

Original Article

# Assessment of fetal cord blood acid-base status following intrapartum maternal glucose infusion

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## Abstract

**Background and Aim:** Supplementation of intravenous fluids is associated with increased incidence of neonatal hypoglycemia. However, WHO guideline recommends no restriction of liquid or solid food to a parturient mother. Therefore, the aim of the study is to compare fetal acid-base status and neonatal blood glucose levels following intrapartum infusion of ringer lactate (RL) solution or dextrose normal saline (DNS) solution in active labor.

**Methods:** It is a prospective, analytical study conducted on hundred women in active labor and they were randomly allocated into two groups. First group (Group A) received intravenous infusion of DNS, and the other group (Group B) was given RL infusion for at least 1 h before delivery.

**Results:** There was no significant difference in fetal acid-base status between the two groups although neonatal blood glucose levels were higher in the DNS group (Group A).

**Conclusion:** Intrapartum infusion of DNS can raise neonatal blood glucose level but does not cause fetal acidosis or any alteration in fetal acid-base status.

**Key words:** Acid-base status, dextrose normal saline, intrapartum infusion, ringer lactate

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## INTRODUCTION

Labor is an energy-demanding and exhaustive process. Fluid and nutrient needs during labor are not well-studied.<sup>[1]</sup> The need for energy is increased during pregnancy and labor, and metabolic processes generally adjust to address these needs.<sup>[2]</sup> The WHO guideline recommends no restriction of liquid and solid food to a parturient mother.<sup>[3]</sup> However, considering high incidence of emergency cesarean section, a restrictive policy regarding oral intake of food in labor has prevailed for a long time because of the fear of aspiration of gastric contents and complications leading to Mendelson syndrome and maternal death.<sup>[4]</sup> Restriction of food or fluid may lead to maternal dehydration and adverse maternal and fetal outcome. Hence, the mothers are supplemented with intravenous fluids (IVFs) which maintain maternal and fetal electrolyte balance adequately.

Historically, practitioners administered high-dose glucose solutions to combat the development of ketones.<sup>[5]</sup> More commonly now, IVFs are isotonic or low glucose as high-dose glucose solutions have been shown to be associated with increased incidence of neonatal hypoglycemia.<sup>[6,7]</sup> Dextrose-only solutions cause a fall in serum osmolality and sodium concentration (hyponatremia) too.<sup>[8]</sup> However fetal acid base status following intrapartum glucose infusion remains uncertain.<sup>[9]</sup>

This study was performed to compare fetal acid-base status and neonatal blood glucose levels following

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intrapartum infusion of ringer lactate (RL) solution or a glucose-boostered saline solution (dextrose normal saline [DNS]) in healthy women in active labor.

## MATERIALS AND METHODS

A prospective study was carried out in a tertiary medical center in Eastern India from July 2010 to June 2011. The institution and the university ethical clearance were granted. Hundred women admitted to the labor ward in active phase of labor with term singleton pregnancy were randomly allocated into two groups, one receiving IV infusion of DNS (Group A) and the other group receiving RL solution (Group B).

Patients received IVF for at least 1 h before delivery at a rate of 125 ml/h.

Manufactured solutions were not modified by addition of any drug. Blood samples were analyzed in ABL 555 machine. Patients with obstetric complication, multiple pregnancy, glucose intolerance, evidence of antepartum fetal compromise, cervical dilatation more than 9 cm on admission and in those where delivery was conducted by operative methods were excluded from the study.

Immediately after delivery of the baby and prior to delivery of the placenta, 1 ml of blood was collected from the placental side of the umbilical artery in a 2cc plastic syringe flushed with heparin (1000  $\mu$ /ml). This sample was promptly transported to the laboratory with ice packing and analyzed for pH, pCO<sub>2</sub>, and base excess (BE) by ABG analyzer utilizing cassette based estimation procedure run on the principle of optical electrode (Optrode). Neonatal blood glucose was estimated within 1 h of delivery by glucometer from heel prick blood. Comparison of these parameters was done among the two groups.

## RESULTS

In this study, mean age of the patients in Group A (DNS group) was 21.89 years and mean age in Group B (RL group) was 22.81 years. Comparisons of the demographic and clinical profile of patients between the two groups are shown in Table 1. About 20.4% of the women in Group A and 24.48% of the women in Group B had antenatal booking in the hospital. Mean period of gestation in both groups was 38 weeks. Fetal heart rate was monitored by intermittent auscultation with stethoscope. Signs of fetal distress were not detected in any patient of either group. Labor was monitored with modified WHO partograph. Maternal vitals, urinary protein, and ketone bodies were measured. Twelve women in Group A and 18 women in Group B had 1+ proteinuria by urine dipstick (not significant).

**Table 1:** Comparative demographic and clinical profiles of patients with study group and control group

	Study arm (IVF DNS)	Control arm (IVF RL)	P
Age (years) (mean)	21.89	22.81	0.1093 (Mann-Whitney U-test)
Booked (%)	20 (40)	24 (48)	0.4203 ( $\chi^2$ )
Gravida			
Primi	34	32	0.6729 ( $\chi^2$ )
Second	13	16	
Third	3	2	
POG (weeks) (mean)	38.24	38.38	0.2177 (Mann-Whitney U-test)
Cx (cm) (mean)	5.38	5.34	0.3936 (Mann-Whitney U-test)
Station			
-1	24	25	0.5086
0	21	19	
1	5	6	
FHR (/min) (mean)	140	142	0.21
Urinary protein (trace)	12	18	0.1907
PPBS (mg/dl)	95.95	94.65	0.2297
Duration of IVFs (h)			
2	1	4	
3	24	27	
4	21	17	
5	4	2	
Birth weight (kg) (mean)	2.726	2.698	0.2148
Baby sex			
Male	28	29	0.8399
Female	22	21	
Apgar score (mean)	7	7	0.3859

Distribution of patients with respect to duration of IVF infusion was almost equal in both groups to avoid bias. (IV: Intravenous, PPBS: Postprandial blood sugar, FHR: Fetal heart rate, POG: Period of gestation, IVFs: Intravenous fluids, DNS: Dextrose normal saline, RL: Ringer lactate)

Distribution of patients with respect to duration of IVF infusion was almost equal in both groups. Average Apgar score (in first 1 min) of babies in both the groups was 7 ( $P = 0.3859$ ). Prior to beginning of infusion, mean maternal blood glucose level in Group A was 77.68 mg/dl and in Group B was 77.88 mg/dl ( $P = 0.896$ ).

Newborns delivered in both the groups had a mean PH of 7.3, whereas mean pCO<sub>2</sub> in Group A and Group B was 42.73 mmHg and 41.95 mmHg, respectively ( $P = 0.294$ ). Umbilical artery BE in Group A was -3.56 mEq/L and in Group B was -3.76 mEq/L ( $P = 0.2236$ ). Mean neonatal fasting blood glucose levels were 74.55 mg/dl and 60.22 mg/dl in Group A and Group B, respectively. All the above results are summarized in Table 2.

## DISCUSSION

Assessment of the acid-base status of the umbilical cord blood at birth provides an objective measure of the fetal response to labor and was recommended for intrapartum fetal surveillance by the 26<sup>th</sup> Study Group of the Royal College of Obstetricians and Gynecologists.<sup>[10]</sup> An

**Table 2:** Comparison of fetal and maternal blood parameters

	Study arm (IVF DNS)	Control arm (IVF RL)	P (Mann-Whitney U-test)
Maternal sugar (mg/dl) (mean)	77.68	77.88	0.8966
pCO <sub>2</sub> (mean) (mmHg)	42.73	41.95	0.2946
pH (mean)	7.30	7.30	0.4404
BE (mean) (mEq/L)	-3.56	-3.76	0.2236
Newborn sugar (mg/dl) (mean)	74.55	60.22	<0.0001

The results of the study showed that infusing RL or DNS made no difference in the acid base status of the baby. DNS infusion at a proper rate to the mother during labor can although raise neonatal blood sugar level. This may well maintain neonatal glucose level immediately following birth and also the initial energy requirement. IVF: Intravenous fluid, DNS: Dextrose normal saline, RL: Ringer lactate, BE: Base excess

international consensus Statement in 1999 also regarded this as an essential requirement for assessing the outcome of labor. In our study, there was similar distribution of mothers between the two study groups, with respect to age, parity, and blood glucose level measured at the beginning of IV infusion in labor. None of the babies had an Apgar score below 7, which removed the influence of fetal hypoxia on fetal acid-base status. In all the neonates, umbilical cord acid-base values were within normal limit and there was no significant difference in values between the two groups, too.

In a similar study by Fisher and Huddleston, mothers were given either RL or RL with 5% glucose and reported reduced umbilical cord acidemia and hypercarbia but no change in cord blood levels of glucose or BE with glucose-boostered RL solution.<sup>[11]</sup> Another study by Jamal *et al.* also had similar findings with 5% glucose boostered infusion.<sup>[9]</sup>

In our study, maternal baseline blood sugar was within normal range in all recruited patients of both groups. Glucose was infused at a rate of 6.2 g/h, and henceforth, we excluded measurement of maternal blood sugar at the end of infusion. Following delivery of the baby, heel prick blood of newborn was measured and value was significantly higher in Group A than Group B (74.55 mg/dl in DNS group and 60.22 in RL group) ( $P < 0.0001$ ). This finding is different from a study done by Mendiola *et al.* in 1982, where the presence of low blood glucose in the newborn significantly correlated ( $P < 0.05$ ) with a maternal blood glucose level of 120 mg/dl or greater. However, this low neonatal glucose level correlated ( $P < 0.05$ ) with a maternal glucose infusion rate of 20 g/h or greater.<sup>[7]</sup>

Philipson *et al.* in a study on effects of maternal glucose infusion on fetal acid-base status in human pregnancy concluded that acute maternal glucose infusion in normal patients can cause fetal hyperglycemia, metabolic

acidosis, and neonatal hypoglycemia. The results of the study showed that infusing RL or DNS made no difference in the acid-base status of the baby. In our study, although neonates from study group had higher glucose value than the control group, umbilical artery blood gas value pCO<sub>2</sub>, pH, and BE of study group neonates were not different from control group. These findings may be of particular clinical importance when fetal distress or fetal hypoxemia is due to other intrapartum events. Under these circumstances, acute maternal glucose infusion may further contribute to fetal metabolic acidosis.

### Limitations of the study

A multicentric study is required to further evaluate the effect of infusion of glucose-boostered solution to the laboring mothers on neonatal cord blood acid-base status and neonatal blood glucose level. Thus, a meta-analysis can recommend the ideal fluid to be infused to the laboring mothers for a better neonatal outcome.

## CONCLUSION

The application of the study is that glucose-boostered solution (DNS) infusion at a proper rate to the mother during labor can although raise neonatal blood sugar level has no deleterious effect on the fetal umbilical artery acid-base balance or fetal acidosis. This may well maintain neonatal glucose level immediately following birth and also the initial energy requirement. Therefore, infusion of such solution should not be restricted during labor in women who require infusion, especially in larger quantities.

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### Conflicts of interest

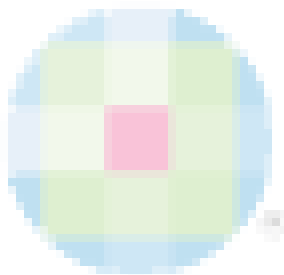
There are no conflicts of interest.

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