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ORIGINAL ARTICLE

A Comparative Analysis of Combined Approaches to Labor Induction

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ABSTRACT
Induction of labor involves a variety of methods, such as pharmacological, non-pharmacological (mechanical), and combination techniques. The possible advantages of combining methods highlight the need for further research to enhance labor induction techniques. The objective of the present study was to evaluate the effects of combining oxytocin with Foley's catheter and stripping of membrane on the health outcome of the mother. This study was an observational clinical study conducted in the Rising Medicare Hospital, Kharadi, Pune, Maharashtra, India between 11th March 2021 to 12th September 2023. Pregnant women were divided into three groups according to the induction techniques used as pharmacological, non-pharmacological, and combined methods of IOL. Data analysis was done using IBM SPSS Statistics version 20. The present study involved 296 pregnant women who underwent labor induction. The combined methods of IOL showed the highest 65.71 % normal delivery rates and 15.71 % instrumental (vaginal) delivery rates compared to both pharmacological 53.18 % and non-pharmacological 49.06 % with negligible instrumental (vaginal) delivery rates. Combined methods showed very less (18.57%) chances of C-section (LSCS) rates than both pharmacological (43.35 %) as well as non-pharmacological methods of IOL (49.06 %). The combined methods showed a 75 % success rate within 12 hours of initiation of the dose of induction of labor and are highly significant for achieving a normal mode of delivery with fewer maternal complications. Further research is needed to optimize these combined methods for improved maternal health outcomes.
Keywords*:* Cervical status, combined, Induction of labor, non-pharmacological, pharmacological, PV findings, success rate

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INTRODUCTION

Induction of labor is a common procedure in modern obstetrics since it is frequently performed to prevent unfavorable neonatal and maternal outcomes [1]. The procedure involves stimulating uterine contractions to facilitate delivery before the onset of natural labor [2-4]. According to research, 20 % to 25 % of all deliveries are preceded by labor induction, making it a common obstetric technique [4 & 5]. It is indicated when the continuation of the pregnancy poses a great danger to the well-being of the mother, neonate, or both [6]. The pharmacological method of induction of labor is frequently achieved using prostaglandin E1 (misoprostol), prostaglandin E2 (dinoprostone), and oxytocin a hormone [7 & 8] along with non-pharmacological (mechanical) methods like Foley catheter and stripping of the membrane [9 & 10] to assist ripen the cervix and cause contractions to speed up the start of labor. The potential synergistic effects seen when non-pharmacological (mechanical) and pharmacological treatments are merged to support the induction process serve as reasons for the investigation of combination methods [11]. Nonetheless, there is constant conflict on the effectiveness of these combinations, as seen by the inconsistencies in the findings of research comparing various induction techniques [12]. A mixed

technique used for labor induction is the combination of oxytocin, membrane stripping, and Foley's catheter. Prior studies have demonstrated the importance of non-pharmacological (mechanical) techniques such as the Foley catheter in cervical ripening and the onset of labor. It is also possible that these techniques could improve the efficacy of pharmacological medicines like oxytocin [13]. Prostaglandins and mechanical dilatation techniques have been recommended as possible ways of reducing the rate of induction failure as well as improving the advancement of labor because of their combined effect on cervical ripening [14]. Despite of this many researchers clearly stated that there is a lack of comprehensive studies on the combination techniques for inducing labor [15-17]. Comparative studies are required to examine various combination strategies, such as misoprostol [18 & 19], and oxytocin with mechanical methods. Enhancing maternal and neonatal healthcare needs research on the long-term results, safety, effectiveness, and patient preferences of combination induction methods. [20-23] Studies have also examined the connection between the combined technique of labor induction and outcomes like cesarean birth and failed induction rates [24]. The current literature on the induction of labor using combined methods found several gaps in knowledge and areas that warrant further investigation.

The objective of the study was to evaluate the effects of combination induction approaches, namely oxytocin administered with membrane stripping and oxytocin administered with a Foley catheter a blend of pharmacological and non-pharmacological (mechanical) labor induction methods to offer insights regarding the most effective method for labor induction.

Study design

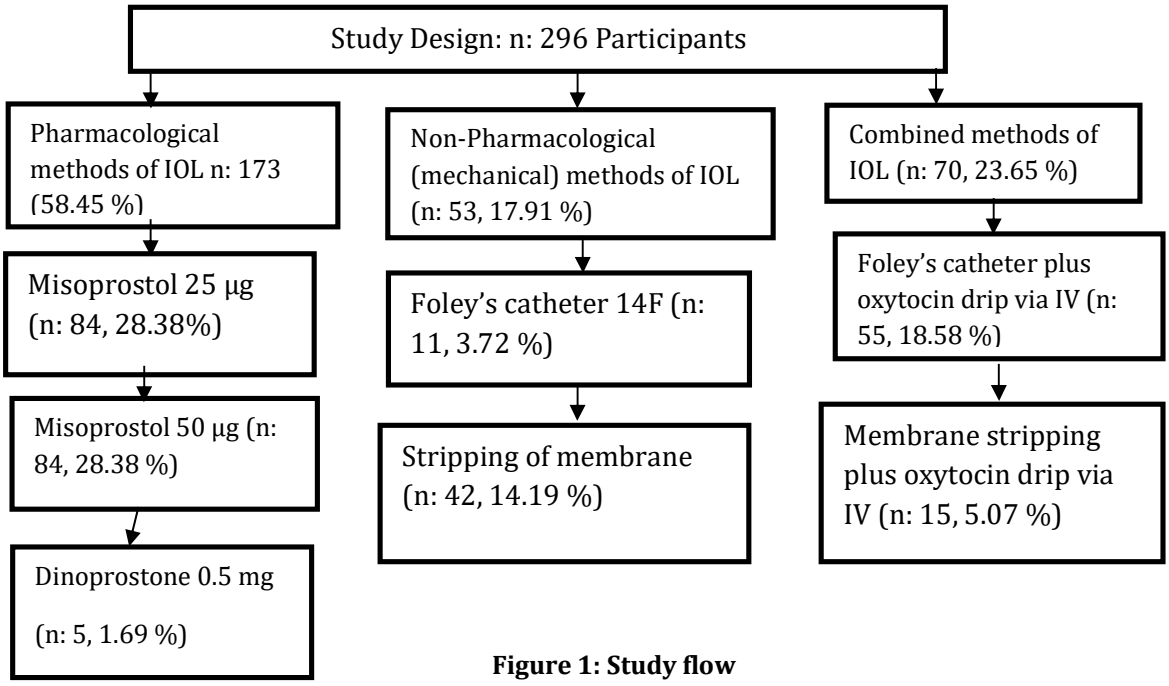

Figure 1: Study flow

MATERIAL AND METHODS

This study was an observational type of study conducted in Rising Medicare Hospital in Kharadi, Pune, Maharashtra, India, between 11th March 2021 and 12th September 2023. It was approved by the hospital ethics committee approval number: ECR/1578/Inst/MH/2021, date of registration was 30 September 2021. Patients were explained the study by a trained healthcare provider before the start of the induction process and written consent was obtained from those who were willing to participate in the study. Standardized protocol of induction and active phase management was followed throughout the study. The first group named "pharmacological methods" considered women induced with 25 ug and 50 ug misoprostol respectively and 0.5 mg dinoprostone gel. The second group named "non-pharmacological (mechanical) methods" included women induced using trans cervical Foley catheter filled with 30 cc normal saline and stripping of membrane. All interventions were administered intracervically. The third group named the combined methods group employed a blend of pharmacological and non-pharmacological methods for the induction of labor (IOL). This cohort included women who were induced using a transcervical Foley catheter (14 F) filled with 30 cc normal saline, coupled with the

administration of oxytocin at an initial dose of 2 mU every 15 minutes, increasing up to a maximum of 40 mU via the intravenous route. Additionally, stripping of the membrane was performed in conjunction with oxytocin administration under the same dosing regimen [11]. Every six hours, the dose was repeated until the desired Bishop score and uterine contraction were attained. Cesarean delivery is performed by healthcare providers if the patient is in labor (>4 cm dilated and at least 90% or > 5 cm dilated) after 36 hours of cervical ripening or after 12 hours of activation. Data analyses were done by using IBM SPSS Statistics version 20.

Participant selection criteria:

Inclusion Criteria: All the pregnant women above 18 years of age were admitted to the labor room and who were expected to undergo induction.

Exclusion Criteria: Less than 37 weeks of gestation; scarred uterus (previous surgery on the uterus, i.e., cesarean delivery); twin's pregnancy; breech presentation; and fetal anomalies.

Statistics used

In the data analysis, categorical variables were compared with Pearson's Chi-square test, and the importance of independent variables was assessed with likelihood ratio tests. Logistic regression models utilize Nagelkerke R^2 to determine explained variation, while multivariate logistic regression examines relative risks for ineffective labor induction techniques, and binomial logistic regression assesses event probabilities. Statistical significance was determined at $p < 0.05$.

Outcome measures assessed

In the present study the following maternal outcomes were assessed: the success rate of induction, normal delivery rates, cesarean section (LSCS) rate, to evaluate the effectiveness of the interventions.

RESULTS

There was a total of 680 women admitted to the labor room during the study period from 11th March 2021 to 12th September 2023. Of them, 187 denied participating, whereas 197 participants were excluded from the study as they were not fitting the inclusion criteria. The final count was 296 women who met the eligibility criteria and were willingly ready to participate were enrolled in the study (Figure 1). All the patients enrolled were from the same demographic and clinical characteristics.

Out of 296 participants, 58.45% received pharmacological methods of induction of labor (IOL), a smaller subset of patients 17.91% of the total were treated with non-pharmacological methods of IOL whereas, combined methods of IOL to handle 23.65% of the subjects.

Table 1: Maternal Characteristics of all the three groups

A. Maternal Parameters:	**Pharmacological**		**Non-Pharmacological**		**Combined**	
Maternal Age groups:	Subjects	%	Subjects	%	Subjects	%
18-25	46	15.54	13	4.39	16	5.41
26-30	75	25.34	21	7.09	32	10.81
31-35	45	15.2	17	5.74	17	5.74
36-40	7	2.36	2	0.68	5	1.69
Maternal Height groups:						
140-150	24	8.11	6	2.03	7	2.36
151-160	92	31.08	26	8.78	47	15.88
161-170	52	17.57	21	7.09	16	5.41
171-180	5	1.69	0	0	0	0
Maternal Weight						
Low Weight: <50 kg	0	0	0	0	0	0
Normal Weight: 50 - 70 kg	82	27.7	23	7.77	33	11.15
High Weight: 71 - 90 kg	90	30.41	30	10.14	36	12.16
Very High Weight: > 90 kg	1	0.34	0	0	0	0
BMI						
Underweight: BMI < 18.5	0	0	0	0	0	0
Normal weight: BMI 18.5 - 24.9	28	9.46	10	3.38	8	2.7
Overweight: BMI 25 - 29.9	79	26.69	23	7.77	39	13.18
Obese (Class I): BMI 30 - 34.9	50	16.89	17	5.74	20	6.76
Obese (Class II): BMI 35 - 39.9	16	5.41	3	1.01	3	1.01
Morbidly Obese (Class III): BMI ≥ 40	0	0	0	0	0	0
Maternal gravida Status						
Primi	98	33.11	33	11.15	36	12.16
Multi	75	25.34	20	6.76	34	11.49

Maternal para Status:						
0	90	30.41	26	8.78	41	13.85
1	69	23.31	24	8.11	24	8.11
>1	14	4.73	3	1.01	5	1.69
Maternal Living children:						
0	106	35.81	31	10.47	47	15.88
1	55	18.58	19	6.42	22	7.43
>1	12	4.05	3	1.01	1	0.34
Abortion/IUD/Ectopic:						
0 (No)	127	42.91	38	12.84	46	15.54
1 (Abortion)	32	10.81	12	4.05	15	5.07
2 (Intra Uterine fetal Death)	9	3.04	1	0.34	4	1.35
3 (Ectopic)	0	0	1	0.34	2	0.68
4 (All Yes)	5	1.69	1	0.34	3	1.01
POG(completed weeks of pregnancy)						
<37 weeks	7	2.36	4	1.35	3	1.01
>37 weeks	161	54.49	49	16.55	67	22.63
PUS (Previous uterine scar):						
No	169	57.09	43	14.53	70	23.65
Yes	4	1.35	14	4.73	0	0
Number of gestation in uterus:						
Single	172	58.11	53	17.91	70	23.65
Multiple	1	0.34	0	0	0	0
Duration of pregnancy within 37 weeks:						
No	170	57.43	51	17.23	69	23.31
Yes	3	1.01	2	0.68	1	0.34
Is patient in active labor:						
No	94	31.76	29	9.79	16	5.41
Yes	79	26.69	24	8.11	54	18.24
EFW on last trimester USG (gms):						
High Birth Weight: >2500 g	157	53.04	49	16.55	62	20.95
Low birth weight: 1501–2500 g	12	4.05	4	1.35	7	2.36
Very low birth weight: 1001–1500 g	1	0.34	1	0.34	1	0.34
Extremely low birth weight: 500–1000 g.	2	0.68	0	0	0	0
Maternal Medical disorders:						
No	157	53.04	50	16.89	59	19.93
Yes	16	5.41	3	1.01	11	3.72
Maternal Gestational Diabetes Mellitus (DM):						
No	164	55.4	47	15.88	67	22.64
Yes	9	3.04	6	2.03	3	1.01
Maternal Hypertension (HTN):						
No	162	54.73	41	13.85	69	23.31
Yes	11	3.72	12	4.05	1	0.34
Maternal Cardiac disease:						
No	171	57.77	53	17.91	69	23.31
Yes	2	0.68	0	0	1	0.34
Maternal other disease:						
Hyperthyroidism	15	5.07				
Depression	2	0.68				
Hyperthyroidism			1	0.34		
PCOD			1	0.34		
Gestational thrombocytopenia					2	0.68
Bell's palsy					1	0.34
Hypothyroidism					3	1.01
Anemia					1	0.34
Bronchial asthma and atopic dermatitis					3	1.01

The distribution of maternal characteristics across the three groups viz., pharmacological, non-pharmacological, and combined methods of induction of labor. Most participants were between the ages of 26 and 30, and a sizable fraction were prim gravidas with high BMIs and weights. In all populations, the

prevalence of hypertension and gestational diabetes was relatively small. Age: Sig. = 0.007, Height: Sig. = 0.035, Weight: B = 0.36, BMI: Sig. = 0.030, Active Labor: Sig. = 0.000.

Table 2: Comparison of Methods of IOL wise mode of delivery

	Mode of delivery					
	Normal (Vaginal)		Instrumental (Vaginal)		LSCS (Caesarean)	
Methods	Subjects	%	Subjects	%	Subjects	%
Pharmacological	92	53.2%	6	3.5%	75	43.4%
Non-Pharmacological	26	49.1%	1	1.9%	26	49.1%
Combined	46	65.7%	11	15.7%	13	18.6%

The combined approach to labor induction demonstrated the highest rate of spontaneous vaginal delivery, with 65.71 % of subjects achieving normal vaginal birth without the need for instrumental assistance. Additionally, 15.71 % of cases required instrumental intervention, underscoring the effectiveness of this method in facilitating vaginal delivery. In contrast, the pharmacological method resulted in 53.18 % of women delivering vaginally without instrumental aid, while 3.47 % required such instrumental assistance. The non-pharmacological group showed similar outcomes, with 49.06 % achieving unassisted vaginal delivery and 1.89% requiring instrumental support. Importantly, the combined approach not only favored normal vaginal deliveries but also significantly reduced the cesarean section rate to 18.57 %, highlighting its potential benefits in labor induction strategies. In contrast, the non-pharmacological group faced a higher incidence of cesarean deliveries, with 49.06 % undergoing lower segment cesarean sections (LSCS) and the pharmacological group recorded a LSCS rate of 43.35%. While the combined method carries certain risks, it appears to enhance the likelihood of vaginal delivery while minimizing the need for surgical interventions. After evaluating $\chi 2=17.074$ df 6 and p value= 0.009 was reported.

DISCUSSION

In this study, a thorough assessment was carried out to compare different induction of labor (IOL) methods in relation the results of administering induction dosages. The goal of this investigation was to clarify how different approaches work in concert.

Our findings indicate enhanced normal delivery rates and expedited delivery times associated with combined approaches to labor induction with lower risk of cesarean delivery, consistent with previous research in the field. The present findings align with prior research that underscores the effectiveness of combined methods. For example, Silva et al. (2023) reported similar outcomes, demonstrating a lower incidence of cesarean sections with combined induction techniques compared to pharmacological methods alone [25]. Li et al. (2022) also emphasized the advantages of a combined approach in achieving more favorable delivery outcomes with fewer surgical interventions [26]. According to a systematic analysis by Thomson et al. (2019), women who used several analgesic treatments reported better satisfaction and shorter labor times than women who only used pharmaceutical interventions [27]. Additionally, it has been demonstrated that using standardized labor induction procedures reduces the rate of cesarean deliveries while increasing vaginal deliveries, which is consistent with our findings [28]. Acupressure and water immersion are two non-pharmacological techniques that have been shown to effectively supplement pharmacological therapies, improving labor outcomes and accelerating delivery timeframes [29 & 30].

Such results reinforce the growing consensus that integrated methods of IOL may offer superior outcomes in promoting successful vaginal deliveries and minimizing unnecessary cesarean sections.

The data collectively supports the notion that combined methods of induction are more likely to result in successful vaginal deliveries and reduce the reliance on cesarean sections, presenting a strong case for the broader adoption of this approach in clinical practice.

CONCLUSION

In the present study, the integration of combined labor induction methods has demonstrated promising results in optimizing normal delivery outcome. The findings underscore the importance of personalized and comprehensive approaches to labor induction, emphasizing the need for further research to refine and optimize these combined methods for normal vaginal delivery with reduced risk of cesarean section.

Limitations of the study and suggestions for future research:
1. Small Sample Size: The study had a limited sample size, potentially impacting the generalized ability of the findings.
2. Lack of multicenter data: The study has included data from one hospital

Conflicts of interest: No conflicts of interest.

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