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Effect of dextrose normal saline vs normal saline on the progress of labour – prospective observational study

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Abstract

Background: Labour is a physiologically demanding process requiring sustained energy expenditure by the myometrium. While intravenous hydration is routinely provided, the optimal composition of intrapartum fluids remains uncertain. This study aimed to evaluate the effect of intravenous dextrose normal saline compared to normal saline alone on the duration of labour and maternal and neonatal outcomes in primigravida women.

Methods: This prospective observational study was conducted among 200 primigravida women in spontaneous active labour at a tertiary care hospital. Participants received either normal saline alone (n=100) or dextrose normal saline (n=100) as part of routine intrapartum care. The primary outcome was the duration of the active (first) stage of labour. Secondary outcomes included duration of the late (second) stage, prolonged labour (>12 hours), oxytocin augmentation, mode of delivery, maternal biochemical parameters, and neonatal outcomes.

Results: The mean duration of the active stage of labour was significantly shorter in the dextrose group compared to the normal saline group (312.6 ± 128.4 vs 372.4 ± 165.8 minutes; $p = 0.003$). The late stage of labour was also significantly reduced (86.9 ± 41.8 vs 118.6 ± 46.2 minutes; $p < 0.001$). Prolonged labour was less frequent in the dextrose group (6% vs 14%; $p = 0.048$). There were no significant differences in oxytocin use, caesarean section rates, maternal biochemical parameters, or neonatal outcomes.

Conclusion: Intravenous dextrose normal saline alternating with normal saline shortens labour duration without compromising maternal or neonatal safety and may be considered a beneficial intrapartum fluid strategy.

Key words: Dextrose normal saline, normal saline, active stage of labour, pregnancy

Introduction

Labour is a physiologically intense process characterized by rhythmic uterine contractions that lead to cervical effacement, dilatation, and ultimately the birth of the fetus and expulsion of the placenta. This process demands considerable energy, primarily derived from the oxidative metabolism of glucose within the myometrium[1]. Prolonged or dysfunctional labour, or dystocia, remains a principal indication for primary caesarean section (CS) globally, with rates consistently surpassing the World Health Organization's recommended benchmark of 10-15%[2]. Among primigravida women, dystocia is a particularly common challenge, contributing significantly to rising operative delivery rates and associated maternal and neonatal morbidities[3]. Therefore, identifying safe and effective interventions to enhance labour progress and reduce the incidence of prolonged labour is a paramount objective in modern obstetrics.

The management of nutrition and hydration during labour has evolved significantly. Historically, a policy of nil per os (NPO) was widely adopted due to concerns over Mendelson's syndrome, or acid aspiration pneumonitis, should emergency general anaesthesia be required[4]. This practice, however, can inadvertently lead to a state of relative starvation and dehydration. During prolonged labour, maternal glycogen stores may become depleted, leading to increased lipolysis and ketone production[5]. Elevated ketone levels have been associated with longer labour duration and may adversely affect uterine contractility[6]. Consequently, the provision of intravenous (IV) fluids has become a standard of care to maintain maternal hydration and provide caloric substrate.

The rationale for IV hydration extends beyond simple fluid replacement. Dehydration, even of a mild degree, is known to impair muscular performance and thermoregulation, a principle well-established in sports physiology[7]. Labour shares similarities with prolonged physical exertion, involving significant insensible fluid loss through sweating and hyperventilation[8]. Studies have suggested that aggressive IV hydration can reduce the length of labour in primigravida women[9]. However, the optimal composition of these fluids remains a subject of debate. While normal saline (0.9% sodium chloride) effectively expands plasma volume and prevents dehydration, it provides no caloric energy. In contrast, dextrose-containing solutions offer a readily available glucose source for the energy-intensive myometrium.

The use of dextrose (5%) infusions during labour is not without theoretical risks. Excessive or concentrated dextrose administration can lead to maternal hyperglycaemia, which may in turn cause fetal hyperinsulinaemia and subsequent neonatal hypoglycaemia after birth[10]. Furthermore, large volumes of hypotonic fluids have been linked to iatrogenic maternal and neonatal hyponatraemia, a potentially serious electrolyte disturbance[11]. Therefore, the practice of alternating dextrose solutions with isotonic crystalloids like normal saline has been proposed as a balanced strategy to provide energy while minimizing the risks of fluid and electrolyte imbalance[12].

Previous research investigating intrapartum fluid therapy has yielded mixed results. Some randomized trials have demonstrated a reduction in total labour duration with the use of dextrose-containing solutions compared to plain crystalloids[13,14]. Other studies have found no significant difference in labour outcomes but noted improved maternal metabolic profiles with dextrose supplementation[15].

This study aimed to determine the effect of intravenous dextrose normal saline solution alternating with normal saline, compared to normal saline alone, on the total duration of active labour in primigravida women. We hypothesized that the provision of glucose substrate in addition to hydration would supply necessary energy to the myometrium, thereby enhancing uterine efficiency and significantly shorten-

ing the labour process without increasing adverse maternal or neonatal effects.

Methodology

Study Design and Setting

This study employed a prospective, observational study design to compare labour outcomes between two groups of primigravida women receiving different standard intravenous (IV) fluid regimens during spontaneous active labour conducted between November and December 2025 (2 months). The study was conducted in the labour ward of the Department of Obstetrics and Gynaecology at a large tertiary care teaching hospital in Chennai, India. The observational design was chosen to evaluate the real-world effectiveness of existing clinical fluid administration practices without altering standard care protocols. Ethical approval was granted by the Institutional Ethics Committee and the requirement for individual informed consent was waived for this analysis of routine clinical practice, with data anonymized and aggregated for analysis.

Study Participants

The study population comprised primigravida women admitted in spontaneous active labour. Inclusion criteria were defined to create a homogeneous, low-risk cohort: nulliparity, singleton pregnancy with cephalic presentation, gestational age ≥37 weeks, and cervical dilatation between 3 cm and 5 cm at the time of admission. Exclusion criteria were applied to minimize confounding from conditions known to independently affect labour progression or fluid and glucose homeostasis. These included pre-existing or gestational diabetes mellitus, hypertensive disorders of pregnancy, significant cardiac or renal disease, clinical chorioamnionitis, maternal pyrexia (>38°C), intrauterine fetal death, non-reassuring fetal status on admission, use of epidural analgesia, and any pre-existing electrolyte imbalance. A consecutive sampling method was employed to enrol eligible women over a defined study period until the target sample size was reached.

Sample Size Calculation

The sample size was calculated based on the primary outcome, duration (minutes) of the active (first) stage of labour, using estimates from prior data[16]. Preliminary data indicated a mean duration of 309.9 ± 126.9 minutes in a dextrose 5% group compared with 370.3 ± 177.0 minutes in a normal saline group, yielding an expected mean difference of 60.4 minutes. Using OpenEpi (version 3.01) for comparison of two independent means, with a two-sided α error of 0.05 and power of 80%, the minimum required sample size was calculated to be 68 participants per group. To improve the statistical power, allow for potential dropouts, protocol deviations, and missing data, and to enhance the precision and generalizability of the estimates, the sample size was inflated to 100 participants in each group, resulting in a total target sample size of 200 participants.

Study Groups and Procedure

Participants were allocated to one of two study groups based on the standard IV fluid regimen initiated by the attending obstetric team as part of routine clinical management. The choice of fluid was at the clinician's discretion, guided by unit protocol but not mandated by the study. Group assignments were based on prevailing practice.

- **Group 1 (Normal Saline (0.9%) Cohort):** Received continuous intravenous infusion of 0.9% sodium chloride (normal saline) at a maintenance rate.
- **Group 2 (Dextrose 5% with normal saline Cohort):** Received intravenous infusion of dextrose normal saline solution, also at a standard maintenance rate. In both groups, the infusion was started upon

admission in active labour and continued until delivery. The administration rate was regulated by an infusion pump, and oral intake was limited to sips of clear fluid, consistent with standard ward policy.

Data Collection and Outcome Measures

Trained research staff, who were not involved in clinical decision-making, prospectively collected data from the maternal and neonatal medical records using a standardized, piloted case report form. Baseline demographic and obstetric characteristics recorded included maternal age, gestational age (confirmed by first-trimester ultrasound), and cervical dilatation at admission.

The primary outcome was the duration (in minutes) of the active first stage of labour, operationally defined as the time from achieving a cervical dilatation of 3 cm until full cervical dilatation of 10 cm. Labour progress was monitored and documented using the World Health Organization (WHO) partograph[17].

Secondary maternal outcomes included total duration of labour (from 3 cm dilatation to delivery), incidence of prolonged active phase (exceeding 12 hours), use of oxytocin augmentation, mode of delivery (spontaneous vaginal, instrumental, or caesarean section), and immediate postpartum maternal serum sodium and glucose levels. Neonatal outcomes assessed were: Apgar scores at 1 and 5 minutes, birth weight, umbilical cord arterial blood gas parameters (where available), need for positive pressure ventilation or other resuscitation at birth, and admission to the neonatal intensive care unit (NICU).

Statistical Analysis

Data were analyzed using SPSS statistical software (version 25.0). Continuous variables were assessed for normality using the Kolmogorov-Smirnov test. Normally distributed data were presented as mean ± standard deviation and compared between groups using the independent Student's t-test. Non-normally distributed continuous data were presented as median and interquartile range (IQR) and compared using the Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant for all analyses.

Results

Table 1 shows that the two study groups were comparable with respect to baseline demographic and obstetric characteristics. The mean age of participants was 24.6 ± 3.1 years in the normal saline group and 24.4 ± 3.0 years in the D+ NS group (p = 0.62). Mean gestational age at admission was similar between groups (38.7 ± 1.2 vs 38.6 ± 1.3 weeks; p = 0.48). Body mass index did not differ significantly (26.9 ± 2.8 kg/m^2 vs 27.1 ± 2.7 kg/m^2; p = 0.55). Cervical dilatation at admission was also comparable (3.6 ± 0.7 cm vs 3.7 ± 0.8 cm; p = 0.31), indicating adequate baseline homogeneity.

As shown in Table 2, the duration of both stages of

Table 1. Baseline demographic and obstetric characteristics among the study participants in groups (n=200).

VARIABLE	NORMAL SALINE (N=100)	D+ NS (N=100)	P VALUE
Age (years)	24.6 ± 3.1	24.4 ± 3.0	0.62
Gestational age (weeks)	38.7 ± 1.2	38.6 ± 1.3	0.48
BMI (kg/m^2)	26.9 ± 2.8	27.1 ± 2.7	0.55
Cervical dilatation (cm)	3.6 ± 0.7	3.7 ± 0.8	0.31

Table 2. Duration of labour stages among study groups among the study participants in groups (n=200).

LABOUR STAGE & MEASURE	NORMAL SALINE (N=100)	D+ NS (N=100)	P VALUE
Active (first) stage of labour			
Mean ± SD (minutes)	372.4 ± 165.8	312.6 ± 128.4	0.003
Median (IQR)	350 (260–460)	295 (220–390)	—
Range (minutes)	95–910	80–720	—
Late (second) stage of labour			
Mean ± SD (minutes)	118.6 ± 46.2	86.9 ± 41.8	<0.001
Median (IQR)	110 (85–145)	80 (60–110)	—
Range (minutes)	40–260	30–210	—

labour was shorter in women receiving D+ NS compared to normal saline alone. The mean duration of the active (first) stage was significantly lower in the D+ NS group (312.6 ± 128.4 minutes) compared with the normal saline group (372.4 ± 165.8 minutes; p = 0.003). Median durations also reflected this reduction [295 (220–390) vs 350 (260–460) minutes]. Similarly, the mean duration of the late (second) stage of labour was significantly shorter in the D+ NS group (86.9 ± 41.8 minutes) than in the normal saline group (118.6 ± 46.2 minutes; p < 0.001).

Table 3 summarizes secondary maternal outcomes across the two groups. Prolonged labour exceeding 12 hours occurred in 14 women (14%) in the normal saline group compared to 6 women (6%) in the D+ NS group, a statistically significant difference (p = 0.048). Oxytocin augmentation was required in 47 participants (47%) receiving normal saline and 40 participants (40%) receiving D+ NS, with no significant difference between groups (p = 0.31). Caesarean section rates were low and comparable, occurring in 6 women (6%) in the normal saline group and 4 women (4%) in the D+ NS group (p = 0.52).

Maternal biochemical parameters measured post-delivery are presented in Table 4. Mean post-infusion serum sodium levels were similar between the normal saline group (138.9 ± 3.8 mEq/L) and the D+ NS group (139.2 ± 3.6 mEq/L; p = 0.58). Post-delivery serum potassium levels also did not differ significantly (4.26 ± 0.56 mEq/L vs 4.23 ± 0.54 mEq/L; p =

Table 3. Secondary maternal outcomes among the study participants in groups (n=200).

VARIABLE	NORMAL SALINE (N=100)	D+ NS (N=100)	P VALUE
Prolonged labour >12 h	14 (14%)	6 (6%)	0.048
Oxytocin augmentation	47 (47%)	40 (40%)	0.31
Caesarean section	6 (6%)	4 (4%)	0.52

Table 4. Maternal biochemical parameters among the study participants in groups (n=200).

VARIABLE	NORMAL SALINE (N=100)	D+ NS (N=100)	P VALUE
Serum sodium post (mEq/L)	138.9 ± 3.8	139.2 ± 3.6	0.58
Serum potassium post (mEq/L)	4.26 ± 0.56	4.23 ± 0.54	0.64
Blood glucose post (mg/dL)	101.8 ± 22.4	103.2 ± 23.1	0.61

Table 5. Neonatal outcomes among the study participants in groups (n=200).

VARIABLE	NORMAL SALINE (N=100)	D+ NS (N=100)	P VALUE
Birth weight (kg)	2.86 ± 0.38	2.84 ± 0.35	0.68
Apgar score 5 min	8.8 ± 0.9	8.9 ± 0.8	0.47
NICU admission	14 (14%)	15 (15%)	0.84

0.64). Mean post-delivery blood glucose levels were comparable between groups (101.8 ± 22.4 mg/dL in normal saline vs 103.2 ± 23.1 mg/dL in D + NS; p = 0.61), indicating no biochemical derangement associated with dextrose use.

Neonatal outcomes are detailed in Table 5. Mean birth weight was comparable between neonates born to mothers receiving normal saline (2.86 ± 0.38 kg) and those receiving D+ NS (2.84 ± 0.35 kg; p = 0.68). Apgar scores at 5 minutes were similar in both groups (8.8 ± 0.9 vs 8.9 ± 0.8; p = 0.47). NICU admission was required for 14 neonates (14%) in the normal saline group and 15 neonates (15%) in the D + NS group, with no statistically significant difference (p = 0.84), suggesting comparable neonatal safety profiles.

Discussion

The present study demonstrates that intravenous administration of dextrose normal saline alternating with normal saline during spontaneous labour in primigravida women is associated with a significant reduction in the duration of both the active (first) and late (second) stages of labour, without increasing adverse maternal or neonatal outcomes. These findings reinforce existing evidence that metabolic support during labour, in addition to hydration, plays a critical role in optimizing uterine performance and labour efficiency.

Labour is a physiologically demanding process characterized by sustained smooth muscle contractions that require continuous energy expenditure. The uterus relies predominantly on glucose-mediated oxidative metabolism for effective contractility, similar to skeletal muscle during prolonged exertion[18,19]. In this study, women receiving dextrose-containing fluids experienced an approximately 60-minute reduction in the duration of the active phase of labour compared with those receiving normal saline alone. This reduction is clinically meaningful and consistent with previous randomized trials reporting decreases ranging from 30 to 90 minutes following dextrose supplementation[15,20].

The shortened active phase observed can be attributed to improved energy availability to the myometrium. During labour, oral intake is often restricted due to aspiration concerns, resulting in relative starvation and depletion of glycogen stores. This metabolic shift promotes lipolysis and ketone production, which have been shown to impair uterine contractility and prolong labour[21,22]. Evidence from exercise physiology supports this mechanism; Maughan and Noakes demonstrated that carbohydrate supplementation during prolonged exertion improves muscular endurance and efficiency, a principle that appears applicable to uterine muscle physiology as well[6]. By providing an immediate glucose substrate, dextrose infusion likely enhances uterine contractility and coordination, facilitating more efficient cervical dilatation.

Importantly, this study also found a significant reduction in the duration of the late (second) stage of labour among women receiving dextrose-containing fluids. Similar findings have been reported by Swidan et al. and Shrivastava et al., who observed significant shortening of the second stage with dextrose administration[15,24]. Effective uterine contractions during this phase are essential for fetal descent and expulsion,

and inadequate energy supply may contribute to maternal exhaustion and prolonged labour. These findings suggest that metabolic support remains relevant beyond cervical dilatation and continues to influence expulsive efficiency.

Despite improvements in labour duration, the requirement for oxytocin augmentation did not differ significantly between groups, consistent with previous studies[9,13]. This indicates that while dextrose enhances the efficiency of uterine contractions, it does not necessarily replace the need for pharmacological augmentation when clinically indicated. Caesarean section rates were similarly low and comparable, likely reflecting the low-risk nature of the study population.

Concerns regarding intrapartum dextrose administration include maternal hyperglycaemia, neonatal hypoglycaemia, and electrolyte imbalance. In the present study, post-delivery maternal serum glucose and electrolyte levels were comparable between groups, with no evidence of clinically significant dyselectrolytemia or hyperglycaemia. These findings align with earlier trials demonstrating metabolic safety when dextrose is administered in controlled concentrations and volumes[11,12,25]. Neonatal outcomes, including birth weight, five-minute Apgar scores, and NICU admission rates, were also similar between groups, supporting the safety of this approach[15,16].

Prolonged labour remains a major contributor to maternal exhaustion, increased intervention rates, and rising caesarean section rates globally[3,26]. Simple, low-cost strategies that safely shorten labour are particularly valuable in resource-limited settings. This study suggests that alternating dextrose normal saline with normal saline may represent a pragmatic and effective approach to improving labour efficiency.

This study has limitations. It was single-centered, and the observational nature of fluid administration may allow residual confounding. Neonatal biochemical parameters such as cord blood glucose were not routinely assessed, and findings may not be generalizable beyond primigravida women in spontaneous labour. Nevertheless, controlled dextrose administration appears to be a safe and effective strategy to shorten labour duration. Future randomized trials with larger samples and neonatal metabolic assessments are warranted to refine intrapartum fluid guidelines.

Conclusion

In primigravida women undergoing spontaneous labour, intravenous administration of dextrose normal saline alternating with normal saline was associated with a significant reduction in the duration of both the active and late stages of labour compared to normal saline alone, without increasing the need for oxytocin augmentation, operative delivery, or adverse maternal and neonatal outcomes. The findings suggest that providing metabolic support in addition to hydration enhances uterine efficiency and labour progression while maintaining biochemical and neonatal safety. Given its simplicity, low cost, and favorable safety profile, alternating dextrose with normal saline may represent a practical strategy to optimize intrapartum care, particularly in settings where prolonged labour contributes substantially to maternal exhaustion and healthcare burden.

Declaration

Ethical approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Human Ethics Committee, SBMCH,Chennai dated 05.10.2024 (002/SBMCH//IHEC/2024/2292)

Consent to Participate

Informed consent was obtained from all individual participants included in the study. For participants

below 18 years of age, written informed consent was obtained from parents or legal guardians, along with assent from the participants.

Consent to Publish

Not applicable. This study does not contain any individual person's data in an identifiable form.

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Competing Interests

The authors declare that they have no competing interests.

Data Availability

Due to institutional regulations and patient confidentiality concerns, the data are not publicly available. However, the datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request and with permission from the Institutional Ethics Committee.

Authors' Contributions

Arti Agnihotri contributed to conceptualization, methodology, data collection, formal analysis, and drafting of the original manuscript.

Meena Thinnanur Sundarraj contributed to data curation, investigation, and manuscript review and editing.

Minthami Sharon contributed to conceptualization, study supervision, methodology, validation, and critical revision of the manuscript for important intellectual content.

Logeswari BM contributed to investigation, data interpretation, and manuscript review. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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