

Effect of Normal Saline Infusion versus Dextrose 5% Infusion on The Duration of Labor in Nulliparous Women: Randomized Controlled Trial

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ABSTRACT

Background: During labor, it is common for women to have no or little nutrient intake, inspite of the fact that the demand of energy increases as a result of skeletal and smooth muscle contraction.

Aim of the Work: This study aims to evaluate the effect of intravenous dextrose-saline infusion compared with intravenous normal saline infusion in acceleration of active phase of labor in nulliparous women.

Patients and Methods: This prospective randomized controlled trial was conducted on nulligravida patients recruited from those attending labor ward of Ain Shams University, Maternity hospital who are, singleton gestation, 36 weeks or more. **Results:** Total duration of first and second stages of labor was significantly shorter among Dextrose 5% group than among Normal saline group. **Conclusion:** Dextrose 5% solution administration is associated with shortened duration of labor because it provides the required energy for pregnant mothers during the labor procedure through the detraction of harmful metabolites produced together with ATP production and results in acceleration of the labor process.

Recommendations: Dextrose 5% administration during labor is associated with shortened duration of labor. Further studies with larger sample sizes, more outcomes and different dextrose concentration is required to determine the exact effect of dextrose.

Key words: dextrose, labor, nulliparous women, saline infusion.

INTRODUCTION

During labor, it is common for women to have no or little nutrient intake, in spite of the fact that the demand of energy increases as a result of skeletal and smooth muscle contraction⁽¹⁾. Myometrial contractility is one of the multiple factors affecting the progress of labor. As adequate hydration improves the muscle performance in prolonged exercise and labor can be considered as a prolonged exercise, adequate fluid administration may improve the labor progress⁽²⁾.

Glucose is the main substrate for pregnant uterus. Adequate resource of glucose is needed to maintain exercise tolerance and muscle efficiency, because these are important factors in the progress of human labor and parturition. Therefore, it can be postulated that dysfunctional or prolonged labor procedure, a leading indication for primary cesarean delivery, could at least in part be raised from inadequate uterine forces or inappropriate coordinated contractions because of inadequate availability of the substrate⁽³⁾.

Garite et al. demonstrated that by increasing the rate of maternal hydration, a reduction in frequency of prolonged labor could be achieved, and possibly there will be a lesser need for oxytocin and cesarean delivery⁽⁴⁾.

Eslamian et al. confirmed the effect of increased parenteral hydration on decreasing the duration of labor⁽⁵⁾. This work was followed by

Shrivastava et al. who demonstrated that parenteral administration of dextrose solution was associated with shortened labor course in term vaginally delivered nulliparous women in spontaneous labor⁽⁶⁾. *Dappuzzo-Argiriou et al.* demonstrated that the use of intravenous fluid containing 5% dextrose did not lower the chance of cesarean delivery for women admitted in active labor⁽⁷⁾.

Fong et al. demonstrated that neither rate of delivery nor dextrose administration in intravenous fluid altered the labor length or delivery outcomes in nulliparous women who were presented in active labor⁽⁸⁾.

Administration of a dextrose solution, regardless of concentration, was associated with a shortened labor course in term vaginally delivered nulliparous subjects in active labor⁽⁹⁾.

AIM OF THE WORK

This study aims to evaluate the effect of intravenous dextrose-saline infusion compared with intravenous normal saline infusion in acceleration of active phase of labor in nulliparous women.

Methodology

Study design

Randomized controlled trial.

Study setting

This study was conducted in Ain Shams University Maternity hospital.

Participants:

Those attending labor ward of Ain Shams University Maternity hospital.

Consent:

A written consent was obtained from each woman after explaining the nature of the study.

Eligibility criteria**Inclusion criteria**

- 1- Primiparous.
- 2- Singleton gestation.
- 3- Vertex presentation.
- 4- Spontaneous active labor, Cervical dilatation 4 cm or more with or without ruptured membranes.
- 5- Term pregnancy.

Exclusion criteria

1. Any maternal medical disorder for example: Preeclampsia, pregestational or gestational diabetes mellitus.
2. Fetal compromise for example: chorioamnionitis, intrauterine growth restriction.
3. Macrosomia that is defined as estimated birth weight more than 97th percentile of gestational age⁽¹⁰⁾.

Intervention**History taking**

Demographic data, menstrual history, gestational age, expected delivery date, medical and surgical history.

Examination**General examination:**

- 1- Vital data measurements: arterial blood pressure, pulse rate, body temperature and respiratory rate.
- 2- Detailed systemic examination.

Abdominal examination:

It included:

1. Inspection of the abdomen
2. Leopold maneuvers that includes: fundal level, fundal grip, umbilical grip and pelvic grip to assess the position, presentation and the lie of the fetus.
3. Uterine contractions by palpation including rate/10 min and duration.
4. Auscultation of fetal heart sounds.
5. Tenderness and scars of previous operations.

P.V examination (under aseptic precautions):

- Dilatation and effacement of the cervix.
- Exclusion of cord presentation and prolapse.
- State of membranes (intact or ruptured).
- Detection of meconium staining of amniotic fluid after rupture of membranes.
- Presentation and position.

Investigations

Complete blood picture, blood group and Rh.

Follow up

All the women were randomly assigned into two groups:

- **Group A:** was provided with normal saline (0.9%).
- **Group B:** was provided with dextrose 5%.

After randomization, vaginal examination was done by the senior registrar (with at least three years experience) to diagnose labor that is diagnosed by cervical changes and efficient uterine contractions (3-5 contractions / 10 minutes last for 45-60 seconds).

Fluid was administrated by the head nurse in all the cases by drop infusions at a rate of 60 drops / min to reach a rate of 120ml/hour and the women did not consume anything by mouth. Each woman followed up by the registrar by having vaginal examination every 2 hours; and their result were recorded on the partogram, artificial rupture of membranes was done at 4cm cervical dilatation; if any woman had excess leakage, immediate vaginal examination would be performed to rule out cord prolapse and her cervical finding would be noted.

Measurements recorded on the partogram include cervical dilation, fetal heart rate, duration of labor and vital signs as well as the fluid initiation time.

The partogram showed cervical dilation versus time include an alert line. It started at the position where there was 4 cm of cervical dilation. It is then continued diagonally at a rate of 1 cm per hour in primigravida and 1.5 cm in multigravida. An *action line* is parallel to the alert line, and is located 4 hours to the right of the alert line⁽¹¹⁾.

For a dilatation progress lower than 1 cm/hour, uterine contraction was controlled and oxytocin was administered in case of inefficient uterine contractions⁽¹²⁾.

Oxytocin in 5 IU/L of solution with an initial rate of five drops per minute was administered to enhance uterine contractions and then the rate was increased accordingly⁽¹²⁾.

Outcomes**Primary outcome**

The duration of first stage of labor in minutes from 4 cm cervical dilatation to the full dilatation.

Secondary outcomes

1. The duration of second stage of labor.
2. Need for oxytocin.
3. Apgar score (one and five minutes) that is determined by evaluating the newborn baby on five simple criteria on a scale from zero to two, then summing up the five values thus obtained. The

resulting Apgar score ranges from zero to ten. The five criteria are summarized using words chosen to form a backronym (Appearance, Pulse, Grimace, Activity and Respiration) ⁽¹³⁾.

Sample size justification

Sample size was calculated using PASS 11.0 sample size calculation program and based on a study finding carried out by ***Farideh et al., 2015*** who found out that there was a significant difference in the duration of first stage of labor between the groups (NS: 270.20 ± 13.37 minutes; D5%: 206.67 ± 11.72 minutes) ($P < 0.001$). Sample size was estimated to be **120** nulliparous women with gestational age of ≥ 36 weeks in the active phase of spontaneous labor who will be divided into two groups, **60** women receiving either normal saline (NS) and **60** women receiving dextrose 5% with a rate of 120 mL/hour. The calculated sample size would achieve 100% power to detect a difference of 63.5 between the null hypothesis that both group means are 270.2 and the alternative hypothesis that the mean of group 2 is 206.7 with known group standard deviations of 13.4 and 11.7 and with a significance level (alpha) of 0.05000 using a two-sided Mann-Whitney test assuming that the actual distribution is uniform. Sample size was inflated by 15.0% to account for lost to follow up.

The primary outcome was the duration of first stage of labor in vaginally-delivered subjects.

Assignment of intervention:

Allocation:

Sequence generation:

Randomization was done in advance by computer using variable blocks the random number generator in Microsoft Office Excel Worksheet 2007.

Randomization:

120 patients were randomly assigned to either:

Group A (60 patients): who received normal saline infusion.

Group B (60 patients): who received dextrose 5% infusion.

Allocation concealment:

This was done by sequentially numbered, opaque sealed envelopes. Each envelope contained the method of intervention according to the random sequence. The envelope was opened just before the intervention.

Blinding

- Participants: All women giving birth participating in the study was blinded to the study.
- Investigator: was blinded as an independent nurse opened the sealed envelope and applied a covered fluid to the participant.
- Outcome assessor was blinded to the study.
- Data analyzer was blinded to the study.

The study was done after approval of ethical board of Ain Shams university .

Statistical methods

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 22.0, IBM Corp., Chicago, USA, 2013.

Descriptive statistics were done for quantitative data as minimum & maximum of the range as well as mean \pm SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage.

Inferential analyses were done for quantitative variables using independent t-test in cases of two independent groups with normally distributed data and paired t-test in cases of two dependent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Chi square test for differences between proportions and Fisher's Exact test for variables with small expected numbers. Log rank test used for survival analysis. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

Table (1): Demographic characteristics among the studied groups

Variables		Dextrose 5% (N=60)	Normal saline (N=60)	^{^P}
Age (years)	Mean\pmSD	27.4 \pm 3.1	27.3 \pm 3.4	0.843
	Range	20.0–35.0	21.0–33.0	
BMI (kg/m²)	Mean\pmSD	28.6 \pm 1.7	28.5 \pm 1.4	0.754
	Range	25.0–32.7	25.6–31.7	
GA (Weeks)	Mean\pmSD	39.6 \pm 1.0	39.3 \pm 1.0	0.109
	Range	38.0–42.0	37.0–41.0	
Cervical dilatation at admission (cm)	Mean\pmSD	4.9 \pm 0.4	4.9 \pm 0.5	0.426
	Range	4.0–6.0	4.0–6.0	

[^]Independent t-test

No significant difference between Dextrose 5% and Normal saline groups regarding **demographic characteristics**.

Table (2): Duration (minutes) of active (first) stage of labor among the studied groups

Measures	Dextrose 5% (N=60)	Normal saline (N=60)	[^] P
Mean±SD	309.9±126.9	370.3±177.0	0.034*
Range	73.0–644.0	99.0–888.0	
Value of dextrose 5% over normal saline			
Items	Mean±SE		95% CI
Duration reduction	60.4±28.1		4.7–116.1

[^]Independent t-test, *Significant, CI: Confidence interval

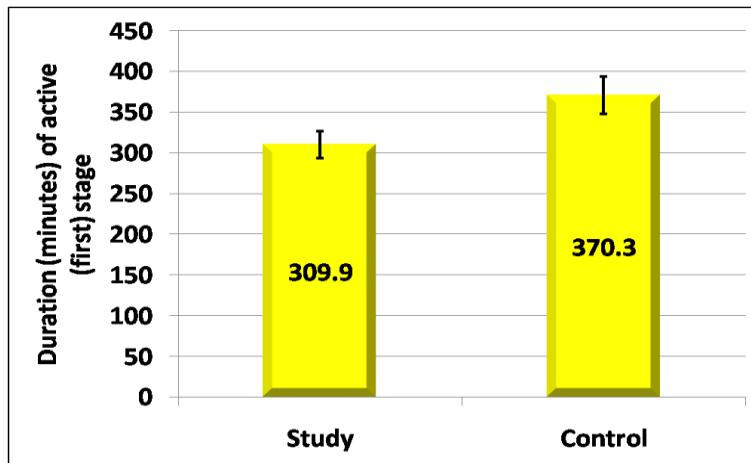
**Figure (1): Duration of active (first) stage of labor among the studied groups**

Table (2) and figure (1) show that: **Duration of active (first) stage of labor** was significantly shorter among Dextrose 5% group than among normal saline group.

Table (3): Duration (minutes) of second stage of labor among the studied groups

Measures	Dextrose 5% (N=60)	Normal saline (N=60)	[^] P
Mean±SD	85.1±48.0	116.7±44.3	<0.001*
Range	33.0–213.0	32.0–206.0	
Value of dextrose 5% over normal saline			
Items	Mean±SE		95% CI
Duration reduction	31.6±8.4		14.9–48.3

[^]Independent t-test, *Significant, CI: Confidence interval

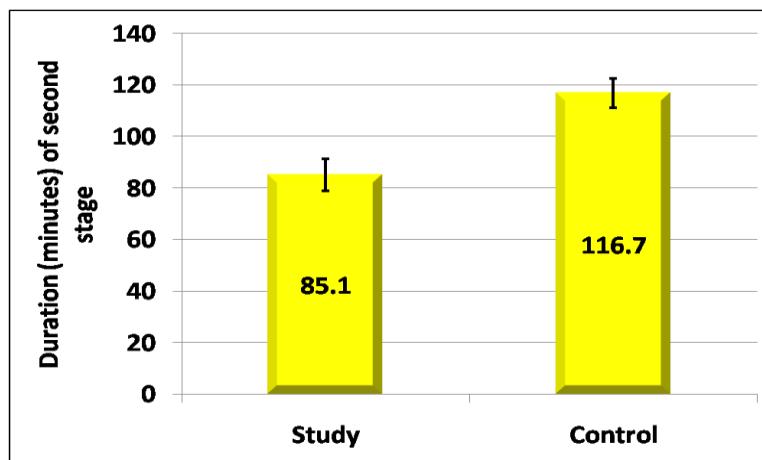
**Figure (2): Duration of second stage of labor among the studied groups**

Table (3) and figure (2) show that: **Duration of second stage of labor** was significantly shorter among Dextrose 5% group than among Normal saline group.

Effect of Normal Saline Infusion versus Dextrose 5% Infusion...

Table (4): Total duration (minutes) of first and second stages of labor among the studied groups

Measures	Dextrose 5% (N=60)	Normal saline (N=60)	^P
Mean±SD	395.0±172.4	487.0±220.5	0.012*
Range	106.0–857.0	131.0–1094.0	
Value of dextrose 5% over normal saline			
Items	Mean±SE		95% CI
Duration reduction	92.0±36.1		20.4–163.5
Rate of delivery			
#P	0.013*		

[^]Independent t-test, #Log rank test, *Significant, CI: Confidence interval

Table (4) and figures (3 & 4) show that: **Total duration of first and second stages of labor** was significantly shorter among Dextrose 5% group than among Normal saline group.

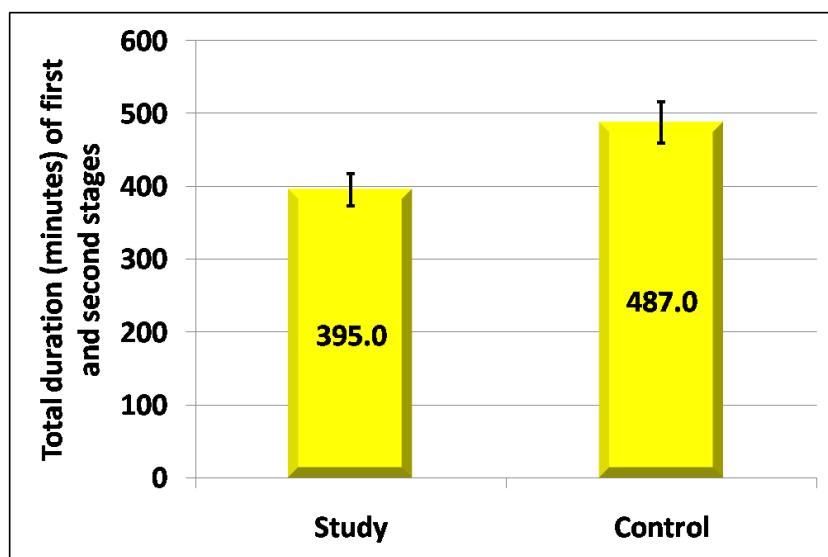


Figure (3): Total duration of first and second stages of labor among the studied groups

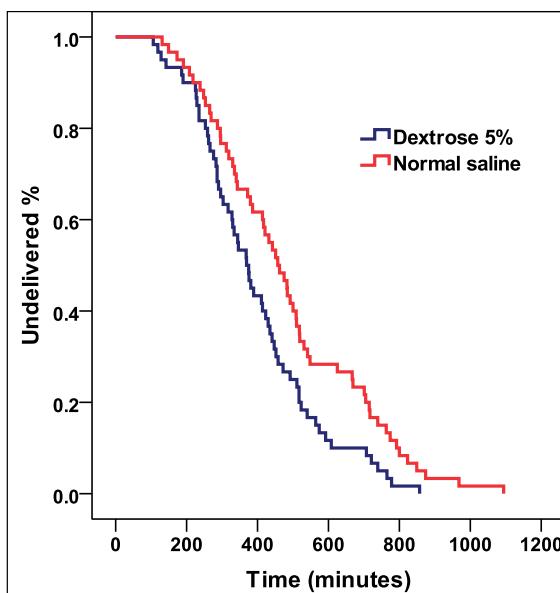


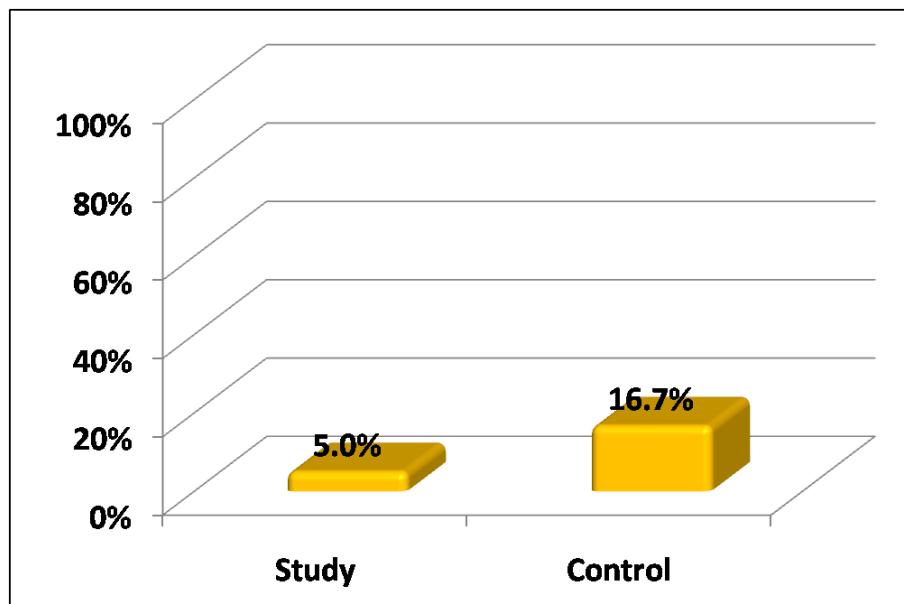
Figure (4): Kaplan-Meier study plot of vaginally delivered subjects from initiation of the infused fluid

Table (5): Prolonged labor (>12.0 hours) among the studied groups

Prolonged labor	Dextrose 5% (N=60)	Normal saline (N=60)	#P
Present	3 (5.0%)	10 (16.7%)	0.040*
Absent	57 (95.0%)	50 (83.3%)	
Value of dextrose 5% over normal saline in avoiding prolonged labor			
Items			95% CI
Rate in Dextrose 5% group	95.0%		88.6%–98.6%
Rate in Normal saline group	83.3%		79.7%–89.7%
Rate elevation	11.7%		-1.1%–19.0%
Efficacy	14.0%		-1.2%–23.8%
Relative Rate	1.14		0.99–1.24
Number needed to prevent	8.6		5.3–Infinite

#Chi square test, *Significant, CI: Confidence interval

Table (5) and figure (5) show that: **Prolonged labor** was significantly less frequent among Dextrose 5% group than among Normal saline group

**Figure (5): Prolonged labor among the studied groups****Table (6): Oxytocin requirement among the studied groups**

Oxytocin	Dextrose 5% (N=60)	Normal saline (N=60)	#P
Required	41 (68.3%)	46 (76.7%)	0.191
Not required	19 (31.7%)	14 (23.3%)	
Value of dextrose 5% over normal saline in requiring oxytocin			
Items			95% CI
Rate in Dextrose 5% group	31.7%		22.9%–39.8%
Rate in Normal saline group	23.3%		15.2%–32.1%
Rate elevation	8.3%		-9.1%–24.6%
Efficacy	35.7%		-28.5%–162.4%
Relative Rate	1.357		0.72–2.62
Number needed to harm	12.0		4.1–Infinite

#Chi square test, *Significant, CI: Confidence interval

Table (6) and figure (6) show that: **Oxytocin requirement** was non-significantly less frequent among Dextrose 5% group than among Normal saline group.

Effect of Normal Saline Infusion versus Dextrose 5% Infusion...

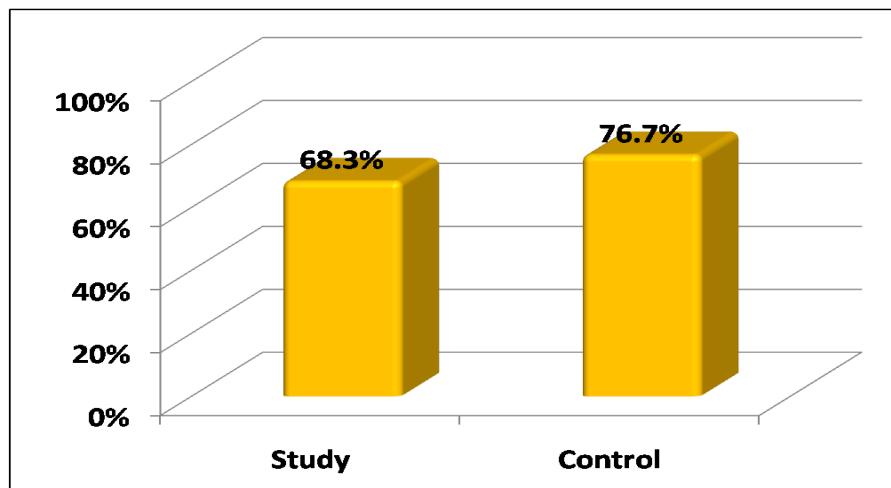


Figure (6): Oxytocin requirement among the studied groups

Table (7): Mode of delivery among the studied groups

Mode of delivery	Dextrose 5% (N=60)	Normal saline (N=60)	#P
NVD	53 (88.3%)	49 (81.7%)	0.306
CS	7 (11.7%)	11 (18.3%)	
Value of dextrose 5% over normal saline in avoiding CS			
Items	Value	95% CI	
Rate in Dextrose 5% group	88.3%	81.3%–94.3%	
Rate in Normal saline group	81.7%	75.7%–88.7%	
Rate elevation	6.7%	-7.4%–18.6%	
Efficacy	8.2%	-8.4%–24.6%	
Relative Rate	1.082	0.916–1.246	
Number needed to prevent (CS)	15	5.364→100.0	

#Chi square test, *Significant, CI: Confidence interval

Table (7) and figure (7) show that: CS was non-significantly less frequent among Dextrose 5% group than among Normal saline group.

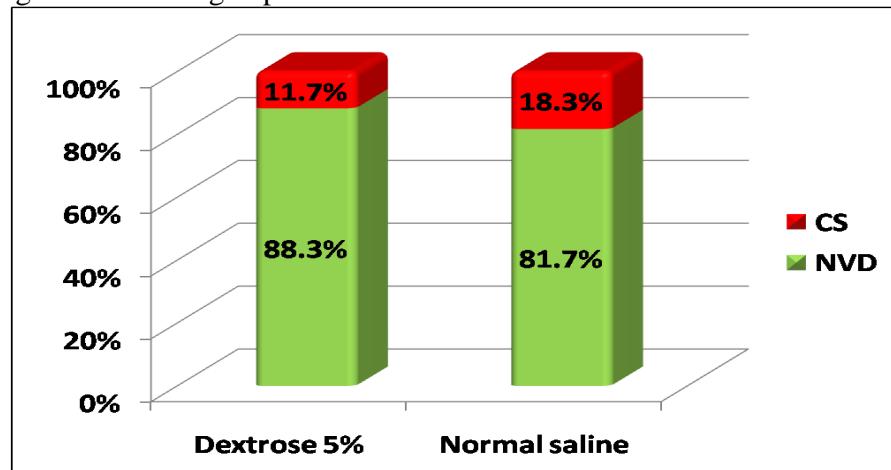


Figure (7): Mode of delivery among the studied groups

Table (8): Causes of cesarean section among dextrose group and saline group

Indication of caesarian section	No. of women in dextrose group	No of women in saline group
Acute fetal distress (category 3 CTG)	3	4
Obstructed labor	2	4
Cord prolapse	1	1
Secondary arrest of cervical dilatation	1	2

Table (9): Neonatal condition among the studied groups

Variables		Dextrose 5% (N=60)	Normal saline (N=60)	P
APGAR 1	Mean±SD	8.2±0.9	8.1±0.9	^0.699
	Range	5.0–10.0	5.0–10.0	
APGAR 5	Mean±SD	9.2±0.7	9.1±0.7	^0.446
	Range	7.0–10.0	6.0–10.0	
NICU		1 (1.7%)	2 (3.3%)	#1.000

[^]Independent t-test, #Fisher's Exact

No significant difference between Dextrose 5% and Normal saline groups regarding neonatal condition.

DISCUSSION

The primary aim of this study was to evaluate the effect of intravenous dextrose 5% infusion compared with intravenous normal saline infusion in acceleration of first stage of labor in nulliparous women.

In this randomized controlled trial of 120 subjects, we observed that dextrose 5% solution compared with normal saline solution was associated with significant reduction in the duration of labor. It led to significant attenuation in active labor phase course as well as detraction in labor second phase ($P < 0.001$).

However, it showed no statistically significant difference in the need for administration of oxytocin as well as neonatal Apgar score. The observed reduction in the active phase duration and in the second stage of labor in vaginally delivered women was at minimums of 32.1 minutes and 22.9 minutes, respectively, in the dextrose group compared with the normal saline group ($P < 0.001$).

An explanation of the improvement observed in labor performance by the dextrose-treated groups can be explained by concepts derived from exercise physiology. The uterus, comprised primarily of smooth muscle that persistently contracts and relaxes during labor, is comparable with skeletal muscle utilized in exercise models. It has been demonstrated that the administration of carbohydrates and fluid during prolonged exercise can enhance muscular performance and improve overall endurance compared with hydration alone⁽¹⁴⁾.

The researches on interventions that can enhance the progress of labor or minimize the frequency of labor dystocia to date remains limited.

Garite et al. and *Eslamian et al.* demonstrated that by increasing the rate of intravenous normal saline, the duration of labor can be shortened and the frequency of prolonged

labor can be reduced but they didn't include the effect of dextrose as we did in our study^(5,15).

Studies to date on the effects of carbohydrate intake on the course of labor to this point have mainly been limited to orally administered calories.

Scrutton et al. performed a randomized trial comparing light diet versus water alone in laboring subjects and noted no differences in obstetrical course. However, whereas there was resolution of ketosis in the light diet group, these subjects also had more emesis than the water-alone group, unlike our study that concentrated mainly on the fluid infusion not the oral intake as the laboring woman often have restricted oral caloric intake because of diminished patient desire as well as concerns for gastric aspiration if caesarian is deemed necessary⁽¹⁶⁾.

Kubli et al. and *Sheepers et al.* performed 2 randomized trials study using carbohydrate solutions. No differences were noted in labor duration, oxytocin use, or mode of delivery in either study; however, both studies were underpowered to detect differences with sample sizes of 60 and 201 subjects, respectively, while in our study we wanted to compare saline with carbohydrates represented by dextrose^(17,18).

Incidentally similar to this study, *Scheepers et al.* noted that the cesarean rate was higher in the carbohydrate solution group. He attributed this to either blood flow redirected from the myometrium toward the gastrointestinal tract or statistical coincidence. It is possible that the lack of efficacy of oral carbohydrates could be explained in part by ineffective gastrointestinal absorption in laboring patients. That's why in our study we examined the effect of intravenous carbohydrates on the course of labor, which would be more advantageous because of direct delivery to the uterus.⁽¹⁸⁾.

Concerns have also been raised regarding neonatal safety following continuous or prolonged dextrose infusions in labor with the

possible development of neonatal hypoglycemia and hyperbilirubinemia.

These concerns have persisted despite the absence of validation from randomized trials.

In other study, *Jamal et al*, performed a randomized controlled trial comparing intravenous 5% dextrose with normal saline powered to evaluate fetal acid-base balance. There were no differences in fetal acidemia among the groups, nor hypoglycemic episodes, and non reassuring fetal heart rate patterns. Similarly in our study sample, no adverse neonatal outcomes were observed in the dextrose-treated groups, regardless of dextrose concentration administered intrapartum to the mother. Importantly, there were no differences in the rate of hypoglycemia at 1 and 2 hours after delivery, despite the significant differences in the cord arterial glucose at time of delivery. These results, however, should be interpreted with caution because our study was not powered to evaluate the effects of dextrose on the neonate apart from APGAR score⁽¹⁹⁾.

Sharma et al. studied a 250 nulliparous pregnant women who had singleton term pregnancies and were in labor active phase were included in a study. One group received normal saline with 175 mL/hour rate and the other received the same amount for dextrose-saline in which the labor course was shortened in dextrose-saline group ($P = 0$) and prolonged labor was less likely to be seen ($P = 0.01$). No difference was seen in terms of the cesarean rate. The researchers concluded that the administration of dextrose-saline in nulliparous women who were in autonomic active labor phase was preferred to other infused fluids. These results are the same in our study in spite that we used dextrose only not dextrose-saline⁽²⁰⁾.

Shrivastava et al. performed a clinical trial on 289 pregnant women who were in their labor active phase. They randomly assigned the subjects into three groups. The first group received normal saline, the second normal saline with dextrose 5%, and the third normal saline with dextrose 10% with a 125 mL/hour rate. The results showed that dextrose-saline administration regardless of its concentration led to a significant detraction of the labor total course as well as the labor second phase ($P = 0.01$); however, this difference was not significant in regards with the cesarean rate ($P = 0.21$), we concluded the same results using only dextrose 5%⁽⁶⁾.

Improvement in labor performance with decreased duration of labor, need for oxytocin, and lesser incidence of prolonged labor with the use of dextrose solution alternating with normal saline can be explained on the basis of the fact that the uterine muscle receives better nutrition as well as early removal of the toxic products of metabolism due to better hydration⁽¹⁴⁾.

In a randomized clinical trial, Hatami Rad et al. compared the effects of normal saline solution with dextrose-saline in 80 pregnant women who were in their active labor phase. The ultimate results showed that the duration of first and second labor phases in group who received dextrose-saline was significantly shortened ($P < 0.001$), which is consistent with the present study. In their study, the need of oxytocin was significantly attenuated ($P = 0.019$), which is different from our study. As in the present study, 81.7% of mothers in the normal saline group and 90% in the dextrose one were in the need of oxytocin at the time of labor, but the difference was not statistically significant ($P = 0.1$)⁽²¹⁾.

Advantages of this study that it was blinded to the participants, investigator, outcome assessor and the data analyzer, also it concentrated mainly on the fluid infusion not the oral intake as the laboring woman often have restricted oral caloric intake because of diminished patient desire as well as concerns for gastric aspiration if caesarian is deemed necessary, and it studied the effect of intravenous dextrose that is delivered directly to the uterus rather than the blood flow shift that happens toward the gastrointestinal tract if the carbohydrates were delivered orally.

Limitations of this study that it was defective in studying the effect of continuous or prolonged dextrose infusions in labor on the mother and with the possible development of neonatal hypoglycemia and hyperbilirubinemia, we also studied only the 5% concentration of dextrose.

CONCLUSION

We concluded that dextrose 5% solution administration is associated with shortened duration of labor because it provides the required energy for pregnant mothers during the labor procedure through the detraction of harmful metabolites produced together with ATP production and results in acceleration of the labor process.

RECOMMENDATIONS

Dextrose 5% administration during labor is associated with shortened duration of labor.

Further studies with larger sample sizes, more outcomes and different dextrose concentration is required to determine the exact effect of dextrose.

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