusion was the same as that for the induced group.

The outcomes of interest were time to vaginal delivery (normal labor, vacuum extraction, and forceps extraction). Time to vaginal delivery was calculated from time at the onset of labor to time at vaginal delivery. Time at the start of Oxytocin treatment, amniotomy, or PGE2 suppositories, was defined as time at the onset of labor for the induced group. For the spontaneous

group, patients were asked by nurses to recall what time they felt regular pain before they came to hospital. Nurses also observed uterine contraction for an hour after admission. If the frequency of contraction was 10 minutes or less and patients could recall an accurate commencement time, we used this time to mark the onset of labor. Otherwise, we used the time of the first observed uterine contraction with an interval of less than 10 minutes from the previous contraction. In Ramathibodi Hospital, the chief residents of obstetrics (or staff for private cases) are responsible for the decisions relating to obstetric deliveries, including choice of delivery mode. The indications for each were clearly defined and all involved obstetricians were asked to observe strict compliance. In practice, well-trained nurse specialists would observe uterine contraction and fetal heart rate every 15 minutes while the women were receiving Oxytocin, or every 30 minutes in the case of aminiotomy only.

A senior nurse specialist (the second author) reviewed women's records. Data collected included time of onset labor, time of delivery, mode of delivery, parity, age, weight at first visit, weight at delivery, maternal height, use of analgesics, type of case (service/private), evidence of intra-postpartum complication, Apgar score, cervical examination, and birth weight. If there was any problem in the data recording, especially in time of labor onset, consensus was reached with assistance from a senior obstetrician. Confounding variables which had been recorded, such as age, maternal height, weight gain during pregnancy, type of case, parity, gravida, gestational age at delivery, and cervical status at onset of labor were considered and included in analysis. The only available information on cervical status was cervical dilation, cervical effacement, and station. Thus a modified Bishop score[8] was used as a surrogate variable to measure cervical ripening.

The software package EPI INFO was used for data base management. A data-checking file was developed in order to control the quality during data entry. After the data were checked, analyses were conducted using STATA (version 5.0).[10] Depending on the outcome and distribution of data, t-tests, Mann-Whitney tests, and Chi-squared tests, were used to compare various characteristics between two groups. Kaplain-Meier method was applied to estimate probability of vaginal delivery in hourly after labor was initiated. Cesarean section was claimed to be censored in analysis. Log rank test was applied to compare the probability of vaginal delivery between two MOL. Cox hazard model was used to determine the risk of vaginal delivery among MOL after adjusting for confounding variables.

Results

Patients' Characteristics

All 230 women in each group were included in the analyses. General characteristics of patients are shown below (Table 1). There was no difference between groups for maternal ages, height, education level, gravida, and weight gain during pregnancy. There were significant differences in gestational age at delivery, parity, Bishop score, and type of case between the two groups. Gestational age at delivery ranged between 37 to 41 weeks for both groups. The proportion of nulliparous pregnancies in the induced group was 53.48% and, in the spontaneous group, 64.35%. The mean of Bishop score at the onset of labor was 4.12 (1.52) for the induced group and 4.64 (1.59) for the spontaneous group. Most women in the induced group (68.26%) were private cases, while only 37.83% were private cases in the spontaneous group.

Time to Delivery

There were 381 (82.83%) of patients who delivered via vagina. 50% of patients delivered at 7.3 hours after in labor. The outcome of interest was the time elapsed between labor onset and delivery. Vaginal deliveries resulted in a complete time and cesarean section was the censoring event. A Kaplan-Meier curve was used to estimate the probability of delivery after in labor. We found that, after labor was initiated in, delivery time for the induced group was much shorter than for the spontaneous group (Figure 1). The median time for the induced group was about 6 hours while it was 9

hours for the spontaneous group. For the induced group, the probability of deliveries within 4, 8, and 12 hours were 26.1%, 71.8% and 90.1% respectively, with the corresponding estimated 95% confidence intervals were 20.9%-32.3%, 65.3%-77.9% and 83.5%-94.9%. Compared to the spontaneous group, the corresponding probability were much lower; 7.8% (95% CI = 5.0-12.1), 41.6 (95% CI = 35.6-48.3) and 53.4% (95% CI = 47.1-60.1) respectively. A log rank test to compare the two MOL groups was highly statistically significant ($p < 0.0001$).

Table 1. Comparison of Characteristics between Elective Induction and Spontaneous Groups

Characteristics	MOL Groups		P-value
	Induction (n=230)	Spontaneous (n=230)	
Education level; number(%)			
6 yrs	43(18.7)	47(20.4)	.456*
6-12 yrs	82(35.7)	92(40.0)	
13-14 yrs	24 (10.4)	16 (7.0)	
15 yrs	81(35.2)	75 (32.6)	
Age in year mean (SD)	29.4 (4.8)	28.6 (4.7)	.066**
Maternal Height (cm) mean (SD)	156.0 (5.3)	156.2 (5.2)	.646**
Weight Gain (kg) median (range)	13.5 (5.0-22.5)	13.6 (4.9-26.0)	.594***
Gestation Age (week) mean (SD)	39.2 (0.1)	38.6 (0.1)	<.001**
Bishop Score mean (SD)	4.1(1.5)	4.6 (1.6)	<.001**
Gravida; number (%)			
1	93 (40.4)	113 (49.1)	.061*
2	88 (38.3)	84 (36.5)	
3	43 (18.7)	22 (9.6)	
4	6 (2.6)	11 (4.8)	
Parity; number (%)			
0	123 (53.48)	148 (64.35)	.043*
1	85 (36.96)	69 (30.00)	
2	22 (9.57)	13 (5.65)	
Type of cases; number (%)			
Private	157 (68.26)	87 (37.83)	<.001*
Service	73 (31.74)	143 (62.17)	

* Chi-square test, ** t-test, *** Mann-Whitney test

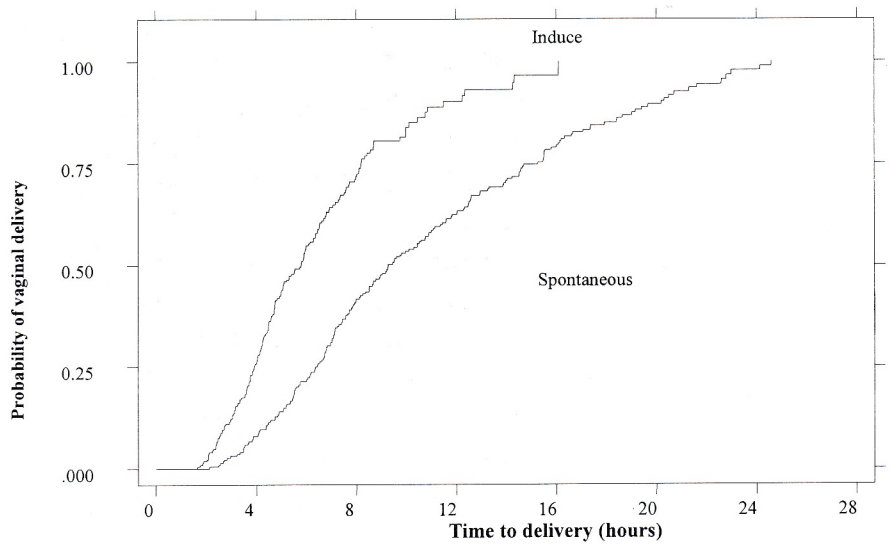

Fig. 1. Estimation of time to delivery between elective induction and spontaneous labor.

Cox's proportional hazards model was used to determine the probability of vaginal delivery after adjusting for some confounding variables such as age, type of cases, gestational age at delivery, weight gain during pregnancy, maternal height, education level, parity, Bishop's score, and gravida. We found that MOL, parity, Bishop's score, and the interaction between MOL and parity were significant (Table 2). The assumption that the hazard of vaginal delivery was constant for each different combination of variables was checked and verified. After adjusting for Bishop's score, nulliparous patients whose labor were elective induced were 2.4 times (95% CI =1.8 –3.1) more likely to have a vaginal delivery compared to nulliparous patients in spontaneous group. The probability of vaginal delivery increased dramatically if there was non-zero parity. For instance, induced women who had previously delivered 1, 2, or 3 times would have a chance of vaginal delivery 4.0, (95% CI = 3.1-5.3), 6.8 (95% CI = 4.1-11.3), and 11.5 (95% CI = 5.2-25.7) times higher than those with a spontaneous delivery. Bishop's score also affected the vaginal delivery rate; for each unit increased, the chance of vaginal delivery increased 1.4 times (95% CI = 1.3-1.5). This means that patients who had a Bishop's score of 5 at the onset of labor would have a chance of vaginal delivery which was 4.7 (95% CI = 3.3-6.7) times higher compared with patients whose Bishop's score was 0.

Table 2. Harzard Rates, 95% Confidence Interval for the Mode of in Labor and Confounding variables in Cox Model

Factors	Adjusted HR	95% CI for HR
Mode of in labor		
Induce	2.36	1.78 - 3.14
Spontaneous	1	
Parity	1.55	1.23 - 1.94
Bishop score	1.36	1.27 - 1.46
MOL x Parity	1.69	1.24 - 2.31

Discussion

In this study ,the elective induced group had much shorter time to delivery and resulted in higher probability of delivery at 4, 8, and 12 hours after in labor when compared to spontaneous group. Fifty percent of induced patients delivered at about 6 hours after labor while about 9 hours for spontaneous group. Increasing parity and Bishop score were very important factors in increasing the risk for vaginal delivery.

Three observational studies by Vierhout et al,[2] Macer et al,[3] and Yudkin et al[7] found that the length of labor was significantly shorter under elective induction than in spontaneous labor, while one observational, study by Cole et al,[11] found the time to be about the same. The length of labor is affected by many factors, which were not included in the analysis of these studies. On the other hand, reports on two randomized controlled trials gave conflicting results. Martin et al.[6] reported that the elective induction group had a longer labor time than a spontaneous group. This contrasts with a report by Tylleskar T, et al,[8] which found no difference in labor time between the two groups. A most important factor in determining this time is the accuracy of estimation of the time of onset of labor, especially in the spontaneous group. If the onset of labor is systematically under- or over-estimated, measurement of length of labor will be biased. Vierhout et al[2] had defined the onset of labor in a spontaneous group as the regular pain with an interval 4-5 minutes or as the moment of spontaneous rupture of membrane. However, some patients whose membranes ruptured spontaneously might not have regular pain and might take a long time to be in labor. This definition would may result in a long measurement of length of labor. Macer et al[3] defined length of labor in the same as Vierhout et al[2] but, with or without spontaneous rupture of membrane. However, neither study mentioned how they could verify the time of onset of regular pain. Martin et al,[6] Yudkin et al,[7] and Tylleskar T, et al[8] did not specify this definition. In our study, as much as possible was taken to estimate this from the medical record. In practice, patients in the spontaneous labor group go to the hospital when they have some sign or symptoms, which may result in true or false labor. Nursing specialists interviewed the women upon arrival and recorded when this sign or symptom had occurred and uterine contractions were observed during the first hour after admission. This information was then used to pinpoint the time of labor onset. However, since ours was a retrospective cohort study, all information was necessarily based on the available medical records.

In summary, when compared to spontaneous labor, elective induction appear to have much shorter time and higher probability of delivery.

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