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Research Article

Rate of Failed Induction of Labor at a Single Academic Medical Center in Saudi Arabia: A 10-Year Experience

Fatmah A Alzharani[1], Samera F AlBasri[2]*, Raghad A Khashab[1], Maryam M Alamoudi[1], Deyala M Badawi[1], Daniyah N Alsharif[1], and Atheer T Almrzouqi[1]

[1]Faculty of Medicine, King Abdulaziz University, Saudi Arabia

[2]Department of Obstetrics and Gynecology, King Abdulaziz University Hospital, Saudi Arabia

*Corresponding author

Samera AlBasri, Department of Obstetrics and Gynecology, King Abdulaziz University Hospital, Faculty of Medicine, Jeddah, Saudi Arabia, Tel: 966505653412

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- Induction of labor
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Abstract

Failed induction of labor (IOL) often necessitates cesarean section (CS), which is associated with serious obstetric complications. However, there are no updated studies about the factors associated with and complications of failed IOL in Saudi Arabia. Therefore, this retrospective study reviews the hospital records of 127 cases of failed IOL followed by emergency CS from King Abdulaziz University Hospital, Jeddah, Saudi Arabia, over a 10-year period (May 2012 to June 2022). The study included 127 pregnant women, who comprised 1.13% of 11238 CS cases and 4.9% of 2582 IOL cases. Preeclampsia (44, 34.65%) and post-date pregnancy (24, 18.90%) were the most common indications for IOL. Nulliparous women were the dominant group (88, 69.29%), and prostaglandin E1 was the most commonly used induction agent (98, 77.17%).

Postpartum hemorrhage was the most common maternal complication (5, 3.94%), and neonatal intensive care unit admission (17, 24.41%) and low pH (26, 20.47%) were the most common fetal outcomes. The findings indicate that IOL is safe as long as it is performed based on the standards of care and available evidence.

INTRODUCTION

Induction of labor (IOL) is a frequently used technique in modern obstetrics that involves the iatrogenic stimulation of uterine contractions before spontaneous commencement of labor to promote vaginal birth [1]. According to the World Health Organization, IOL is indicated mainly for enhancement of the standard of care and outcomes of the pregnancy [2], with the goal of labor induction primarily being to ensure the best outcome for the mother [3], and prevent unwanted cesarean section (CS) and potentially severe obstetric complications [2]. Some of the obstetric indications for terminating pregnancy include eclampsia, post-term pregnancy, premature rupture of membrane (PROM), gestational diabetes mellitus (GDM) at term, intrauterine growth retardation (IUGR), and placental abruption [3].Thus, IOL methods should only be used when the advantages of terminating the pregnancy outweigh the hazards of delaying labor [4], and they should only be carried out under the supervision of a physician [2].

Failed IOL is commonly defined as the inability to achieve vaginal birth with IOL methods [5], or performance of CS in the latent phase of labor induction [6]. However, some studies have suggested an alternate definition and have described failed IOL as unsuccessful induction of labor despite the induction of a strong contraction, thus necessitating CS [7,8].The majority of cases of failed IOL require CS [9], and accordingly, failed IOL has been associated with increased maternal morbidity and mortality due to the complications associated with CS, such as postpartum hemorrhage (PPH) and sepsis [8]. A previous study showed that the prevalence of failed IOL was 31.4% in Amhara regional state, Ethiopia [10], and another study carried out in Ethiopia reported the prevalence as 29.6%. In addition, PROM was found to be the most common indication for IOL (46.4%), and it was followed by hypertensive disorder of pregnancy (21.6%) [11]. With regard to the factors associated with the success of IOL, a study from Eastern Ethiopia reported that the likelihood of successfully inducing labor was 67% lower in nulliparouswomen than in multiparous women [12]. In addition, birth weight above 4000 g has also been found to be associated with failed IOL [11-13]. According to existing research, pregnant women who undergo IOL have a higher chance of requiring CS or instrumental delivery, PPH, and longermaternal hospitalization than those who experience spontaneous labor [14]. Considering that failed IOL has an impact on maternal health and can lead to certain maternal complications, it has become an important medical concern.

The outcomes of failed IOL are well covered in international studies, but there is limited evidence from local studies in Saudi Arabia. Therefore, the present retrospective study was conducted to determine the most relevant factors associated with failed IOL and maternal and neonatal outcomes. The study covered a 10-year period from May 2012 to June 2022 and was conducted at King Abdulaziz University Hospital (KAUH), Jeddah.

MATERIALS AND METHODS

This retrospective study was approved by the Research Ethics Committee of KAUH (Reference no. 249-22). It was performed at the Obstetrics and Gynecology Department, KAUH, Jeddah, Saudi Arabia, for a 10-year period between May 2012 and June 2022. It included a sample of 127 pregnant women with gestational age above 24 weeks who underwent CS after failed IOL. Women who did not receive any augmentation, had a history of CS, had IUFD, underwent CS due to fetal distress, or had gone through the active phase of labor were excluded from this study. Data for each patient were extracted from the birth registry records and via Google forms that included the following information: maternal age, parity, induction type, induction dose, and indications for induction (such as GDM, frank DM, preeclampsia, post-date pregnancy, PROM, oligohydramnios, antepartum hemorrhage, IUGR, and fetal malformation). In addition to the timing of CS, that is, whether it is conducted during the latent or active phase,data on maternal outcomes were also collected, for example, endometritis, wound complications (infection and separation), hysterectomy, intensive care unit (ICU) admission, blood transfusion, pulmonary embolism, and maternal death. Data were also collected on neonatal characteristics such as birth weight; presence of twins, sex; whether the Apgar score at 1 and 5 min was greater, less than, or equal to 7; neonatal pH; whether the newborn was admitted to the neonatal ICU (NICU) or not; and whether neonatal death occurred. The data collected were entered into an Excel data spreadsheet (version 16.64). Statistical analysis was conducted using SPSS for Windows, version 26.

RESULTS

The primary focus of this retrospective study was to assess the contributing elements and outcomes of failed IOL at KAUH, Jeddah, over a 10-year period ranging from May 2012 to June 2022. The medical records of 127 women who underwent CS after failed IOL were retrieved: these 127 cases represent 1.13% of all 11238 CS cases and 4.9% of all 2582 IOL cases over the study period (Table 1). The rate of labor induction, that is, the number of deliveries for which IOL was required, was 6.8% (2582 out of 37959 deliveries). The vast majority of our sample comprised Saudi nationals (77, 60.63%). The study was carried out on all women in whom IOL had failed, regardless of their age group. However, the majority of these women were between26 and 30 years of age (45, 35.43%), while 29 (22.83%) each were in the age groups 20–25 years and 31–35 years (Table 2). With regard to parity, 69.29% of the sample, that is, more thanhalf of the sample, was nulliparous.

Preeclampsia was the most common factor related to failed IOL (44, 34.65%), and it was followed by post-date pregnancy (24, 18.90%), GDM (19, 14.96%), and PROM (18, 14.17%) (Table 3). Prostaglandin E1 was the most commonly used agent for induction (98, 77.17%), andprostaglandin E2 was the second most commonly used one (24, 18.90%). The least used method of IOL was cervical ripening, which was used on only 1 (0.79%) woman (Table 4). The majority of the mothers (18, 14.2%) received more than 10 doses of the induction agent (Table 5). PPH was the most common maternal complication (5, 3.94%), and it was followed by woundcomplications (2, 1.57%). Other complications, such as hysterectomy, ICU admission, blood transfusion, and maternal death, were not found in our sample.

In this study, most of the neonates were female (67, 52.76%), and birth weight was between 2.5 and 4 kg in 81 (63.78%) neonates and below 2.5 kg in 31 (24.41%) (Table 6). With regard toApgar score, the number of neonates with a score below 7 at 1

Table 1: Data related to deliveries over the 10-year study period.

Total no. of deliveries	37959
Total no. of CS	11238
% of CS among all deliveries	29.6%
Total no. of IOL	2582
% of IOL among all deliveries	6.8%
Total no. of FIOL	127
% of FIOL among all IOL	4.9%
% of FIOL among all CS	1.13%

CS = cesarean section, IOL = induction of labor, FIOL = failure of induction of labor

Table 2: Rate of failed induction of labor according to age (N = 127)

Maternal age (years)	Number	Percentage (%)	95% CI
<20	8	6.30%	2.7–12.4
20–25	29	22.83%	15.9–31.1
26–30	45	35.43%	27.2–44.4
31–35	29	22.83%	15.9–31.1
36–40	9	7.09%	3.3–13.0
41–45	5	3.94%	1.3–9.0
>45	2	1.57%	0.2–5.6

CI = confidence interval

Table 3: Indications for induction of labor

Indication of induction	Number	Percentage (%)	95% CI
HTN (preeclampsia)	44	34.65%	26.4–43.6
Post-date pregnancy	24	18.90%	12.5–26.8
GDM	19	14.96%	9.3–22.4
PROM	18	14.17%	8.6–21.5
IUGR	9	7.09%	3.3–13.0
Frank DM	7	5.51%	2.2–11.0
Post-term	4	3.15%	0.8–7.9
Oligohydramnios	3	2.36%	0.5–6.8
Malformation	1	0.79%	0.02–4.3
Advanced maternal age	1	0.79%	0.02–4.3
Abdominal pain	1	0.79%	0.02–4.3
Hyperstimulation	1	0.79%	0.02–4.3
Twin	1	0.79%	0.02–4.3
APH	0	0.00%	0.0–2.8

CI = confidence interval, HTN = hypertension, GDM = gestational diabetes mellitus, PROM = premature rupture of membrane, IUGR = intrauterine growth retardation, APH= antepartumhypertension

Table 4: Methods used for induction of labor

Table 4: Methods used for induction of labor

Type of induction	Number	Percentage (%)	95% CI
Prostaglandin E1	98	77.17%	68.9–84.1
Prostaglandin E2	24	18.90%	12.5–26.8
Oxytocin	18	14.17%	8.6–21.5
AROM	6	4.72%	1.7–10.0
Balloon	2	1.57%	0.2–5.6
Cervical sweeping	1	0.79%	0.02–4.2

CI = confidence interval

Table 5: Number of doses of the induction agent administered

Number of doses	Number	Percentage (%)	95% CI
1	5	3.9%	1.3–8.9
2	8	6.3%	2.8–12.0
3	10	7.9%	3.8–14.0
4	4	3.1%	0.9–7.9
5	4	3.1%	0.9–7.9
6	3	2.4%	0.5–6.8
7	3	2.4%	0.5–6.8
8	4	3.1%	0.9–7.9
9	3	2.4%	0.5–6.8
10	4	3.1%	0.9–7.9
>10	18	14.2%	8.6–21.5

Table 6: Neonatal birth weight

Birth weight	Frequency (N)	Percentage (%)	CI 95%
<2.5 kg	31	24.41%	17.2-32.8
2.5-4.00 kg	81	63.78%	54.8-72.1
>4.0 kg	8	6.30%	2.8-12.0

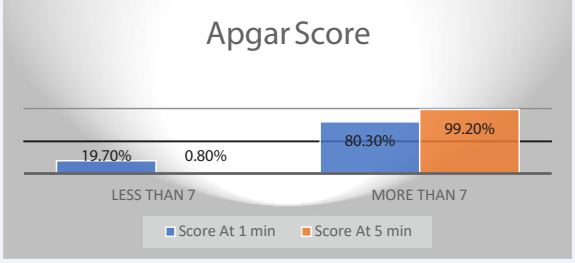

Figure 1 Neonatal Apgar scores

min was 25 (19.69%), and this number decreased significantly at 5 min to 1 (0.79%) (Figure 1). pH readings revealed that 26 (20.47%) neonates had low pH, while only 1 (0.79%) had high pH. In addition, a considerable percentage of neonates required NICU admission (17, 24.41%), and one neonatal death was reported throughout the study period.

DISCUSSION

The present study investigates the most common factors and outcomes of failed IOL in a cohort from Saudi Arabia. We retrospectively reviewed the records of 127 women treated at KAUH, Jeddah, between May 2012 and June 2022, in whom IOL had failed in order to predict the relevant variables and outcomes. The age group 26 to 30 years was the most common maternal age group in our study, and it was followed by the groups 20–25 and 31–35 years, both of which had an equally high prevalence. Another study conducted in southeast Ethiopia also reported that IOL is 8.788 times more likely to fail in mothers aged 31–35 years than in mothersaged 20 years [15]. A possible contributing factor might be maternal anatomical stability in women younger than 25 years and the increase in deformities in the sacral promontory, ischial spine, and coccyx bone with age [12]. Another explanation might be the decrease in myometrialcontractility with age, as this can result in poor uterine contraction and, subsequently, failed IOL [16,17].The labor induction rate (6.8%) in this cohort was the same as that reported in a study from Algeria [18], but it was lower than that reported in one study from Ethiopia (9%) [19], and higher than that reported in another study from Ethiopia (4%) [20].The prevalence of failed IOL in our study was 4.9%, which is much lower than that reported in another study (7.2%) [19].

With regard to the factors associated with failed IOL, our data indicate that the likelihood of IOLfailure was higher in nulliparous women than in multiparous women. This is in agreement with the findings of studies conducted in Ethiopia [11,12,21], Saudi Arabia [22], and Ireland [23]. IOL failure in nulliparous women may be a result of direct induction before cervical ripening, amniotomy, and the undoing of cervical sweeping after the active phase of the first stage of labor [12]. Another associated factor may be the pre-induction cervical status, which is differentbetween nulliparous and multiparous women and may affect their response to induction procedures [24]. This may also be partially explained by the flexibility of the uterine muscles of multiparous women as compared to those of nulliparous women [12], in whom the cervix is immature and stimulation by induction requires more time and effort [24]. Another factor associated with failed IOL was preeclampsia, which has also been reported as an influencing factor in studies conducted in Ethiopia [11,12,24], Tanzania [25], the USA [26], and Australia [27]. Preeclampsia may increase the risk of uteroplacental insufficiency or placental abruption, whichmay lead to non-reassuring fetal heart rate (NRFHR) and, thereby, increase the likelihood of CS [26]. In addition, when the placenta's function is impaired, the hormones secreted by it do not respond to uterotonic medications [11]. This may also increase the likelihood of failed IOL. Another explanation may be the administration of magnesium sulfate during labor induction for seizure prevention in patients with pregnancy-induced hypertension, as it is a known tocolytic drug [28,29], that can terminate labor and lead to slower labor progress and even failed IOL [30]. Additionally, it has been demonstrated in certain studies that magnesium sulfate reduces fetal heart rate variability, and this may explain why its administration is associated with NRFHR and the need for CS [31,32]. In the present study, post-date pregnancy was also associated with a high rate of IOL failure. This is in line with a study in Ethiopia which reported that the risk of IOL failure was 4.1 times higher in mothers who underwent IOL because of post-date pregnancy.

The association can be explained by placental calcification associated with post-date pregnancy. As the pregnancy progresses, the placenta may become calcified and its function

may be comprised. As a result, the fetus's ability to cope with uterotonic agents is affected because theflow of oxygen and other nutrients to the fetus is reduced [10]. In addition to the factors discussed so far, GDM is also associated with a relatively high rate of IOL failure. Some studies have illustrated this through the changes that occur with gestational diabetes, such as increase in fetal weight, decrease in the volume of amniotic fluid, and placental aging, all of which are associated with an increased need for intrapartum CS due to dystocia [33,34]. Finally, PROM was also associated with failure of IOL. This association may be explained by the gush of amniotic fluid, which increases the risk of ascending infection, leads to chorioamnionitis, and eventually causes NRFHR. These events may increase the chance of failed IOL by inducing fetal distress [11]. This finding is in alignment with studies from Ethiopia [11,24],and Pakistan [35].

One of the main limitations of our study is the poor documentation of hospital records, which affected the reliability of the data. Another limitation was that our study was conducted at a single center (KAUH). This also meant that the sample size was rather small. Furthermore, we did not examine some relevant variables, such as maternal cervical status, Bishop score, and clinician practice during IOL, which may have contributed to the failure of IOL. In addition, regarding our study design, there may be a lack of association between the factors and the fate of delivery, which may affect the outcomes of IOL. Finally, there is no published research in thesame region of the world for comparison of our results.

CONCLUSIONS

Based on the evidence gathered over the 10-year period of this study, IOL appears to be a safeobstetric procedure. That is, as long as it is performed according to the standards of care and based on the best available evidence, it can protect mothers and neonates from seriousoutcomes.

AUTHOR CONTRIBUTIONS

Concept of the study: Fatmah Alzahrani

Literature review: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, Deyala Badawi,Daniyah Alsharif.

Writing of the research proposal: Fatmah Alzahrani

Writing of introduction: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, DeyalaBadawi, Daniyah Alsharif.

Writing of Method: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, Deyala Badawi,Daniyah Alsharif.

Data collection: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, Deyala Badawi,Daniyah Alsharif, Atheer Almrzouqi.

Data analysis: Samera AlBasri, Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi,Deyala Badawi, Daniyah Alsharif, Atheer Almrzouqi.

Writing of Result: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, Deyala Badawi,Daniyah Alsharif.

Writing of Discussion: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, DeyalaBadawi, Daniyah Alsharif.

Writing of Conclusion: Fatmah Alzahrani, Raghad Khashab, Maryam M Alamoudi, DeyalaBadawi, Daniyah Alsharif.

Review and edit the manuscript: Samera AlBasri, Fatmah Alzahrani, Atheer Almrzouqi.Disclosures

ETHICAL APPROVAL

This study was approved by the institutional review board of the hospital, and informedconsent was obtained from all included patients.

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Additional Information

This research was presented as a poster at the 1st international MFM conference at Riyadh andthe 14th scientific forum at King Abdulaziz University students.

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