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Original Research Article

A cross-sectional study for induction to delivery interval with sweeping of membrane followed by misoprostol

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ABSTRACT

Background: Post-term pregnancy carries increased maternal and neonatal risks, necessitating timely and effective induction. Membrane sweeping is a simple mechanical technique that promotes endogenous prostaglandin release and may enhance the cervical-ripening effect of misoprostol. This study evaluated whether membrane sweeping before misoprostol improves induction outcomes in term nulliparous women.
Methods: A cross-sectional study was conducted among 78 low-risk nulliparous women ≥40 weeks. Group 1 (n=39) received misoprostol alone, and group 2 (n=39) underwent membrane sweeping followed by misoprostol. Primary outcome was the induction-to-delivery interval; secondary outcomes included latency period, induction-to-full dilatation, labor duration, oxytocin requirement, maternal complications, and neonatal outcomes. Standard statistical tests and logistic regression were applied using IBM SPSS v1.0.0.1406.
Results: Baseline characteristics were comparable (mean age 26.47 years, BMI 23.38 kg/m^2, gestational age 40.32 weeks, Bishop score 4.37). Membrane sweeping significantly shortened duration of labor and time to full dilatation ($p<0.05$). The mean induction-to-delivery interval was 18.01 hours, with a faster trend in the sweeping group. Latency period strongly correlated with full dilatation ($r=0.853$) and induction-to-delivery interval ($r=0.876$) ($p<0.001$). Maternal and neonatal complications were similar. Mean APGAR scores were 6.87 at 1 minute and 8.88 at 5 minutes; mean birth weight 3.11 kg.
Conclusions: Membrane sweeping before misoprostol is a safe and effective adjunct that improves labor progression without increasing maternal or neonatal risks.

Keywords: Induction, Labor outcomes, Membrane sweeping, Misoprostol, Term pregnancy

INTRODUCTION

Post-term pregnancy, defined as gestation extending beyond 40–42 weeks, is associated with a progressive rise in maternal and neonatal complications, including oligohydramnios, meconium aspiration, fetal distress, shoulder dystocia, postpartum hemorrhage, and increased operative delivery rates.[1-3] As pregnancy advances, placental senescence and reduced uteroplacental perfusion may further compromise fetomaternal well-being. For this reason, timely induction of labor becomes particularly important in term nulliparous women. NICE (2024) recommends counselling all women by 38 weeks regarding the risks of prolonged pregnancy and available options such as membrane sweeping or induction of labor.[4] Several factors- such as primigravidity, prior post-term pregnancy, and fetal anomalies- predispose to post-maturity, while fetal and maternal complications have been widely documented.[5-8]

Induction of labor (IOL), defined as the artificial initiation of cervical ripening and contractions, has increased globally to nearly 25.5% due to rising medical indications and contemporary evidence supporting earlier induction.[9-

[13] The Bishop score remains central to assessing readiness for induction, while methods such as prostaglandins, oxytocin, and mechanical techniques including Foley catheters and membrane sweeping- are commonly used.[14-17]

Membrane sweeping is a simple mechanical procedure that promotes endogenous prostaglandin release and cervical remodeling.[18] It has been shown to be safe even in group B *Streptococcus*-colonized women and is supported by large reviews, including the 2020 Cochrane update, which confirmed its effectiveness in reducing prolonged pregnancies without increasing maternal or neonatal infection.[19-21] Some studies indicate that repeated sweeping may be more effective than a single attempt, and sweeping may enhance the clinical performance of misoprostol by improving cervical favorability.[22-28]

Given these findings, this study evaluated whether membrane sweeping prior to misoprostol induction shortens the induction-to-delivery interval and improves maternal and neonatal outcomes.

METHODS

This cross-sectional comparative study was conducted in the department of obstetrics and gynecology, Regional Institute of Medical Sciences (RIMS), Imphal, over a two-year period from May 2022 to June 2024. A total of 78 sample size was calculated as per the formula N= $(Z)^2$ σ^2/L^2 at 95% confidence interval, where the allowable margin of error was considered as 1.29 A total of 78 low-risk nulliparous women with singleton, cephalic pregnancies at ≥40 weeks of gestation were recruited after confirming eligibility through clinical assessment and first-trimester dating ultrasound. Only women with unfavorable cervices (Bishop score <6), intact membranes, and no signs of spontaneous labor were included. Women with meconium-stained liquor, cephalopelvic disproportion, antepartum hemorrhage, hypertensive disorders, gestational diabetes, oligohydramnios, PROM, previous uterine surgery, or any contraindication to vaginal delivery were excluded to ensure homogeneity and safety.

After informed consent, participants were randomly allocated into two equal groups: group 1 received misoprostol alone, whereas group 2 underwent membrane sweeping immediately prior to misoprostol induction. Membrane sweeping was performed during sterile vaginal examination by inserting a gloved finger through the internal os and rotating circumferentially to separate the membranes from the lower uterine segment. Induction was carried out using 25 mcg vaginal misoprostol administered every 4-6 hours, up to a maximum of four doses or until adequate contractions and cervical change occurred. Oxytocin augmentation and artificial rupture of membranes were used when clinically indicated. Continuous maternal and fetal monitoring was ensured using partographs, intermittent auscultation, and electronic fetal monitoring as required.

The primary outcome was the induction-to-delivery interval. Secondary outcomes included latency period, induction-to-full cervical dilatation time, total duration of labor, mode of delivery, need for oxytocin, maternal complications (tachysystole, hyperstimulation, PPH, fever), neonatal outcomes (APGAR scores, NICU admissions), and birth weight. Data were entered and analyzed using SPSS v21, applying independent t-test, Mann-Whitney U test, chi-square test, Spearman correlation, and logistic regression, with statistical significance set at $p<0.05$.

RESULTS

A total of 78 women were included in the study, with 39 induced using misoprostol alone and 39 undergoing membranes sweeping followed by misoprostol. The mean age was 26.47±3.33 years, comparable between groups (Table 1).

Table 1: Descriptive statistics.

	N	Min.	Max.	Mean	SD	Variance
Age: method of induction: misoprostol only	39	19	39	26.67	3.709	
Age: method of induction: sweeping f/b misoprostol	39	20	39	26.28	2.946	
Age: total	78			26.47	3.333	
BMI pre-pregnancy (kg/m^2)	78	21.0	27.0	23.385	1.3116	1.720
Period of gestation (weeks)	78	40.0	41.0	40.327	0.2607	0.068
Latency period (hours:minute)	78	5:00	17:00	10:20	2:43	95711883.117
Bishop score at induction	78	4.00	5.00	4.3718	0.48641	0.237
Duration of ruptured membranes	78	1:00	6:00	3:36	0:50	9233759.041
Induction to full dilatation (hours:minute)	75	10:00	24:00	16:58	2:56	111575124.324
Duration of labor (hours:minute)	78	3:00	10:00	7:36	1:18	22289865.135
Induction to delivery time interval	78	11:30	25:45	18:01	2:56	112172547.453
APGAR Score at 1 minute	78	5	8	6.87	0.437	0.191
APGAR Score at 5 minutes	78	7	9	8.88	0.360	0.129
Birth Weight (Kg)	77	2.4	3.6	3.114	0.2905	0.084

Table 2: Correlation statistics.

List of significant correlations on Spearman's test.		
Variables	**Coefficient**	**Significance 2-tailed (p value)**
Method of induction and Bishop score at induction	-0.292	0.01**
Method of induction and induction to full dilatation	-0.232	0.046*
Method of induction and duration of labor	-0.270	0.017*
Age and neonatal complications	0.235	0.072*
Age and APGAR at 1 minute	-0.270	0.017*
Age and APGAR at 5 minutes	-0.257	0.023*
BMI and neonatal complications	0.248	0.029*
BMI and APGAR at 1 minute	-0.289	0.010**
Bishop score and method of induction	-0.292	0.010**
Bishop score and duration of rupture of membranes	-0.249	0.028*
Latency period and induction to full dilatation	0.853	0.000**
Latency period and induction to delivery time	0.876	0.000**
Latency period with intrapartum need for oxytocin	0.266	0.019*
Latency period with labor complications	0.321	0.004**
Latency period with neonatal complications	0.298	0.008**
Latency period and APGAR1	-0.323	0.004**
Latency period and APGAR5	-0.266	0.019*
Duration of rupture of membrane and intrapartum need for oxytocin	0.229	0.044*
Induction to full dilatation and duration of labor	0.410	0.000**
Induction to full dilatation and induction to delivery time interval	0.941	0.000**
Induction to full dilatation and intrapartum need for oxytocin	0.478	0.000**
Induction to full dilatation and neonatal complication	0.273	0.018*
Induction to full dilatation and APGAR1	-0.301	0.009**
Duration of labor and Induction to delivery time interval	0.467	0.000**
Duration of labor and intrapartum need for oxytocin	0.718	0.000**
Duration of labor and APGAR5	0.243	0.032*
Induction to delivery time and intrapartum need for oxytocin	0.559	0.000**
Labor complications and neonatal complications	0.795	0.000**
Labor complications and APGAR1	-0.762	0.000**
Labor complications and APGAR5	-0.852	0.000**
Neonatal complications and APGAR1	-0.954	0.000**
Neonatal complications and APGAR5	-0.938	0.000**
APGAR1 and APGAR5	0.896	0.000**

**Corelation is significant at the 0.01 level (2-tailed). *Corelation is significant at the 0.05 level (2-tailed).

Table 3: Test of significance- independent samples test.

	Levene test for equality of variances		**t-test for equality of means**						
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean diff.**	**SE diff.**	**95% CI lower**	**95% CI upper**
Latency period (equal variances assumed)	2.071	0.154	0.961	76	0.339	0.35	0.36	-0.38	1.49
Latency period (equal variances not assumed)			0.961	68.991	0.340	0.35	0.36	-0.38	1.49
Induction to full dilatation (equal variances assumed)	1.626	0.206	1.813	73	0.074	1.12	0.40	-0.07	2.32
Induction to full dilatation (equal variances not assumed)			1.806	66.489	0.076	1.12	0.40	-0.07	2.32
Induction to delivery time interval (equal variances assumed)	1.461	0.231	1.674	76	0.098	1.06	0.39	-0.12	2.24
Induction to delivery time interval (equal variances not assumed)			1.674	71.239	0.098	1.06	0.39	-0.12	2.24

For parametric variables - independent samples test was used. Assumption test for independent t test was run (Levene's test)

Table 4: Ranks.

	Method of Induction	N	Mean rank	P value
Latency period	Misoprostol only	39	42.64	
Latency period	Stripping f/b misoprostol	39	36.36	
Latency period	Total	78		0.221
Duration of ruptured membranes	Misoprostol only	39	39.69	
Duration of ruptured membranes	Stripping f/b misoprostol	39	39.31	
Duration of ruptured membranes	Total	78		0.942
Induction to full dilatation	Misoprostol only	38	42.93	
Induction to full dilatation	Stripping f/b misoprostol	37	32.93	
Induction to full dilatation	Total	75		0.046
Duration of labor	Misoprostol only	39	45.50	
Duration of labor	Stripping f/b misoprostol	39	33.50	
Duration of labor	Total	78		0.018
Induction to delivery time interval	Misoprostol only	39	44.17	
Induction to delivery time interval	Stripping f/b misoprostol	39	34.83	
Induction to delivery time interval	Total	78		0.068

WMW test reveals significant difference only in Duration of labor and the time from induction to full dilatation between the two methods of induction.

Table 5: Logistic regression.

Variables in the equation (logistic regression)- labor complications									
	Variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% CI lower**	**95% CI upper**
Step 1[a]	Latency period	0.002	0.053	0.002	1	0.964	1.002	0.904	1.112
	Duration of ruptured membranes	0.001	0.000	4.166	1	0.041	1.001	1.000	1.002
	Induction to full dilatation	-0.001	0.001	1.568	1	0.210	0.999	0.997	1.001
	Duration of labor	0.002	0.053	0.002	1	0.967	1.002	0.904	1.112
	Induction to delivery time interval	-0.001	0.053	0.001	1	0.982	0.999	0.900	1.108
	Constant	-17.331	7.854	4.869	1	0.027	0.000		

Testing model for assessing association between different variables and presence and absence of Labor complications. [a]Variables entered on step 1: latency period, duration of ruptured membranes, induction to full dilatation, duration of labor, induction to delivery time interval. This model has a 92% accuracy in predicting labor complications in this study. This can successfully predict 71.6% (Pseudo R square) of the variance in the labor complications. Only Duration of labor after rupture of membranes has a significant association with presence or absence of labor complications with a p value of 0.041 although it has a low OR of 1.001.

Baseline parameters showed a mean BMI of 23.38 kg/m^2, mean gestational age of 40.32 weeks, and mean Bishop score of 4.37, indicating uniformly unfavorable cervices. The mean latency period was 10:20 hours, the mean induction-to-full dilatation time was 16:58 hours, the duration of labor averaged 7:36 hours, and the induction-to-delivery interval was 18:01 hours (Table 2). Neonatal outcomes were favorable, with mean Apgar scores of 6.87 at 1 minute and 8.88 at 5 minutes, and a mean birth weight of 3.11 kg.

Normality testing identified latency period, induction-to-full dilatation, and induction-to-delivery interval as parametric variables (Table 3). Spearman correlation revealed significant associations between the method of induction and Bishop score, induction-to-full dilatation, and duration of labor. The latency period showed strong positive correlations with induction-to-full dilatation (r=0.853) and induction-to-delivery interval (r=0.876), along with significant correlations with oxytocin requirement, labor complications, neonatal complications, and Apgar scores (Table 4). Induction-to-full dilatation time correlated strongly with both duration of labor and overall induction-to-delivery interval.

Mann-Whitney U analysis demonstrated significant differences between the two induction methods in duration of labor and time to full dilatation, favoring membrane sweeping. Logistic regression identified duration of labor after rupture of membranes as the only significant predictor of both labor (p=0.041) and neonatal complications (p=0.022), albeit with a low odds ratio. Chi-square testing showed no significant difference between groups in labor complications, neonatal complications, or oxytocin requirement.

Table 6: Chi square test.

	Labor complications		Neonatal complications		Need for oxytocin		
Method of Induction	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Total**
Misoprostol only	32	7	34	5	15	24	39
Stripping f/b Misoprostol	35	4	35	4	18	21	39
Total	67	11	69	9	33	45	78
Fisher's exact/chi square value	0.517		1.0		0.473		
Significance	Not significant		Not significant		Not significant		

DISCUSSION

The spontaneous onset of labor is a strong physiological process guided by fetal system maturation, and should be allowed to progress naturally whenever safely possible. As Turnbull noted, "We should only induce labor when we are confident that we can do better".[30] Effective induction of labor (IOL) reduces cesarean delivery rates, but despite multiple pharmacological and mechanical options, the optimal method remains unclear because success varies with maternal and obstetric factors.[31] This study aimed to determine whether membrane sweeping combined with misoprostol offers any advantage over misoprostol alone in achieving vaginal delivery within 24 hours.

Membrane sweeping was first introduced by James Hamilton in 1810. Multiple studies report that sweeping increases spontaneous vaginal delivery, shortens induction-to-delivery intervals, reduces post-term pregnancy, and decreases the need for formal induction.[32,33] The STRIP-G study further demonstrated that sweeping is safe even in women colonized with group B *Streptococcus*.[34]

Several studies have evaluated timing and effectiveness of sweeping. Yildirim et al. compared sweeping at 38-40 weeks (n=179) with pelvic examination alone (n=167), reporting significantly shorter time to delivery in the sweeping group (4 versus 8 days, $p<0.0001$).[35] Hassan reported an 86.4% success rate of vaginal birth with sweeping at 40 weeks.[36] In this study, sweeping was also initiated at 40 weeks to determine whether it shortened the induction-to-delivery interval when used before misoprostol.

A total of 78 women were enrolled and randomized into group 1 (misoprostol alone, n=39) and group 2 (membrane sweeping + misoprostol, n=39). Baseline demographics were comparable: mean age was 26.67±3.709 versus 26.28±2.946; booking status identical (51.28% booked in each group). Working women comprised 38.46% versus 30.76%, and homemakers 61.53% versus 69.23%. Education levels were also similar: ≤12th standard (76.92% versus 71.79%), undergraduate (15.38% versus 25.64%), and postgraduate (7.69% versus 2.56%).

Vaginal delivery occurred in 87.17% of women receiving misoprostol alone versus 92.30% in the sweeping group ($p=0.300$). Although this trend favored sweeping, it did not reach statistical significance. Liu similarly reported higher vaginal birth rates in nulliparous women following sweeping.[37]

Maternal outcomes were favorable in both groups. Overall, 76.92% of women had no complications. Tachysystole occurred in 2.56%, hyperstimulation in 5.12%, and PROM in 12.82-15.38%. No cases of postpartum hemorrhage or chorioamnionitis were observed.

Neonatal outcomes were similarly reassuring. Apgar ≥7 at 1 minute was 87.17% versus 92.30%, and Apgar ≥8 at 5 minutes 97.43% versus 100%. One neonate (2.56%) in the misoprostol-only group required NICU admission. These findings mirror Nyamzi et al, who reported NICU admission rates of 3.1% and 4.1% following sweeping.[38]

Latency periods were 10:38 hours versus 10:03 hours ($p=0.169$). Induction-to-delivery time was shorter in the sweeping group: 66.66% delivered in 12-18 hours versus 48.71% in the misoprostol group, while 51.28% versus 30.76% delivered between 18-24 hours. Additionally, 10.25% of women in the sweeping group delivered within 12 hours. Despite these improvements, differences were not statistically significant- consistent with Day's findings (19.9 versus 18.7 hours).[39]

The major strength of this study is that all inductions were conducted uniformly at a single center, minimizing management-related bias.

CONCLUSION

In this study, 78 low-risk nulliparous term women were randomized to induction with misoprostol alone or membrane sweeping followed by misoprostol. Both groups were comparable in age, pre-gestational BMI, gestational age, and other baseline parameters. There were no significant differences in uterine hyperstimulation, abnormal fetal heart rate patterns, neonatal Apgar scores, or oxytocin and analgesic requirements. Membrane sweeping did not increase maternal or neonatal complications and was associated with a higher rate of spontaneous rupture of membranes, without increasing PROM. Despite having a lower modified Bishop score, the membrane-sweeping group experienced a shorter

induction-to-delivery interval, though not statistically significant.

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