Comparison of water and glucose in improving the biophysical profile score

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Abstract

Hypoxia during pregnancy causes fetal distress. Evaluation of fetal heart rate and movement advised as the helpful tool for evaluation of fetal well being. Glucose intake before the assessment in case of decreased fetal movement was advised but there are some limitations to this approach especially in diabetic mothers. The aim of this study was to determine the effect of glucose ingestion compared to water consumption on the fetal biophysical profile (BPP) parameters in pregnant woman. This study was a double blind randomized controlled trial which were divided into two groups (intervention and control, 47 women per group) and then evaluated. In the control group 200cc of water orally was administered and in intervention group 50 gram glucose diluted in 200 cc of water was administered. BPP score of all patients were taken at baseline and 30 minute after intervention. Paired t-test, McNemar's, Wilcoxon and ANCOVA were used to analysis by SPSS 16. In the glucose group, mean BPP score before and after the intervention were 6.38 and 8.76, and in the water group were 4.85 and 8.85 respectively ($p<0.001$). Based on our results, we have showed that water consumption can increase the BPP score and could be an alternative to the oral glucose intake especially in those who have contraindications in the use of glucose (Iranian RCT registration No: IRCT2012120111628N1).

Keywords: *fetal vitality, ultrasound, fetal biophysical profile, fetal movement, fetal monitoring*

Introduction

Hypoxia during pregnancy causes fetus to enter a state of fetal distress. This is a condition of increasing fetal asphyxia causing break down of physiological responses due to failure in oxygenation of vital organs. It may lead to irreversible central nervous system (CNS) damage or death[1,2]. Fetal distress is correlated with hypoxemia leading to metabolic and respiratory acidosis leading to termination of pregnancy and preterm emergency cesarean section[2,3].

Emergency cesarean section can reduce the effects of hypoxia and asphyxia on the fetus with better results if conducted within 30 minutes[4]. However, false positive rate for the diagnosis of fetal distress is extremely high, leading to preterm labor or surgical complications[5]. Fetal heart rate (FHR) is an assessment tool for evaluation of fetal well being to prevent unnecessary termination of pregnancy.

FHR deceleration is an essential sign of hypoxia and occurs typically during labor. However, these decelerations are only pathological without presence of uterine contractions[6]. Not all FHR decelerations in labor could be considered fetal distress and the use of a clear terminology to describe the condition may alleviate this controversial issue[6]. There are multiple ways to improve FHR monitoring, including fetal electrocardiogram analysis, computerized FHR pattern analysis and vibroacoustic stimulation, however these techniques may not be affordable for patients in many developing countries[7]. Difficulty in the interpretation of FHR may be a limitation, and some women may feel the technique is more intrusive because of the frequency of assessments. After developing FHR, a new noninvasive technique called the biophysical profile (BPP) was introduced to the medical world. Nevertheless, BPP score is not perfect and is also a matter of controversy[8].

BPP is a valuable procedure for medical community due to its easy availability, noninvasive nature, and minimal learning curve[4]. It shows fetal asphyxia and risk for fetal death. The physiological and pathological basis of BPP is the observed association between hypoxia and alterations in measures of CNS performance, such as FHR patterns, fetal movement, and fetal tone which have been observed in both human and animal fetuses. BPP uses FHR and ultrasound imaging to improve our clinical judgment[9].

Despite its predictive value, further studies are required to define its intrapartum role. One limitation of BBP is that hypoglycemia may affect BPP criteria due to FHR and fetal movement modification[10]. For this reason some studies suggest that BPP should not be performed in fasting state because hypoglycemia reduces fetal activity. Yet, pregnant women with gestational diabetes may suffer this limitation of BPP[1].

Most of the traditional fetal well being assessments tools suggest glucose intake before assessment in case of decreased fetal movement; however there are some limitations to this approach especially in diabetic mothers[1].

The aim of this study was to determine the effect of glucose ingestion compared to water consumption on the fetal BBP parameters in pregnant woman.

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Methods

Pilot phase

A pilot study was conducted on two groups of 50 patients, one group took carbohydrate (glucose group) and the other group took only water (water group). After ingestion of carbohydrate in the first group, BPP scores went up from 2 to 6 in 42 patients.

The remaining 8 patients did not show any changes in BPP scores. In the second group, BPP raised 2 scores only in 20 patients and there was no significant change in the other 30 patients.

According to the pilot phase of the study, the sample size was calculated as 94 people. Participants in the pilot phase were not included in the main study since we did not have enough statistical assumptions for determining the sample size.

Design

This was a double blind randomized controlled trial conducted in the imaging section of the Imam Reza in Kermanshah, Western Iran. The participants in the study were referred from gynecologists for imaging studies. This trial was approved by Ethics Committee of Kermanshah University of Medical Sciences and it was registered in the Iranian randomized control trials registration site (IRCT2012120111628N1).

Total number of participants were 94 people (two groups: one glucose group and one water group); each group comprised 47 patients. After an explanation of study aim, informed consent was obtained from all patients participating in the study. The inclusion criteria were singleton pregnant with gestational age between 32-40 weeks. The exclusion criteria were: fetal malformations, hypertension, diabetes mellitus, thyroid problems, use of analgesics, sedatives and medications that affect uterine contractions, and the premature rupture of membranes.

Patients were randomized by simple randomization using computer software. Randomization and intervention was conducted by a trained radiology assistant who was removed from outcome assessment process.

Tools and Assessments

BPP: BPP gives two points for each parameter including fetal movements, fetal tone, fetal breathing movements, amniotic fluid volume, and non-stress test, making a maximum score of ten. Scores less than six may lead to neonatal death[6]. BPP score of all patients were taken and recorded using Siemens ultrasound device (Siemens G40, Germany) at least 3 hours after taking the last meal (while in fasting state) and 30 minute after intervention. Parameters of BPP scores was conducted as follows[10-12]:

Fetal breathing movements: 1 or more episodes of ≥20 s within 30 min are considered as normal and absent or no episode of ≥20 s within 30 min is abnormal.

Gross body movements: 2 or more discrete body/limb movements within 30 min (episodes of active continuous movement considered as a single movement) is normal and <2 episodes of body/limb movements within 30 min is abnormal.

Fetal tone: 1 or more episodes of active extension with return to flexion of fetal limb(s) or trunk (opening and closing of hand considered normal tone) is considered as normal and slow extension with return to partial flexion, movement of limb in full extension, absent fetal movement, or partially open fetal hand is considered abnormal.

Reactive FHR: two or more episodes of acceleration of ≥15 beats per minute (bpm) within 20 minutes were considered normal. Meanwhile, one or more episodes of acceleration of FHR or acceleration of < 15 bpm within 20 min were considered abnormal.

Qualitative amniotic fluid volume (AFV): 1 or more pockets of fluid measuring ≥2 cm in vertical axis is considered normal and either no pockets or largest pocket <2 cm in vertical axis is abnormal.

In case of being normal, two points for each variable and in case of being abnormal, zero was considered. Maximum score on this test was 10.

Blood Glucose: Fasting blood glucose was checked with a glucometer (CONTOURLINK, Bayer, Germany) in the glucose group before and 30 minutes after ingestion of glucose.

Interventions

We had two intervention groups, water and glucose. The radiology assistant administered 200cc of water orally to the water group and 50 gram glucose diluted in 200 cc of water to the glucose group.

Data analysis

Data were analyzed using SPSS version 19. For comparison of data (Before - After) in 6 fold variables (5 minor and 1 main variables) paired t-test and McNemar's test were used. In the case of nonparametric data, Wilcoxon test was used. To compare variables between the two groups, T-test was used. Also ANCOVA was used to evaluate difference between two groups after intervention.

Results

Participants were between 32 to 40 weeks of gestational age. Patients were between 15 to 46 years of age with a mean of 25.2 years. Gestational age was between 32 to 40 weeks with a mean of 36.7 weeks. The mean age of glucose and water groups were 24.02 and 26.4 years, respectively (p=0.05). Mean gestational age of glucose and water groups were 35.8 and 37.6 weeks respectively (p<0.001).

Frequency parameters of BPP score before and after the intervention are listed in Table 1 in both groups. Significant difference was found before and after the intervention in fetal breathing movements, fetal movements and fetal tone of both groups (p<0.001). AFV in both groups showed no significant difference before and after the intervention (p>0.05). However, in the water group heart rate was different before and after the intervention. Descriptive characteristics of the BPP scores of both groups before and after the intervention are listed in Table 2. In both groups, BPP score

Table 1 Effect of glucose and water intake by pregnant women on the parameters of biophysical profile score. Analysis was performed using McNemar test

Parameters of a biophysical profile score	Group	Measurement Phase	Normal		Abnormal		P_Value
			Frequency	Percentage	Frequency	Percentage	
Fetal breathing movements	Glucose	Before	20	42.5	27	57.7	<0.001
		After	43	91.5	4	9.5	
	water	Before	25	54.2	22	46.8	<0.001
		After	42	89.3	5	10.7	
Fetal movements	Glucose	Before	24	51	23	49	<0.001
		After	38	80.8	9	19.2	
	water	Before	3	6.3	44	93.7	<0.001
		After	37	78.7	10	21.3	
Fetal tone	Glucose	Before	28	59.5	19	40.5	<0.001
		After	42	89.3	5	10.7	
	water	Before	36	76.6	11	23.4	0.001
		After	47	100	0	0	
Acceleration of fetal heart rate	Glucose	Before	33	70.2	14	29.8	0.219
		After	37	78.8	10	21.3	
	water	Before	3	6.3	44	93.7	<0.001
		After	35	74.5	12	25.5	
Amniotic fluid volume Increasing	Glucose	Before	45	95.7	2	4.3	0.31
		After	46	97.8	1	2.2	
	water	Before	47	100	0	0	1
		After	47	100	0	0	

Table 2 Descriptive characteristics of the biophysical profile score and the relationship of dietary intake of glucose by pregnant with biophysical profile score. Wilcoxon Signed Ranks Test shows a significant difference before and after the intervention in the biophysical profile scores of both groups

Group	Measurement Phase	Biophysical profile score										P_Value
		2		4		6		8		10		
		n	%	n	%	n	%	n	%	n	%	
Glucose	Before	1	2.1	11	23.4	16	34	16	34	3	6.4	<0.001
	After	0	0	2	4.3	5	10.6	13	27.7	27	57.4	
Water	Before	5	10.6	20	42.6	19	40.4	3	6.4	0	0	<0.001
	After	0	0	2	4.3	10	21.3	1	201	34	72.3	

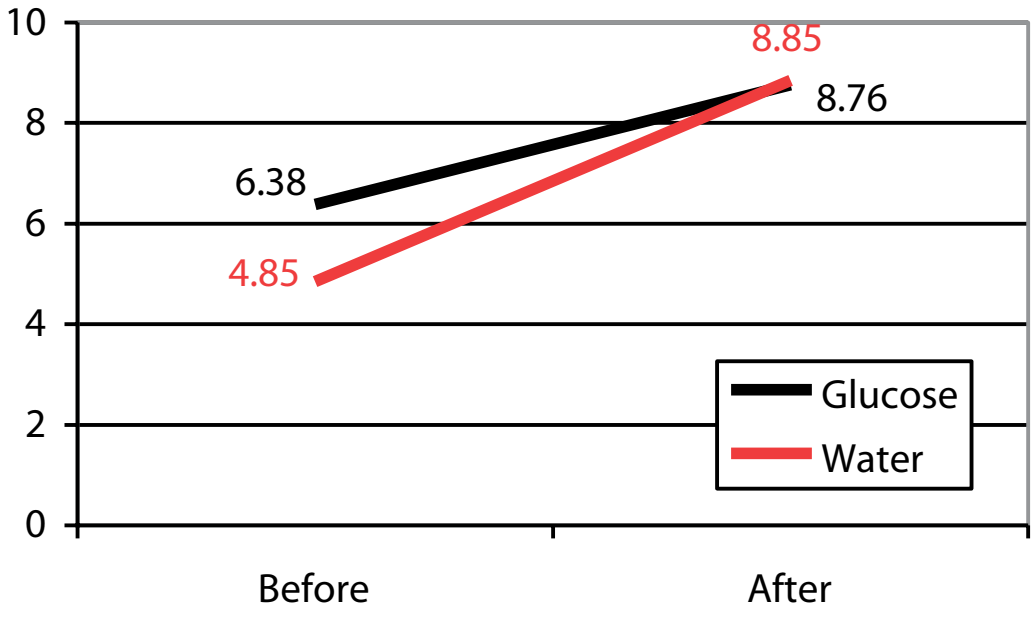

Figure 1. Change in the biophysical profile score during the study. Analysis with ANCOVA shows no significant differences in overall BPP score between two groups (p=0.135)

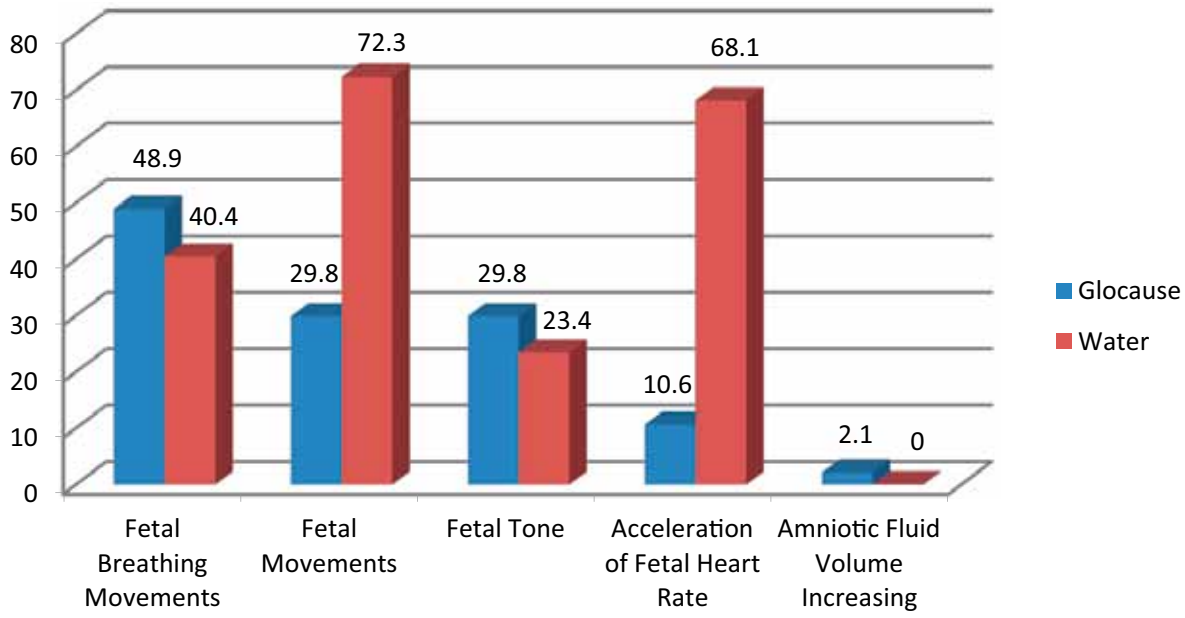

Figure 2. ***Comparison of fetal index improvement percentages between two groups. Acceleration of fetal heart rate (p<0.001) and fetal movements (p<0.001) showed a significant improvement between the two groups; however, no significant improvement were observed in fetal breathing movements (p=0.407), fetal tone (p=0.484) and increase in the amniotic fluid volume (p=0.315) using Chi-Square test***

increased after the intervention. In the glucose group, mean score before and after the intervention were 6.38 and 8.76, and in the water group were 4.85 and 8.85 respectively (p<0.001).

In the analysis of covariance, no significant difference was observed in the scores between the two groups before and after the intervention. Later we found that rise of the score difference of both interventions were equally effective (F(1,92)=0.051, p=0.822, partial eta-squared=0.01).

However, no significant improvement were seen in fetal breathing movements (p=0.407), fetal tone (p=0.484), and AFV (p=0.315, Figure 1). According to Figure 2, FHR between the two groups were compared before and after the intervention resulting in a statistical difference (p<0.001) and fetal movements (p<0.001).

Discussion

The aim of this study was to compare water and glucose intake in pregnant women based on BPP score. In our study, from the five variables of BPP scores, FHR acceleration and AFV did not change significantly in both groups, but the other variables (i.e. fetal breathing movements, fetal movements, and fetal tone) changed in both groups. Based on the results of this study, water consumption can increase the biophysical score and could be an alternative to the oral glucose intake especially at patients who have contraindications in the use of glucose.

Over the past two decades prediction of fetal well being has shown special significance. Thus, fetal well being tests like fetal movement, fetal non stress test and BPP score has become an integral component of midwifery care[11,13-15]. Research on these tools is still ongoing. Previous studies have shown that fetal BPP assessment can be valuable in predicting the prognosis of pregnancy[16,17]. It is included in Group B recommendation of "Recommendation for Primary Screening in High-Risk Patients"[11]. However, some other studies suggest that doing this test is not that effective all alone[18]. Some other studies recommend further investigations[1]; however, interpretation of these indicators are dependent on fetal movements, fetal heart rate, fetal breathing movements and tone, which could be affected by sleeping fetus[19]. One way to measure accurately is glucose consumption which will help prevent false positive results. However, usefulness of glucose intake is under question[20].

In a study of Booking et al.[21], after injection of 25 g of glucose only fetus breathing movements increased and the remaining components were unchanged. In a study of Zimmer et al.[22] acceleration of fetal FHR reduced after oral administration of 50 grams of glucose. In a study of Weizman et al.[23] fetal movements and FHR before and after administration of 100 grams of glucose did not change.

Later, Mirghani et al. conducted a study aimed at determining the effect of fasting on fetal activity showing

that only fetal breathing movements reduced during fasting without any other change in other components[10]. Sarafraz et al.[24] administered 5 grams of glucose. The authors showed that only increased fetal movement and did not accelerate FHR which is an indication of the fetal well being.

The above mentioned studies showed that glucose had varied and limited effect on the fetal well being. In our study, most of the indices have increased after glucose intake, being in accordance with the other studies. However water consumption had a greater increase in fetal movements and FHR. This means that water alone can at some point replace glucose. FHR is an important indicator in fetal assessment and is the first index that occur[19]. Our study showed furthermore a significant increase in FHR after water consumption.

Some studies did not find BPP useful in several circumstances. For example, Kaur et al.[25] did not recommend this test since in intrauterine growth restriction fetuses having in the view the majority of false positive results.

Considering different aspects of fetal well being in BPP, this could be provided with valuable information. Assessment of the FHR can indicate hypoxia and problems of the fetal nervous system. Assessment of amniotic fluid can evaluate fetus urinary system and changes due to placental insufficiency or hypoxia. Fetal tone, fetal movements and fetal breathing movements collectively can be referred to as "Dynamic Fetal Variables" which could be an indicator of development of the CNS, maternal factors and oxygen supply of the body's regulatory centers[26].

Changes in fetal breathing movements are one of the earliest changes caused by hypoxia[26]. In our study, water was not effective as much as glucose in the increase of fetal breathing movements. Therefore, in stages when hypoxia is suspected, consumption of glucose with plenty of water could improve much better the patient state. BPP is a simple and valuable index[19] hence, to avoid false results in patients with diabetes or patients who may have complications after intake of glucose.

Conclusions

Our results show that in the patients with hypoxia, consumption of glucose with plenty of water could improve the state of the patient. BPP showed to represent a simple and valuable method, especially in patients with diabetes or patients who may have complications after intake of glucose. One of the limitations of this study was the lower number of samples as well as no consideration for the ultimate prognosis of the fetus. Therefore, future studies should be conducted with a larger sample size and other consequences including fetal prognosis should be also considered. ■

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