Fetomaternal Outcomes of Induced versus Spontaneous Labor in an Urban Omani Hospital

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Received: 24 April 2025

Accepted: 2 November 2025

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DOI 10.5001/omj.2025.99

Abstract

Objective: Induction of labor (IOL) is a common obstetric procedure with controversies around its safety and success. This study was performed to compare the fetal and maternal outcomes in women who had induction of labour to women who experienced spontaneous labor.

Methods: A retrospective study involving 260 pregnant women with singleton pregnancies at term that were planned for vaginal delivery in Armed Forces Hospital Muscat. One hundred and thirty women who underwent IOL were compared to 130 women that had spontaneous labor. Data was extracted from their electronic records and fetomaternal outcomes of interest were mode of delivery, maternal complications, neonatal appearance, pulse, grimace, activity and respiration (APGAR) score, neonatal intensive care unit (NICU) admission and status at discharge, the duration of stages of labor and duration of hospital stay.

Results: Our rate of IOL was 18.2%. Compared to their spontaneous counterparts, cesarean section and operative vaginal delivery rate was significantly higher in the IOL group (36.2% vs 14.6%) and (10% vs 6.9%) respectively, (p= 0.0314). Fetal distress was the leading indication for the operative deliveries (49.1%). The higher rate of operative delivery was also noted in the subgroup of women with previous cesarean section who underwent IOL (p =0.03). Maternal and neonatal complications were low and similar between groups. The admission to delivery interval and total duration of hospital stay in hours were also significantly longer in induced patients (33:58 ± 27:20 vs 8:49 ± 13:09, p = 0.001 and (90:44 ± 57:00 vs 63:12 ± 98:29, p =0.008) respectively.

Conclusion: This study has shown that IOL is associated with increased risk of operative delivery. Its comparable safety profile to spontaneous delivery implies that it should be offered when indicated. The longer duration of hospital stay should be considered in patient counselling and health facility planning.

Keywords: Induction of labor, Spontaneous labor, Cesarean section rate, Maternal outcomes, Fetal outcomes, Duration of labor.

Introduction

Induction of labor (IOL) is the artificial initiation of uterine contractions after the age of viability with the aim of achieving vaginal delivery.[1] A common obstetric intervention which is indicated when the fetomaternal risks of continuing the pregnancy outweighs those of delivery.[1,2] According to the World Health Organization, the global rate of IOL is approximately 10%, these rates vary according to population distribution, economic development and accessibility to healthcare, for example, rates 6% and 20% have been reported in Nigeria and the United Kingdom respectively.[1,2] In Oman, an induction rate of 15% has been previously reported.[3]

Globally, the proportion of deliveries by IOL has been on the rise, likely due to improved antepartum fetal surveillance, access to quality health care and scientific evidence showing that IOL significantly improved feto-maternal outcomes.[1,4] In 2018, Grobman et al. conducted a randomized controlled trial (RCT) of induction versus expectant management (ARRIVE) study in the United States of America (USA) and concluded that in low-risk pregnant women, IOL significantly decreased the risk of other maternal complications including caesarean delivery (CD) and neonatal morbidities which could arise after 39 weeks of pregnancy.[4] This result led to the renewal of the previous policy statement of the American College of Obstetricians and Gynaecologists (ACOG), which supports that non-medically indicated induction at 39 weeks for nulliparous women could be considered a "reasonable" option.[5] However, some of the study limitations were its limited external validity as it was conducted among the USA patients alone, also because the study was unmasked ascertainment bias cannot be completely ruled out. Therefore, large-scale observational studies in diverse settings were recommended.[5,6] Also, Middleton et al.'s meta-analysis of 30 RCTs by concluded that IOL from 37 weeks of gestation compared to expectant management was associated with fewer perinatal deaths, neonatal intensive care unit admissions, babies with low Apgar score and CDs. However, the rate of operative vaginal deliveries (OVD) was higher.[7] The authors concluded that further investigations were needed to determine optimal timing of IOL, together with exploration of women's risk profiles and preferences.[7]

In contrast, other studies have associated a higher risk of CD and maternal complications including uterine hyperstimulation, uterine rupture, postpartum haemorrhage(PPH), maternal morbidity and mortality with IOL.[1,8] Associated fetal complications included fetal distress, low neonatal appearance, pulse, grimace, activity and respiration (APGAR) scores, neonatal jaundice and neonatal intensive care unit (NICU) admission.[9] Factors associated with these complications were patient characteristics, IOL protocol and quality of peri-partum and neonatal care. This suggests that the incidence of these complications may vary between and within countries.[1,8,9]

In Oman, only two studies have examined IOL, each concentrating on specific sub-group of pregnant women; those with previous caesarean delivery and grandmultiparas rather than the general obstetric population.[3,10] The increasing proportion of e-patients in Oman calls for local study to aid clinical decision making on IOL as against evidence they read on the internet from other countries.[11] Our study compared the fetomaternal outcomes in women who underwent induction of labour between June and November 2024 to those who laboured spontaneously. To our knowledge, this is the first study on IOL that also assessed the duration of stages of labour, admission to delivery interval and duration of hospital stay among the general obstetric population.

Methods

This retrospective comparative study was conducted at the Department of Obstetrics and Gynaecology, Armed Forces Hospital, Muscat, Sultanate of Oman, between June and November 2024. Institutional approval was obtained from the Ethics committee of the hospital with the approval code AFMS-MREC 112/2024 before commencing this study. Parturient with singleton fetuses in cephalic presentation between 37 weeks and 41weeks + 6 days were included in the study. Exclusion criteria were babies who had pre-diagnosed congenital abnormalities that could affect intrapartum fetal heart, prelabour rupture of membranes, abnormal lie and abnormal admitting CTGs. The spontaneous group were selected using purposive sampling to include women who had spontaneous labour within same 24-hour shift as those who had IOL with closest characteristics to them in age, parity and gestational age. Methods of IOL included vaginal pessaries containing 10mg of prostangaldin E2 (removed in active labor i.e cervical dilation of 4 cm, uterine hyperstimulation, abnormal fetal heart pattern on cardiotocogram (CTG) or if it has been in place for 24 hours) or vaginal prostangladin E2 gel inserted every 4-6 hours or cervical balloon, any of these methods may lead to active labor. However, if contractions are not adequate in active phase, oxytocin infusion will be commenced). Information including maternal demography, obstetric history, method of IOL, duration of active labour (time interval from when the parturient started having at least 3 painful contractions in 10 minutes to time of delivery), admission to delivery interval, total duration of hospital stay were extracted from their antenatal, intrapartum and postpartum electronic records. The duration of active labour was defined as the time from which the patient started having progressive painful uterine contraction till the time of delivery. Non progress of labour was diagnosed after exceeding the time limits on the WHO Labor Care Guide[12] despite adequate contractions and/or maximum oxytocic and fetal distress was the assessment when there is persistent pathological CTG despite intrauterine resuscitation. The maternal outcomes included mode of delivery, indications for operative delivery, clinically estimated blood loss (EBL), peripartum complications PPH (EBL exceeding 500mls in vaginal delivery and 1000mls in caesarean section), perineal laceration (2nd degree perineal tear or more), blood transfusion,

hysterectomy, uterine rupture and shoulder dystocia. Fetal outcomes were birth weight, 1st and 5th minute APGR scores, NICU admission and neonatal status at discharge. The data was collated and analysed using the open-source software IBM SPSS 29 (SPSS Inc. Chicago, Illinois, USA). Chi-square was used to compare categorical variables, while continuous variables were analysed using an independent t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Statistical difference was set at p-value of < 0.05 at confidence interval of 95%.

This research was sponsored by the researchers and no additional cost was transferred to the hospital.

Results

A total of 974 deliveries were conducted between June and November 2024. One hundred and seventy- seven (18.2%) of the parturient were induced. As shown in table 1, the mean ages of the study groups were similar: 32.5 ± 6.2 in women who had IOL and 30.9 ± 5.8 in the spontaneous labor group. There were more nulliparas in the IOL group (32.3% vs 18.5%) and this finding was statistically significant (p=0.001). More patients were induced at early term (37weeks- 38+ 6days) compared to spontaneous labour that occurred more at full term. This difference was also significant (p=0.001). A lower proportion of patients in the IOL group had previous caesarean delivery (17.7% vs 22.3%, p=0.031). The commonest indication for IOL was gestational diabetes mellitus/diabetes Mellitus (GDM/DM) (58.5%), followed by intrauterine growth restriction (IUGR) (8.5%). The indications classified as 'others' included macrosomia, cardiac disorder in pregnancy, maternal request, polyhydramnios and gestational thrombocytopaenia. The commonest method of induction of labor was prostaglandin pessary (52.3%) and about 1/3rd was induced with Prostaglandin E2 gel (29.2%).

Table 1: Maternal demographic and obstetric characteristics by labour onset type.

Parameter	**IOL n(%) n=130**	**Spontaneous Labor n(%) n=130**	**Total n(%) n=260**	***p*-value**
Maternal Age				0 .121
20-29 54 40	40(30.876)	54(41.54)	94(36.215)	
30-39	76(58.546)	69(53.108)	145(55.778)	
40-49	14(10.877)	7(5.438)	21(8.107)	
Mean ± SD	32.50 ± 6.215	30.988 ± 5.84	31.769 ±6.05.99	
Parity				
0	42(32.31)	24(18.465)	66(25.439)	0.048
1-4	72(55.438)	93(71.54)	165(63.546)	
≥5	16(12.31)	13(10)	29(11.215)	
Mean ± SD	2.218 ± 2.01.97	2.43± 1.67	2.31 ± 1.82	
Gestational Age				
37-38+6days	82(63.108)	51(39.23)	133(51.215)	0.001
39-40+6days	42(32.31)	76(58.546)	118(45.439)	
41-41+6days	6(4.62)76	3(2.31)	9(3.546)	
Mean	38weeks+5days	39 weeks + 1day	39weeks	
Previous CD	23(17.769)	29(22.31)	52(20.0)	0.031
Indications for IOL				
GDM/DM	76(58.54)			
IUGR	11(8.546)			
Hypertension	10(7.769)			
Postdatism	6(4.62)			
Reduced fetal movement	5(3.85)			
Oligohydramnios	4(3.108)			
Others	18(13.85)			

Methods of IOL	
PGE2 pessary	68(52.30)
PGE2 gel	38(29.23)
Cervical balloon	20(15.439)
Gell + Ballon	3(2.31)
Pessary + gel	1(0.877)

IOL: induction of labor, CD: cesarean delivery, GDM/DM: gestational diabetes mellitus /diabetes mellitus, IUGR: intrauterine growth restriction, PGE2: prostanglandin E2,

Table 2 compares the outcome of labor between study groups. More patients had operative delivery in the IOL group: (36.2% vs 14.6%) for cesarean delivery and (10% vs 6.9%) for operative vaginal delivery (p= 0.0314). The commonest indication for cesarean delivery was fetal distress accounting for almost half of the total cases (49.1%). Also, cesareans due to poor progress in labor were about four times more common in the IOL group than in the spontaneous labor group (38.2% vs 10.5%). As with caesarean delivery, the leading indication for operative vaginal delivery was also fetal distress (81.8%) and this was higher among mothers who had IOL (92.3%vs 66.7%). There was no significant difference in the mean estimated blood loss (283.4 ± 357.2 vs 266.4 ± 244.4, p=0.725), incidence of perineal laceration (11.5% vs 14.6% p = 0.462) and PPH (3.1% vs 4.6% p = 0.519) between the study groups. The only patient that was transfused had spontaneous labor. None of the participants in the study experienced complications such as shoulder dystocia, uterine rupture, or the need for a hysterectomy.

Table 2: Maternal and fetal outcomes.

Parameters	**IOL n=130**	**Spontaneous Labor n=130**	**Total n=260**	***p*-value**
Mode of Delivery{n(%)}				0.0314
VD	83(63.85)	102(78.546)	185(71.215)	
CD	34(36.215)	19(14.62)	53(20.438)	
Indications for CD n(%)	14(41.218)	12(63.216)	26(49.106)	
Fetal distress	13(38.24)	2(10.53)	15(28.30)	
Poor progress of labor	4(11.877)	2(10.53)	6(11.32)	
Maternal request	3(8.82)	2(10.53)	5(9.43)	
Scar tenderness	0	1(5.326)	1(1.89)	
APH				
OVD n(%)	13(10)	9(6.92)	22(8.54)	
Indications for OVD n(%)	12(92.31)	6(66.67)	18(81.82)	
Fetal distress	1(7.78.46)	1(11.11)	2(9.109)	
Maternal exhaustion	0	1(11.11)	1(4.655)	
Medical disorders	0	1(11.11)	1(4.655)	
No progress in 2nd stage				
Estimated blood loss(mls) Mean ± SD	283.438 ± 357.20	266.43 ± 244.438	274.91 ±300.879	0.725
Maternal Outcomes n(%)				
Perineal laceration (2nd degree)	15(11.53)	19(14.62)	34(13.108)	0.462
Blood transfusion	0	1(0.877)	1(0.439)	
PPH	4(3.108)	6(4.62)	10(3.985)	0.519
Hysterectomy	0	0		
Uterine rupture	0	0		
Shoulder Dystocia	0	0		
Birth weight (g) n(%)				0.913
<2500	15(11.54)	13(10.0)	28(10.877)	
2500 – 3500	90(69.23)	93(71.54)	183(70.489)	
>3500	25(19.23)	24(18.546)	49(18.985)	
1st Minute APGAR score n(%)				0.953
≤3	2(1.54)	1(0.877)	3(1.215)	
4&5	1(0.877)	2(1.54)	3(1.152)	

6	2(1.54)	2(1.54)	4(1.54)	
≥7	125(96.215)	125(96.215)	250(96.215)	
5th Minute APGAR score n(%)				0 .478[y]
<7	1(0.877)	1(0.877)	2(0.877)	
≥7	129(99.23)	129(99.23)	258(99.23)	
NICU Admission n(%)				0.734
Yes	5(3.85)	4(3.108)	9(3.546)	
No	125(96.215)	126(96.92)	251(96.53)	
Neonatal status at discharge n(%)				0.614
Alive and well	127(97.769)	129(99.23)	256(98.546)	
Alive and sick	3(2.31)	1(0.877)	4(1.54)	
Still born	0	0		
Early neonatal death	0	0		

IOL: induction of labor, VD: vaginal delivery, OVD: Operative vaginal delivery, APH: antepartum haemorrhage, CPD: cephalopelvic disproportion, PPH: postpartum haemorrhage, CD: Cesarean delivery, y: *yates correction, NICU: neonatal intensive care unit*

Concerning neonatal outcomes, there was no statistically significant difference in birthweight (p = 0.913), 1st and 5th minute APGAR scores (p = 0.953 and 0 .478 respectively), NICU admission (p=0.734) and neonatal status at discharge (p = 0.614) between the two groups. There was no incidence of perinatal death in this study.

Figure 1 displays the mode of delivery in patients with one previous cesarean delivery: Women who underwent IOL had a higher rate of cesarean delivery (14 out of 23) compared to women who went into labor spontaneously (9 out of 29). Conversely, the spontaneous labor group had a higher rate of vaginal delivery (20 out of 29) compared to the induced labor group (8 out of 23). Additionally, operative vaginal delivery was non-existent in the spontaneous labor group (0), but there was 1 case of OVD in the IOL group. This difference was statistically significant (p =0.03).

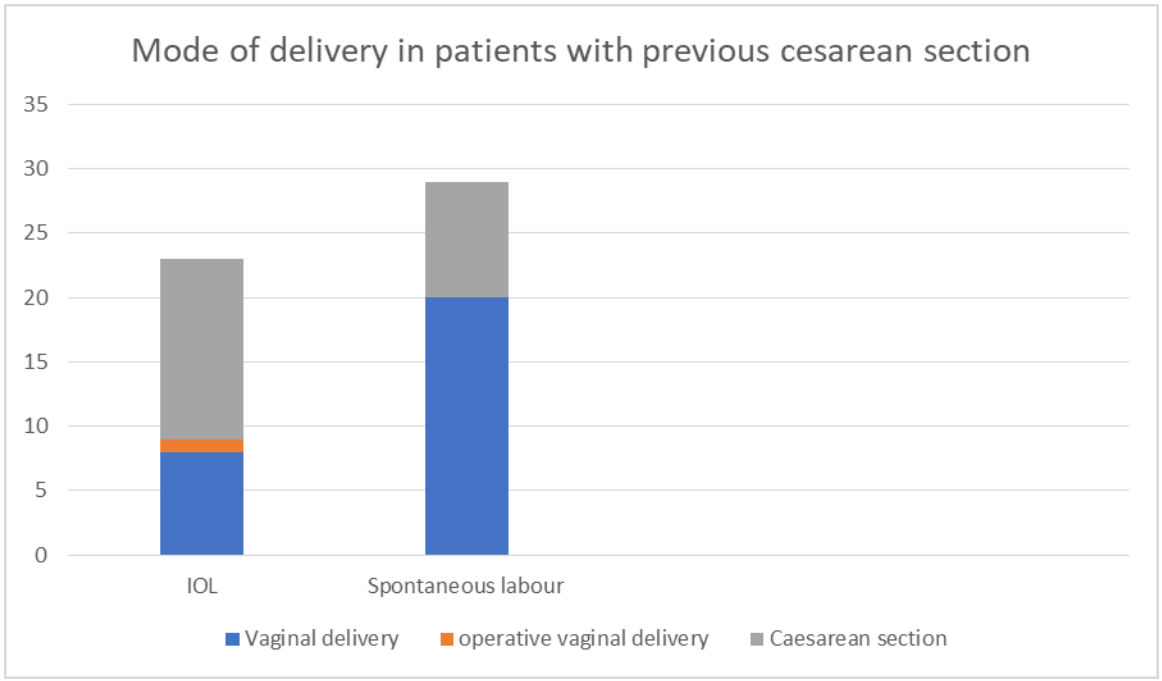

Figure 1: Comparison of mode of delivery in women who had previous cesarean delivery who had IOL to those who underwent spontaneous labor.

Table 3 compares the duration of stages of labor between the study groups and there was no statistically significant difference in the mean duration of active labor in hours (5:31 ± 3:18 vs 6:11 ± 2:45, p=0.060), Mean duration of second stage in minutes (20:58 ± 28:56 vs 17:30 ± 19:06, p = 0.410) and the mean duration of third stage of labor in minutes (5:36 ± 2:42 vs 6:49 ± 7:48, p = 0.154).

Table 3: Comparison of duration of stages of labor.

Parameter	IOL (n=94)	Spontaneous Labor (n=111)	*p*-value
Duration of active labour (hr:min) (Mean ± SD)	5:31 ± 3:18	6:11 ± 2:45	0.060
Duration of second stage (min:sec) (Mean ± SD)	20:58 ± 28:56	17:30 ± 19:06	0.410
Duration of 3rd stage (min:sec) (Mean ± SD)	5:36 ± 2:42	6:49 ± 7:48	0.154

IOL: induction of labor

As illustrated in Table 4, the longer time interval between admission and delivery in hours in the IOL group was statistically significant (33:58 ± 27:20 vs 8:49 ± 13:09, $p = 0.001$). The total duration of hospital stay in hours was also significantly higher in the IOL group (90:44 ± 57:00 vs 63:12 ± 98:29, $p = 0.008$).

Table 4: Admission to delivery interval and total duration of hospital stay.

Parameter	IOL n=130	Spontaneous Labor n=130	*p value*
Admission to delivery interval (hr:min) (Mean +SD)	33:58 ± 27:20	8:49 ± 13:09	0.001
Total duration of hospital stay	90:44 ± 57:00	63:12 ± 98:29	0.008

IOL: induction of labor

Discussion

Our results show that close to 1/5th of our pregnant women deliver by induction of labor which is an increase from 15% that was reported by Paliwal et al. in 2009.[3] The women who had IOL were more likely to be of lower parity, older and deliver at a lower gestational age. Our findings align with the study by Harper et al.[13] The higher mean gestational age among patients who had spontaneous labour have been consistently reported in studies since induction of labor means artificial initiation of labor, the group of patients left to the natural process are likely to have higher number of deliveries at a later gestational age[3,6,10,13]

The leading indication for IOL was preexisting or gestational diabetes mellitus. The diagnosis of GDM/DM affects the timing and mode of delivery as pregnancy should not exceed 38 weeks in those controlled by medications and 40 weeks in those controlled by diet. This explains the need to ensure delivery before its spontaneous onset which mostly occurred at a higher gestational age than IOL among our study sample. Our observation on the indication for IOL contrasts with that of Ellenberg et al in Helsinki where the commonest indication was postdated pregnancy. This may be due to the lower threshold for diagnosis of hyperglycaemia in pregnancy in Oman compared to Finland.[14,15]

Irrespective of mode of labor onset, majority of our patients had vaginal delivery. However, operative delivery was significantly higher among the induced patients which corroborates reports from observational studies by Adler et al. and Harper et al.[13,16] They were retrospective analysis of deliveries among the general obstetric population with similar study methods to ours.[13,16] On the contrary, two randomized controlled trials: the ARRIVE trial and the trial by Walker et al reported a lower risk of operative delivery with IOL.[3,17] In the ARRIVE trial, elective IOL at 39 weeks was associated with a reduced risk of operative delivery while there was no significant difference in the study by Walker et al. Both trials excluded all parturient who delivered before 39 weeks which constituted more than half of our study population. Their focus was more on the delivery at that gestational age versus continuing pregnancy and the patients who eventually had IOL in the expectant management group were not analysed as having had IOL. Also, these studies were in specific population of patients; ARRIVE study was conducted among low risk nulliparas while the Walker et al study was done in women over 35 years.

Although the diagnosis of fetal distress varies among facilities and often subjective without a standard clinical criterion,[18] it accounted for most of our operative intervention. Our routine use of electronic fetal monitoring without fetal pH testing may also be a contributing factor as shown in previous studies.[18] Standardizing the CTG interpretations and ensuring experienced obstetrician input may reduce cesarean deliveries due to this reason. In women with one previous cesarean delivery, vaginal delivery was more likely if they had spontaneous labour aligning with previous studies from the Royal College of Obstetricians and Gynaecologist (RCOG) that emphasized that spontaneous labor offers better chances for successful vaginal birth after cesarean (VBAC).[19]

The low proportion of mothers with complications is likely due to the quality of obstetric care available. There was no significant difference in the estimated blood loss, occurrence of PPH or blood transfusion. All the perineal lacerations recorded were 2nd degree and there was no significant difference between the study groups. Brun et al. found that EBL and rate of PPH in IOL may be slightly higher compared to spontaneous labor, the difference was small and not statistically significant.[20] Our study supports this, showing that while IOL might lead to slightly higher EBL, the difference is not large enough to be clinically significant.[20]

Previous researchers have documented conflicting effects of IOL on neonatal outcomes mainly because of heterogenous study population and design, different exclusion and inclusion criteria as well as different outcomes of interest.[9] In our study, most of the neonates had APGAR scores ≥7 at the 1st and 5th minutes irrespective of mode of delivery. NICU admissions and neonatal morbidity were low and similar between the groups. Brun et al found that while the risk of severe neonatal outcomes may be slightly higher in induced labor, the differences are often minimal and the overall prognosis for neonates is generally good.[20] Studies showing a reduced risk of adverse neonatal outcomes with IOL have compared elective IOL at term with expectant management with focus on the gestational age of delivery and not the mode of labor onset.[3,7,17,22,23] In the study by Bengtsson et al, the neonatal outcomes were worse in the IOL group, a very large study population over an 18year period was used. With the constantly evolving evidence to support intrapartum care, the intrapartum care may not be identical to what was received by our study sample.[9] Also, many of the neonatal outcomes including neonatal sepsis, hyperbilirubinemia, neonatal seizures that were recorded did not occur in our study probably due to our smaller sample size.

The effect of IOL on duration of stages of labor has ranged from prolongation to no effect to reduction. In our study, the duration of active labor, 2nd and 3rd stages of labor was not significantly different between the study groups. Our methods of inducing labor using prostaglandins or cervical balloon closely mimics the natural process by working on cervical ripening as well as stimulating uterine contractions, suggesting that the process of induction does not drastically alter the physiological timing of labor stages compared to spontaneous onset once active labor is achieved. Harper et al, observed that parturient who had IOL spent a longer time in labor compared to those who had spontaneous labor, the longer duration was spent in the latent phase of labor and there was no difference in the rate of labor progress once active phase was established.[13] Hassan et al, have explained the shorter duration of active phase of labor in their study by potentiation of contractions induced by medications.[23]

The determination of admission to delivery interval and total duration of hospital stay is important counselling and birth planning for patients and their relatives, it also aids the health facility to plan and to estimate the cost of this intervention. The admission to delivery interval of 33:58 hours in the IOL group is about 4 times more than 8:49 hours of the Spontaneous group while the mean total duration of hospital stay is about 1.5 times longer in the IOL group and this difference was statistically significantly (90:44 hours vs 63:12 hours).

Previous studies have established that admission to delivery interval is significantly longer in the IOL group due to the time required for pre-IOL evaluation and medical interventions like cervical ripening, other speciality review of pre-existing medical conditions and blood transfusion in anaemic patients.[3,13,22]

The limitations of our study include its retrospective nature that leaves out some important factors of interest including pain assessment and maternal satisfaction which were not routinely documented. The purposive sampling method of the spontaneous labor group puts us at risk of selection bias: GDM/DM and IUGR, the leading indications for IOL were not matched in the spontaneous delivery group and this could be a confounding variable in the higher rate of operative delivery. Also, some of our observations including EBL, duration active labour and 2nd stage of labor were assessed subjectively, they are thereby prone to observation error.

The major strengths are that the duration of hospital stay was compared and this could assist with staff planning and counselling of patients and their relatives. Also, women with previous caesarean delivery were included and results could be used in their counselling. Although our study has not been able to resolve the controversies surrounding safety of IOL in our environment, it serves as a baseline data and a stimulant for well-designed prospective studies on the subject matter.

Conclusion

Induction of labor is associated with increased risk of operative delivery. However, it is a safe obstetric procedure with low risks to the mother and the baby and should be performed when indicated. Its burden on health facility, patient and their relatives and should be considered and incorporated into counselling.

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