Journal of Health & Population in Developing Countries; 1999, 2(2):17-22

Comparison of Cesarean Section Rates between Elective Induction and Spontaneous Labor in Ramathibodi Hospital, Thailand

Ammarin Thakkinstian, MSc, M Med Stats, Patrick EB Fitzgerald, M App Sc and Lynette Lai-Ying Lim, PhD

This retrospective cohort study was designed to determine whether, after adjusting for confounders, cesarean section rates between elective induction and spontaneous labor were different. Logistic regression was used to estimate the odds of cesarean section. There were 460 patients included in the analysis. Elective induction had non-significant odds of cesarean section (1.87; 95% CI 0.98–3.55) when compared with spontaneous labor. Cesarean section rate was higher in elective induction, but the observed difference was not statistically significant.

Key words: Thailand; elective induction; spontaneous labor; cesarean section

Introduction

Elective induction of labor is defined as an initiation of labor, either by mechanical or pharmacologic means, at a time earlier than nature regardless of a medical or obstetric indication.[1-4] Some authors are not enthusiastic about elective induction since they think that unnecessary elective induction increases the risk of maternal and fetal morbidity.[14] The morbidity event that should be avoided most in neonates is prematurity which results in pulmonary immaturity.[14-15] However, the ability to assess fetal and maternal risks has recently increased, as has obstetricians' understanding of the mechanism of labor. 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 in Asia and also obstetricians prefer elective induction rather than spontaneous labor. Patients give reasons such as 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 greater peace of mind. From an obstetrician's point of view, they prefer to set the delivery time during the daytime of a working day when related teams such as obstetrician staff, anesthetists, pediatricians, and nursing teams are more likely to be available, rather than after working hours or during the weekend. We know that the policy of induction is not consistent between hospitals[6] and may also vary between Western and Asian hospitals. As a result of this, the cesarean section rate of induction labor in Asian countries may differ from that in Western countries.

There are some Western studies,[1-3, 7-12] and a few Asian studies[13] that compare the effect of induction to spontaneous labor with regard to maternal and neonatal outcome. The most important factors examined are mode of delivery, length of labor and complications during delivery, such as uterine

Ammarin Thakkinstian, Division of Clinical Epidemiology, Faculty of Medicine, Ramathibodi Hospital, Rama 6 Rd., Bangkok 10400, Thailand Tel: 66-02-2011762 • Fax: 66-02-2011542 • E-mail: raatk@mahidol.ac.th
Patrick EB Fitzgerald, Center for Clinical Epidemiology and Biostatistics, Faculty of Medical and Health Sciences, Royal Newcastle Hospital, Newcastle University, New South Wales, 2308, Australia.
Lynette Lai-Ying Lim, National Center for Epidemiology and Population Health, The Australian National University, Canberra Act 0200, New South Wales, Australia.

rupture, prolapsed cord, and post-partum hemorrhage. The results of the effects regarding mode of delivery are still equivocal. Some randomized-controlled trials[7-8, 10-12] and observational studies[1-3,9,13] (retrospective and prospective cohort) compared the cesarean section rate between elective induction and spontaneous labor. All trials found no significant differences in mode of delivery (MOD) between the two mode-of-labor (MOL) groups. Conversely, most observational studies found higher cesarean section rate in elective induction, compared to spontaneous labor. Length of labor is also of major interest and there are some studies[2-3, 8-10], which also had equivocal results with respect to MOL.

We know that the mode of delivery and the length of labor are affected by many factors.[14-16] However, most previous observational studies, which were conducted in Western countries, do not control for confounding factors. Only one study has been conducted in Asia. Therefore, the results of this study will be useful for Asian countries. We conducted a retrospective cohort study with two main objectives. The first was to determine whether, after adjusting for confounding factors, the failure rate of elective induction differs from spontaneous labor and the second was to compare the length of labor between the two MOL groups among vaginal delivery patients.

Methods

The retrospective cohort study included women who had visited an antenatal care clinic and delivered at Ramathibodi Hospital, Bangkok, Thailand, between January 1 and December 31, 1997. Ramathibodi Hospital is a governmental tertiary hospital and medical school. There were 5895 deliveries during the study period, of which 1400 births(23.8 percent) were induced and 4495 (76.2 percent) were spontaneous. Women were eligible for the study if they had a single fetus with a gestational age of between 37 and 41 weeks and cephalic presentation, and had a regular menstrual cycle with accurate Length of Menstrual Period (LMP). All patients who had previous or current obstetric/ medical complications, or were induced because of medical indication were excluded.

The focus of this study was 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 (PGE2) gel suppositories, or any combination thereof. Oxytocin dosage was 5 units, diluted in 5 percent 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 the 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 length of labor and MOD. All vaginal deliveries, normal labor, vacuum extraction, and forceps extraction were claimed as successes and cesarean sections as failures. The length of labor was calculated as the time between the onset of labor and the delivery. The time at the start of oxytocin treatment, amniotomy, or PGE2 suppositories, was defined as the 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 the hospital. The nurses also observed uterine contraction for an hour after admission. If the frequency of contraction was 10 minutes or less and the 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 the obstetricians involved 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 reviewed women's records. Data

collected included time of onset of labor, time of delivery, mode of delivery, parity, age, weight at first visit, weight at delivery, maternal height, use of analgesics, type of case (public/private), evidence of intra-postpartum complications, Apgar score, cervical examination, and birth weight. If there was any problem in the data recording, especially about 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 the analysis. The only available information on cervical status was cervical dilation, cervical effacement, and station. Thus a modified Bishop score[4] was used as a surrogate variable to measure cervical ripening.

Sample size was based on a pilot study of 100 women from each MOL group. We obtained an incidence of cesarean section in spontaneous labor of 11 percent. On this basis, the study was designed to detect the difference in proportion between two groups of least 10 percent, with 80 percent power and a 5 percent significance level. The calculations were done using the software package PS (Power and Sample size)[17]. The data from the pilot study were also included in the analysis.

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).[18] Depending on the outcome and distribution of data, t-tests, Mann-Whitney tests, and Chi-square tests were used to compare various characteristics between the two groups. Multiple logistic regression analysis was used to estimate the odds of failure, or cesarean section, in the two MOL groups, after controlling for age, education, parity, gravida, Bishop score, weight gain during pregnancy, gestational age at delivery, type of case, and maternal height. Likelihood ratio tests were used to test for effect modifications by Bishop score, parity, and age on MOL. None of these interactions were significant and were subsequently excluded from the model. Multiple regression analyses were conducted to determine whether MOL affected the length of labor among the 381 vaginal delivery women. The same confounding variables used in the logistic regression analysis were also considered in this analysis. The length of labor was transformed by taking the (natural) logarithm in order to improve the symmetry of the distribution.

Results

Patient Characteristics

All the 230 women in each group were included in the analyses. The general characteristics of the patients are shown in Table 1. There was no difference between the groups for maternal age, height, education level, gravida, and weight gain during pregnancy. There were significant differences between the two groups in gestational age at delivery, parity, Bishop score, and type of case. Gestational age at delivery ranged between 37 and 41 weeks for both the groups. The proportion of nulliparous pregnancies in the induced group was 53.48 percent and, in the spontaneous group, 64.35 percent. The mean of Bishop score at the onset of labor was 4.1 (1.5) for the induced group and 4.6 (1.6) for the spontaneous group. Most women in the induced group (68.26 percent) were private cases, while only 37.83 percent were private cases in the spontaneous group.

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

Characteristics	MOL Group		P-value
	Induction (n=230)	Spontaneous (n=230)	
Education level; no. (%)			
≤ 6 yrs	43(18.7)	47(20.4)	.456*
6-12 yrs	82(35.7)	92(400.0)	
13-14 yrs	24(10.4)	16(7.0)	
≥ 15 yrs	81(35.2)	75(32.6)	
Age in Years mean (sd)	29.4(4.8)	28.6(4.7)	.066**
Maternal Height in cm mean (sd)	156.0 (5.3)	156.2(5.2)	.646**
Weight Gain in kg median (range)	13.5(5.0-22.5)	13.6(4.9-26.0)	.594***
Gestation Age in weeks 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; no. (%)			
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)	(4.8)	
Parity; no. (%)			
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; no. (%)			
Private	157(68.26)	87(37.83)	<.001*
Service	73(31.74)	143(62.17)	

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

Mode of Delivery

The cesarean section rate in the elective induced group was 22.2 percent, significantly higher than that of 12.2 percent in the spontaneous labor group (Table 2). The elective induction group had odds of cesarean section of 2.1 times (95 % CI = 1.2-3.4), relative to the spontaneous group. The main indication for cesarean section was cephalic-pelvic disproportion, a complication noted in 92.2 percent and 85.7 percent of cesarean section cases in the induced and spontaneous labor groups, respectively.

Table 2 *Strength of Association between Elective Induction and Cesarean Section Rate after Controlling for Confounding Variables.*

Factors	Outcome		Adjusted OR (95% CI)
	Cesarean Section (79)	Vaginal Delivery (381)	
MOL Group; no. (%)			
Induced	51(22.2)	179(77.8)	1.9(0.9-3.6)
Spontaneous	28(12.2)	202(87.8)	1
Parityl; no. (%)			
Multipara	9(4.8)	180(95.2)	0.1(0.1-0.4)
Nullipara	70(25.8)	201(74.2)	1
Bishop score mean (sd)	3.48(1.4)	4.57(1.6)	0.7(0.5-0.8)
Age in years Mean (sd)	29.50(4.3)	28.85(4.8)	1.1(1.1-1.2)
Type of case; no. %			
Private	54(22.1)	190(77.9)	1.7(0.8-3.7)
Service	25(11.6)	191(88.4)	1
Gravida; no. (%)			
Multigravida	23(9.1)	231(90.9)	0.76(0.4-1.6)
Primigravida	56(27.2)	150(72.8)	1
Weight Gain in kg mean (sd)	14.5(3.8)	13.6(3.8)	1.0(1.0-1.1)
Gestational Age in weeks mean (sd)	39.1(1.3)	38.8(1.2)	1.2(1.0-1.5)
Maternal height in cm mean (sd)	154.9(5.1)	156.3(5.3)	0.9(1.0-1.0)
Education; no. (%)			
≥ 15 yr	38(24.4)	118(75.6)	1.5(06-3.7)
13-14 yr	5(12.5)	35(87.5)	0.9(02-3.2)
6-12 yr	25(14.4)	149(85.6)	1.2(0.5-2.9)
≤ 6 yr	11(12.2)	79(87.8)	1

The estimated adjusted odds ratio and 95 percent confidence interval for each variable are shown in Table 2. After controlling for confounding variables (age, parity, gravida, gestational age at delivery, maternal height, weight gain during delivery, type of case, education, and Bishop score) a patient whose labor was induced had greater odds of a cesarean section (OR =1.9; 95 % CI =0.9 -3.6) relative to a patient whose labor occurred spontaneously. However, these adjusted odds were not statistically significant (Wald test statistic = 1.91, p = 0. 056). We also explored the goodness of fit of the model in Table 2 using the Hosmer - Lemshow goodness of fit criterion and found the model did fit well (p=0.447). Only three confounding variables (parity, Bishop score, and age) were significantly associated with the MOD. For parity, multipara patients had the preventive estimated odds of cesarean section of 0.1 (95 % CI=0.1 -0.4) compared to nullipara patients. Higher Bishop score was also a preventive factor in cesarean section, with each unit increase in the Bishop score resulting in 30 percent reduction in the odds of cesarean section (OR = 0.7, 95 % CI =0.5 - 0.8). Conversely, increasing maternal age was associated with increased odds of caesarean section (OR = 1.1 per year of increasing age).

Length of Delivery

There were 381 patients who delivered via vagina and were included in the analysis for length of labor. We found (Table 3) that, after control for confounding variables, the elective induced group had a significantly shorter length of labor than the spontaneous labor group by 33 minutes [60x exp (60), 95% CI = 30 – 37]. Confounding variable, parity, and Bishop score were also significant and were negatively associated with the length of labor. We also found that the length of labor for the multipara patients was about 44 minutes (95 % CI = 38 – 51 min) shorter than the nullipara patients and would be also shortened by about 53 minutes (95 percent CI = 51 - 54 min) for each additional unit of Bishop score.

Table 3 *Regression Coefficients and their exponential for Mode of Delivery Regressed on [in Length of labor in hours]*

Factors	Coefficients	95% CI of Coefficients	Exp. [Coefficients] (95% CI)
MOL Group			
Induced Spontaneous	-60	-.70,-.50	.55(50, .61)
Parity	-.30	-.44,-.16	.74(.64, .85)
Multiparae Nulliparae	-.13	-.16,-.10	.88(.85, .90)
Bishop score	.00	-.00, .01	1.00(1.00, 1.01)
Age in years	.02	-.09, .13	1.2(.191, 1.14)
Type of case Private/ Service Gravida	-.04	-.18, .10	.96(.84, 1.11)
Multigravida/Primi gravida	.01	-.00, .02	1.01(1.00, 1.02)
Weight Gain in kg	.04	.00, .07	1.04(1.00, 1.07)
Gestational Age in weeks	.01	-.00, .01	1.01(1.00, 1.01)
Maternal height in cm			
Education			
≥ 15 yr	-06	-21, .07	.94(.81, 1.07)
13-14 yr	-.11	-.30, 07	.90(.74, 1.07)
6-12 yr	.03	-.09, .15	1.03(.91, 1.16)
≤ 6 yr	1		

Discussion

In this study, when compared with spontaneous labor, cesarean section rate was higher in elective induction, but the observed difference was not statistically significant. However, the time of vaginal delivery was much shorter when elective induction was used. Increasing parity and Bishop score were very important factors in reducing the chance of cesarean section. Conversely, increasing age resulted in an increase in this chance.

Some randomized-controlled trials[7-8, 10-12] found no significant difference in cesarean section rate between the two MOL groups. It is known that confounding bias can be minimized in a randomized- controlled trial. Although our study design did not control for confounding bias, we were able to do this via the statistical analysis. As a result, we obtained results similar to those of previous randomized controlled trials. However, all previous trials had smaller sample size, less than 190 for each group, which may be prone to resulting in higher false negative, or Type II errors. Studies by Cole AR et al.[7] Martin HD et al.[8] Sande AS et al.[11] and Bergsjo et al[12] had some noncompliance with the mode of labor after randomized allocation. Three studies[7-8,11] excluded patients from analysis or used "analysis of compliers approach". Only one trial[12] used intent to treat analysis, which is the appropriate method to obtain minimized bias results[19].

Some observational studies, retrospective and prospective cohort, have also compared cesarean section rates between the two MOL groups.[1-3, 9] Studies by Smith et al[1], Macer et al.[3] and Yudkin et al.[9] found that cesarean section rates were higher in nulliparous induced women compared to spontaneous labor birth women, and no significant difference was found between the groups of multiparous women. Wilailak et al.[13] conducted a study in an Asian country and reported that cesarean section rates among private patients were the same with regard to MOL groups, but much higher in the induced patients among service cases. However, none of these observational studies controlled for confounding variables. Thus, any confounding effect that these factors might have on the association between MOL and mode of delivery still remained. Jarvelin RM et al.[6] used logistic regression analysis for adjusting for confounding variables. They found, that after adjusting for confounding variables, induced labor had a higher risk of cesarean section than spontaneous labor. However, only age, parity, education, and obstetric specialization level were included in this analysis. Some important variables, especially Bishop score, were not considered.

Length of labor time was also of major interest. Only three observational studies by Vierhout et al.[2], Macer et al.[3], and Yudkin et al[9] found that the length of labor time was significantly shorter under elective induction than in spontaneous labor, while one observational study by Cole et al.[7], found the time to be about the same. As for the MOD, the length of labor is affected by many factors, which were not included in the analyses of these studies. On the other hand, reports on two randomized controlled trials gave conflicting results. Martin et al.[8] reported that the elective induction group had a longer labor time than the spontaneous group. This contrasts with a report by Tylleskar et al.[10], 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 the spontaneous group as regular pain with an interval of 4-5 minutes or as the moment of spontaneous rupture of membrane. However, some patients whose membranes ruptured spontaneously might not have had regular pain and might have been a

long time in labor. This definition may result in measurement of a longer length of labor. Macer et al.[3] defined length of labor in the same way 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.[8], Yudkin et al.[9], and Tylleskar et al.[10] did not specify this. In our study, as much information as possible was taken from the medical record to estimate this. 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 these signs or symptoms 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 the information was necessarily based on the available medical records.

In the studies we reviewed, neither sample size nor power issues were addressed prior to the study. In our study, sample size and power were considered in the planning stage. We were also aware that a number of other factors might affect MOD[14-16] and length of labor. Therefore, statistical analysis which would include the effects of confounding variables was used.

We conclude that, with appropriate adjustment for confounding variables, observational studies in this setting appear to result in the same conclusion as randomized controlled trials; that is, cesarean section rate was higher in elective induction, but the observed difference was not statistically significant.

Acknowledgments

This study was supported by Ramathibodi Research Grant No. 26/1997. We gratefully acknowledge Associate Professor Somsak Suthutvoravut for providing clinical information and Mrs Manirat Srimanoy for her assistance in data collection.

References

1. Smith, PL, AB Nagourney, HF McLean and HR Usher. 1984. Hazards and benefits of elective induction of labor. *Am J Obstet Gynecol* 148:579-585.
2. Vierhout, EM, JJ Out and SCH Wallenburg. 1985. Elective induction of labor: a prospective clinical study, I: Obstetric and neonatal effects. *J Perinat Med* 13: 155-162.
3. Macer, AJ, LC Macer and SL Chan. 1992. Elective induction versus spontaneous labor: a retrospective study complications and outcome. *Am J Obstet Gynecol* 166: 1690-7.
4. Jackson, M and C Regan. 1997. Elective induction of labor. *Clin Obstet Gynecol* 40: 496-509.
5. Rielly, HEK. 1994. Induction of labor. *American Family Physician* 49: 1427-32.
6. Jarvelin, MR, AL Hartikaien and P Rantakallio. 1993 Labour induction policy in hospitals of different levels of specialisation. *Br J Obstet Gynaecol* 100: 310-315.
7. Cole, AR, WP Howie and CM Macnaughton. 1975. Elective induction of labor: a randomized prospective trial. *Lancet* 1: 767-70.
8. Martin, HD, W Thompson, MHJ Pinkerton and DJ Watson. 1978. A randomized control trial of selective planned delivery. *Br J Obstet Gynaecol* 85: 109-113.
9. Yudkin, P, MA Frumar, MBA Anderson and CA Turnbull. 1979. A retrospective study of induction of labor. *Br J Obstet Gynaecol* 86: 257-265.
10. Tylleskar, J, O Finnstrom, I Leijon, S Hedenskog and G Ryden. 1979. Spontaneous labor and elective induction: a prospective randomized study. *Acta Obstet Gynecol Scand* 58: 513-518.
11. Sande, RA, J Tuveng and T Fonstelien. 1983. A prospective randomized study of induction of labor. *Int J Gynaecol Obstet* 21: 333-336.
12. Bergsjo, P, H Guidan, Y Sugin, G Zhizeng and LS Bakketei. 1989. Comparison of induced versus non-induced labor in post-term pregnancy. *Acta Obstet Gynecol Scand* 68: 683-687.
13. Wilailak, S, N Saropala and K Chaturachinda. 1993. Elective induction of labor: Ramathibodi Hospital (Jan-Jun, 1990). *Journal of the Medical Asociation of Thailand* 76: 44-47.
14. Williams, CM, J Krammer and FW O'Brien. 1997. The value of the cervical score in predicting successful outcome of labor induction. *Obstet & Gynecol* 90: 784-9.
15. Watson, JW, D Stevens, S Weiter and D Day. 1996. Factors predicting successful labor induction. *Obstet & Gynecol* 88: 990-992.
16. Lange, PA, JN Secher, GJ Westergaard and IB Skovgard. 1982. *Obstet Gynecol* 60: 137-147.
17. Dupont, WD and WD Plummer, Jr. 1990. Power and sample size calculations : a review and computer program. Controlled clinical trials 11: 116-128.
18. Stata Statistical Sofware : Release 5.0 College station, TX : Stata Corporation 1997.
19. Pocock, SJ, 1984. Clinical Trials : Practical approach. New York : John Wiley & Sons 176-186.