

Determinants of successful labor induction in a teaching hospital in Nigeria: a 10-year review

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Abstract

Objectives: to evaluate the success rate of labor induction and determinants of successful outcome.

Methods: retrospective cohort study of parturients that undergone labor induction between 2006 and 2015. Data was retrieved from the medical records and multivariate logistic regression was used to evaluate the determinants of successful labor induction.

Results: the rate of labor induction was 10.9%. Out of the 940 women analysed, six hundred and fifty-six women (69.8%) had successful vaginal delivery. Labor induction at 39-40 weeks (OR=2.70; CI95%=1.17-6.36), 41 weeks (OR=2.44; CI95%=1.14-5.28), estimated fetal weight between 2.5 and 3.4kg (OR=4.27, CI95%=1.96-5.59) and estimated fetal weight of 3.5-3.9kg (OR=5.45; CI95%=2.81-10.60) increased the odds of achieving vaginal delivery.

Conclusions: our findings suggest that 39, 40 and 41 weeks are optimal gestational ages for labor induction with respect to successful vaginal delivery. Also, estimated fetal weight between 2.5kg and 3.9kg favours successful vaginal delivery.

Key words Cesarean section, Gestational age, Labor induction, Vaginal delivery



Introduction

Labor induction is a common obstetric procedure that is widely carried out all over the world in cases where continuation of pregnancy is hazardous to either mother; baby or both.^{1,2} Labor induction can be defined as any procedure that stimulates uterine contractions before labor begins spontaneously.³ The decision to induce labor is usually made when its benefits outweigh the risks.^{2,4,5} Labor induction could be life-saving for both mother and baby; improving maternal and perinatal outcomes.⁶⁻⁸ In fact, labor induction was found to reduce perinatal deaths by 66% in Africa.⁶ Some researchers highlighted the criticisms that greeted labor induction in the early years.⁵

Elective labor induction was even described as “meddlesome obstetrics” by some Obstetricians.⁹ The major concerns were precipitate labor, postpartum hemorrhage, cervical lacerations and birth asphyxia.⁵ It however continued to gain acceptance despite the objections from leading Obstetricians. This acceptance was due to reports from case series and matched case control studies that showed that the benefits outweigh the risks in selected patients.^{5,10} The labor induction rate has been on the increase since then. The labor induction rates vary worldwide. According to World Health Organization (WHO) Global survey on Maternal and Perinatal Health, which included 373 healthcare facilities in 24 countries and nearly 300, 000 deliveries, 9.6% of the deliveries involved labor induction.¹ The induction rate was the lowest in Niger (1.4%) and the highest in Sri Lanka (35.5%).¹ In Nigeria, Lawani *et al.*,¹⁰ reported induction rate of 11.5%.

Indications for labor induction include post-dated pregnancy, premature rupture of membranes, intrauterine growth restriction and rhesus isoimmunisation.⁹⁻¹² Maternal conditions like diabetes mellitus, hypertensive disorders of pregnancy, and renal disease can also create a need for labor induction.^{4,10-12} Several methods are available for labor induction.⁶ These include amniotomy, oxytocin, prostaglandins and mechanical methods such as sweeping of membrane.¹¹⁻¹⁴ Prior assessment of the cervix is necessary to determine the favorability of the cervix for labor induction.¹⁵ This is usually done with the aid of Bishop score.^{15,16}

However, labor induction is not without complications; these include uterine hyperstimulation, fetal distress, intrapartum fetal death, uterine rupture, genital tract lacerations, postpartum hemorrhage, etc.¹⁴ Many parturients are usually concerned whenever labor induction is being discussed as the preferred mode of delivery. Their concerns usually ranged from prolonged labor, dystocia, fetal distress, intrapartum fetal demise and eventual cesarean section due to failed labor induction.

It is therefore necessary to audit the practice of labor induction in this center in order to know the success rates and its determinants. These factors can be used to predict success; and ultimately improve patient selection process for labor induction. We aimed to evaluate the success rate of labor induction and determinants of successful outcome in a teaching hospital in Nigeria.

Methods

This was a retrospective cohort study of parturients who undergone cervical ripening and labor induction at the Department of Obstetrics and Gynecology at a teaching hospital in Nigeria between January 2006 and December 2015. This hospital serves as a referral center for patients in three states in Nigeria. The hospital is located in a semi-urban area of the state. Parturients scheduled for labor induction was usually assessed for cervical ripening before labor induction. The departmental protocol for labor induction involved prior cervical ripening before labor induction if the Bishop score is less than 6. The methods of cervical ripening prior to labor induction were transcervical extra amniotic passage of Foley catheter (Agary Catheters, Yangzhou, Jiangsu, China) and passage of vaginal misoprostol. (CytotecR Pfizer, Division of Pfizer Inc, NY, USA) Labor induction is routinely commenced when Bishop Score is greater than 6. Some parturients progressed into labor spontaneously after cervical ripening while some did require amniotomy, oxytocin or both for labor induction. Amniotomy is the preferred option for labor induction after successful cervical ripening. Oxytocin may be added if required to augment uterine contractions. Oxytocin may be used alone if there are contraindications to amniotomy e.g intrauterine fetal death and retroviral infection.

Inclusion criteria were parturients with singleton cephalic pregnancy, fetal biophysical profile of 8 or 10 with reactive cardiotocograph and no previous cesarean section who underwent labor induction for medical reasons after the age of viability; which is 28 weeks of pregnancy in Nigeria. Exclusion criteria were previous cesarean section at any gestational age, fetal abnormalities, uterine fibroid, placenta previa, placenta abruption, chorioamnionitis, previous myomectomy or any uterine surgery, amniotic fluid index less than 7, multiple gestation and incomplete medical records. All participants were identified through labor ward and delivery records. The written medical records were retrieved from the Department of Health Information Management and a study proforma was used to extract the relevant data. Data retrieved include age, parity, schooling, indication for labor induction, method of labor induction, duration of labor, complications, Apgar score, and birth weight. The primary outcome measure

was successful vaginal delivery. Data was analyzed with Statistical Package for Social Sciences version 23 by IBM Incorporated, NY., USA. Continuous variables were summarized with means and standard deviation while categorical variables were summarised with frequency and percentages. Chi-square was used for bivariate analysis of associated factors with labor induction. Multivariate logistic regression was used to predict the determinants of successful vaginal delivery. A logistic regression model was used to control for confounding factors. Model for fit for the model was assessed with the Hosmer-Lemeshow test. All tests were two tailed and $p < 0.05$ was taken as statistically significant.

Ethical clearance for this study was obtained from the Ethics and Research Committee of the hospital (Protocol Number ERC/2013/09/05).

Results

During the study period, there were 10,012 deliveries, 1,090 (10.9%) had labor induction. Data for 940 women were complete and available for review; and therefore, included in analysis. (Figure 1) The mean age of the participants was 30.24 ± 4.5 years. Majority of the women were married and received antenatal care in our center (booked) (Table 1). The mean parity was 0.80 ± 1.31 . Majority of the participants were nulliparous (Table 1). The common indications for labor induction were post-dated pregnancy, pre-labor rupture of membranes, hypertensive disorders of pregnancy, intrauterine growth restriction and intrauterine fetal death (Table 1). More than half of the participants progressed to spontaneous labor after cervical ripening while the remaining had amniotomy (10.2%), oxytocin (20.7%), or oxytocin with amniotomy (7%). The mean of labor induction interval was 10.45 ± 6.22 hours. Most of the women delivered between 3- 12 hours of commencement of labor induction (91.4%). Vaginal delivery was achieved in 656 (69.8%) parturients while 284 (30.2%) had emergency cesarean section. The main indications for cesarean section were cephalopelvic disproportion (62.5%), fetal distress (24.8%), and cord prolapse (2.8%). The mean birth weight was 3.12 ± 0.77 kg. Most babies had good Apgar score (Apgar score ≥ 7) at 1st minute (749, 79.7%) and 5th minute (836, 88.9%). Thirteen babies (1.4%) were severely asphyxiated and there were 4 (0.4%) intrapartum fetal deaths. Primary postpartum hemorrhage was the major complication reported in 26.2%. There was no maternal mortality.

There were significant associations between the outcomes of labor induction and socio-demographic characteristics (Table 2). Women older than 19 years old were less likely to achieve vaginal delivery compared with those younger than 19 years of age, although it was not statistically

significant (Table 2). In addition, women aged 24 to 34 years were less likely to achieve vaginal delivery compared to women older than 35 years (Table 2). Unbooked patients were also less likely to achieve vaginal delivery compared with booked patients though the association was not statistically significant (OR=0.65; CI95%=0.38-1.10; $p=0.11$). Use of oxytocin+amniotomy increased the probability of achieving vaginal delivery in this cohort (OR=5.56; CI95%=3.20-13.40, $p < 0.001$) (Table 2).

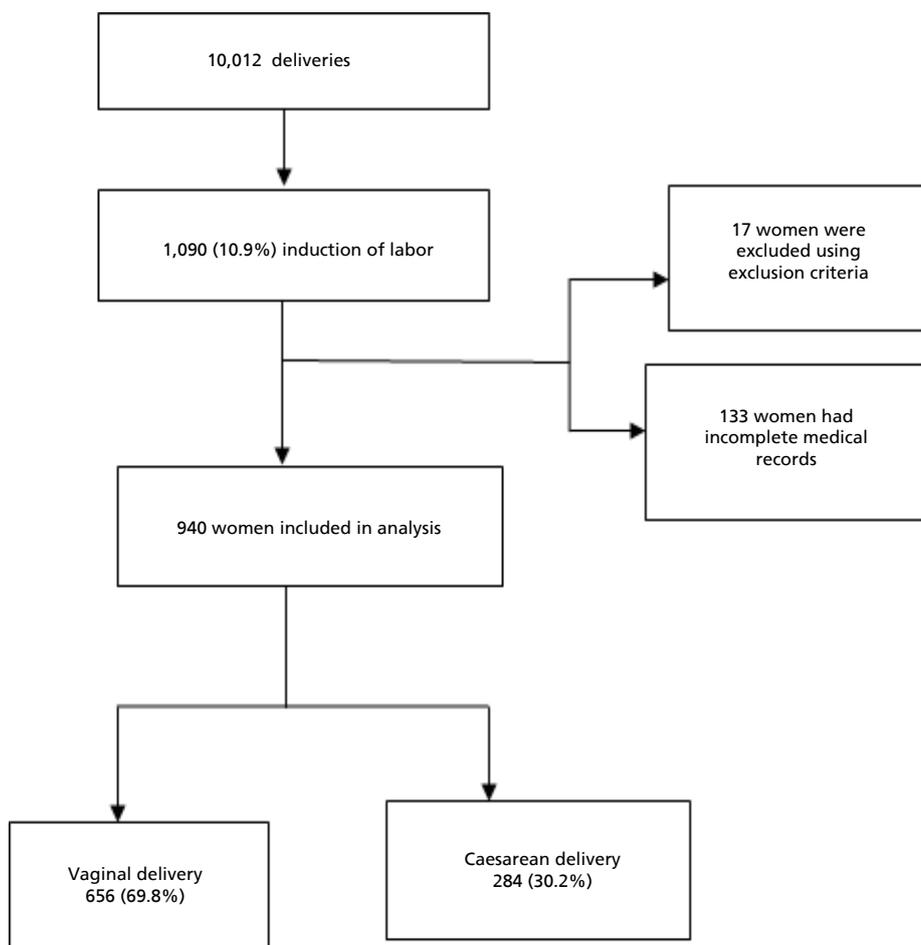
After controlling for age, parity and indication for labor induction with a multivariate logistic regression model, the odds of achieving vaginal delivery with labor induction was doubled at weeks 39-40 (adjusted OR=2.70; CI95%=1.17-6.36) and weeks 41 (adjusted OR=2.44; CI95%=1.14-5.28) when compared with labor induction at 42 weeks of pregnancy. (Table 3) Also, the odds of achieving vaginal delivery with labor induction was increased at estimated fetal weight between 2.5 and 3.4 kg (adjusted OR=4.27; CI95%=1.96-5.59) and estimated fetal weight of 3.5-3.9kg (adjusted OR=5.45; CI95%=2.81-10.60) compared with estimated fetal weight of greater than or equal to 4kg. However, no induction agent could predict successful vaginal delivery (Table 3).

Discussion

The labor induction rate in this study was comparable to induction rates in other parts of the country and Africa,^{2,10} however, this rate was higher than 6.3% reported by Bukola *et al.*⁶ This could be attributed to the fact that this study was a review of practice at a referral center where high risk pregnancies are being managed which is in tandem with Bukola's submission that induction rates were significantly higher at tertiary health facilities.^{3,6} In developed countries with better facilities for intrapartum fetal monitoring, the labor induction rates are higher.^{6,17,18} Also, the labor induction rate has been on upward trend, even in the developing nations. In 2002, Ekele *et al.*¹⁹ reported induction rate of 3% while several studies afterwards reported higher rates.^{6,10} Increase in availability of intrapartum fetal monitoring devices like continuous electronic fetal monitoring could be responsible for this trend.

The commonest indication for labor induction in this study was comparable to other studies in Nigeria. Post-dated pregnancy was the commonest indication for labor induction as reported by other studies in Nigeria.^{10,12} The high prevalence of post-dated pregnancy in this audit might be connected to unavailability of dating scan which would have assisted in dating the pregnancies as induction rates have been found to be higher when there was gestational error.²⁰ The proportion of women that had labor induction on account of intrauterine fetal death in this study was similar to the proportion documented by

Figure 1
Study flowchart.



Bukola *et al.*⁶ Bukola *et al.*⁶ however moved on to affirm that some of these deaths could have been averted by timely recourse to labor induction. Misoprostol was the preferred agent for cervical ripening in this center and majority of these women progressed spontaneously into labor. Use of prostaglandin E1 analogue was however not a statistically significant determinant of labor induction outcome. This finding is similar to a previous study in this center by Owolabi *et al.*²¹ in which misoprostol was compared to Foley's catheter for cervical ripening and labor induction. Prostaglandins are now the commonest induction agents being used worldwide.¹¹ Misoprostol has been found to be safe and effective.^{22,23}

The mean of labor induction interval was less than 12 hours which was also comparable to labor induction interval reported by Owolabi *et al.*²¹ The proportion of parturients that had vaginal delivery was comparable to 64.7% documented among nulliparous women who had labor induction in 2008.²⁴ It was however lower than 85% reported by Ibrahim *et al.*¹² in another center in Nigeria.

This difference might be attributed to differences in induction rates and probably patients' selection process. The commonest indication for cesarean section was cephalopelvic disproportion as reported in similar studies. The first and fifth minute Apgar score were comparable to other studies in which most babies had good Apgar score.^{12,24} The four intrapartum deaths were due to delay in decision-incision interval for four women with fetal distress. Most women did not have complications; and the reported complications have been documented by previous studies.^{10,12,25} An important fact to note is that these complications also occur in spontaneous labor.²⁴

Labor induction at 39th and 41st weeks of pregnancy doubled successful labor induction outcome. This suggests that 39th, 40th and 41st weeks are optimal gestational ages for labor induction with respect to successful vaginal delivery. Many existing evidences had shown that delivery before 41st or 42nd weeks of pregnancy leads to improved maternal and neonatal outcomes.^{26,27} Nilcoson *et al.*²⁶ estimated optimal gestational age for delivery

Table 1
Characteristics of the study participants. Teaching Hospital, Nigeria, Jan 2006-Dec 2015.

Characteristics	N	%
Age (years)	18	1.9
≤19	114	12.1
20-24	326	34.7
25-29	342	36.4
30-34	140	14.9
≥35		
Marital status		
Single	29	3.1
Married	911	96.9
Booking status		
Booked	747	79.5
Unbooked	193	20.5
Schooling level		
No formal schooling	65	6.9
Primary schooling	183	19.5
Secondary schooling	383	40.7
Higher education	309	32.9
Parity		
0	582	61.9
1	149	15.9
2	101	10.7
3	78	8.3
≥4	30	3.2
Indications of labor induction		
Postdated pregnancy	340	36.2
Pre-labor rupture of membranes	322	34.3
Hypertensive disorders of pregnancy	66	7.0
Intrauterine growth restriction	94	10.0
Intrauterine fetal death	66	7.0
Others	52	5.5
Methods of labor induction		
Amniotomy	96	10.2
Oxytocin	194	20.7
Oxytocin and amniotomy	66	7.0
Foley's catheter	80	8.5
Prostaglandin E1 analogue	504	53.6
Labor induction Interval (hours)		
<3	32	3.4
3-12	860	91.4
>12	48	5.2
Complications		
None	654	69.6
Postpartum Hemorrhage	246	26.2
Retained placenta	20	2.1
Uterine hyperstimulation	20	2.1

to be between 38th and 41st weeks for different groups of women. However, there have been concerns about increased cesarean section rates associated with labor induction.^{25,28,29} Therefore, further studies are necessary to compare the maternal and neonatal outcomes of labor induction with spontaneous labor at these gestational ages.

Similarly, estimated fetal weight of 2.5kg to 3.9 kg doubled the odds of achieving vaginal delivery. Macrosomia is known to predict failed labor induction as documented in other studies.^{2,30} The strength of this study is that it is a comprehensive audit of the labor induction practice in this center; and it can be generalised

for the tertiary obstetric care centers in Nigeria because their obstetric practices are comparable. The weakness lies in being a retrospective review; accompanied with missing data. Also, neonatal death was not captured in this review. In conclusion, labor induction is a safe obstetric intervention that should be offered to women when it is indicated especially in developing nations where there is still great aversion for abdominal delivery. Delays before surgical intervention should be reduced to the minimum in order to prevent avoidable perinatal deaths. Our findings suggest that 39, 40 and 41 weeks are optimal gestational ages for labor induction with respect to successful vaginal

Table 2

Associated factors with successful labor induction. Teaching Hospital. Nigeria, Jan 2006-Dec 2015.						
Factors	Vaginal delivery (N=656)		Cesarean section (N=284)		OR (CI95%)	p
	n	%	n	%		
Age group (years)						
≤19	18	100.0	0	-	0.00 (0.00)	0.44
20-24	54	47.4	60	52.6	0.75 (0.36-1.57)	<0.001
25-29	244	74.8	82	25.2	0.19 (0.11-0.35)	<0.001
30-34	282	82.5	60	17.5	0.28 (0.15-0.53)	<0.001
≥35	58	41.4	82	58.6	Ref	Ref
Booking status						
Booked	505	67.6	242	32.4	Ref	Ref
Unbooked	151	78.2	42	21.8	0.65 (0.38-1.10)	0.11
Indications						
Postdated Pregnancy	270	79.4	70	20.6	Ref	-
PROM	183	56.8	139	43.2	0.1 (0.03-0.34)	0.06
Hypertensive disorders	34	51.5	32	48.5	0.25 (0.06-1.04)	0.03
IUGR	64	68.1	30	31.9	0.24 (0.07-0.90)	1.00
IUFD	66	100.0	0	-	1.00 (0.27-3.89)	1.00
Others	39	75.0	13	25.0	1.00 (0.19-5.29)	<0.001
Induction agent						
Misoprostol	418	82.9	86	17.1	Ref	-
Oxytocin	136	70.1	58	29.9	1.20 (0.48-2.97)	0.69
Oxytocin+Amniotomy	46	69.6	20	30.4	6.56 (3.20-13.40)	<0.001
Amniotomy	40	41.7	56	58.3	0.34 (0.29-5.14)	0.22
Foley's catheter	16	20.0	64	80.0	0.69 (0.14-23.70)	0.28
Estimated Gestational Age (weeks)						
<34	88	74.6	15	25.4	Ref	-
34-36	6	23.1	10	76.9	3.63 (0.48-8.16)	0.97
37-38	76	65.5	20	34.5	6.46 (0.93-45.40)	0.98
39-40	132	61.7	41	38.3	2.54 (0.44-3.86)	0.29
41	300	79.4	78	20.6	2.07 (0.67-98.71)	0.47
≥42	54	61.4	34	38.6	6.32 (0.57-16.32)	0.82
Parity						
0	459	78.9	123	21.1	Ref	-
1	100	67.1	49	32.9	1.67 (0.95-2.98)	0.08
2	47	46.5	54	53.5	4.07 (2.21-7.52)	<0.001
3	39	50.0	39	50.0	3.23 (1.62-6.44)	0.001
≥4	11	36.7	19	63.3	8.48 (2.43-28.48)	0.001
Labor induction interval (hours)						
<3	31	96.9	1	3.1	Ref	-
3-12	602	70.0	258	30.0	1.00 (0.54-1.98)	0.92
>12	23	47.9	25	52.1	0.12 (0.01-0.03)	<0.001
Estimated fetal weight (kg)						
<2.5	84	85.7	14	14.3	Ref	-
2.5-3.4	220	78.0	62	22.0	8.26 (0.98-32.12)	0.07
3.5-3.9	318	78.3	88	21.7	6.09 (0.37-13.44)	0.91
≥4	34	22.1	120	77.9	2.04 (0.74-13.61)	0.76
Baby's weight (kg)						
<4	648	71.1	263	28.9	5.72 (1.73-18.91)	0.001
≥4	8	27.6	21	72.3	Ref	-
Apgar score at 1st minute						
<7	163	91.6	15	8.4	1.57 (1.46-1.69)	<0.001
≥7	493	64.7	269	35.3	Ref	-
Apgar score at 5th minute						
<7	96	92.3	8	7.7	1.49 (1.33-1.82)	<0.001
≥7	560	67.0	276	33.0	Ref	-
Neonatal intensive care admission						
Yes	110	84.0	21	16.0	1.26 (1.08-3.92)	0.001
No	546	67.5	263	32.5	Ref	-

Table 3

Multivariate logistic regression of determinants of successful labor induction. Teaching Hospital. Nigeria, Jan 2006-Dec 2015.			
Predictors	OR (CI95%)	Adjusted OR (CI95%)	p
Induction agent			
Misoprostol	Reference	Reference	-
Oxytocin	0.83 (0.34-2.07)	0.13 (0.04-1.93)	0.22
Oxytocin+Amniotomy	0.18 (0.05-1.13)	0.52 (0.14-1.96)	0.37
Amniotomy	0.11 (0.06-2.24)	0.09 (0.04-1.72)	0.34
Foley's catheter	0.15 (0.08-0.31)	0.24 (0.15-5.48)	0.11
Estimated gestational age (weeks)			
<34	0.23 (0.02-1.66)	0.11 (0.08-11.75)	0.36
34-36	0.17 (0.05-0.64)	0.32 (0.27- 6.38)	0.15
37-38	0.97 (0.45-2.12)	3.89 (0.97-15.64)	0.06
39-40	2.50 (1.30-4.82)	2.70 (1.17-6.36)	0.03
41	2.06 (1.05-4.03)	2.44 (1.14-5.28)	0.02
≥42	Reference	Reference	-
Estimated fetal weight (kg)			
<2.5	2.04 (0.36-8.26)	4.26 (0.55-4.62)	0.44
2.5-3.4	2.47 (1.38-4.42)	4.27 (1.96-5.59)	0.001
3.5-3.9	3.36 (1.93-5.83)	5.45 (2.81-10.60)	0.001
≥4	Reference	Reference	-
Labor induction interval (hours)			
<3	1.74 (0.41-6.62)	4.15 (0.72-7.18)	0.30
3-12	1.66 (1.11-2.48)	2.32 (0.13-4.03)	0.42
>12	Reference	Reference	-

Controlled for age, parity and indication for labor induction.

delivery. Future studies should compare maternal and fetal outcome of spontaneous labor with induced labor at 39, 40 and 41 weeks of pregnancy.

Authors' contribution

Okunola TO: conceived the study, participated in its design and coordination of the study, data analysis and drafting the manuscript. Bola-Oyebamiji SB and Sowemimo O: in study design, data analysis and drafted the manuscript. Ajenifuja KO: study design, drafting of manuscript and supervision.

All authors approved the final version of the article and declare no conflicts of the interest.

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