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ORIGINAL ARTICLE

DETERMINANTS OF OUTCOME OF INDUCTION OF LABOR IN FOUR TEACHING HOSPITALS IN ADDIS ABABA

Rahel Demissew , MD[1], Eyasu Mesfin, MD[1]

ABSTRACT

Introduction: *Induction of labor is an increasingly common intervention in obstetrics and known to decrease maternal and perinatal mortalities. Failed induction is one of the unwanted outcomes of induction of labor. Therefore, it is necessary to determine the safety and effectiveness of our institutions' labor induction process.*
Objective*: This study tried to address the obstetric outcomes and determinants of the outcomes of induction of labor.*
Method: *A cross sectional prospective quantitative study was done. Data was collected from a sample of 339 induction cases that were selected consecutively during the study period. Data was collected from medical records of cases using a structured questionnaire and analyzed using Statistical Package for Social Sciences. Descriptive analysis, Chi-square test, Student t-test and logistic regressions were used to analyze the data. A p-value of <0.05 was used to define statistical significance.*
Result: *The rates of failed induction and Cesarean section were 25.4% and 37.8% respectively. Failed induction contributed to 66.7% of indications for cesarean section. Direct oxytocin was used for induction in 39.2%, vaginal misoprostol in 27.7%, prostaglandin E2 in 23.6% and foley Catheter in 9.4%. There is significant association between failed induction and unfavorable Bishop Score, indication for induction, gestational age and nulliparity, all having a P<.01.*
Conclusion: *Failed induction and associated cesarean section rate is high in our setup compared with global rates. Therefore, reviewing our institutions' induction guideline in an attempt to increase the success of vaginal delivery is important.*
Keywords: *Induction of labor, Failed induction, Cesarean section*

INTRODUCTION

Induction of labor is one way of terminating a pregnancy. Its goal is to pre-empt the natural process of labor by initiating its onset artificially by ripening the cervix and stimulating uterine contractions before this occurs spontaneously. Induction of labor is beneficial both for the mother and the new born if it is undertaken for appropriate reasons and by appropriate methods (1,2).

The overall incidence of induction of labor worldwide has not been established but it is estimated to be 9-33%, but its incidence varies in different locations and institutions (1,2). The indications for induction of labor include post term pregnancy, hypertensive diseases of pregnancy and premature rupture of membrane. Their rates vary in different settings (1,3). Despite its impact in the improvement of maternal and perinatal outcome, it has its own risks. Increased risk of operative deliveries, maternal and fetal complications are the major risks associated with it.

(4-6). In a recent study made in 2010 in Tikur Anbessa Hospital (TAH), Ghandi Memorial Hospital (GMH) and St Paul's Hospital (SPH), the risk of Caesarian section (C/S) done for failed induction was 38%, which was higher than the studies done in 1996 and 2004 in the same settings 21.1% and 28.4% respectively (3,7). The progressive increment in failure rate of induction and hence rise in C/S rate needs further study. The Bishop score at onset of induction is found to be the primary determinant of success of induction in many settings (8). The parity of the woman, the indication for the induction and other factors also affect the success (9-12).

There are several methods of induction of labor, the common ones being oxytocin, misoprostol, dinoprostone(PGE2), and mechanical methods. During the study done in 2010 in Ethiopia, oxytocin was used in 85% of inductions and the cervical ripening agent used was prostaglandin E2 (PGE2) (3).

[1] Departiment of Obstetrics and Gynecology, Addis Ababa University, College of Health Sciences.
*Corresponding Author E-mail: raheldemissewgy@gmail.com

In more recent years though, Misoprostol 25micrograms to be inserted 6 hours apart for a maximum of two doses and mechanical methods have been used in similar study areas, because PGE2 was not available in the market.

In recent years, several randomized controlled trials (RCT) and Meta analyses favored the use of low dose misoprostol over PGE2. The justification is that both have comparable effectiveness, maternal and fetal outcomes but PGE2 is much more expensive and its storage needs refrigeration. Hence PGE2 might not be a good choice in resource constraint countries like ours where cost and availability of infrastructures are still real challenges. Foley catheter, as a ripening agent, is another good option (13-15).

This study tried to see the outcomes and the determinants of the outcomes of induction of labor. It also addressed the current rate of failed induction of labor and agents used for induction of labor. It made an internal comparison between the different cervical ripening and induction agents in line with their effectiveness and complications. It will give a crucial information that might help in designing a solution to make the outcome in the acceptable range, if the factor contributing for the failure is found to be modifiable.

PATIENTS AND METHOD

The study was conducted in Addis Ababa, Ethiopia, at four teaching hospitals; TAH, GMH, ZMH and SPH. These hospitals' labor wards use a common management protocol for induction of labor. The four hospitals share the highest number of deliveries in the city. This is a facility based prospective cross-sectional study. It was approved by the Institutional Review Board of Addis Ababa University, College of Health Sciences and written consent was taken from each study participant. The study period was between May, 2016 –August, 2016.

The calculated sample size was 339. The prevalence (P) used in the calculation was 38% failed induction rate from the study done in the same setting in 2010. All pregnant women for whom induction of labor was done as per the protocol of the department of Gynecology and Obstetrics, SOM, A.A.U, 2004 were included. Gestational age (GA) less than 28 weeks, pregnancies with induction started outside the study hospitals, pregnancy which required serial induction and pregnancy with unknown GA and regarded clinically non-viable were excluded from the study.

Data was collected by interviewing each of the study subjects and revising their medical records. Data was cleaned, entered and analyzed using SPSS version 20.0 statistical software. Descriptive analysis, chi-square test, student t-test were used to analyze socio-demographic, obstetric outcomes, maternal and perinatal outcomes. Multiple logistic regression model was used for failure of induction of labor and confounding factors were controlled taking level of significance at $P<0.05$.

Operational definitions:

Induction of labor: is the process of artificially stimulating the uterus to start labor, usually performed by administering oxytocin, prostaglandins, mechanical methods or by rupturing the amniotic membranes.

Cervical ripening: is one of the methods used for induction of labor by using pharmacological agents or mechanical interventions to soften, efface or dilate the cervix to increase the likely hood of vaginal delivery.

Failed induction: is defined when there is no cervical change or decent of the presenting part after 6 -8 hours of start of oxytocin or when contractions of 3 in 10 minutes haven't been achieved in these hours.

Favorable cervical status: is defined as a Bishop score ≥9.

RESULTS

A total of 339 mothers who fulfill the eligibility criteria were included with a response rate of 100%. The mean (SD) age of the participants was 26 (±4.3) and nearly one-half, 157 (46.3%) fall in the age range of 25 – 29 years, and 309 (91%) of them were from Addis Ababa.

One-half, 170 (50.1%), of the participants, were nulliparous and almost all, 326 (96.2%) had at least one antenatal care (ANC) visit. The rate of preterm, term and post term pregnancies were 57 (16.8%), 221 (65.2%) and 61 (18%), respectively. Majority, 317 (93.6%), of the induced women had unfavorable Bishop Score before the start of induction. The pre-induction Bishop Scores were 0-4 and 5-8 in 228 (67.3%) and 89 (26.2%) of the participants respectively. Only 22 (6.5%) of the women had favorable Bishop score that is ≥9.

Preeclampsia was the leading indication for induction of labor accounting for 151 (44.5%).

The most commonly used method of induction in this study was oxytocin alone accounting for 137 (40.4%) (Table 1).

Table 1: Characteristics of induction of labor at four hospitals, Addis Ababa, May 2016 – August 2016.

Variables		No (%)
Indication for induction	Preeclampsia	151(44.5)
	Pre-mature rupture of memberanes	90(26.5)
	Post term	59(17.4)
	others	39(11.6)
Method	Oxytocin alone	137(40.4)
	PGE2 alone	13(3.8)
	PGE2+ Oxytocin	21(6.2)
	Misoprostol alone	14(4.1)
	Misoprostol + oxytocin	74(21.8)
	Foley + oxytocin	80(23.6)

Misoprostol (vaginal route in all the time) was used in 88 (26%) of participants and all had unfavorable Bishop Score before ripening. Single dose was used in eight (9.1%) of the mothers as labor was established with the first dose. Two, three and four doses of misoprostol were used in 73/ (83%), six (6.8%) and one (1.1%) of the cases, respectively. The Bishop Score was intermediate (5-8) and remained 0-4 at the time of oxytocin initiation after misoprostol use in 40 (45.5%) and 23 (26.1%) of cases, respectively. Overall, misoprostol use changed unfavorable Bishop score in to favorable in 28.4% of the cases.

PGE2 was used in 34 (10% of induction) patients. Overall, PGE2 changed unfavorable Bishop Score to favorable in 14)41.2%). Foley catheter was inserted for 80 (23.6%) of induced patients. Twenty percent of patients achieved favorable Bishop Score by the use of Foley catheter.

Vaginal delivery was achieved in 62.2% (211/339) of cases and the cesarean section delivery rate in this study was 37.8% (128/339). The rate of failed induction was 25.4% (86/339). Failed induction was the commonest indication for cesarean delivery followed by Non-reassuring fetal heart rate pattern (NRFHRP) accounting for 66.7 % (86/128) and 25.6 % (33/128) of cases respectively.

Unfavorable Bishop Score is the most significant risk factor for failed induction (AOR=424.3; 95%CI 4.352 -8.354). When linear regression was done, for every unit increase in Bishop score, the failure rate decreased by 68%.

Nulliparity has nearly threefold risk of failed induction (AOR=2.771; 95%CI: 1.415-5.426). Gestational age also has significant association with failed induction. Induction of labor done for post-term pregnancies and preeclampsia had higher failure rates compared with those induced for other indications. PGE2, misoprostol and Foley catheter have failure rates of 23.5%, 35.2% and 30%, respectively. But method of induction in general did not have any association with failed induction. (Table 2) Neonatal birth weight and maternal age do not have association with failed induction.

The mean induction to delivery time was 16.13 hours while the range was 4 – 40 hours. Majority, 207 (61%) delivered in 12-23 hours and 44 (13%) delivered in ≥24 hours. Among the ones who delivered vaginally (without assistance with instrument), 187 (91.7%) delivered in <24 hours and while 17 (8.3%) delivered in ≥24 hours. In this study, Foley catheter use was found to be less likely to prolong labor (AOR=0.025, 95% CI,0.003 -0.222). But when misoprostol was compared with PGE2, misoprostol use was associated with less failure to deliver within 24 hours (AOR=0.110, 95% CI, 0.019-0.623).

In 23 (6.8%), induction of labor was done for negative FHB from the outset. There were five (1.5%) intra-partum still births. Additional five (1.5%) immediate neonatal deaths were recorded based on the 5th minute Apgar score. Five neonates (1.5%) had 5th minute Apgar score 1-7 which signify a poor neonatal outcome.

Table 2: Association of different variables with failed induction of labor labor at four hospitals, Addis Ababa, May, 2016 –August, 2016.

Variable		Outcome: Not failed Number (%)	Outcome: Failed Number (%)	COR (95%CI)	AOR (95% CI)
Bishop Score	<5	28(38.4)	45(61.6)	122.50 (2.768-12.652) ***	424.30(4.352-8.354)***
	5-8	149(78.8)	40(21.2)	20.43(2.783-12.367)***	66.00(5.697-16.452)***
	≥9	76(98.7)	1(1.3)	1.00	1.00
Parity	Nulliparous	121(71.2)	49(28.8)	1.44(0.882-2.365)*	2.77(1.415-5.426)***
	Parous	132(78.1)	37(21.9)	1.00	1.00
Gest. Age	<37weeks	36(63.2)	21(36.8)	2.97(1.252-15.354)**	32.37(2.654-18.512)***
	37-41weeks	166(75.1)	155(24.9)	1.69(0.804-3.558)*	64.59(6.163-222.548)***
	≥42weeks	51(83.6)	10(16.4)	1.00	1.00
Indication for induction	preeclampsia	97(64.2)	54(35.8)	3.062(1.206-7.771)**	8.604(2.394-30.918)***
	Post- term	43(72.9)	16(27.1)	2.047(0.722-5.802)*	213.046(16.526-32.417)***
	PROM*	80(88.9)	10(11.1)	0.688(0.231-2.045)	0.588(0.149-2.328)
	Others	33(84.6)	6(15.4)	1.00	1.00

* Premature rupture of membranes

One fourth (25.6%) of the C/S 33 cases were done for NRFHRP. Both meconium staining and NRFHR pattern were not found to have association with method of induction. Forty-eight (15.5%) of the neonates were admitted to NICU, of which meconium aspiration syndrome is the leading cause of admission in 14 (28.6) of the time. Method of induction, gestational age, indication for induction and meconium staining do not have association with NICU admission when multivariate analysis was done. All admissions with a diagnosis of early onset neonatal sepsis (EONS) are delivered from mothers with PROM induced with oxytocin alone.

DISCUSSION

Preeclampsia has been found to be the leading cause of induction of labor accounting for 44.5% of inductions followed by PROM and post-term pregnancy. The above three contribute for 88.4% of indications for induction of labor. This result is similar with the report of the WHO global survey done in 2004- 2008 (16).

Induction with oxytocin alone was done in 39.2% of the time. Misoprostol was used in 27.7% of the cases. PGE2 and Foley catheter were used in 23.6% and 9.4% respectively.

This is different from the study done in 2010 where PGE2 was used in 34% of the cases (3) and there was no use of misoprostol or Foley catheter. During the study period, the availability of PGE2 was variable, therefore the main ripening and induction method in GMH, ZMH and BLH was Misoprostol. Almost all the Foley catheters were used in SPH. In this study, method of induction is not associated with failed induction. Both maternal and neonatal complications are also similar when Foley catheter was compared with other methods. This is also confirmed in RCT done in 12 hospitals in Netherlands with an intention to compare Foley catheter and vaginal PGE2 gel, C/S rates were the same between the two groups (23% vs. 20%), hyper stimulation was high with PGE2 and comparable neonatal infection (probably because of the increased vaginal examination in the prostaglandin group) (15).

C/S was done in this study in 128 (37.8%) of the cases) which is lower than the rate in 2010 study in the same setup (3). The decrement in failed induction might have contributed for this. It is a general fact that induction of labor is associated with high operative deliveries, greater maternal and perinatal complications when compared with spontaneous labor (4). The major indication for C/S is failed induction (66.7%) followed by NRFHRP (25.6%)

A study done in Latin America, which included 37,444 deliveries in women with low risk pregnancies, 4.9% were electively induced. Among the induced deliveries, 88.2% were vaginal (27). In another study made in 2009 in Pakistan, 18% of pregnant population who underwent induction failed to deliver vaginally (6). In most other studies also, they found higher vaginal delivery rate compared to our setting which is 211 (62.2%)**.** This might be due to the increased failed induction rate in our setting.

In almost all studies throughout the world, Bishop Score was found to be the best available tool for predicting the likelihood that induction will not fail and results in vaginal delivery (1). This is also consistent with both the previous and current studies done in our setting (3).

There were multiple cervical ripening and induction methods used during the study period unlike in the past study where either oxytocin alone or PGE2 with oxytocin were used. When unfavorable bishop was found, the ripening/inducing agent used was either misoprostol or PGE2. There was no PGE2 found in the market for some time during the study period of the current study therefore misoprostol was used in the majority of the cases based on the department's guideline where the two can be used interchangeably.

In all the ripening methods used, the rate of achievement of favorable Bishop Score (as defined by the score of ≥9) is very low compared with global experiences**.** This might be due to the frequency (doses) of the ripening agents used in our setup. In this study, a maximum of two doses of the prostaglandins was used even though favorable Bishop score was not achieved after their use. But the frequency of dosing used in multiple large trials was 4-6 (until favorability reached or established labor diagnosed). This is also similar in the Ethiopian guideline of 2004, where 4 doses can be used every 6 hours unless there is an ample reason that urges to terminate the pregnancy in a lesser time frame. Therefore, the practice in this regard during the study period is not in line with the large trials and even the Ethiopian guideline (5,13,26).

Failed induction rate in this study is 25.4% accounting for 66.7% of all C/S. This is almost comparable with the local study in 1996 (21%) and 2004 study (28.4%) but much lower than the rate found in 2010 (38%). The reason for the difference cannot be extrapolated clearly. Unfavorable Bishop score is the most significant risk factor for failed induction. When linear regression was done, for every unit increase in Bishop score, the failure rate decreased by 68%.

This is consistent with many global findings (12). Dr. Bishop once wrote that "induction in the nulliparous patient, there still remains the pertinent question why it should be done". This is because the failure rate in nulliparous lady is significantly high. Felghali, etal. reported that parity has the strongest correlation with attaining vaginal delivery (5,28). This is also true in this study where nulliparity has nearly threefold risk of failed induction.

All methods used for induction have almost similar rates of failed induction. Induction with oxytocin alone has failure rate of 16.8%. This low failure rate is most probably associated with the indication for induction, as most are PROM (which augments successful induction of labor) or have favorable Bishop from the outset.

When misoprostol was compared with PGE2, misoprostol use was associated with less failure to achieve vaginal delivery in <24 hours from the start of induction of labor (AOR=0.110, 95%CI: 0.019-0.623, P=0.013). This is one advantage of misoprostol over PGE2.This finding is consistent with many global studies. For instance, in a randomized and prospective study in Tunisia, comparing misoprostol and PGE2, misoprostol group showed a significant reduction in delivery time, an increase in birth rate in the first 24 hours after the first dose and a decrease use of oxytocin for augmentation (14). This also was true in the Cochrane review (13).

Induction of labor in general is associated with high maternal and perinatal complications compared with spontaneous labor. The fifth minute Apgar score is between 1 and 7 in 7.7% of the neonates. This low 5th minute APGAR was found both in the preterm and term group. These figures have shown significant improvement from the study done in 2010 in similar setup (3). This improvement could be attributed to an improvement in the close follow up of patients on induction.

Meconium staining was found in 15.9%. The only significantly associated factor with meconium staining is gestational age. In our study post-term pregnancy has a fourfold risk of meconium staining. This is consistent with the findings of Cochrane review in 2013(13). The incidence of NRFHRP in oxytocin alone, PGE2, misoprostol and Foley catheter groups were 32.5%, 26.7%, 19% and 25% respectively. There is no significant association between method of induction used and indication for induction with NRFHRP.

This is in line with the finding of other studies (1,13,20). Forty-eight neonates (15.5%) were admitted to NICU, Meconium aspiration syndrome (MAS) accounted for 28.6% of NICU admissions. All admissions with EONS (diagnosed from delivery attending group) are from patients with PROM induced with oxytocin. It is difficult to see the correlation of mechanical methods and EONS because it needs follow up in the NICU which is beyond the scope of this study.

Conclusion

Failed induction and therefore the rate of cesarean section done for failed induction is high in our setup compared to the global rates.

Complications previously thought to associate with misoprostol such as uterine hyper stimulation, meconium staining, FHR abnormalities and low fifth minute APGAR score have not been found in this study which is the same finding as global large trials. Therefore, their use is largely recommended in low resource setting where cost and storage mechanism of PGE2 are the challenges. The use of Foley catheter in SPH has shown a similar outcome with the other methods and hence its use should be encouraged in the other settings too.

The dose of the ripening agent we use is limited to a maximum of two. This might have an impact on the rate of failed induction. Hence considering the increment of the doses to 4-6 might help but this needs further study.

Limitation

Bishop scoring is subjective and there will be some amount of interpersonal differences, due to this the study may suffer some degree of inaccuracy.

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Competing interest:

The authors have declared that no competing interests exist.

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