



## FACTORS ASSOCIATED WITH SUCCESSFUL INDUCTION OF LABOR IN UDONTHANI HOSPITAL

**Chutinan Chantarakhantee\***

M.D., Department Of Obstetrics And Gynecology, Udonthani Hospital, Udonthani, Thailand. \*Corresponding Author

**Srisuda Songthamwat**

M.D., Department Of Obstetrics And Gynecology, Udonthani Hospital, Udonthani, Thailand.

**Ueamporn Summart Ph.d.**

Faculty Of Health Sciences, Udon Thani Rajabhat University, Udonthani, Thailand

**Metha Songthamwat**

M.D.,Ph.D., Department Of Obstetrics And Gynecology, Udonthani Hospital, Udonthani, Thailand.

### ABSTRACT

**BACKGROUND:** The prevalence of induction of labor varies between countries. The successful rate of IOL and associated factors also varied in different reports.

**OBJECTIVE:** To determine the prevalence and associated factors for successful induction of labor (IOL).

**MATERIALS AND METHODS:** Medical records of patients who underwent IOL in Udonthani Hospital from October 2017 to June 2019 were reviewed.

**RESULTS:** There were 242 patients who underwent IOL and had completed data. The prevalence of IOL was 3.7% (242/6469) of total deliveries. A Successful IOL was achieved in 126 (52.1%) patients (95% CI 45.6-58.5). Multiparity had a 3.5 times (95% CI 1.76-6.97,  $p < 0.01$ ) higher success rate than nulliparity. Preterm pregnancy increased successful IOL of 3.9 times (95% CI 1.48-10.49,  $p < 0.01$ ).

**CONCLUSION:** Successful IOL was achieved in about half of the IOL cases. Multiparity and preterm pregnancy were associated with higher IOL success rate.

**KEYWORDS :** Induction Of Labor, Success Rate, Factors, Bishop Score

### INTRODUCTION

Induction of labor (IOL) is a common procedure in obstetrics which implies stimulation of contractions before the spontaneous onset of labor. The indications for IOL were postterm pregnancy, oligohydramnios, gestational hypertension, chronic hypertension, gestational diabetes mellitus, intrauterine fetal growth restriction and also fetal death<sup>(1)</sup>. This procedure is important for both safety of mother and baby.

There are mechanical and pharmacological techniques for IOL. Mechanical techniques include transcervical catheter, extra amniotic saline infusion, and hygroscopic cervical dilators. Common pharmacological techniques include oxytocin and prostaglandins (PG) such as Misoprostol, a synthetic PG E1 analogue, can be administered intravaginally, orally and sublingually, it is widely used to terminate pregnancy in the first and second trimesters<sup>(2)</sup>.

Reported IOL prevalence varies between countries and over time<sup>(3)</sup>. For example, in Saudi Arabia it was 16% in 2012; in the United States it was approximately 20% of all births. The United States rate increased from 9.5% in 1990 to 22.8% in 2007 and 23.3% in 2012<sup>(4,5)</sup>. The successful rate of IOL and associated factors also varied in different reports<sup>(6-9)</sup>. This information is necessary for patient's management and counseling. Therefore, the objectives of this study are to determine the prevalence and associated factors of successful IOL, and the maternal and perinatal outcomes in our center.

### MATERIALS AND METHODS

This study is a descriptive study in the Department of Obstetrics and Gynecology, Udonthani Hospital, Udonthani,

Thailand. It was conducted after the Human Research Ethical Committee of Udonthani Hospital approved the protocol. Patients' medical records who underwent IOL in Udonthani Hospital from October 2017 to June 2019 were reviewed.

The inclusion criteria were; singleton pregnant woman who received IOL during the study period. The indications for IOL were late term pregnancy (gestational age 41 weeks), post term pregnancy (gestational age  $\geq 42$  weeks), oligohydramnios, preeclampsia, chronic hypertension, gestational diabetes mellitus and overt diabetes mellitus, prelabor rupture of membrane, intrauterine fetal growth restriction, chorioamnionitis, fetal anomaly and death fetus in utero. The contraindications of IOL were; previous cesarean delivery or myomectomy, multifetal pregnancy, active genital herpes, estimate fetal weight  $\geq 4000$  grams. An exclusion criterion was incomplete medical record.

The sample size was calculated using a formula for a descriptive study, with an estimated prevalence for a successful IOL 0.65 with 0.06 acceptable error<sup>(10)</sup>, a 0.05 chance of making a type 1 error. The result was 242 women were needed for the study. The statistical analysis was performed using Stata program version 13. Continuous variables are presented by the mean  $\pm$  standard deviation. Categorical variables are presented by number and percentage. Binary regression analysis was performed to evaluate the difference of variable. Multivariable logistic regression analysis was applied to evaluate the factors associated with successful IOL. Results were presented as adjusted odds ratio with 95% confidence interval. A p-value  $< 0.05$  was considered statistically significant.

Data collection included patients' baseline characteristics,

cervical condition and, obstetrics and neonatal outcomes. Successful IOL was defined as vaginal delivery could be achieved. The prevalence and associated factors for successful IOL were analyzed.

**RESULTS**

There were 242 patients who underwent IOL and had complete patient data during the study period. The prevalence of IOL in Udonthani Hospital was 3.7% (242/6,469) of total deliveries. Baseline characteristics of the pregnant women and obstetric outcomes are presented in Table 1. The mean age was 26.7 ± 7.2 years. The mean gestational age was 38.4 ± 3.3 weeks. Mean body mass index at term was 29.1 ± 5.4. The mean Bishop score was 5.2 ± 2.2. The most common indication for IOL was late term in 83 women (34.3%). The most common method of IOL was oxytocin in 129 (53.3%) patients. The mean time for IOL was 20.8 ± 20.0 hours.

Successful IOL was achieved in 126 (52.1%) patients (95% CI 45.6-58.5). Comparison of possible associated factors between successful and non-successful IOL groups found advanced maternal age group (age ≥ 35) and preeclamptic patients had a lower IOL success rate. While multiparity, preterm pregnancy had a higher IOL success rate. There were no significant difference found with body mass index, initial cervical dilatation and effacement, cervical consistency and position, fetal head station and membrane status, induction methods between two groups which shown in Table 2.

Maternal and neonatal outcomes are presented in Table 3. The neonatal birthweight was higher in the non-successful IOL group. The meconium stained amniotic fluid was found to be higher in the cesarean (non-successful IOL) group, however the birth asphyxia was lower in this group than the vaginal delivery (successful IOL) group. There were no difference found in other maternal and neonatal complications in both groups.

**DISCUSSION**

This study demonstrated that the IOL prevalence rate in our institute is 3.7%. This rate is less than other reports, such as in USA which approximately 20% of deliveries<sup>(3)</sup>, 16% in Saudi Arabia<sup>(11)</sup>, 12.1% in Asia and 4.4% in Africa<sup>(12)</sup>. Induction of labor rate was higher rate in higher income countries and the elective induction of labor (without indication) is more common. The recent randomized controlled study and meta-analysis reported that elective induction in low risk pregnant women with gestational age more than 39 weeks has the better composite neonatal outcome than expectant management<sup>(13,14)</sup>.

Successful IOL was achieved in only half of the patients in this study. This rate is lower than previously reported studies which

the successful IOL rate was approximately 70-80%<sup>(6-9)</sup>. This study's rate is closest to Osmundson S, et al study at 56.9 %<sup>(15)</sup>. The low IOL success rate might be caused by the various and subjective criteria of failed IOL, the unsuitable adjustment of oxytocin dosage, and the discontinuation of IOL in the nighttime, which increase the failure rate of IOL in our center.

Associated factors for successful IOL in this study were multiparity and preterm pregnancy. While multiparity is similar to previous studies<sup>(6-8)</sup>, preterm pregnancy is different from other studies which had higher IOL success rate in term pregnancy<sup>(6-8)</sup>. Maternal body mass index was similar between groups which is also different from previous studies. Those studies reported higher successful IOL in lower body mass index or taller women<sup>(6-8)</sup>. Cervical status from Bishop score is not a successful factor in this study which is different from some previous studies<sup>(6,16,17)</sup>, however this result is similar to a systemic review by Kolkman DG, et al which reported that the Bishop score is a poor predictor for the IOL outcome and should not be used for IOL decision making<sup>(18)</sup>.

The most common indication for IOL in this study was late term pregnancy, which is similar to Al-Shaikh GK, et al and Dällenbach P, et al studies<sup>(11,19)</sup>. The most common method of IOL was oxytocin which is similar to data in Africa from Vogel JP, et al study<sup>(12)</sup>. The prevalence, indication and, method of IOL with a high rate of cesarean delivery in our center reflects too low of use of IOL. This arose from the fear of its complication especially with misoprostol, although the World Health Organization<sup>(20)</sup> and the American College of Obstetricians and Gynecologists<sup>(21)</sup> recommend misoprostol as being safe and effective for IOL. The only two interventions to delivery before the onset of labor are cesarean delivery and IOL, therefore the careful selection of IOL can reduce unnecessary cesarean delivery which cause many complications<sup>(22)</sup>. This study's limitation is the information was retrospective from a single tertiary care center. A larger prospective multicenter study is needed to indicate the effect on the general population.

**CONCLUSION**

Successful IOL was achieved in about half of the IOL cases. Multiparity and preterm pregnancy were associated with higher successful IOL rate.

**ACKNOWLEDGEMENTS**

We gratefully acknowledge Dr. Narong Tadadech Director of Udonthani Hospital for permission and grant support. Thanks for Udonthani Hospital staff who participated in this trial.

**POTENTIAL CONFLICTS OF INTEREST**

The authors declare no conflict of interest.

**Table 1: Comparison of maternal characteristics in successful IOL and non-successful IOL group.**

**IOL:induction of labor, SD: standard deviation, CPD: cephalo pelvic disproportion.**

Characteristics	Total	Delivery Type		P value <sup>β</sup>
		Vaginal delivery	Cesarean delivery	
Total, n (%)		126 (52.1)	116 (48.0)	
Maternal age (years), n(%)				
20-34	163	91 (55.8)	72 (44.2)	0.20
<20	40	19 (47.5)	21 (52.5)	
>35	39	16 (41.0)	23 (59.0)	
Mean ± SD	26.7 ± 7.2	26.1 ± 6.9	27.5 ± 7.6	0.14
Parity, n (%)				
Nullipara	136	60 (44.1)	76 (55.8)	<0.01*
Multipara	106	66 (62.3)	40 (37.7)	
Gestational age (weeks),n(%)				
< 37	37	27 (73.0)	10 (27.0)	<0.01*
≥37	205	99 (48.3)	106 (51.7)	
Mean ± SD	38.4 ± 3.3	38.0 ± 4.0	39.0 ± 2.1	0.02*

Body mass index (kg/m <sup>2</sup> ), mean±SD	29.1(±SD 5.4)	28.8 (±SD 5.5)	29.5 (±SD 5.2)	0.26
Bishop score, n(%)				
<5	85	38 (44.7)	47 (55.3)	0.09
≥5	157	88 (56.1)	69 (44.0)	
Mean ± SD	5.2 ± 2.2	5.3±2.2	5.1±2.1	0.35
Cervical dilatation (cm), n(%)				
<2	191	95 (49.7)	96 (50.3)	0.16
≥2	51	31 (60.8)	20 (39.2)	
Effacement, n(%)				
≤50	211	108 (51.2)	103 (48.8)	0.47
>50	31	18 (58.1)	13 (42.0)	
Consistency, n(%)				
Firm	21	11 (52.4)	10 (47.6)	0.48
Medium	70	32 (45.7)	38 (54.3)	
Soft	150	82 (64.7)	68 (45.3)	
Station, n(%)				
-3	20	12 (60.0)	8 (40.0)	0.73
-2	74	36 (48.7)	38 (51.4)	
-1	126	65 (51.6)	61 (48.4)	
0	22	13 (59.1)	9 (40.9)	
Membrane, n(%)				
Intact	202	109 (54.0)	93 (46.0)	0.19
Ruptured	40	17 (42.5)	23 (57.5)	
Position, n(%)				
Posterior	78	37 (47.4)	41 (52.6)	0.60
Middle	139	75 (54.0)	64 (46.0)	
Anterior	25	14 (56.0)	11 (44.0)	
Indication for induction, n(%)				
Late term	83	46 (36.5)	37 (31.9)	0.01*
Pre-eclampsia	37	11 (8.7)	26 (22.4)	
PROM	43	20 (15.9)	23 (19.8)	
Other	79	49 (38.9)	30 (25.9)	
Mode of induction, n(%)				
Misoprostol				
Oxytocin	55	33 (26.2)	22 (19.0)	0.33
Misoprostol + Oxytocin	129	61 (48.4)	68 (58.6)	
Other	3	1 (0.8)	2 (1.7)	
Route of delivery, n(%)				
Normal delivery	117 (48.4)	117	0	
Cesarean section	116 (48.0)	0	116	
Vacuum extraction	6 (2.5)	6	0	
Breech assisting	3 (1.2)	3	0	
Indication of C/S, n(%)				
Failed induction	63 (54.3)	-	63	
Fetal distress	33 (28.5)	-	33	
CPD	19 (16.4)	-	19	
Chorioamnionitis	1 (0.7)	-	1	

β -P value was calculated by linear regression analysis for continuous outcome and by binary regression for binary outcome.  
\*statistically significant difference (P value <0.05)

**Table 2: Univariate and multiple logistic regression analysis of possible associated factors for successful IOL.**

Characteristics	Vaginal delivery	Cesarean delivery	OR (95%CI)	Adjusted OR (95% CI)	P-value
Maternal age (years)					
20-34	91	72	1	1	0.99
<20	19	21	0.72(0.36-1.43)	1.01 (0.44-2.30)	0.02*
≥35	16	23	0.55(0.27-1.12)	0.40 (0.17-0.94)	
Parity					
Nullipara	60	76	1	3.50 (1.76-6.97)	<0.01*
Multipara	66	40	2.09(1.24-3.51)		
Gestational age (wks)					
≥37	99	106	1	3.94 (1.48-10.49)	<0.01*
<37	27	10	2.89(1.33-6.27)		

BMI mean (kg/m <sup>2</sup> ), mean+SD	28.77 (SD± 5.46)	29.54 (± SD 5.22)	0.97(0.93-1.02)	0.98 (0.92-1.03)	0.41
Bishop score					
<6	59	63	1	NA	NA
≥6	67	53	1.35(0.81-2.24)		
Cervical dilatation(cm)					
<2	95	96	1	1.59 (0.72-3.50)	0.25
≥2	31	20	1.57(0.85-2.94)		
Effacement					
≤50	108	103	1	1.56(0.58-4.23)	0.38
>50	18	13	1.32(0.62-2.83)		
Consistency					0.80
Firm	11	10	1	0.69(0.20-2.44)	
Medium	32	38	0.77(0.29-2.03)	1.17(0.34-4.11)	
Soft	82	68	1.09(0.44-2.74)		
Station		8	1		
-3	12	38	0.63(0.23-1.72)	0.54(0.16-1.82)	0.32
-2	36	61	0.96(0.28-3.31)	0.68(0.13-3.55)	0.65
-1	65	9	0.71(0.27-1.86)	0.52(0.15-1.77)	0.29
0	13				
Membrane					
Intact	109	93	1	0.56(0.22-1.44)	0.23
Ruptured	17	23	0.63(0.32-1.25)		
Position					0.09
Posterior	37	41	1	1.80(0.91-3.56)	0.66
Middle	75	64	1.30(0.75-2.26)	1.28(0.42-3.88)	
Anterior	14	11	1.41(0.57-3.49)		
Indication for induction					
Late term	46	37	1	1	0.01*
Pre-eclampsia	11	26	0.34(0.15-0.78)	0.26 (0.09-0.73)	0.66
Pre labor rupture of membrane	20	23	0.70(0.33-1.46)	0.79 (0.28-2.24)	
Others	49	30	1.31(0.70-2.46)	1.34 (0.63-2.84)	0.45
Mode of induction					
Misoprostol	33	22	1	1	0.36
Oxytocin	61	68	0.60(0.32-1.13)	0.68 (0.29-1.57)	0.86
Misoprostol+Oxytocin	31	24	0.86(0.40-1.83)	1.08 (0.46-2.58)	0.43
Others	1	2	0.33(0.02-3.90)	0.34 (0.02-4.95)	

IOL: induction of labor, OR: Odd ratio, CI: confidence interval.

β -P value was calculated by multiple logistic regression analysis.

\*statistically significant difference (P value <0.05)

**Table 3. Comparison of obstetrics and neonatal outcomes in successful and non-successful IOL groups.**

Characteristics	Vaginal delivery, n(%)	Cesarean delivery, n(%)	P valueβ
Route of delivery	126 (52.1)	116 (48.0)	
Complication			
Uterine atony	15 (11.9)	18 (15.5)	0.41
Postpartum hemorrhage	9 (7.1)	0 (0.0)	NA
Birth weight (gm)			
4000+	2 (2.0)	4 (3.5)	0.46
2500-4000	94 (74.6)	90 (77.6)	
<2500	30 (23.8)	22 (19.0)	
Mean birthweight + SD (gm)	2778.7 + 807.5	2992.3 + 546.5	0.02*
Apgar score<7 at 1 min	23 (18.3)	2 (1.7)	< 0.01*
Apgar score<7 at 5 min	23 (18.3)	0 (0.0)	NA
Meconium strained AF	14 (11.1)	20 (17.4)	<0.01*
NICU admission	1 (0.8)	4 (3.5)	0.14

IOL: induction of labor, SD: standard deviation, AF: amniotic fluid, NICU: neonatal intensive care unit.

β -P value was calculated by linear regression analysis for continuous outcome and by binary regression for binary outcome.

\*statistically significant difference (P value <0.05)

**REFERENCES**

- Cunningham F, Leveno K, Bloom S, Dashe J, Hoffman B, Casey B, Spong CY. Williams Obstetrics. 25 ed. New York:Mcgraw-hill 2018.
- Hofmeyr GJ. Induction of labour with misoprostol. Curr Opin Obstet Gynecol 2001;13:577-81.
- Martin JA, Hamilton BE, Ventura SJ, Osterman MJ, Mathews TJ. Births: final data for 2011. Natl Vital Stat Rep 2013;62:1-69, 72.
- Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Mathews TJ, Kirmeyer S, et al. Births: final data for 2007. Natl Vital Stat Rep 2010;58:1-85.
- Osterman MJ, Martin JA. Recent declines in induction of labor by gestational age. NCHS Data Brief 2014;1-8.
- Crane JM. Factors predicting labor induction success: a critical analysis. Clin Obstet Gynecol 2006;49:573-84.
- Gibson KS, Waters TP. Measures of success: Prediction of successful labor induction. Semin Perinatol 2015;39:475-82.
- Pevzner L, Rayburn WF, Rumney P, Wing DA. Factors predicting successful labor induction with dinoprostone and misoprostol vaginal inserts. Obstet Gynecol 2009;114:261-7.
- Tolcher MC, Holbert MR, Weaver AL, McGree ME, Olson JE, El-Nashar SA, et al. Predicting Cesarean Delivery After Induction of Labor Among Nulliparous Women at Term. Obstet Gynecol 2015;126:1059-68.
- Wayne W. Biostatistics: A Foundation of Analysis in the Health Sciences. 6 ed. John Wiley&Sons, Inc.; 1995.
- Al-Shaikh GK, Wahabi HA, Fayed AA, Esmail SA, Al-Malki GA. Factors

- associated with successful induction of labor. *Saudi Med J* 2012;33:298-303.
12. Vogel JP, Souza JP, Gulmezoglu AM. Patterns and Outcomes of Induction of Labour in Africa and Asia: a secondary analysis of the WHO Global Survey on Maternal and Neonatal Health. *PLoS One* 2013;8:e65612.
  13. Grobman WA, Rice MM, Reddy UM, Tita ATN, Silver RM, Mallett G, et al. Labor Induction versus Expectant Management in Low-Risk Nulliparous Women. *N Engl J Med* 2018;379:513-23.
  14. Grobman WA, Caughey AB. Elective induction of labor at 39 weeks compared with expectant management: a meta-analysis of cohort studies. *Am J Obstet Gynecol* 2019;221:304-10.
  15. Osmundson S, Ou-Yang RJ, Grobman WA. Elective induction compared with expectant management in nulliparous women with an unfavorable cervix. *Obstet Gynecol* 2011;117:583-7.
  16. Vrouenraets FP, Roumen FJ, Dehing CJ, van den Akker ES, Aarts MJ, Scheve EJ. Bishop score and risk of cesarean delivery after induction of labor in nulliparous women. *Obstet Gynecol* 2005;105:690-7.
  17. Teixeira C, Lunet N, Rodrigues T, Barros H. The Bishop Score as a determinant of labour induction success: a systematic review and meta-analysis. *Arch Gynecol Obstet* 2012;286:739-53.
  18. Kolkman DG, Verhoeven CJ, Brinkhorst SJ, van der Post JA, Pajkrt E, Opmeer BC, et al. The Bishop score as a predictor of labor induction success: a systematic review. *Am J Perinatol* 2013;30:625-30.
  19. Dallenbach P, Boulvain M, Viardot C, Irion O. Oral misoprostol or vaginal dinoprostone for labor induction: a randomized controlled trial. *Am J Obstet Gynecol* 2003;188:162-7.
  20. World Health Organization WHO recommendations for induction of labour. Geneva 2011.
  21. Obstetrics ACoPB--. ACOG Practice Bulletin No. 107: Induction of labor. *Obstet Gynecol* 2009;114:386-97.
  22. World Health Organization. WHO recommendations: non-clinical interventions to reduce unnecessary caesarean sections; 2018.