Original Article

Predictors of successful induction of labour at a tertiary obstetric service in Southwest Nigeria

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ABSTRACT

Context: Induction of labour is a useful obstetric intervention, yet it is underutilized in Africa. Recommendations for practice may reduce its unmet need.

Objective: This study aims to determine labour induction success rates and identify predictors of outcome.

Study Design, Setting and Patients: This was a retrospective, descriptive, cross-sectional study of 104 women who had induction of labour at the University College Hospital, Nigeria.

Main Outcome Measures: Primary outcomes were vaginal delivery within 24 hours and caesarean delivery. Analyses were done by Chi-square tests, *t*-tests and logistic regression.

Results: Labour induction rate was 12.7%; most were performed on account of post-dated pregnancies and pre-labour rupture of membranes. Forty-six, (44.2%) had vaginal delivery within 24 hours whereas induction failed (i.e. caesarean delivery) in 38 (36.5%). The mean duration of the process was 12.0 ± 6.6 hours with misoprostol, 8 hours less than with oxytocin ($P < 0.01$). Misoprostol was significantly more likely to result in delivery within 24 hours in comparison to extra-amniotic transcervical catheter for ripening ($P = 0.02$, OR = 5.1, 95% CI = 1.2–21.1), and to oxytocin for induction ($P = 0.03$, OR = 6.5, 95% CI = 1.2–36.3), respectively. Adverse effects were infrequent and comparable with either method.

Conclusion: Success rate needs to be improved upon. Higher parity, later gestation and misoprostol ripening or induction are associated with successful outcomes. It is recommended that clients' experience may be improved by commencing misoprostol cervical ripening the night before induction and administering the medication orally rather than vaginally.

Key words: Induction of labour; intervention; outcome; predictor of success.

Introduction

Induction of labour (IOL) is the process of artificially creating uterine contractions with the aim of achieving a vaginal delivery. It is a common obstetric intervention; prevalence was 23.2% of deliveries in the US in 2011;[1] however, it is underutilized in Africa at 4.4%, with an unmet need of 66.0–80.2%.[2] It accounts for 6.3% of deliveries in Nigeria.[2] It is commonly indicated in prevention of prolonged pregnancy, pre-labour rupture of membranes after 34 weeks, intrauterine foetal death, placental abruption, chorioamnionitis and hypertensive disorders.[3,4] It may be selectively offered on maternal request in exceptional circumstances and in births following previous caesarean sections. It has been employed in women with diabetes in pregnancy, twin gestation, foetal

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macrosomia, oligohydramnios and maternal cardiac disease; however, current evidence is insufficient to recommend these indications.[5,6] It is generally not recommended for cases of breech presentation, severe foetal growth restriction with foetal compromise, or suspected foetal macrosomia.[3]

Oxytocin is the most common agent used for induction of labour.[7] Prostaglandins E1 (misoprostol) and E2 (dinoprostone) are also commonly used, both for cervical ripening and labour induction. Oral misoprostol was found to be as effective as the vaginal regimen, and was preferred on account of less risk of ascending infection and less need for the intensive monitoring required for the vaginal route.[8]

The cervix is considered ripe at a Bishop score of 8,[3,4] implying that an unripe cervix would score 7 or less. However, most clinical trials use cut-off scores of 6 and less;[4] and most clinicians will ripen the cervix with the latter scores. In addition to the medications earlier discussed, mechanical means such as osmotic dilators and extra-amniotic transcervical catheters are used. Catheters are as efficacious as pharmacological methods and may offer the added advantage of less likelihood of contraction abnormalities, less discomfort, less cost and being useful for outpatient ripening.[9] A Nigerian study comparing catheter ripening to 50 mcg of vaginal misoprostol found similar success rates in both, and shorter ripening duration and lesser oxytocin need with misoprostol.[10]

The study centre's protocol has changed severally over recent years with regards to methods of cervical ripening and labour induction, dosing protocols and timing. Catheter ripening was performed previously for all suitable patients until misoprostol became available. Misoprostol use was commenced with high-dose regimens, until lower doses appeared to be more suitable. Catheters for ripening are inserted in the evening, so that labour induction can commence early in the morning and interventions can be done during active work hours, if indicated. In order to pre-empt the risk of inadvertent labour stimulation during the night, misoprostol ripening is commenced in the morning. The demerit of this is that labour induction may not commence until late in the day, and the parturient will not benefit from daytime interventions. These considerations have prompted this formal assessment of the process.

The aim of the study is to determine success rates and identify predictors of successful outcomes to make recommendations for practice, which may hopefully reduce the unmet need for induction of labour.

Materials and Methods

It was a retrospective, cross-sectional, descriptive study of all inductions of labour carried out over a 4-month period at the labour ward of the University College Hospital, Ibadan, Nigeria. Approval was obtained from the State Ethical Review Committee.

Routine practice of the facility is outlined as follows. Patients for elective induction of labour are booked on the list for the elective days—Mondays, Wednesdays and Fridays (which alternate with the elective Caesarean section days of Tuesdays and Thursdays). Blood for possible transfusion is made available for them in the blood bank and patients are fasted overnight. Bishop score is estimated and cervical ripening is performed if score is less than 7. When misoprostol is used as the primary ripening agent, it is commenced in the morning for elective inductions, at a low dose of 25 mcg 6 hourly. Mid-trimester inductions may be initiated with 6 hourly doses as high as 200–400 mcg. Some patients are planned for induction with misoprostol; others may go into active labour while undergoing cervical ripening with misoprostol. The latter do not require oxytocin, and are grouped as induction by misoprostol in this study. Oxytocin is not commenced until 6 hours after the last misoprostol dose was given. When extra-amniotic transcervical catheter is used for ripening, it is passed by the unit registrar the evening before induction, and it is expected to fall out spontaneously. If this does not happen after 24 hours, the catheter is removed and the cervix is re-assessed. If the cervix is yet unripe, misoprostol may be administered instead. Amniotomy is performed at the earliest opportunity during induction, when the membranes are accessible and the presenting part is well applied to the cervix.

A high-dose protocol is used for oxytocin induction,[11] in which 2 or 4 U of oxytocin (depending on whether the parturient is multiparous or nulliparous, respectively) is added to 500 ml of normal saline to run at 15 drops per minute. This gives an initial rate of 4 or 8 mU/min, respectively, which is doubled every 30 minutes until the contractions are adequate—three strong contractions in ten minutes, lasting 45–60 seconds each. Urgent inductions are performed at any time when indicated, without prior preparation.

Based on a caesarean section rate of 6% in a Nigerian trial of cervical ripening methods by Adeniji *et al*.[10] minimum sample size was calculated to be 87. All women who were listed consecutively in the register as having had induction of labour were identified and their medical records were retrieved. This was done until the sample size was achieved, covering a 4-month period from January to April 2014. A data

collection tool was employed to retrieve demographic details, obstetric features, indications, method and duration of the induction of labour, as well as the outcome. The explanatory variables were the obstetric and demographic characteristics and the method of ripening or induction of labour. The primary outcomes were caesarean delivery (indicating that the intervention failed) and vaginal delivery within 24 hours, whereas secondary outcomes were the duration of labour, the need for analgesia and the occurrence of complications in the mother or the neonate.

Data were cleaned, entered into a spreadsheet and imported into IBM® SPSS® Statistics 20 (IBM Corp, Armonk, USA). Analyses were performed with Chi-square test for categorical variables and students' *t*-test for continuous variables. Multivariate analysis was carried out with logistic regression. *P* was set at <0.05.

Results

One hundred and four cases of induction of labour were reviewed over the study period. The total number of deliveries in the study hospital over the same period was 819, giving an induction rate of 12.7%. The demographic data of the study participants are depicted in Table 1. The participants mean age was 31.2 ± 4.8 years. Table 2 shows their obstetric characteristics. Thirteen women (12.5%) had undergone a previous induction of labour. Most of the participants were nulliparous, and most inductions were performed for term pregnancies. Eight were for mid-trimester pregnancy losses. The indications for induction are outlined in Table 3. Most inductions were done on account of post-dated pregnancies and pre-labour rupture of membranes.

Sixty-six women (63.5%) had vaginal deliveries, whereas 38 (36.5%) had caesarean sections. Forty-six (44.2%) vaginal deliveries were done within 24 hours. Eighty-seven (83.7%) had cervical ripening. Most of these ripenings were performed with misoprostol [Table]. Misoprostol was typically given per vaginam (in 90.9%), whereas 9.1% were given sublingual doses. The median number of doses required in this study was 2; the mean was 2.4 ± 1.3 doses. The duration of ripening ranged from 3–45 (mean: 14.0 ± 8.7) hours. On average, it took about the same time to ripen a cervix with either misoprostol or an extra-amniotic transcervical catheter. However, the entire process from commencement of ripening till delivery was on the average, 5 hours shorter with misoprostol, howbeit statistically insignificant [Table 4]. On comparison of obstetric features and outcomes, patients whose cervixes were ripened with misoprostol were more likely to deliver within 24 hours of intervention than those who had catheters [Table 5].

Table 1: Demographic characteristics of women who had induction of labour

Variables	*N* (%)
Age (in years)	
≤19	3 (2.9)
20–29	33 (31.7)
30–39	64 (61.5)
≥40	4 (3.8)
Occupation	
Unemployed/student	14 (13.5)
Unskilled worker	44 (42.3)
Skilled worker	28 (26.9)
Professional	18 (17.3)
Education	
Nil/primary	9 (8.7)
Secondary	26 (25.0)
Post-secondary	40 (38.5)
Tertiary	29 (27.9)
Tribe	
Yoruba	88 (84.6)
Other Nigerian tribes	16 (15.4)
Religion	
Christianity	79 (76.0)
Islam	25 (24.0)
Marital status	
Married	102 (98.1)
Single	2 (1.9)
Registered for antenatal care	
Yes	71 (68.3)
No	33 (31.7)
Total	104

Table 2: Obstetric characteristics of women who had induction of labour

Variables	*N* (%)
Parity	
Primigravidae	51 (49.0)
Multigravidae	40 (38.5)
Grandmultigravidae	13 (12.5)
Gestational age at induction	
Pre-viable (<28 weeks)	8 (7.7)
Preterm (28-36 weeks)	20 (23.1)
Term (37-42 weeks)	72 (69.2)
Bishop score	
0-4 (unripe cervix)	87 (84.5)
5-6 (moderate)	15 (14.5)
7-13 (ripe)	1 (1.0)
Method of cervical ripening	
Misoprostol	62 (59.6)
Transcervical catheter	19 (18.3)
Both methods	6 (6.9)
Cervical ripening not done	17 (16.3)
Method of induction of labour	
Oxytocin	65 (62.5)
Misoprostol	34 (32.7)
No medication required following catheter passage	5 (4.8%)

Table 3: Indications for induction of labour among study participants

Indication	*N* (%)
Prelabour rupture of membranes	27 (26.0)
Post-date pregnancy	26 (25.0)
Intrauterine foetal death	19 (18.3)
Hypertensive disorders	14 (13.5)
Intrauterine growth restriction/oligohydramnios/abnormal findings on foetal surveillance	4 (3.8)
Intrauterine foetal death in previous pregnancy	4 (3.8)
Gestational diabetes mellitus	3 (2.9)
Severe congenital anomalies	2 (1.9)
Sickle cell disease	1 (1.0)
Others	3 (2.9)

Table 4: Comparison of duration of interventions between different methods

Processes	Methods used	Mean duration (hours)	*P*
Cervical ripening			
	Transcervical catheter	14.8±11.1	0.94
	Misoprostol	15.0±8.7	
When the entire duration* of the cases are considered	Transcervical catheter	23.8±11.1	0.09
	Misoprostol	18.7±9.1	
Induction of labour			
	Oxytocin	9.5±5.6	0.15
	Misoprostol	5.8±2.5	
When the entire duration* of the cases are considered	Oxytocin	20.6±10.1	<0.01
	Misoprostol	12.0±6.6	

*Refers to the duration from commencement of cervical ripening till time of delivery

It took 2–25 (mean 9.9 ± 5.8) hours from commencement of induction to delivery of the baby. The failure of induction was diagnosed on average after 14.6 ± 12.6 hours. On comparison with oxytocin, misoprostol induction was almost 4 hours shorter, while the whole duration of intervention was 8.6 hours shorter ($P < 0.01$) [Table 4]. Oxytocin infusion rates ranged between 4–128 mU/minute. The modal dose was 16 mU/minute. Twenty-seven (26.0%) women were given analgesics (opioid) during the induction. There was no uterine rupture recorded in the series. However, 15 (14.4%) developed maternal complications such as retained placenta or products, 8 (7.7%); postpartum haemorrhage, 3 (2.9%); post-caesarean wound infection, 2 (1.9%) and perineal tears, 2 (1.9%). The babies' modal Apgar scores were 9 and 10, at 1 and 5 minutes, respectively. Three (2.9%) were admitted into the Special Care Baby Unit. There were no stillbirths (except for those with previously-diagnosed intrauterine foetal death). Grandmultigravid women were less likely to have induction by misoprostol [Table 6].

Table 5: Cervical ripening-comparison of obstetric features and outcomes associated with misoprostol and transcervical catheter use

Variables	Ripening by misoprostol *N* (%)	Ripening by catheter *N* (%)	*P*
Parity			
0	34 (52.3)	9 (40.9)	0.08
1-3	27 (41.5)	8 (36.4)	
≥4	4 (6.2)	5 (22.7)	
Gestational age			
Pre-viable	7 (10.8)	0 (0)	0.08
Preterm	11 (16.9)	8 (36.4)	
Term	47 (72.3)	14 (63.6)	
Bishop score			
Unripe	61 (93.8)	20 (95.2)	>0.99
Moderately ripe	4 (6.2)	1 (4.8)	
Required oxytocin			
Yes	33 (50.8)	15 (68.2)	0.16
No	32 (49.2)	7 (31.8)	
Given analgesia			
Yes	15 (23.1)	7 (31.8)	0.42
No	50 (76.9)	15 (68.2)	
Vaginal delivery within 24 hours			
Yes	30 (73.2)	6 (40.0)	0.02
No	11 (26.8)	9 (60.0)	
Delivery by C-section			
Yes	24 (36.9)	7 (31.8)	0.67
No	41 (63.1)	15 (68.2)	
Instrumental delivery			
Yes	1 (1.6)	0 (0)	0.76
No	62 (98.4)	2 (100.0)	
Apgar score at 5 min			
0-6	2 (3.8)	0 (0)	>0.99
7-10	50 (96.2)	12 (100.0)	
Neonatal admission			
Yes	1 (1.5)	1 (4.8)	0.39
No	64 (98.5)	20 (95.2)	
Maternal complications			
Yes	9 (13.8)	5 (23.8)	0.32
No	56 (86.2)	16 (76.2)	

The main study outcomes were put into logistic regression models to evaluate associations. When adjusted for age, parity, Bishop score, gestational age at induction, misoprostol was more likely to result in a vaginal delivery within 24 hours in comparison to catheter for ripening ($P = 0.02$, OR = 5.1, 95% CI = 1.2–21.1), and in comparison to oxytocin for induction ($P = 0.03$, OR = 6.5, 95% CI = 1.2–36.3), respectively. Neither method of cervical ripening or induction of labour was statistically associated with eventual delivery by caesarean section; however, patients with higher parity ($P < 0.01$, OR = 0.4, 95% CI = 0.2–0.7) and higher gestational age at delivery ($P = 0.02$, OR = 1.20, 95% CI = 1.0–1.4) were significantly less likely to end up with a caesarean delivery.

Table 6: Induction of labour-comparison of obstetric features and outcomes between misoprostol and oxytocin

Variables	Induction by misoprostol *N* (%)	Induction by oxytocin *N* (%)	*P*
Parity			
0	20 (58.8)	30 (46.2)	0.01
1-3	14 (41.2)	22 (33.8)	
≥4	0 (0)	13 (20.0)	
Gestational age			
Pre-viable	4 (11.8)	3 (4.6)	0.17
Preterm	4 (11.8)	17 (26.2)	
Term	26 (76.5)	45 (69.2)	
Given analgesia			
Yes	6 (17.6)	17 (27.0)	0.30
No	28 (82.4)	46 (73.0)	
Vaginal delivery within 24 hours			
Yes	16 (88.9)	29 (63.0)	0.07
No	2 (11.1)	17 (37.0)	
Delivery by C-section			
Yes	16 (47.1)	19 (29.2)	0.08
No	18 (52.9)	46 (70.8)	
Instrumental delivery			
Yes	0 (0)	2 (3.2)	0.43
No	33 (100.0)	61 (96.8)	
Apgar score at 5 min			
0-6	1 (3.6)	2 (4.0)	>0.99
7-10	27 (96.4)	48 (96.0)	
Neonatal admission			
Yes	1 (2.9)	2 (3.1)	0.73
No	33 (97.1)	62 (96.9)	
Maternal complications			
Yes	6 (17.6)	12 (18.8)	0.89
No	28 (82.4)	52 (81.2)	

Discussion

Most of the inductions in the study centre were carried out for term (and often post-dated) pregnancies, yet the cervices of most women were unripe at the time of the intervention. Cervical ripening is, therefore, an important part of the process. Misoprostol was the most common ripening agent used. This appears to be an appropriate choice because it took 5 hours less than a catheter to ripen a cervix, and was 5 times more likely to result in a vaginal delivery within 24 hours. There were no other differences in maternal or foetal outcome, or in need for analgesia, or complications, in either method. When one method failed to achieve ripening, the other method was employed in series—these were excluded from the comparison. A relatively newer obstetric practice is to apply both methods simultaneously;[12] a pilot was being done at the study centre at the time of writing.

Cervical ripening with misoprostol is typically commenced in the morning in the study centre because of concerns regarding inadequate monitoring if carried out at night, along with the possibility of nocturnal labour commencement following misoprostol ripening. The average ripening duration of 15 hours found in this study implies that oxytocin infusion would typically commence late at night, which is not desirable. Nature appears to generally select spontaneous onset of labour in the evening due to circadian rhythm, however, a systematic review of labour induction did not find any advantage of either timing.[13] The patients in the quoted review preferred morning onset to avoid their sleep being disturbed. However, the long duration in the index study suggests that ripening should be commenced at night, so that oxytocin infusion can commence at daytime when it can be adequately supervised.

In comparison to oxytocin as an induction agent in this study, misoprostol also appeared to be superior. Labour lasted 8 hours less, and was six times more likely to result in a vaginal delivery within 24 hours, without any increased incidence of adverse outcomes in either group. Oxytocin doses at which contractions became adequate were rather high in this study, as much as 128 mU/min was given in some instances. The average dose was 16 mU/min, which is double the usual dose.[14] This may be explained by the heat instability of oxytocin; because Nigeria does not enjoy uninterrupted power supply, one is unable to ensure that the cold chain is not broken at any point until it is used for the patient. This results in reduced efficacy of the drug. This further supports misoprostol (which does not require refrigeration) use in the study area. Neither induction method was significantly associated with a caesarean delivery.

All the mid-trimester inductions were performed with misoprostol. This is recommended as the most efficient method before 28 weeks,[4] due to the paucity of oxytocin receptors on the uterus before then. Misoprostol is mostly given vaginally at the study centre. The documented risks of frequent vaginal examinations and need for closer monitoring may be avoided by adopting the use of the oral route because the latter's effects are comparable.[8] This quoted systematic review did not give information on how cervical ripening was assessed, seeing that one of the purposes of the oral route is to avoid frequent pelvic examinations. In the index study, patients required on average two doses of misoprostol before ripening was achieved. In the absence of uterine contractions, it may be reasonable to administer two doses before a pelvic examination is done (that is, after 12 hours).

Induction was less likely to result in a caesarean delivery as gestational age and parity increased. This is expected because labour is generally more likely to be successful in late term (American College of Obstetricians and Gynecologists (ACOG) recommends that elective induction should not be

performed before 39 weeks),[4] and women with previous deliveries are generally less likely to have dysfunctional labour. The risk of caesarean delivery has been shown to be lower with elective induction of labour at term than with expectant management, without an increased risk of morbidity or perinatal mortality.[15] It is the study centre's practice to induce post-dated pregnancy, rather than manage expectantly.

This study is limited by being a retrospective review rather than a prospective trial. It may be difficult to control for confounders, which include the reasons for choosing either method for labour induction. It is hoped, however, that the multivariate analyses have assisted in dismissing some of these confounders.

Conclusion

In conclusion, induction of labour success rate needs to be improved. Higher parity, later gestation and misoprostol use (either for cervical ripening or induction) are associated with successful outcomes. It is recommended that clients' experience may be improved by commencing misoprostol cervical ripening the night before induction and administering the medication orally, rather than vaginally.

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Conflicts of interest
There are no conflicts of interest.

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