MEASURING THE ENERGY SPENT BY PARTURIENT WOMEN IN FASTING AND IN INGESTING CALORIC REPLACEMENT (HONEY)

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Melo CRM, Peraçoli JC. Measuring the energy spent by parturient women in fasting and in ingesting caloric replacement (honey). Rev Latino-am Enfermagem 2007 julho-agosto; 15(4):612-7.

This research aims to measure the energy spending in parturient women of low gestation risk. Participants were selected randomly and submitted to fasting (n=15; Group I) or honey ingestion (n=15; Group II). Data were collected by means of capillary blood values and heart frequency monitoring. The paired t-test with a 5% significance level and Tukey's method were used in statistical analysis. The results showed that honey ingestion did not promote an overload in the mother's glucose; the lactate response demonstrated that the substrate offered was well used; the cardiorespiratory rate demonstrated "good performance" for both groups; the total energy spent during labor demonstrated that carbohydrate ingestion exerts significant influence, improving maternal anaerobic performance; the group which remained in fasting presented, immediately after labor, higher levels of lactate, showing the organism's efforts to compensate for the energy spent.

DESCRIPTORS: honey; energy metabolism; lactic acid; blood glucose

MENSURACIÓN DE LA ENERGIA DESPENDIDA EN EL AYUNO Y EN EL APORTE CALÓRICO (MIEL) EN PARTURIENTAS

Este estudio tiene como objetivo mensurar el gasto energético de parturientas de bajo riesgo de gestación. Las participantes han sido seleccionadas en dos grupos de manera aleatoria y sometidas a ayuno (n=15; Grupo I) e ingestión de miel (n=15; Grupo II). Los datos han sido colectados a partir de los valores de la sangre capilar y monitor de frecuencia cardíaca. Para el análisis estadística han sido empleados el test t pareado, y el método de Tukey. Los resultados han mostrado que la ingestión de miel no provocó sobrecarga en la glicemia materna; la respuesta del lactato demostró que el substrato ofrecido fue bien utilizado; los índices de capacidad cardiorrespiratoria han demostrado "buen desempeño" para los dos grupos; el gasto energético total durante el trabajo de parto demuestra que la ingestión de carbohidrato tiene influencia significativa, mejorando el desempeño anaeróbico materno; el grupo que ha permanecido en ayuno presentó, inmediatamente después del parto, niveles de lactato más altos, demostrando el esfuerzo del organismo en compensar la energía gasta.

DESCRIPTORES: miel; metabolismo energético; ácido láctico; glucosa de la sangre

MENSURAÇÃO DA ENERGIA DESPENDIDA NO JEJUM E NO APORTE CALÓRICO (MEL) EM PARTURIENTES

Este estudo tem como proposta mensurar o gasto energético de parturientes de baixo risco gestacional. As participantes foram selecionadas em dois grupos de maneira aleatória e submetidas a jejum (n=15; grupo I) e ingestão de mel (n=15; grupo II). Coletaram-se dados mediante valores do sangue capilar e monitor de freqüência cardíaca. Para a análise estatística empregou-se o teste t pareado e o método de Tukey. Os resultados mostraram que a ingestão de mel não provocou sobrecarga na glicemia materna; a resposta do lactato demonstrou que o substrato oferecido foi bem utilizado; os índices de capacidade cardiorrespiratória demonstraram "bom desempenho" para os dois grupos; o gasto energético total durante o trabalho de parto demonstra que a ingestão de carboidrato tem influência significativa, melhorando o desempenho anaeróbico materno; o grupo que permaneceu em jejum apresentou, imediatamente após o parto, níveis de lactato mais elevados, demonstrando o esforço do organismo para compensar a energia despendida.

DESCRITORES: mel; metabolismo energético; ácido láctico; glicemia

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INTRODUCTION

The fetus needs glucose and amino acids for its development and growth, which submits the pregnant woman to the constant demand for these substrates in order to meet its needs[1].

When labor is prolonged and the supply of glucose is scarce, gluconeogenesis can be insufficient. During normal labor, the concentration of free fatty acids and ketone bodies increases, leading to a greater mobilization of other substrates other than glucose and a relative decrease of carbohydrates[2-3].

Fasting reduces the availability of carbohydrates for the efforts demanded in labor, making the organism metabolize fat in order to generate energy. Therefore, the availability of amino acids in the mother's and fetus' blood is diminished, while the fatty acids and ketones increase[4].

It is well known that, during physical activity, the consumption of energy is correlated to its duration and the energy spent[5]. Labor can take hours and consequently requires great energy consumption. During long periods of physical activity, the anaerobic environment is used, inducing the elevation of lactate levels and decrease in blood pH. In low-risk parturients, the moderate increase in maternal lactate and slight decrease in pH sustain the hypothesis that normal labor, although it requires physical effort, does not produce a notable O_2 deficit, which would lead to an anaerobic metabolism as source of energy[6].

In low-risk parturients, the metabolic homeostasis probably occurs due to the nature of the uterine contractions, which are intermittent, and by the adequate oxygenation during the muscle relaxation periods[6].

The oxidative environment involves the major part of energy demands during labor, while glucose is the main maternal source of energy as well as energetic fuel for the fetus. Hypoxia and fetal hyperglycemia can increase the production of maternal and fetal lactate, resulting in metabolic acidosis[7].

In classic labor care, it is usual to restrict oral nutrition and administrate intravenous fluids to prevent or treat dehydration, ketosis and electrolyte unbalance[8]. The use of intravenous fluid can have adverse effects on maternal well-being, such as the overload of fluids, discomfort and restriction of movements, and can also cause hyponatremia, hyperglycemia and subsequent hypoglycemia[8-9] in the fetus/newborn.

Although the intravenous infusion is necessary in many obstetric circumstances, for the medication and anesthesia administration, it is not considered a fully secure substitute for food and liquids during labor[9].

It is currently recommended for low-risk pregnant women in the active phase of labor to ingest small quantities of clear fluids, such as water, fruit juice without pulp, tea, coffee and soda. However, there are no studies informing about the adequate nutritional diet during labor, quantity to be ingested, and evaluation of risk/benefit for mother and fetus[10].

It is estimated that the excessive energy spent during labor can be compensated by a caloric replacement; without which the organism weakens, since the combustion supply is performed to the detriment of tissues. Thus, we chose forest flower honey, which is an innocuous food rich in carbohydrates, which are immediately assimilated and capable of providing energy, strengthening the muscles, improving resistance, favoring recovery and allowing for strong and prolonged effort[11].

This study aimed to offer forest flower honey to the parturients in order to assess and measure the differences between the two groups under different treatments (in fasting and controlled food supply), so as to confirm the hypothesis that honey improves maternal performance during labor and delivery.

SUBJECTS AND METHOD

This is a prospective and random study with 30 parturients registered in the Single Health System, who received care during labor and childbirth at the Santa Isabel Maternity Hospital-Bauru, SP, Brazil, agreed to participate in the study after being informed and clarified about the research. The present study was approved by the Institutional Review Board from the Sagrado Coração University. The parturient women were

stratified in two groups by random pooling: Group I (fast) and Group II (honey). Those considered eligible for the study were in low-risk pregnancy, age between 18 and 25 years, white, gestational age between 38 and 40 weeks, in the latent phase, parity from 0 to IV, with vaginal childbirth.

The factor honey was studied in the experiment, and its effect was compared between the two groups. In each group, the mean and standard error were calculated for all the reported attributes and the results were compared using the Paired Student's *t* test with a significance level of 0.05. For the constants between the pairs of means, the minimum significant difference was calculated (msd) for α= 0.05, using Tukey's method. When 0.05<p<0.10, a tendency to significance was reported (*p* is the probability of wrongly concluding significance).

Groups GI and GII, composed of 15 women each, were evaluated every hour regarding the aerobic threshold by the indirect assessment of maximum oxygen consumption (VO_2max), through the control of cardiac frequency with a Polar® monitor, model S610 with IR Interface Infrarouge. Capillary blood collection was performed for lactate dosage in the Accutrend Ò Lactate analyzer and for glucose dosage in a Glucosimeter Advantage®. Group II was submitted to oral ingestion of 3.5 grams of honey, independently of the proximity of fetal expulsion. For baseline energy expenditure (BEE) and the total energy expenditure (TEE) within 24 hours, equations that preview the energetic needs in healthy non-trained individuals were used:

(BEE(Kcal/24h) = 65.51 + 9.56 x weight(Kg) = 1.85 x Height (cm) - 4.68 x Age (years) and (TEE=1.674 x 1.2 (activity factor) x 1.2 (stress factor)

The value 1.2 was used for the activity factor (confined to bed), since it was the women's choice to stay in bed, and the value of 1.2 for the stress factor (small surgery), since all of them were submitted to episiotomy and perineal suture.

Equations[13] for sub maximum testing were also used (cardiac frequency and VO_2) during labor (MCF=205-(0.41 x age) for untrained individuals[13] for women (VO_2max = 65.81 - 0.1847 x CF from the end of the test).

In both groups, the last capillary blood collection was performed in the fifth minute after delivery. The Polar® monitor was turned off ten minutes after birth.

The pregnant women's initial weight was taken from the first notes made on the prenatal card and the final weight was checked at the moment of hospitalization on a mechanical balance Filizola® Model 31. All of them had their delivery induced, with a medical prescription of intravenous infusion with 0.9% physiological serum 0.9%, using a 5U ampoule of oxytocin. The nutritional information and food science analysis of the honey were performed at the Laboratory of the Veritas Foundation at the Sagrado Coração University in Bauru.

RESULTS

A total of 32 low-risk parturient women were invited to participate in the study. Among those who adhered to the study, two were excluded from the analysis because they presented functional dystocia and were referred to cesarean section.

The homogeneity variables between GI and GII evidenced that the parturients were respectively 21 and 20 years olds, initiated prenatal care between 13 and 14 weeks of pregnancy and started labor at 39 weeks. The two groups studied are similar regarding weight in the first prenatal consultation (53 to 55 kg) and final weight (64 to 67Kg), height (1.60 to 1.62), labor duration (2h36min to 3h03min) and fasting duration (8h55min to 10h40min) at the start of data collection (Table 1).

Table 1 - Mean and standard error of the homogeneity variables between Groups GI (fast) and GII (honey) at the beginning of data collection. Bauru, 2004

Variables	Groups				
	GI		GII		
	Mean	SE	Mean	SE	p*
Age (years)	21.80	3.12	20.80	2.37	0.38
Prenatal initiated (weeks)	13.40	3.77	14.27	3.21	0.47
Gestational age at delivery (weeks)	39.00	0.92	39.27	0.88	0.38
Initial weight (Kg)	55.20	10.98	55.87	9.14	0.20
Final weight (Kg)	64.33	11.62	67.87	951	0.44
Height (m)	1.60	004	1.62	0.05	0.35
Labor duration (h)	2.60	0.91	3.06	1.41	0.34
Fasting duration (h)	10.67	3.88	8.93	4.28	0.14

*Paired Student's *t* test

The glucose level, evaluated during labor, did not presented statically significant differences, neither in the group who fasted nor in the group to whom honey was offered. Likewise, the lactate value of the group to whom honey was offered did not present statically significant differences when compared to the value of the group who fasted. In the post-labor period, there was no statically significant difference in glucose levels between the two groups, although lactate levels were higher for group I in the first and fifth minute (Table 2).

Table 2 - Mean and standard error of glucose (mg/dL) and lactate (mmol/L) of groups GI and GII during labor, childbirth and in the first and fifth minutes after birth. Bauru, 2004

Time		Groups GI Mean	GI SE	GII Mean	GII SE	p*
		Delivery				
T_0	Glucose	81.00	+7.15	80.13	+7.98	0.76
	Lactate	2.54	+0.73	2.66	+0.64	0.64
1h	Glucose	84.00	+877	82.46	+4.20	0.30
	Lactate	2.48	+0.58	2.90	+0.68	0.04
2h	Glucose	87.13	+8.95	88.53	+7.60	0.59
	Lactate	2.71	+0.56	2.93	+0.78	0.27
		Post-delivery				
1st min	Glucose	100.20	+9.89	103.80	+5.29	0.28
	Lactate	4.68	+1.25	3.74	+0.73	0.02
5th min	Glucose	95.47	+10.30	102.60	+6.83	0.06
	Lactate	4.51	+1.14	3.48	+0.74	0.02

*Paired Student's *t* test

The values of baseline energy expenditure (BEE) and total energy expenditure (TEE) did not present significant differences between the two groups under study (Table 3).

Table 3 - Mean and standard error of baseline energy expenditure (BEE) and total energy expenditure (TEE) in 24 hours, and maternal aerobic capacity (sub maximum test) during labor in the groups studied. Bauru, 2004

Performance		Groups GI Mean	GI SE	GII Mean	GII SE	p*
BEE		1171.06	±106.94	1209.55	±88.06	0.35
TEE		1616.06	±147.58	1669.18	±121.53	0.35
Sub maximum Test	CF	141.00	±30.24	145.60	±10.18	0.59
	$VO_{2máx}$	39.76	±5.59	39.00	±1.88	0.50

*Paired Student's *t* test

To calculate the energy spent (Kcal), the total energy expenditure during labor was used (TEEL), and it was verified that the mean energy spent by those who ingested honey was higher than for those who fasted (Table 4).

Table 4 - Mean and standard error of energy spent (Kcal) during labor. Bauru, 2004

Labor	Groups GI Mean	GI SE	GII Mean	GII SE	p*
Energy spent	294.73	±137.92	519.73	±261.17	0.01

*Paired Student's t test

DISCUSSION

The strength involved in labor include the strength of the uterus, which expels the fetus, and the effort that must overcome the resistance offered by the cervices, so that dilatation occurs, and the friction created by the tissues of the canal during the fetus's passage[14].

There are peculiar characteristics of the myometrium muscle when compared to the skeletal muscle. These differences are an advantage for the myometrium in the efficiency of uterine contractions and in the fetus' detachment because the degree by which the smooth muscle cells are shortened during contraction is higher than that reached in the striated muscle cells[14].

The effort can be exerted in any direction in the cells of the smooth muscle because the fine and thick filaments are organized in long and random bundles by all cells, providing even more shortening and increasing the capacity of generating multidirectional strength, which permits directing the expulsive power[14].

This characteristic favors the transmission of electric signs, permitting the diffusion of contraction strength in several directions, through successive stimuli responsible for the duration and intensity of the contraction, both in number and intensity.

In the present study, the glucose values of those who fasted and those who received caloric replacement (honey) did not present a significant difference during labor, although lactate levels were significantly higher in the latter group after ingestion of 14 grams of honey (44cal). This result is important for the maternal performance diagnosis during labor because the elevation of lactate evidences that the ingestion of carbohydrate has a fundamental role in

lactate behavior, showing a significant influence on the performance of those who ingested honey.

The concentrations of blood lactate in different workloads are highly dependent on the glycogen storage because, when it is inadequate, the concentration of lactate diminishes, depending on the workload. Despite the complexity of metabolic regulation, the measures of blood lactate can be used to preview the performance in the anaerobic exercise, under physiological or pathological conditions[15].

Although studies that identify the energetic needs during labor are not known, the total energy expenditure in 24 hours was the same for both the group who ingested the caloric replacement and that which fasted.

Sub-maximum tests are useful to determine the cardio-respiratory aptitude level in healthy individuals. Some studies indicate a higher aerobic capacity in trained women, while others do not demonstrate any significant difference in the VO_2max levels among trained and non-trained pregnant women[16-17]. In the present study, the two groups did not have previous training, showing that, during labor, the cardio-respiratory capacity rates present good performance when compared with the conditioning categories for the Harvard women's health watch[13].

For the group that received caloric replacement, 14 grams of honey (44Kcal) were offered during labor and the total final energy expenditure indicated that the honey was immediately used, showing a better anaerobic performance, which was confirmed by the lactate levels verified during the period.

Even though the effort made in labor is compared to athletic performance, such as running a marathon for example, there is a lack of information on the parturients' nutritional needs[8]. In the literature consulted, only one research suggests that during labor, around 50 to 100 calories are spent per hour[18]. Therefore, it remains unanswered which would be the adequate nutritional diet during labor, what quantity should be ingested and what the risk/benefits are for the mother and fetus.

Thus, this study proposal to offer honey during labor is justified by the proprieties of this food, which is rich in carbohydrates, poor in sucrose and whose assimilation does not demand active participation from the organism[11].

In view of orientations by the Ministry of Health[10] to offer small quantities of liquid during the active phase of labor, we consider that the caloric replacement obtained by the ingestion of honey is a low cost alternative which the parturient women will easily accept.

CONCLUSION

These study results reveal that the ingestion of honey did not cause an overload in maternal glucose. The lactate response indicated that the substrate offered was well used. The cardio-respiratory capacity rates demonstrated "good performance" for both groups. The total energy expenditure during labor suggests the ingestion of carbohydrate exerts a significant influence, improving maternal anaerobic performance. Immediately after labor, the group who fasted presented higher levels of lactate, showing the effort the organism exerted to compensate for the energy spent.

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Recebido em: 14.6.2006
Aprovado em: 31.5.2007