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Artificial Induction of Labour in Patients with Scarred Uterus: A Case-Control Study Evaluating the Efficacy and Safety of Misoprostol and the Balloon in Two Maternity Units in Dakar

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Abstract

Objective: To evaluate the efficacy and safety of misoprostol and the balloon catheter in inducing labour in this context. **Methodology:** This is a bi-centric case-control study nested within a descriptive and analytical cohort over a period of 32 months from 1 January 2021 to 31 August 2024. The methods used to induce labour were the balloon catheter and misoprostol, based on FIGO recommendations. **Results:** During the study period, 3330 deliveries on scarred uterus were recorded in the two hospitals. Among these patients, 1064 met the inclusion criteria and 69 patients had artificially induced labour. The proportion of artificial induction of labour on scarred uterus was 5.92%. The balloon was the most commonly used method of induction (55.1%). The Bishop score was considered unfavourable (below 7) in almost all cases (99.7%). Among the indications for induction, the most common was foetal death in utero, with a frequency of 18.8%. Hypertensive disorders and post-term or prolonged pregnancy were noted, with similar prevalences of 17.4%. Premature rupture of membranes was the fourth most common indication, observed in 10.1% of cases. Regarding the effectiveness of labour induction, the duration of labour is significantly longer in cases of labour induction. Vaginal delivery was more common in cases of spontaneous labour induction: prevalence rates of 66.8% were noted for spontaneous induction and 53.6% for artificial induction.

Misoprostol was associated with 67.7% of vaginal deliveries and the balloon with 42.1%: p = 0.034; OR 2.89 [1.07; 7.78]. There was a tendency towards more perinatal asphyxia in the spontaneous labour induction group. **Conclusion:** With careful patient selection and controlled indications, induction of labor remains a highly recommended method for reducing repeat caesarean section rates while minimising foetal and maternal risks.

Keywords

Labor Induction, Scarred Uterus, Misoprostol, Balloon

1. Introduction

Artificial induction of labour is defined as a medical procedure designed to artificially induce uterine contractions that cause the gradual effacement and dilation of the cervix, leading to the birth of a child [1]. It can be performed on both a new uterus and a scarred uterus. Several types of induction have been described, including pharmacological (prostaglandins and analogues, oxytocin) and mechanical methods. The issue of inducing labour in a scarred uterus is a frequently encountered situation, especially given the notable increase in the rate of caesarean sections worldwide [2] [3]. The difficulty is mainly in choosing the method of induction, with the risk of uterine rupture frequently encountered in our countries due to the lack of continuous monitoring during labour, which would allow for better surveillance of abnormalities in uterine dynamics. Another issue is the neonatal outcome in cases of induction on a scarred uterus, with a higher perinatal risk, especially when prostaglandin analogues are used [4].

In our countries, prostaglandin analogues and balloons have long been widely used in the artificial induction of labour due to the high cost of other molecules. Given the increase in caesarean section rates, including attempts at vaginal delivery on scarred uterus, we decided to conduct this study, the main objective of which was to evaluate the efficacy and safety of misoprostol and the balloon catheter in labour induction in this context.

2. Patients and Methods

- **Type of study**

This is a bi-centric case-control study nested within a descriptive and analytical cohort.

- **Study setting**

Our study was conducted at the maternity ward of the Philippe Maguilen Senghor Health Center and the Gynaecology and Obstetrics Department of the Dalal Jamm National Hospital Centre, both located in the suburbs of Dakar.

- **Study period**

This study covers a period of 32 months from 1 January 2021 to 31 August 2024.

- **Study population**

The study population consisted of women who gave birth with a scarred uterus at the Philippe Maguilen Senghor Health Center and the Dalal Jamm National Hospital Centre during the study period.

o Inclusion criteria

We included all patients with a history of caesarean section who were eligible for vaginal delivery according to local protocols (single scar uterus, transverse anterior scar, segmental scar) and who were admitted for delivery.

o Exclusion criteria

We excluded women with:

- A multi-scarred uterus,
- A longitudinal caesarean section,
- A gynaecological scar (myomectomy) or,
- A caesarean section before labour.

In the absence of surgical reports, we were able to predict the type of scar based on the context. Thus, cases of previous caesarean sections performed before 7 months of pregnancy were not included, as there is no lower segment at this stage and longitudinal caesarean section is the norm.

- **Labour induction protocols**

Labour induction protocols depended on the methods used.

o The intrauterine balloon is a medical device used to induce maturation and dilation of the cervix before delivery. This technique, also known as cervical maturation, aims to prepare the cervix for vaginal delivery by softening and opening it. We used CH20 urinary catheters. The catheter was inserted through the cervical canal into the uterine cavity. The balloon was then inflated with 60 ml of saline solution. The device was left in place. The drop in the catheter indicates an improvement in the Bishop score. At this point, the practitioner systematically adds oxytocin.

o With regard to misoprostol, we used the current protocols of the International Federation of Gynaecology and Obstetrics, depending on the stage of pregnancy and the foetal condition [5].

Oxytocin was sometimes used to manage labour after successful induction, regardless of the method used to induce labour.

- **Data collection and analysis**

Data were collected prospectively and recorded in e_Perinatal database. The collected data were exported to Excel and then analysed using Jamovi version 2.3.26 and R Studio 4.4.2 software.

- **Variables studied**

The parameters studied were related to:

o Socio-demographic and anthropometric profile: age, parity, Body Mass Index (BMI);

o Pregnancy data: gestational age, presentation, type of pregnancy, inter-birth interval;

- Delivery methods: mode of admission, mode of labour induction, duration of labour, route of delivery;
- Maternal and foetal complications: perinatal asphyxia, uterine rupture, post-partum haemorrhage.

We first compared the outcomes of women who had artificial labour induction with those who had spontaneous induction. We then compared the outcomes according to the different methods of induction. Qualitative variables were described by proportions relative to the total share. Quantitative variables were expressed by their dispersion parameters. Continuous variables were compared using the ANOVA test and scaled variables using Pearson's chi-square test if the conditions of normality were applicable, or by non-parametric tests if not. All tests were performed bilaterally and the significance level was set at 5%. We calculated the strength and direction of associations using ORs and their 95% confidence intervals.

3. Results

3.1. Descriptive Results

- **Frequency**

During the study period, the maternity unit at the Philippe Maguilen SENGHOR Health Center and the Gynaecology-Obstetrics Department at the Dalal Jamm National Hospital (CHNDJ) recorded 3330 deliveries on scarred uterus, of which 1064 met the inclusion criteria. Among these 1064 deliveries, we counted 69 patients whose labour was artificially induced. The proportion of artificially induced labour was 5.92%.

- **Socio-demographic and anthropometric profile**

The average age of the patients was 29.2 ± 6 years, with extremes of 15 and 45 years. The mode was 30 years and the median was 29 years. The Body Mass Index (BMI) of the patients was 29.3 ± 19.5 kg/m^2. The median was 27.0 kg/m^2. The average gestation was 2.16 with a median of 2 (extremes 1 and 10). The average parity was 1.90 with extremes of 1 and 11.

- **Pregnancy-related data**

The pregnancy was full-term in 60% of patients. Vertex presentation was noted in 97.1% of cases. The pregnancy was twin in 2.1% of cases. A proportion of 30.5%, or 329 women, had had a previous vaginal delivery. Table 1 shows the distribution of pregnancy-related parameters.

Table 1. Prevalence of various pregnancy-related data.

Variables	Frequency (n)	Proportion (%)
Term of pregnancy		
Term	1006	88.6
Preterm	84	7.4
Post-term	45	4.0

Continued

Type of pregnancy		
Single foetus	1145	97.9
Twin	24	2.1
History of vaginal delivery		
Yes	329	30.5
No	748	69.5
Presentation format		
Vertex	1129	97.1
Breech	33	2.8
Face	1	0.1

- **Labour-related data**

Fourteen point five per cent of women were admitted after transfer. Labour was artificially induced in 5.9% of cases. The balloon was the most commonly used method of induction (55.1%). Misoprostol was used in 44.9% of cases. The Bishop score was considered unfavourable (less than 7) in almost all cases (99.7%) (Table 2). Among the indications for induction, the most common was foetal death in utero, with a frequency of 18.8%. Hypertensive disorders and post-term or prolonged pregnancy were noted, with similar prevalences of 17.4%. Premature rupture of membranes was the fourth most frequent indication, observed in 10.1% of cases. Diabetes indicated induction in 4.3% of cases, as did induction for convenience (Table 3).

Table 2. Prevalence of different labour-related variables.

Variables	Frequency (n)	Proportion (%)
Mode of admission		
Home	995	85.5
Transfer	169	14.5
Mode of labour induction		
Spontaneous induction	1061	94.1
Artificial induction	63	5.9
Molecules used		
Balloon	38	55.1
Misoprostol	31	44.9
Bishop score		
≤7	1147	99.7
>7	3	0.3

Table 3. Distribution of different indications for artificial induction of labour.

Indications	Frequency (n)	Proportion (%)
In utero foetal death	13	18.8
SPE[a] and HTA[b]	12	17.4
Post-term pregnancy/Prolonged pregnancy	12	17.4
Premature rupture of membranes	7	10.1
Diabetes	3	4.3
Convenience	3	4.3
Hydramnios	1	1.5
Not specified	18	26.1

SPE[a] = Severe pre-eclampsia, HTA[b] = Hypertension.

- **Perinatal outcome**

Vaginal delivery was more common than caesarean section: 66% versus 34%. An Apgar score ≥ 7 was observed in 91.4% of cases. Maternal complications were rare. These included uterine rupture in 1.9% of cases and postpartum haemorrhage in 0.7% of cases (Table 4).

Table 4. Distribution of the population according to perinatal outcome.

Variables	Frequency	Proportion (%)
Mode of delivery		
Vaginal delivery	771	66
Caesarean	397	34
Foetal condition		
Fresh stillborn	21	1.8
Stillborn macerated	27	2.3
Apgar score ≥ 7	1069	91.4
Apgar score < 7	35	3.0
Maternal complications		
Postpartum haemorrhage	8	0.7
Uterine rupture	22	1.9

3.2. Analytical Results

- **Patient profile**

Women who had their labour artificially induced were on average significantly older than those who had spontaneous induction. The average age was 30.8 years for the first group and 29 years for the second group. The Student's t-test revealed a significant difference with a p-value of 0.018.

We compared the history of vaginal delivery between the two groups. There were slight differences (27.9% versus 30.7%) that were not statistically significant.

When comparing the type of foetal presentation with whether or not labour was induced, no correlation was found.

- **Labour and delivery data**

The duration of labour is significantly longer in cases of labour induction. In fact, the number of patients with a labour duration of more than 12 hours is three times higher in the artificial labour induction group: OR = 3.22; 95% CI = [1.47; 7.14] (Table 5).

Table 5. Association between duration of labour and mode of induction.

Labour induction / Duration of labour	No	Yes	p	OR [95% CI][a]
6 - 12 hours	373 (55.9%)	16 (42.1%)		
Less than 6 hours	207 (31%)	10 (26.3%)	0.773	0.89 [0.40; 1.99]
More than 12 hours	87 (13%)	12 (31.6)	0.002	3.22 [1.47; 7.14]

OR [95% CI] [a] = Odds ratio [95% confidence interval].

There was a tendency towards more perinatal asphyxia in the spontaneous labour induction group: 3.2% versus 0% in the artificial induction group. However, due to the small sample size, we cannot conclude that there was a significant difference.

The rate of uterine rupture was 1.4% in the artificial induction group and 1.9% in the spontaneous induction group. The difference was not significant. No cases of postpartum haemorrhage were noted in the artificial labour induction group (Table 6).

Table 6. Association between perinatal outcomes and method of labour induction.

	Mode of delivery			
Type of induction	Caesarean	Vaginal delivery	p	OR [95% CI][a]
Artificial	32 (46.4%)	37 (53.6)	0.025	0.58 [0.35; 0.94]
Spontaneous	365 (33.2%)	733 (66.8%)		
	Apgar score			
Induction type	Apgar score ≥ 7	Apgar score < 7	p	OR [95% CI][a]
Artificial	53 (76.8%)	0	<0.001	-
Spontaneous	1016 (92.4%)	35 (3.2%)		
	Uterine rupture			
Induction type	Yes	No	p	OR [95% CI][a]
Artificial	1 (1.4%)	68 (98.6%)	0.78	0.76 [0.1; 5.7]
Spontaneous	21 (1.9%)	1079 (98.1%)		

Continued

	Postpartum haemorrhage			
Induction type	Yes	No	p	OR [95% CI][a]
Artificial	0 (0%)	69 (100%)	0.48	0.93 [0.1; 16.2]
Spontaneous	8 (0.7%)	1092 (99.3%)		

Vaginal delivery was more common in cases of spontaneous labour induction: prevalence rates were 66.8% for spontaneous induction and 53.6% for artificial induction. The difference was significant: p = 0.025 OR = 0.58; 95% CI = [0.35; 0.94].

- **Comparison between induction with misoprostol and mechanical induction with a balloon catheter**

Misoprostol was associated with 67.7% of vaginal deliveries and the balloon with 42.1%: p = 0.034; OR 2.89 [1.07; 7.78]. The only case of uterine rupture observed in the artificial induction group followed the use of the balloon (Table 7).

Table 7. Association between perinatal outcome and method of induction.

	Mode of delivery			
Method	Caesarean	Vaginal	p	OR [95% CI][a]
Balloon	22 (57.9%)	16 (42.1)	0.034	2.89 [1.07; 7.78]
Misoprostol	10 (32.3%)	21 (67.7%)		
	Apgar score			
Average	Apgar score ≥ 7	Apgar score < 7	p	OR [95% CI][a]
Balloon	32 (76.8%)	0	-	-
Misoprostol	21 (92.4%)	0 (0%)		
	Uterine rupture			
Average	Yes	No	p	OR [95% CI][a]
Balloon	1 (2.6%)	37 (97.4%)	0.36	-
Misoprostol	0 (0%)	31 (100%)		

4. Discussion

4.1. Main Results

During the study period, we recorded 1064 parturients who met the inclusion criteria. We counted 69 patients whose labour was artificially induced, representing a proportion of 5.92%.

The average age of the patients was 29.2 ± 6 years, ranging from 15 to 45 years. The average gestation was 2.16 and the average parity was 1.90. A proportion of 30.5%, or 329 women, had had a previous vaginal delivery. The pregnancy was full-term in 60% of patients. Vertex presentation was noted in 97.1% of cases.

The balloon was the most commonly used method of induction with 55.1%. Misoprostol was used in 44.9% of cases. The Bishop score was considered unfavourable (less than 7) in 99.7% of cases.

The most common indication for induction was foetal death in utero, with a frequency of 18.8%. This was followed by hypertensive disorders and post-term and prolonged pregnancy, with similar prevalences of 17.4%. Vaginal delivery was noted in 66% of cases. An Apgar score ≥ 7 was observed in 91.4% of cases. Maternal complications were rare. These included uterine rupture in 1.9% of cases and postpartum haemorrhage in 0.7% of cases.

In the analytical study, the patient profiles were similar in both groups (spontaneous induction and artificial induction of labour) in terms of history of vaginal delivery and mode of presentation.

The duration of labour was significantly longer in cases of labour induction. The number of patients with a labour duration of more than 12 hours was three times higher in the artificial labour induction group: OR = 3.22; 95% CI = [1.47; 7.14]. Vaginal delivery was more common in cases of spontaneous labour induction: 66.8% versus 53.6%. There was a tendency towards more perinatal asphyxia in the spontaneous labour induction group: 3.2% versus 0%. The rate of uterine rupture was 1.4% in the artificial induction group and 1.9% in the spontaneous induction group. The difference was not significant. Similarly, the difference was not significant in terms of the occurrence of postpartum haemorrhage.

Misoprostol was associated with 67.7% of vaginal deliveries and the balloon with 42.1%, a significant difference. The only case of uterine rupture in the artificial labour induction group followed the use of the balloon.

4.2. Interpretation of Results

In our study, the frequency of artificial induction in patients with a scarred uterus was 5.92%. This rate is significantly lower than that reported in several international studies. Ukoha *et al.* [5] found a frequency of 13% in Nigeria, while in France, Ouillon J. *et al.* [6] reported a rate of 27%. The frequency found in our study probably reflects a cautious approach to artificial induction, especially in cases of scarred uterus. It reflects a rigorous selection of patients, adapted to a context of limited resources, where the risk of uterine rupture and difficulties in foetal monitoring remain a major concern. Some schools recommend systematic artificial induction of labour at 39 weeks of gestation to improve perinatal outcomes. These recommendations are not applied in our practice setting.

The average age of the patients was 29.2 ± 6 years, with extremes of 15 and 45 years. The average gestation was 2.16 and the average parity was 1.90. Compared to the study by Mazeau *et al.* [7], the population in our study is slightly younger, with an average age of 29.2 years compared to 31.86 years. Similarly, gestation (2.16 versus 3.24) and parity (1.90 versus 2.43) were lower. These differences can be explained sociologically. Women giving birth in Africa are generally younger than in developed countries. Indeed, these countries are more affected by the decline in the age of motherhood.

In our series, foetal death in utero was the main indication for artificial induction (18.8%). This was followed by hypertensive disorders of pregnancy (17.4%) and prolonged pregnancies (17.4%). Hofmeyr *et al.* [8] found prolonged pregnancy to be the primary indication (32%), ahead of hypertensive disorders (28%) and premature rupture of membranes (PROM) (16%). Similarly, Mazeau *et al.* [7] reported PPROM as the main indication (29.01%), followed by prolonged pregnancy (16.67%), gestational diabetes (13.58%) and hypertensive disorders (12.1%). We observe similar indications for labour induction in all these studies. The predominance of intrauterine foetal death in our series highlights weaknesses in the prenatal care of women.

The two main methods of induction were balloon (55.1%) and misoprostol (44.9%). These results are broadly consistent with those reported by several authors. Guise *et al.* [9] highlighted a growing preference for mechanical methods in patients with scarred uterus. This is explained by the balloon's better safety profile with regard to the risk of uterine rupture. Similarly, Leduc *et al.* [10] recommended that women with a history of caesarean section should avoid prostaglandins such as misoprostol, except at very low doses and under strict supervision, due to an increased risk of complications. Nevertheless, the use of misoprostol remains significant in our series (nearly 45%) and can be explained by its availability, affordability, and the mastery of its administration protocol.

The rate of vaginal delivery after induction on a scarred uterus was 66%, which is consistent with data found in the literature. Comparable studies, such as that by Hofmeyr *et al.* [8], report vaginal delivery rates ranging from 55% to 75% depending on the method used and the obstetric profile. Studies by Wallström [11] and Sharma [12] reported vaginal delivery rates of 70% and 66% respectively. These results demonstrate the effectiveness of artificial induction of labour.

They also confirm that, under the right conditions, vaginal delivery after caesarean section is possible, thereby reducing the risks associated with repeat caesarean section.

Furthermore, the chances of vaginal delivery are higher with artificial induction of labour compared to spontaneous induction. A randomised controlled trial should be conducted in order to issue recommendations on the systematic induction of labour in cases of scarred uterus at 39 weeks of gestation.

The Apgar score was above 7 in 91.4% of cases. This result is consistent with the literature, notably Cao *et al.* [13], who conclude in their study that labour induction with o women with a history of caesarean section does not lead to a decrease in the Apgar score at birth. This shows that, when properly supervised, artificial induction does not compromise the health of the newborn at birth, even in high-risk patients.

The rate of vaginal delivery was significantly higher in patients who received misoprostol, at 67.7% compared to 42.1% in the balloon group.

The same conclusions are found in the literature. Hofmeyr *et al.* [8], show that misoprostol is more effective than the balloon. In a meta-analysis based on 2815

patients, the use of the balloon was found to be slightly less effective than oral misoprostol in achieving vaginal delivery [14]. This study concludes that misoprostol is more effective in inducing vaginal delivery, particularly in cases of unfavourable cervical conditions. Thus, despite unfavourable recommendations, misoprostol, used in small doses and under close supervision, can achieve a satisfactory vaginal delivery rate in carefully selected patients.

In terms of complications, the rate of uterine rupture was higher in cases of spontaneous labour induction, although the difference was not significant.

Only one case of uterine rupture was observed in the artificial labour induction group, involving the balloon. No cases of rupture were recorded in women who received misoprostol. These results appear to contradict many studies found in the literature. A study by Henkel A *et al.* [15] shows an increased risk of uterine rupture in patients induced with misoprostol who have had a previous caesarean section. Although misoprostol is sometimes criticised for its potential to induce uterine hyperstimulation [16], our results did not show any serious complications related to its use in this population. The difference lies in the fact that the use of FIGO-recommended doses in our study contributes to safety [17]. This reinforces the idea that, under well-controlled conditions and with a rigorous protocol, misoprostol can be used safely, even in patients with a scarred uterus.

5. Conclusion

Inducing labour in women with a scarred uterus is a high-risk obstetric situation that requires rigorous and individualised assessment. With careful patient selection and controlled indications, it remains a highly recommended method for reducing repeat caesarean section rates while minimising foetal and maternal risks.

Conflicts of Interest

None.

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